EXHIBIT E

ENVIRONMENTAL REPORT

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ACRONYMS, ABBREVIATIONS, AND SHORT FORMS

ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
ADM	Archer Daniel Midlands
AF	acre-feet
AHZ	Active Habitat Zone
AMP	Adaptive Management Plan
Applicant	Loup River Public Power District (also Loup Power District or the District)
Application	Application for a New License for the Loup River Hydroelectric Project (FERC Project No. 1256)
BA	Biological Assessment
BMP	best management practices
CART	Columbus Area Recreational Trails, Inc.
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
CPUE	catch per unit effort
CWA	Clean Water Act
District	Loup River Public Power District (also Loup Power District)
DLA	Draft License Application
DO	dissolved oxygen
EA	Environmental Assessment

EAP	Emergency Action Plan
EFH	essential fish habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FOIA	Freedom of Information Act
FPA	Federal Power Act
FR	Federal Register
ha	hectare
hp	horsepower
HPMP	Historic Properties Management Plan
Hz	hertz
ILP	Integrated Licensing Process
ISR	Initial Study Report
kV	kilovolt(s)
kVA	kilovolt-ampere(s)
LIP	Locational Imbalance Prices
Loup Power District	Loup River Public Power District (also the District)
LPD	Loup Power District
LWCF	Land and Water Conservation Fund
µg/L	micrograms per liter
mL	milliliter(s)
MOU	Memorandum of Understanding

MSL	above mean sea level
MW	megawatt(s)
MWh	megawatt hour(s)
mya	million years ago
N/A	not applicable
NAC	Nebraska Administrative Code
NCDC	National Climatic Data Center
NDEQ	Nebraska Department of Environmental Quality
NDNR	Nebraska Department of Natural Resources
NEPA	National Environmental Policy Act
NESCA	Nongame and Endangered Species Conservation Act
NGPC	Nebraska Game and Parks Commission
NGVD 29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOHVA	Nebraska Off Highway Vehicle Association
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPPD	Nebraska Public Power District
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NRPA	National Recreation and Park Association

NSHS	Nebraska State Historical Society
NTU	nephelmometric turbidity units
NWI	National Wetlands Inventory
O&M	operations and maintenance
OHV	Off-Highway Vehicle
PA	Programmatic Agreement
PAD	Pre-Application Document
PCB	polychlorinated biphenyl
PPA	power purchase agreement
ppb	parts per billion
Project	Loup River Hydroelectric Project
PSP	Proposed Study Plan
PWA	Public Works Administration
RAFTMP	Region VII Ambient Fish Tissue Monitoring Program
RENEW	Recovery of Nationally Endangered Wildlife
RM	River Mile
rpm	revolutions per minute
RPMAs	recovery priority management areas
RSP	Revised Study Plan
RTE	rare, threatened, or endangered
SCADA	supervisory control and data acquisition
SCORP	State Comprehensive Outdoor Recreation Plan
Secretary's Standards	The Secretary of the Interior's Standards for the Treatment of Historic Properties

SHPO	State Historic Preservation Office
SMA	Sand Management Area
SPP	Southwest Power Pool
TCP	traditional cultural property
TMDL	total maximum daily load
TPCP	Tern and Plover Conservation Partnership
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
WMA	Wildlife Management Area

E. ENVIRONMENTAL REPORT

This Exhibit E, Environmental Report, follows the content and format requirements of 18 CFR §5.18(b), with minor changes for enhanced readability. Pursuant to 18 CFR §5.18(b), the content of Exhibit E has also been adapted to conform to FERC's *Preparing Environmental Documents: Guidelines for Applicants, Contractors, and Staff* (September 2008). Exhibit E is organized as follows:

- E.1 – General Description of the River Basin
- E.2 – Cumulative Effects
- E.3 – Compliance with Applicable Laws
- E.4 – Existing Project Facilities and Operations
- E.5 – Proposed Action and Alternatives
- E.6 – Affected Environment and Environmental Analysis
- E.7 – Economic Analysis
- E.8 – Consistency with Comprehensive Plans
- E.9 – Consultation Documentation
- E.10 – References

Loup River Public Power District (Loup Power District or the District) owns and operates the existing 53.4-megawatt (MW) Loup River Hydroelectric Project (FERC Project No. 1256). The Loup River Hydroelectric Project (Project) is located in Nance and Platte counties, Nebraska, 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, Nebraska. The Project includes various hydraulic structures, two powerhouses, and two interconnected regulating reservoirs. The location of the Project and notable Project components are shown in Appendix E-1, Figure E-1.

The Project begins at the Headworks, which are located approximately 34 miles upstream of the confluence of the Loup and Platte rivers at Loup River Mile (RM) 34.2. In this location, often referred to as the point of diversion, a low weir across the Loup River creates sufficient head to divert a variable portion of river flow (not to exceed 3,500 cubic feet per second [cfs]) through an Intake Gate Structure into the Settling Basin. The diverted water is routed through the Upper Power Canal, which carries the water to the Monroe Powerhouse. Then the Lower Power Canal carries the water from the Monroe Powerhouse into two connected regulating reservoirs, Lake Babcock (in-channel) and Lake North (off-channel), which supply water to the Columbus Powerhouse via the Intake Canal. From the Columbus Powerhouse, water discharges to the Tailrace Canal, which in turn discharges Loup River water into the lower Platte River approximately 2 miles downstream of the confluence of the Loup and lower Platte rivers at Platte RM 101.5. The lower Platte River is defined as the reach between the confluence of the Loup and Platte rivers and the confluence of the Platte and Missouri rivers.

The portion of Loup River flow that is not diverted into the Loup Power Canal passes over the Diversion Weir or through the adjacent Sluice Gate Structure and continues downstream. The portion of the Loup River below the point of diversion is referred to as the Loup River bypass reach. The portion of the lower Platte River from the Loup River confluence to the Tailrace Return is referred to as the Platte River bypass reach.

E.1 GENERAL DESCRIPTION OF THE RIVER BASIN

The Project is located in the Loup River Basin, which is part of the larger Platte River Basin, as shown in Appendix E-1, Figure E-2. Information about the Loup River Basin as it relates to the Project is provided below.

E.1.1 Basin Description

The Loup River Basin encompasses approximately 15,200 square miles of central Nebraska, accounting for nearly one-fifth of the state's total land area, as shown in Appendix E-1, Figure E-3 (Nebraska Department of Environmental Quality [NDEQ], December 2005). The Loup River Basin originates in Sheridan County, Nebraska, and extends approximately 260 miles to Platte County and the confluence with the Platte River (NDNR, 1975, as cited in NDEQ, December 2005). The ecoregions of the Loup River Basin are the Nebraska Sandhills and the Central Great Plains (Chapman et al., 2001, as cited in NDEQ, December 2005). The watershed upstream of the Project covers approximately 14,300 square miles of total land area. The Platte River Basin upstream of the Loup River and the Project covers approximately 59,300 square miles compared to the 15,200-square-mile drainage area of the Loup River Basin (U.S. Geological Survey [USGS], 2008).

The Loup River is comprised of three main branches, the North, Middle, and South Loup rivers, which all originate in north-central Nebraska and flow generally east/southeast. The North and Middle Loup rivers flow through the Sandhills region and are primarily fed by groundwater springs from the Ogallala Aquifer. The South Loup River flows through an area of loess hills and receives most of its flows from rainfall runoff (Fowler, June 2005). The South Loup River joins with the Middle Loup River just east of Boelus, Nebraska, and the Middle and North Loup rivers combine to form the Loup River northeast of St. Paul, Nebraska. The Loup River then joins the Platte River southeast of Columbus. As discussed above, the Project is located downstream of the confluence of the Middle and North Loup rivers and in the proximity of the confluence of the Loup and Platte rivers.

E.1.2 Tributaries

In the Loup River Basin, major tributaries of the Loup River include the South Loup River, Mud Creek, the Dismal River, the Middle Loup River, Oak Creek, the North Loup River, the Calamus River, the Cedar River, and Beaver Creek, as shown in Appendix E-1, Figure E-4.

Loup River tributaries in the vicinity of the Project include Beaver Creek, Looking Glass Creek, Dry Creek, and Cherry Creek, as shown in Appendix E-1, Figure E-4. The Loup Power Canal passes under Beaver Creek, Looking Glass Creek, and Dry Creek/Cherry Creek through concrete siphon structures.

Lost Creek is also in the vicinity of the Project. However, Lost Creek is unique in that the entire basin no longer drains naturally into the Platte River. Drainage from the uppermost 7.6 square miles of Lost Creek is collected and passed under the Loup Power Canal through a concrete siphon (916 Siphon). From there, the flow is conveyed to the Loup River through a drainage ditch called Lost Creek Ditch, which predates the Project (see Appendix E-1, Figure E-4). An additional 2 square miles of watershed area downstream of the Loup Power Canal contribute to flows in the Lost Creek Ditch. As part of the U.S. Army Corps of Engineers (USACE) Lost Creek Flood Control Project, drainage east of the Lost Creek Ditch is collected in the Lost Creek Flood Control Channel. The Lost Creek Flood Control Channel is owned and maintained by the City of Columbus. It begins east of U.S. Highway 81 and eventually drains into the Tailrace Canal immediately downstream of the Columbus Powerhouse. Water from the Lost Creek Flood Control Channel is then discharged into the Platte River along with Project flows. Lost Creek flows not captured in the Lost Creek Ditch and the Lost Creek Flood Control Channel are conveyed through a siphon (Lost Creek Siphon) along the Tailrace Canal and continue east in Lost Creek to Schuyler, Nebraska, where they discharge into the Platte River.

E.1.3 Local Drainage in the Vicinity of the Project

Drainage areas transected by the Project that discharge into the Loup River bypass reach in the vicinity of the Project include the watersheds of Beaver Creek, Looking Glass Creek, Dry Creek, Cherry Creek, and a portion of Lost Creek, as shown in Appendix E-1, Figure E-3. These streams and drainages remain separated from the Project. However, several smaller, local drainage areas enter the Loup Power Canal. There are 12 identified culverts that discharge these local drainage areas into the canal between the Headworks and the Columbus Powerhouse. In addition, there are 13 identified culverts as well as the Lost Creek Flood Control Channel (described in Section E.4.17, below) that drain into the Tailrace Canal between the Columbus Powerhouse and the Platte River.

E.1.4 Topography

The Project is located in the Valleys Topographic Region of Nebraska (Flowerday, Kuzelka, and Pederson, 1998). The land in the vicinity of the Project slopes from west to east at an approximate elevation of 1,580 feet above sea level at the start of the Loup Power Canal to 1,410 feet above sea level at the end of the Loup Power Canal. The Valleys Topographic Region consists of areas with low relief along major streams that are underlain by alluvial deposits of clays, silts, sands, and gravels that are stream-deposited, as shown in Appendix E-1, Figure E-5.

E.1.5 Climate

Average annual precipitation in the Loup River Basin ranges from 18.3 inches at Valentine, Cherry County, Nebraska, near the northwest portion of the Loup River Basin (approximately 175 miles northwest of the point of diversion for the Loup Power Canal) to 25.8 inches at Fullerton, Nance County, Nebraska, in the southeast portion of the Loup River Basin (approximately 10 miles upstream of the point of diversion). Average precipitation during the growing season (May 1 to September 30) ranges from 12.8 inches at Valentine to 16.9 inches at Fullerton (Nebraska Department of Natural Resources [NDNR], December 30, 2005). Temperatures in the Loup River Basin are highly variable, as is typical of the Central Great Plains, with hot summers and cold winters. July is typically the hottest month, with average lows in the mid-60s and average highs in the upper 80s. Summer daily high temperatures in the upper 90s and low 100s are not uncommon. January is typically the coldest month, with average lows in the lower teens and average highs in the lower 30s. Winter low temperatures below zero are not uncommon (The Weather Channel, 2008).

E.1.6 Major Land Uses and Economic Activities

The predominant land use in the Loup River Basin is agriculture, with ranch and pasture lands primarily in the Sandhills portion of the Loup River Basin and row crop farmland comprising the majority of the Central Great Plains portion of the Loup River Basin. About one-third, or approximately 3 million acres, of agricultural lands in the Loup River Basin are classified as arable or suitable for cultivation, and approximately 2 million acres are classified as suitable for irrigation. Within the Loup River Basin boundaries, there are 56 municipal communities, with only one community, Columbus, having a population above 20,000 (NDEQ, December 2005).

The predominant land use in the vicinity of the Project is row crop agriculture, as shown in Appendix E-1, Figure E-6. The two larger communities in the vicinity of the Project are Genoa (population 1,003) and Columbus (population 22,111) (U.S. Census Bureau, June 3, 2011). Genoa is located approximately 6.5 miles northeast of the point of diversion for the Loup Power Canal. Columbus' city center is located approximately 3 miles south of Lake Babcock; however, there are portions of the Columbus city limits that are immediately adjacent to the Project Boundary.

Detailed information on employment, economic development, and income in the vicinity of the Project is provided in Section 6.10.1.

E.1.7 Major Water Uses

Water uses in the Loup River Basin are various, consisting of domestic, industrial, livestock, irrigation, hydroelectric power generation, and others. In addition to the District's hydroelectric project, a hydroelectric project owned and operated by the Village of Spalding, Nebraska, exists on the Cedar River (see Appendix E-1, Figure E-3). As of October 1, 2005, a total of 15,824 registered groundwater wells existed within the Loup River Basin. Because wells drilled prior to 1993 were not required to be registered, additional non-registered wells likely exist. With water from approximately 10,000 groundwater wells supplying water to approximately 1.3 million acres, irrigation is the largest use of groundwater in the Loup River Basin. The majority of the approximately 1,200 surface water appropriations present as of October 1, 2005, are also used for irrigation purposes and are typically located on major streams (NDNR, December 30, 2005).

Water uses in the vicinity of the Project are generally similar to that of the overall basin, with most groundwater and surface water being used for irrigation. In addition, a substantial amount of groundwater is used for domestic and industrial purposes in Genoa and Columbus.

In addition to hydropower generation at the Project, Loup River water diverted into the Loup Power Canal provides for important non-consumptive surface water uses, including recreation and aquatic habitat. Water uses adjacent to the Loup Power Canal by others are allowed through water rights granted by the State of Nebraska. In addition to water rights held by the District, there are 108 water right claims, applications, and appropriations adjacent to the Loup Power Canal: 105 are for irrigation, 2 are for manufacturing, and 1 is for domestic use. According to the District's records, as of February 2011, there were 71 irrigation water withdrawal points along the length of the Loup Power Canal. A standardized agreement between each irrigator and the District provides for safe and reasonable access to water in the Loup Power Canal.

E.1.8 Non-Project Dams and Diversion Structures in the Loup River Basin

Three storage dams and reservoirs and three diversion dams are located upstream of the Project in the Loup River Basin. These non-Project dams and reservoirs are for purposes of irrigation, flood control, recreation, and fish and wildlife habitat, as shown in Table E-1 and Appendix E-1, Figure E-3. The three storage dams and reservoirs are as follows (U.S. Bureau of Reclamation, 2008):

- Virginia Smith Dam and Calamus Lake (formerly Calamus Dam and Reservoir) – Virginia Smith Dam is located on the Calamus River approximately 4 miles upstream of its confluence with the North Loup River and approximately 5.5 miles northwest of Burwell, Nebraska.
- Sherman Dam and Reservoir – Sherman Dam is located on Oak Creek approximately 5 miles northeast of Loup City, Nebraska.
- Davis Creek Dam and Reservoir – Davis Creek Dam lies across a tributary of Davis Creek about 5.5 miles south of North Loup, Nebraska.

The three diversion dams are as follows (U.S. Bureau of Reclamation, 2008):

- Kent Diversion Dam – Kent Diversion Dam is located on the North Loup River approximately 8 miles upstream of its confluence with the Calamus River.
- Milburn Diversion Dam – Milburn Diversion Dam is located approximately 5 miles upstream of Milburn, Nebraska, on the Middle Loup River.
- Arcadia Diversion Dam – Arcadia Diversion Dam is located on the Middle Loup River approximately 8.5 miles upstream of Arcadia, Nebraska.

All six of these facilities were constructed as part of the Pick-Sloan Missouri Basin Program administered by the U.S. Bureau of Reclamation (2008).

Table E-1. Loup River Basin Storage and Diversion Dams

Project Name	Dam Location (river or stream)	Drainage Area (mi^2)	Surface Area (acres)[1]	Total Reservoir Storage (acre-ft)[a]
Virginia Smith Dam and Calamus Lake	Calamus River	1,036	5,190	177,623
Sherman Dam and Reservoir	Oak Creek	37	2,868	125,477
Davis Creek Dam and Reservoir	Tributary of Davis Creek	6.3	1,145	46,179
Kent Diversion Dam	North Loup River	240	N/A	N/A
Milburn Diversion Dam	Middle Loup River	Not Available	N/A	N/A
Arcadia Diversion Dam	Middle Loup River	Not Available	N/A	N/A

Sources: NDNR, 2008a, "Databank," *Nebraska Department of Natural Resources*, retrieved on July 18, 2008, http://www.dnr.state.ne.us/databank/dbindex.html;
U.S. Bureau of Reclamation, 2008, "Dataweb," *U.S. Bureau of Reclamation*, retrieved on July 18, 2008, http://www.usbr.gov/dataweb/.

Note:

[a] N/A = not applicable.

E.1.9 Project Return Flow

Flow released from the Columbus Powerhouse is returned to the Platte River approximately 2 miles downstream of the confluence of the Loup and Platte rivers. The drainage area of the Lower Platte River downstream of the Project return flow point is approximately 26,000 square miles (USGS, 2008). Major tributaries of the Lower Platte River include the Elkhorn River and Salt Creek (see Appendix E-1, Figure E-2).

E.2 CUMULATIVE EFFECTS

Cumulative effects, as defined by FERC in its Scoping Document 2 (Section 4.1, page 18) (FERC, March 27, 2009), are as follows:

> According to the Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1508.7), a cumulative effect is an impact on the environment resulting from the incremental impacts of the action when added to other past, present and reasonably foreseeable future

> actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

E.2.1 Resources that Could be Cumulatively Affected

In Scoping Document 2 (Section 4.1.1, pages 18 and 19), FERC identified threatened and endangered species protected under the Endangered Species Act (ESA)—specifically the Federally listed interior least tern (*Sterna antillarum athalassos*), piping plover (*Charadrius melodus*), and pallid sturgeon (*Scaphirhynchus albus)*—as resources that may be cumulatively affected by the continued operation of the Project (FERC, March 27, 2009).

In addition, FERC stated that:

> Water depletions and diversions associated with evaporative losses, irrigation diversions, human disturbances, channelization, encroaching vegetation, and introductions of non-native species may have led to degradation of habitat and reduced populations of the above federally listed species in the lower Platte River. Potential depletions of water (evaporative losses) and flow alterations associated with Loup River Project operations may contribute to adverse effects on these species.

Specific discussion regarding potential cumulative effects on threatened and endangered species is provided in Section 6.6.6.

In addition to threatened and endangered species, the District has identified fish and aquatic resources as resources that may be cumulatively affected by the continued operation of the Project.

The Project's Diversion Weir, and the resulting diversion of Loup River flows, may result in the degradation of aquatic habitat in the Loup River bypass reach and of the ability of fish to migrate therein. These components of Project operations may contribute cumulative effects on fish and aquatic resources; specific discussion is provided in Section 6.3.5.

E.2.2 Geographic Scope

The geographic scope of the cumulative effects analysis in this Exhibit E defines the physical limits or boundaries of the proposed action's effect on the listed species. FERC, in its Scoping Document 2 (Section 4.1.2, page 19), defines the geographic scope for the cumulative effects analysis as "the Loup River basin and the lower Platte River from the Loup River confluence to the Missouri River confluence" (FERC, March 27, 2009).

E.2.3 Temporal Scope

The temporal scope of the cumulative effects analysis in this Exhibit E addresses past, present, and reasonably foreseeable future actions and their effects on each resource that may be cumulatively affected. Based on the potential term of the new license, FERC, in its Scoping Document 2 (Section 4.1.3, page 19), defines the temporal scope of this analysis to address reasonably foreseeable actions as "30-50 years into the future" (FERC, March 27, 2009). The historical discussion will, by necessity, be limited by the amount of available information for each resource (FERC, March 27, 2009).

E.2.4 Past and Present Actions

The cumulative effects of past and present actions on threatened and endangered species and aquatic resources are incorporated into the description of the existing resources in Sections E.6.3.1 and E.6.6.1, respectively.

E.2.5 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions that could have a cumulative affect on listed species include:

- Continued operation of the Loup River Hydroelectric Project
- Continued actions of the Platte River Recovery Implementation Program upstream in the central Platte River
- Continued irrigation practices and municipal supply within the Loup and Platte river basins
- Continued operation of the non-Project storage dams and reservoirs and diversion dams within the Loup River Basin (see Section E.1.8)

E.3 COMPLIANCE WITH APPLICABLE LAWS

E.3.1 Section 401 of the Clean Water Act

Section 401 of the Clean Water Act (CWA) requires any applicant for a Federal license or permit to conduct any activity that may result in a discharge into navigable waters to provide to the licensing or permitting agency a certification from the state in which the discharge originates that such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA. Therefore, a state Water Quality Certification is required to obtain a license from FERC. The Nebraska Department of Environmental Quality (NDEQ) is the state agency designated to carry out the certification requirements prescribed in Section 401 of the CWA for waters of the State of Nebraska.

NDEQ has participated in resource discussions throughout the relicensing process, including development of the District's study plans and presentation of the study results. During the development of the District's Proposed Study Plan and Revised Study Plan, water temperature and a fish consumption advisory related to polychlorinated biphenyl (PCB) levels in fish were the only two water quality issues discussed at length and determined to require study or analysis. The studies/analysis associated with these issues are complete, and the District intends to file a request for CWA Section 401 certification with NDEQ prior to filing the License Application.

E.3.2 Endangered Species Act

Section 7 of the ESA requires a Federal agency to ensure that "any action authorized, funded, or carried out…is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species" (16 USC 1536(a)(2)). FERC designated the District as its non-Federal representative for purposes of conducting informal consultation pursuant to Section 7 (FERC, December 16, 2008). Therefore, the District consulted the U.S. Fish and Wildlife Service (USFWS) to identify any endangered or threatened species or critical habitat associated with the Project or Project Boundary.

Through consultation with USFWS, the following Federally listed endangered or threatened species that may exist in the vicinity of the Project were identified: interior least tern, piping plover, whooping crane,[1] pallid sturgeon, and western prairie fringed orchid (USFWS, July 21, 2008). Based on the potential occurrence of these species, informal consultation with USFWS is ongoing. The District has prepared a Preliminary Draft Biological Assessment (BA) in support of obtaining a new license for the Project (see Appendix E-2). At the time of the submittal to FERC of this Draft License Application, USFWS, NGPC, and the District are consulting on potential conservation measures to address the potential effects on Federally listed threatened and endangered species protected under the ESA as well as potential effects on fish and wildlife protected by the Fish and Wildlife Coordination Act (16 USC 661 et seq.). The District anticipates including mutually agreed upon conservation measures developed during this consultation in the Draft BA to be submitted to FERC with the District's License Application.

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1 The whooping crane was not included in the species list provided by USFWS on July 21, 2008. However, based on discussions between the District and USFWS during the Project relicensing process, the whooping crane is included in this Exhibit E. It is anticipated that USFWS will include the whooping crane in its updated species list in its pending letter to the District.

Additionally, the State of Nebraska has identified the following species for which protection is provided under Nebraska's Nongame and Endangered Species Conservation Act (NESCA): North American river otter, lake sturgeon, sturgeon chub, and small white lady's slipper. Section E.6.6 of this Exhibit E discusses both Federally and state-listed species relevant to the Project.

E.3.3 Magnuson-Stevens Fishery Conservation and Management Act

No essential fish habitat, as defined under the Magnuson-Stevens Fishery Conservation and Management Act and established by the National Marine Fisheries Services, exists in the Loup or Platte rivers or the Loup Power Canal.

E.3.4 Coastal Zone Management Act

The Project is not located within a coastal zone boundary, nor does it affect a resource located within the boundaries of a designated coastal zone; therefore, the Project has no nexus to the Coastal Zone Management Act.

E.3.5 National Historic Preservation Act

FERC's issuance of a new license for the continued operation and maintenance of the Project is considered a Federal undertaking and is therefore subject to the provisions of Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations at 36 CFR 800, Protection of Historic Properties. Consultation under Section 106 has been initiated by FERC, and FERC has designated the District as its non-Federal representative for purposes of conducting informal consultation pursuant to Section 106.

Early in the relicensing process, the District contacted six Federally recognized Native American tribes with historic affiliation to the Project vicinity and the Nebraska State Historic Preservation Office (SHPO) to determine their interest in the Project's effects on historic properties. Nebraska SHPO has been an active participant in consultation, and three tribes provided correspondence stating that they have identified no Project issues.

To meet its responsibilities pursuant to Section 106, the District anticipates that FERC will enter into a Programmatic Agreement (PA) with Nebraska SHPO and the Advisory Council on Historic Preservation (ACHP) for the management of historic properties within the Project's area of potential effects. The stipulations outlined in the PA would ensure that the District manages historic properties in accordance with an approved Historic Properties Management Plan (HPMP). The District has prepared a Draft HPMP that is being provided to Nebraska SHPO for review. The District will file the Draft HPMP with FERC once Nebraska SHPO comments have been received and incorporated.

Section E.6.9 of this Exhibit E provides additional details regarding the historical and cultural resources within the Project's area of potential effects.

E.3.6 Wild and Scenic Rivers and Wilderness Acts

The Project is not located within or adjacent to a river segment that is designated as part of, or under study for inclusion in, the National Wild and Scenic River System. In addition, the Project is not located within or adjacent to any state-protected river segments. Lastly, no area within the Project Boundary is designated as wilderness area under the Wilderness Act.

E.4 EXISTING PROJECT FACILITIES AND OPERATIONS

The following subsections describe the principal features of the Project, generally from upstream to downstream. These Project facilities, along with the Project Boundary, are shown in Appendix E-1, Figure E-7, Sheets 1 through 14. Unless otherwise indicated, the sources of this information are the District's current "Genoa-Columbus Project (FERC Project 1256-NE) Operating Plan" (Loup Power District, 2006) and the *Final Report, Loup River Public Power District, Columbus, Nebraska* (Harza Engineering Co., February 1938).

E.4.1 Diversion Weir

The Diversion Weir is located in the Loup River at River Mile (RM) 34.2, approximately midway between Fullerton and Genoa, Nebraska (see Appendix E-1, Figure E-7, Sheet 1). The structure is founded on the sand and silt river bed, is approximately 1,320 feet long, and has a height of approximately 9 feet above grade. The Diversion Weir consists of a low concrete weir with a concrete apron stabilized with steel sheeting at its heel and toe. The fixed crest of the weir is at an elevation of 1,574 feet above mean sea level[2] (MSL), and wooden flashboards (or planks) are normally maintained along the top of the weir to create an effective crest elevation of 1,576 feet MSL. These sacrificial flashboards are designed to fail under heavy ice loads or extreme high water to prevent damage to the permanent fixed weir. The right, or south, abutment of the Diversion Weir is flanked by a dike extending approximately 3,000 feet to high ground. In mid-channel, the Diversion Weir makes an abrupt downstream turn and extends approximately 250 feet to terminate at the most riverward pier of the Sluice Gate Structure, described in Section E.4.3.

[2] Throughout this application, mean sea level references the U.S. Geological Survey National Geodetic Vertical Datum of 1929 (NGVD 29).

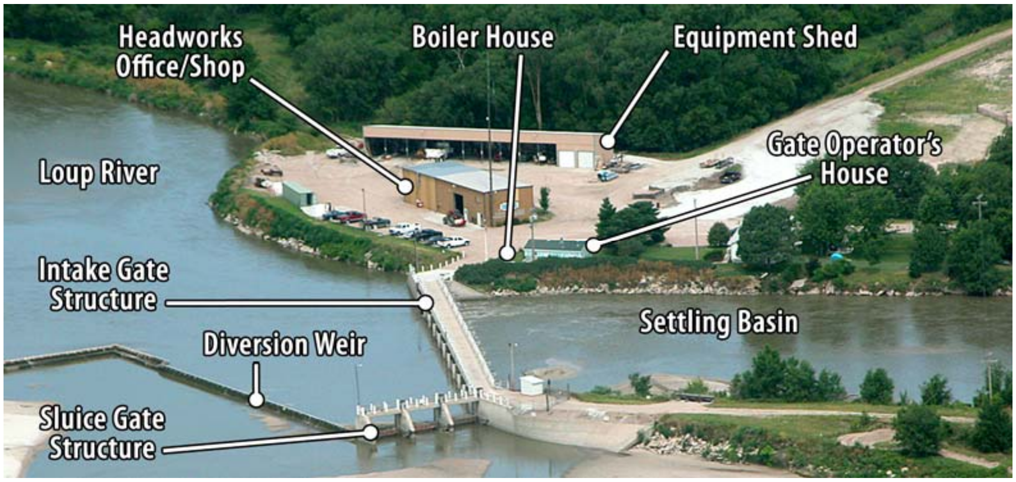

Photo E-1. Aerial view of the Headworks.

Photo E-2. View of the Diversion Weir from the Sluice Gate Structure.

E.4.2 Intake Gate Structure

The Intake Gate Structure is located on the north bank of the river (see Appendix E-1, Figure E-7, Sheet 1). It is constructed of reinforced concrete and supports 11 steel radial gates that admit Loup River water into the Settling Basin, the first segment of the Loup Power Canal. Each gate is 24 feet long with a maximum opening of 5 feet. The elevation of the concrete gate sills is 1,569.5 feet MSL. Six gates are equipped with electric motors; the other five gates are operated by either electric- or gasoline-powered gyros. An integral concrete service bridge spans the Settling Basin and provides for vehicle and operator access to all intake gates and utilities.

The downstream end of the Intake Gate Structure connects at a right angle with the Sluice Gate Structure, described in Section E.4.3. To ensure operation of the intake and sluice gates during cold weather, a steam boiler with appropriate fixed piping and hoses is provided for ice control and thawing of all gates. The upstream end of the Intake Gate Structure is flanked by a sand-fill dike extending approximately 7,200 feet to high ground with a crown elevation of 1,586 feet MSL.

Photo E-3. View of the Intake Gate Structure from the Sluice Gate Structure.

Photo E-4. Downstream face of the Intake Gate Structure.

E.4.3 Sluice Gate Structure

The Sluice Gate Structure spans the portion of river flowing between the downstream leg of the Diversion Weir and the Intake Gate Structure (see Appendix E-1, Figure E-7, Sheet 1). The Sluice Gate Structure is constructed of reinforced concrete and supports three steel radial gates. Each steel gate is 20 feet long with a maximum opening of 6 feet. The elevation of the sluice gate sills is 1,568 feet MSL. All three gates are equipped with electric motors and can be accessed from an integral concrete service bridge.

Photo E-5. Upstream face of the Sluice Gate Structure.

Photo E-6. Downstream face of the Sluice Gate Structure.

E.4.4 Settling Basin

Water diverted from the Loup River enters the Settling Basin (see Appendix E-1, Figure E-7, Sheets 1 and 2). The Settling Basin is designed for very slow flow velocity to allow heavier sediment materials to settle out of the water before it enters the much narrower, faster flowing Upper Power Canal. Design flow velocity through the Settling Basin is less than 1 foot per second. The Settling Basin is approximately 2 miles long and has a bottom width of 200 feet and a nominal depth of 16 feet. Hydraulic capacity of the basin varies depending on the accumulation of sand, silt, and sediment within the basin. Maximum hydraulic capacity, when the basin is largely free of sediment, is 3,500 cfs. Maximum basin water surface elevation is 1,572 feet MSL.

E.4.5 Hydraulic Dredge

A floating Hydraulic Dredge is employed to remove accumulated sediment from the Settling Basin. The Hydraulic Dredge operates using an electrically driven 2,500-horsepower pump with 30-inch suction and 28-inch discharge lines. The hoist-supported suction line is equipped with a dustpan-type suction head.

The dredged material (in the form of silt, sand, and gravel) is pumped by the dredge through an articulated steel pipeline to a series of discharge pipes spaced along both sides of the Settling Basin. These fixed pipes lead to the North and South Sand Management Areas (SMAs), discussed in Section E.4.6, on either side of the Settling Basin. The discharge pipe locations are shown in Appendix E-1, Figure E-8. Return water from the North and South SMAs is routed through a series of dikes and ditches and drains back into either the Loup River or the Loup Power Canal, depending on the location of the discharge.

The District's original 1937 dredge has reached the end of its economic life and is being retired. A new hydraulic dredge has been ordered and is scheduled to enter service in September 2012. The new dredge will be very similar to its predecessor in form and function. However, it will have a more powerful 3,000-horsepower pump and use more energy-efficient variable frequency drive electric motors. The new dredge will also employ modern controls and monitoring systems.

Photo E-7. The 1937 Hydraulic Dredge, “PAWNEE,” in dry dock for maintenance.

E.4.6 Sand Management Areas

The North and South SMAs are located on either side of the Settling Basin (see Appendix E-1, Figure E-7, Sheet 1). The North SMA is approximately 320 acres in size and is located north of the Settling Basin, away from the Loup River, and the South SMA is approximately 400 acres in size and is located south of the Settling Basin, adjacent to the Loup River.

As previously stated, the material dredged from the Settling Basin is distributed to the North and South SMAs through fixed 28-inch-diameter steel discharge pipes on either side of the Settling Basin. There are 13 discharge pipes for the South SMA, evenly spaced from the most northeast corner to the approximate center of the South SMA. The North SMA has 15 discharge pipes evenly spaced along its entire length. The discharge pipe locations are shown in Appendix E-1, Figure E-8.

E.4.7 Skimming Weir

The Skimming Weir is located at the downstream end of the Settling Basin (see Appendix E-1, Figure E-7, Sheet 2). Here, decanted water passes over the Skimming Weir into a narrower section of the Loup Power Canal, where the maximum flow velocity is 2.25 feet per second. This fixed-crest concrete weir is 133.5 feet long and has a bridge-like superstructure with eight 18-inch-wide piers that create nine 12.5-foot-long openings. The weir is fitted with screens to collect trash and debris before it can enter the Upper Power Canal. The crest elevation of the Skimming Weir is 1,568.2 feet MSL. Overflow depth varies from 1.6 feet at 800 cfs to 4.2 feet at 3,500 cfs. The water level in the Settling Basin (and the depth of the basin) varies with the amount of water passing over the Skimming Weir. Just upstream of the Skimming Weir, a stream gage (USGS Gage 06792500, Loup River Power Canal near Genoa, NE) records water flow entering the Upper Power Canal.

Photo E-8. View of the Skimming Weir from upstream.

Photo E-9. View of flow exiting the Skimming Weir.

E.4.8 Upper Power Canal

The Upper Power Canal (see Appendix E-1, Figure E-7, Sheets 2 through 6) has a hydraulic capacity of 3,500 cfs (6,942 acre-feet per day). The Upper Power Canal parallels the south side of the Nebraska Central Railroad (formerly Union Pacific Railroad) from the Settling Basin to Genoa, where it flows under Beaver Creek through an inverted siphon. The 10-mile canal segment then skirts along the south side of Genoa until it flows under the railroad in another siphon. The Upper Power Canal continues along the north side of the Loup River Valley, crosses under Looking Glass Creek in a third siphon, and continues to the Monroe Powerhouse. All three siphons are three-barrel concrete structures designed as rigid boxes and are capable of passing the maximum canal flow of 3,500 cfs at a velocity of 5.22 feet per second. Dimensions of the siphons are provided in Table E-2.

Table E-2. Upper Power Canal Siphon Dimensions

Siphon	Length (ft)	Barrel	
		Width (ft)	Height (ft)
Beaver Creek	550	12.5	16
Railroad	67.5	11.67	15
Looking Glass Creek	420	12.5	16

From the Settling Basin to the Looking Glass Creek Siphon, the Upper Power Canal has a bottom width of 73 feet and a normal water depth of 14.3 feet. Freeboard is 5 feet, and the design velocity is 2.25 feet per second. Much of this upstream canal segment is constructed in sand. From the Looking Glass Creek Siphon to the Monroe Powerhouse, the Upper Power Canal has a bottom width of 39 feet and a normal water depth of 19.5 feet. The canal bottom profile slopes only 3 inches per mile. The Monroe Powerhouse automatically maintains a constant headwater elevation; therefore, the Upper Power Canal has no effective storage.

Photo E-10. View of Upper Power Canal and the Railroad Siphon at Genoa.

Photo E-11. View of the Railroad Siphon exit.

E.4.9 Monroe Powerhouse

The Monroe Powerhouse is located 0.75 mile north of Monroe (see Appendix E-1, Figure E-7, Sheet 6). It is a reinforced concrete structure that is 129 feet long, 39 feet wide, and 87 feet high. The station intake and powerhouse were built as one structure, with the scroll cases formed in concrete. The Monroe Powerhouse spans the canal and functions as an energy-producing canal drop structure.

The plant was designed for a normal gross head of 32 feet. It contains three 3,200-horsepower, vertical axis Francis turbines directly connected to generators rated at 2,750 kilovolt-amperes (kVA) at a 0.95 power factor. At full load, each turbine generating unit can pass 1,000 cfs. All three units were sequentially rehabilitated and modernized from 2004 to 2007. Power is generated at 6.9 kV and stepped up to 34.5 kV at the substation located at the north end of the powerhouse.

There is no transmission associated with the Monroe Powerhouse because the powerhouse bus is directly connected to the substation via underground bus cable. Prior to the power entering the substation, the power is metered and purchased by NPPD. At the substation, the 6.9 kV power from the Monroe Powerhouse is stepped up to 34.5 kV, which interconnects with the District's and Cornhusker Public Power District's 34.5kv sub-transmission system and 12.5kv distribution systems.

Rating and descriptive data for the existing turbine and generating units are provided in Tables E-3 and E-4, respectively.

Table E-3. Monroe Powerhouse Turbines

Item	Monroe Powerhouse
Number of Vertical Axis Francis Turbines	3
Manufacturer	James Leffel/American Hydro
Rotational Speed	112.5 rpm
Maximum Hydraulic Capacity	1,000 cfs
Minimum Hydraulic Capacity	300 cfs
Rated Turbine Capacity	3,200 hp
Rated Net Head	28.6 feet

Notes:
rpm = revolutions per minute
cfs = cubic feet per second
hp = horsepower

Table E-4. Monroe Powerhouse Generators

Item	Monroe Powerhouse
Number of Synchronous Generators	3
Manufacturer	Westinghouse
Rotational Speed	112.5 rpm
Rated Generator Capacity	2,750 kVA
Frequency	60 Hz, 3-Phase
Voltage	6,900
Power Factor	0.95

Notes:
rpm = revolutions per minute
kVA = kilovolt-amperes
Hz = Hertz

Six electrically operated vertical head gates (two to each turbine generating unit) provide for closing off the turbine intake flumes. A 25-ton bridge crane provides for equipment handling and maintenance in the Monroe Powerhouse.

In the event of a total plant shutdown, a single automated radial bypass gate will automatically[3] redirect the canal flow around the turbine units. The 15-foot-4-inch-wide gate is fully enclosed from the elements at the north end of the powerhouse. It is operated by means of a 5-ton electrically powered hoist equipped with a solenoid brake. A 9-ton counterweight is used to lift the gate. When the solenoid is released, a centrifugal fan brake automatically comes into operation. Precise discharge control is accomplished by means of floats and relay control of the radial bypass gate.

Photo E-12. View of the upstream face of the Monroe Powerhouse; the flow bypass gate is located inside the enclosure at left.

[3] The radial bypass gate is fitted with a floatation device that automatically opens the gate in response to high water levels.

Photo E-13. View of the downstream face of the Monroe Powerhouse.

E.4.10 Lower Power Canal

Similar to the Upper Power Canal, the Lower Power Canal has a hydraulic capacity of 3,500 cfs (6,942 acre-feet per day). The Lower Power Canal extends approximately 13 miles from the Monroe Powerhouse to Lake Babcock, a regulating reservoir, and has a bottom width of 39 feet and a water depth of 19.5 feet (see Appendix E-1, Figure E-7, Sheets 6 through 10). The Lower Power Canal flows under two siphons, the Dry/Cherry Creek Siphon and the Oconee Siphon (at the Union Pacific Railroad). These siphons, like those on the Upper Power Canal, are three-barrel concrete structures designed as rigid boxes. Additionally, the 916 Siphon carries Lost Creek under the Lower Power Canal. Dimensions of the siphons are provided in Table E-5.

Table E-5. Lower Power Canal Siphon Dimensions

Siphon	Length (ft)	Barrel	
		Width (ft)	Height (ft)
Dry/Cherry Creek	74	11.75	15
916	315.67	6.67	5
Oconee	67.5	11.67	15

Photo E-14. View of the Lower Power Canal at the Oconee Siphon exit.

E.4.11 Sawtooth Weir

The Sawtooth Weir is a concrete weir structure located where the Lower Power Canal enters Lake Babcock, the in-channel regulating reservoir (see Appendix E-1, Figure E-7, Sheet 10). Its purpose is to control the depth of water in the Lower Power Canal and to prevent Lake Babcock from back-flowing in the event of a canal breach. When this weir is viewed from above, it has a sawtooth or zigzag shape. This design geometry was used to obtain a greater crest length (and overflow capacity) for the 227.5 feet available between abutments. The top of weir elevation is 1,527.4 feet MSL. Head loss at this structure is approximately 0.40 feet at the maximum canal flow rate.

Photo E-15. Unique turbulence created by the submerged Sawtooth Weir.

E.4.12 Regulating Reservoirs

E.4.12.1 Lake Babcock

Lake Babcock, the original, in-channel regulating reservoir, is located 3 miles north of Columbus (see Appendix E-1, Figure E-7, Sheets 10 and 11). Its purpose is to temporarily pond water for later release through the Columbus Powerhouse during peak load periods. Lake Babcock was created in a natural depression by building compacted earth embankments on the north, east, and south sides. Lake Babcock covers 760 acres at its full pool elevation of 1,531 feet MSL.[4] Lake Babcock's effective storage capacity for power generation is approximately 2,270 acre-feet at an elevation of 1,531 feet MSL and 730 acre-feet at an elevation of 1,529 feet MSL. The majority of the time, daily fluctuation of the reservoir surface is about 2 feet; however, during periods of low flow and high electrical demand, fluctuations often increase to 3 feet, with a maximum fluctuation of 5 feet.

The open water portion of Lake Babcock experiences substantial wave buildup on windy days. Therefore, much of the shore is protected with riprap. In addition, a

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4 The original maximum pool elevation in Lake Babcock was 1,529 feet MSL; however, in the 1960s due to siltation that restricted water storage, the District began operating with a maximum pool elevation of 1,531 feet MSL. This change in operations reduced the available freeboard from 6 to 4 feet.

substantial reach of embankment near the reservoir outlet and bordering Lake North is protected with a concave seawall constructed of concrete.

E.4.12.2 Lake North

After 25 years of Project operation, sediment accumulation in Lake Babcock had substantially reduced its ponding capacity, and the District constructed a second regulating reservoir adjacent to and connected with Lake Babcock (see Appendix E-1, Figure E-7, Sheet 11). This off-channel regulating reservoir, named Lake North, was completed in 1962. It was constructed by adding new compacted earth embankments to the north and east and using existing Lake Babcock embankments to the south and west. Lake North covers approximately 200 acres at an elevation of 1,531 feet MSL, providing an estimated 2,080 acre-feet of gross storage capacity.

A concrete control structure in the south dike is the only link between the in-channel reservoir and the off-channel reservoir and is oriented and designed to reduce the inflow of sediment to the lake. All flow into and out of Lake North passes through this opening. A set of steel stoplogs are stored at the control structure; they can be installed using a mobile crane to isolate the two reservoirs as necessary for maintenance or emergency purposes.

To control wave erosion, the majority of the Lake North shoreline has been lined with steel sheet pile protection and concrete riprap.

Photo E-16. View of Lake North from the boat launch area in the northeast corner.

Photo E-17. View from Lake Babcock to Lake North showing the dike that divides the two regulating reservoirs and the control structure that connects them.

Together, these two interconnected lakes form the current connected regulating reservoir for the Project, which has a normal maximum surface area of 960 acres at an elevation of 1,531 feet MSL. The gross storage capacity of this two-reservoir impoundment is approximately 4,350 acre-feet.

The regulating reservoirs are normally operated between elevations of 1,529 and 1,531 feet MSL. Usable ponding capacity between these elevations is estimated to be approximately 1,940 acre-feet. This volume is equivalent to about 14 hours of average inflow from the Lower Power Canal. The regulating reservoirs were not designed to store a large volume of water for later use during dry periods. Instead, they allow for hydrocycling of the daily inflow, ponding water during hours of low electrical demand and releasing water during hours of high electrical demand all within a 24-hour period.

E.4.13 Intake Canal

Water exiting Lake Babcock, the in-channel regulating reservoir, flows 1.5 miles through the Intake Canal to Columbus Powerhouse (see Appendix E-1, Figure E-7, Sheets 11 and 12). There is no control structure at the outlet from Lake Babcock; flow and reservoir elevation are regulated by the turbine gates at the Columbus Powerhouse.

The Intake Canal was designed for a capacity of 4,800 cfs, which is the hydraulic capacity of the turbine generating units in the Columbus Powerhouse. The bottom width of the Intake Canal is 108 feet when it leaves Lake Babcock. This width reduces to 94 feet as the Intake Canal approaches the Powerhouse Inlet Structure. The embankments for the Intake Canal were constructed of compacted earth fill, similar to the reservoir dikes. Intake Canal water depth varies from 17.2 to 22.2 feet, depending on the reservoir stage and rate of flow. The slope of the canal profile is 3 inches per mile. Flow velocity in the canal varies from 1.4 to 2.0 feet per second.

E.4.14 Powerhouse Inlet Structure

The Intake Canal terminates at the Powerhouse Inlet Structure. This three-bay reinforced concrete structure is 60 feet long, 104 feet wide, and 40 feet high. A concrete tower structure for the gate hoists extends an additional 34 feet above the deck of the Powerhouse Inlet Structure. Canal flow is smoothly routed through vertical steel trash rack panels with 2.375-inch openings that are designed to exclude large items that could harm the turbines or mechanical equipment in the Columbus Powerhouse. A large mechanical trash rake is mounted on rails to traverse the inlet width and clean the trash racks.

Behind the trash racks, each inlet bay is provided with a vertical steel inlet gate that can be lowered to stop inflow to the Penstocks for maintenance or emergency purposes. Each gate weighs 26,500 pounds and is designed to close off the passage under maximum flow conditions.

Photo E-18. Upstream face of the Powerhouse Inlet Structure.

Photo E-19. Operating deck of the Powerhouse Inlet Structure.

E.4.15 Penstocks

Three steel Penstocks connect the Powerhouse Inlet Structure with the Columbus Powerhouse. Each penstock is 20 feet in diameter and 385 feet in length. Thickness of the riveted steel sections increases from 3/8 inch at the top to 7/8 inch at the bottom, where hydraulic pressure is greatest. The Penstocks are supported on a gravel base that extends up to the spring line of the pipe. Flow velocity in the Penstocks is approximately 5.1 feet per second. The Penstocks were designed for a low velocity to eliminate the need for a surge tank.

Photo E-20. View of the Penstocks from the Columbus Powerhouse.

E.4.16 Columbus Powerhouse

The Columbus Powerhouse is located 2.5 miles northeast of Columbus (see Appendix E-1, Figure E-7, Sheet 12). It is the primary power-generating element of the Project. With 3.5 times the head and 1.4 times the flow capacity of the Monroe Powerhouse, it generates approximately 80 percent of total Project power.

The Columbus Powerhouse is a reinforced concrete structure that is 180 feet long, 57 feet wide, and 115 feet high. It was designed for a normal head of 115 feet, and it contains three 18,000-horsepower, vertical axis Francis turbines directly connected to generators rated at 16,000 kVA at a 0.95 power factor. All three units were sequentially rehabilitated and modernized from 2004 to 2007. Rating and descriptive data for the turbines and generators are provided in Tables E-6 and E-7, respectively.

Table E-6. Columbus Powerhouse Turbines

Item	Columbus Powerhouse
Number of Vertical Axis Francis Turbines	3
Manufacturer	I.P. Morris/American Hydro
Rotational Speed	150 rpm
Maximum Hydraulic Capacity	2,060 cfs[a]
Minimum Hydraulic Capacity	1,000 cfs
Rated Turbine Capacity	18,000 hp
Rated Net Head	113.5 feet

Notes:
rpm = revolutions per minute
cfs = cubic feet per second
hp = horsepower
[a] This source of this data is Acoustic Technologies, July 15, 2005, "Loup Power District, Columbus Powerhouse Unit 1 Performance Test," Wareham, MA.

Table E-7. Columbus Powerhouse Generators

Item	Columbus Powerhouse
Number of Synchronous Generators	3
Manufacturer	Allis Chalmers/Woods Group
Rotational Speed	150 rpm
Rated Generator Capacity	16,000 kVA
Frequency	60 Hz, 3-Phase
Voltage	13,800
Power Factor	0.95

Notes:
rpm = revolutions per minute
kVA = kilovolt-amperes
Hz = Hertz

At full gate, each turbine generating unit can pass 2,060 cfs. However, total plant generation is limited by the 4,800-cfs hydraulic capacity of the Intake Canal. The turbine generating units normally operate at about 1,600 cfs for the most efficient use of water. The lowest practical discharge from a single turbine generating unit at the Columbus Powerhouse is 1,000 cfs. The Intake Canal, Columbus Powerhouse, and

Tailrace Canal were specifically designed for the zero-to-4,800-cfs flow variation of hydrocycling[5] operation.

A 75-ton bridge crane provides for equipment handling and maintenance in the Columbus Powerhouse. The crane also has a 15-ton auxiliary hook. Power is generated at 13,800 volts and stepped up to 115,000 volts by District-owned transformers as it enters the NPPD-owned transmission facilities located at the east end of the Columbus Powerhouse.

There is no transmission associated with the Columbus Powerhouse because each of the three generator step-up transformers is connected directly to the NPPD 115 kV bus.

Photo E-21. View of the Columbus Powerhouse from the Powerhouse Inlet Structure.

[5] Hydrocycling refers to the method of producing hydroelectricity "on-demand" by temporarily ponding water in a regulating reservoir until the water is needed to produce electricity, typically within the same 24-hour period.

Photo E-22. View of the Columbus Powerhouse from the Tailrace Canal.

E.4.17 Tailrace Canal

After passing through the Columbus Powerhouse, water is discharged to the Tailrace Canal. The Tailrace Canal is approximately 5.5 miles long and was excavated along its entire length (see Appendix E-1, Figure E-7, Sheets 12 through 14). It has a bottom width of 42 feet and a normal water depth of about 19 feet. Immediately upstream of the Outlet Weir, the Tailrace Canal widens to approximately 600 feet. This canal segment was designed to carry a nominal 4,800 cfs at a velocity of 3 feet per second. The slope of the hydraulic gradient is 0.0007 foot/foot (4.4 inches per mile).

Two structures of note in the Tailrace Canal segment are the Lost Creek Flood Control Channel Spillway and the Lost Creek Siphon.

After many years of flooding problems in Columbus related to Lost Creek, the Lost Creek Flood Control Project was constructed in 1983 by USACE. This project included construction of a bypass channel around Columbus and a concrete spillway structure on the west bank of the Tailrace Canal immediately downstream of the Columbus Powerhouse. Due to the high groundwater table in the area, there is a nearly continuous low flow in the Lost Creek Flood Control Channel of approximately 12 cfs, with periodic higher discharges during storm events. The Lost Creek Flood Control Channel is owned and maintained by the City of Columbus.

The Lost Creek Siphon carries Lost Creek under the Tailrace Canal. The siphon consists of a 60-inch-diameter, 247.5-foot-long, west-to-east-flowing pipe that drops approximately 20 feet below Lost Creek to pass under the Tailrace Canal. The pipe then rises approximately 15 feet to discharge into the re-aligned Lost Creek on the east side of the Tailrace Canal. Because of the intermittent flow and high sediment characteristics of Lost Creek, it is necessary to prevent the siphon invert from becoming blocked with sediment. This is accomplished by providing for flow through the siphon using water from the Tailrace Canal. A 24-inch by 45-inch adjustable sluice gate was installed in the west canal embankment. This gate opens to a 24-inch-diameter culvert that passes through the embankment and discharges into the west entrance of the Lost Creek Siphon. At full gate opening and normal canal level, this sluiceway can maintain a flushing flow of 27 cfs from the Tailrace Canal to the Lost Creek Siphon. Based on District gate-opening records, it is estimated that the average daily flow discharged from the Loup Power Canal into the Lost Creek Siphon is approximately 12 cfs.

Photo E-23. View of the Lost Creek Flood Control Channel spillway.

E.4.18 Outlet Weir

The Outlet Weir, also called the Tailrace Weir, is located at the confluence of the Tailrace Canal and the Platte River, at RM 101.5 (see Appendix E-1, Figure E-7, Sheet 14). It is east of Columbus and approximately 2 miles downstream of the confluence of the Loup River with the Platte River. This concrete overflow weir has a straight 700-foot-long crest. The transition from the narrower canal section to this width is 550 feet long. The weir crest was originally constructed at an elevation of 1,413 feet MSL. In late 1952, it was lowered approximately 18 inches to lower the tailwater at the Columbus Powerhouse and to increase the velocity of flow through the Tailrace Canal to carry sedimentation to the Platte River. This action was necessary due to sloughing in the Tailrace Canal, which caused sediment to settle out.

The flow characteristics and accessibility of the Outlet Weir make this a popular fishing, viewing, and recreation area.

Photo E-24. View of the Outlet Weir from the west bank.

E.4.19 Project Bypass Reach

The portion of the Loup River from the Diversion Weir to the confluence with the Platte River, approximately 34 miles, is referred to as the Loup River bypass reach. The portion of the Platte River from the Loup River confluence to the Tailrace Return, approximately 2 miles, is referred to as the Platte River bypass reach. Together, the Loup and Platte river bypass reaches constitute the Project bypass reach.

E.4.20 Transmission Lines

All power produced at the Monroe and Columbus Powerhouses is sold at the on-site substations to NPPD. For this reason, no overhead transmission voltage lines are associated with the Project license.

At the Monroe Powerhouse, the powerhouse bus is directly connected to the substation via underground bus cable. Prior to the power entering the substation, the power is metered and purchased by NPPD. At the substation, the 6.9 kV power from the Monroe Powerhouse is stepped up to 34.5 kV, which interconnects with the District's and Cornhusker Public Power District's 34.5kv sub-transmission system and 12.5kv distribution systems.

At the Columbus Powerhouse, power is generated at 13,800 volts and is stepped up to 115,000 volts by District-owned transformers as it enters the NPPD-owned transmission facilities located to the east of the Columbus Powerhouse. There is no transmission associated with the Columbus Powerhouse because each of the three generator step-up transformers is connected directly to the NPPD 115 kV bus.

E.4.21 Estimated Annual Plant Factor

The Project includes turbine generating units at the Monroe and Columbus Powerhouses. The Monroe Powerhouse consists of three turbine generators of 2,750 kilovolt-amperes (kVA) for a total installed plant capacity of 8,250 kVA. The Columbus Powerhouse consists of three turbine generators of 16,000 kVA for a total installed plant capacity of 48,000 kVA. Average annual energy generation since Project construction (1938 to 2010) is 136,405 megawatt hours (MWh). At a power factor of 0.95, the total Project plant factor is estimated to be 29.1 percent. For the period from 2007 to 2010 (following completion of the refurbishment of the turbine generating units), the Project plant factor is estimated to be 38.2 percent based on an average annual power generation of 178,874 MWh. Table E-8 lists the individual plant factor for each powerhouse as well as the total plant factor for each time period.

Table E-8. Project Plant Factor

	1938 to 2010	2007 to 2010
Monroe Powerhouse	27.3 percent	50.0 percent
Columbus Powerhouse	39.7 percent	35.9 percent
Total Project	29.1 percent	38.2 percent

These relatively modest plant factors are largely explained by the following:

- The Monroe Powerhouse units were sized to handle the Project design flow of 3,500 cubic feet per second (cfs). However, the Project design flow can be diverted only when conditions permit. The long-term (1938 to 2009[6]) average flow diverted to the Upper Power Canal is 1,630 cfs.
- Similarly, the Columbus Powerhouse units were sized to accommodate the maximum Project design flow of 4,800 cfs. However, because of limited diversion and ponding capacity, this flow rate cannot be maintained for many hours of the day. Furthermore, because there is no spillway or other outlet works at the Columbus Powerhouse, the turbine generating units were designed so that any two units can pass over 4,100 cfs if necessary.
- The District's ability to divert flow during the winter months is limited because an ice cap is developed on the canal while maintaining clearance at bridge crossings. This substantially limits the capacity of the canal during the winter.
- Since 1988, the District's ability to divert flow during the summer months has been reduced by the need to suspend dredging activities during June, July, and August to avoid impacting the endangered interior least tern and threatened piping plover while they nest at the North SMA.

E.4.22 Project Operations

Water from the Loup River is diverted into the 35-mile-long Loup Power Canal. While water is being diverted, the Headgate Operator monitors flow and debris in the Loup River, and sediment accumulation at the intake gates. The operator adjusts flow diversion rates on a daily or even hourly basis to optimize the amount of water diverted into the canal in consideration of the following factors:

- River conditions, rising or falling flow
- Debris in the river and in the Settling Basin
- Presence of slush or frazil ice
- Sediment accumulation at the intake gates and the need to sluice sediment
- Condition of the flashboards at the Diversion Weir
- Anticipated weather conditions, including temperature, wind, and precipitation

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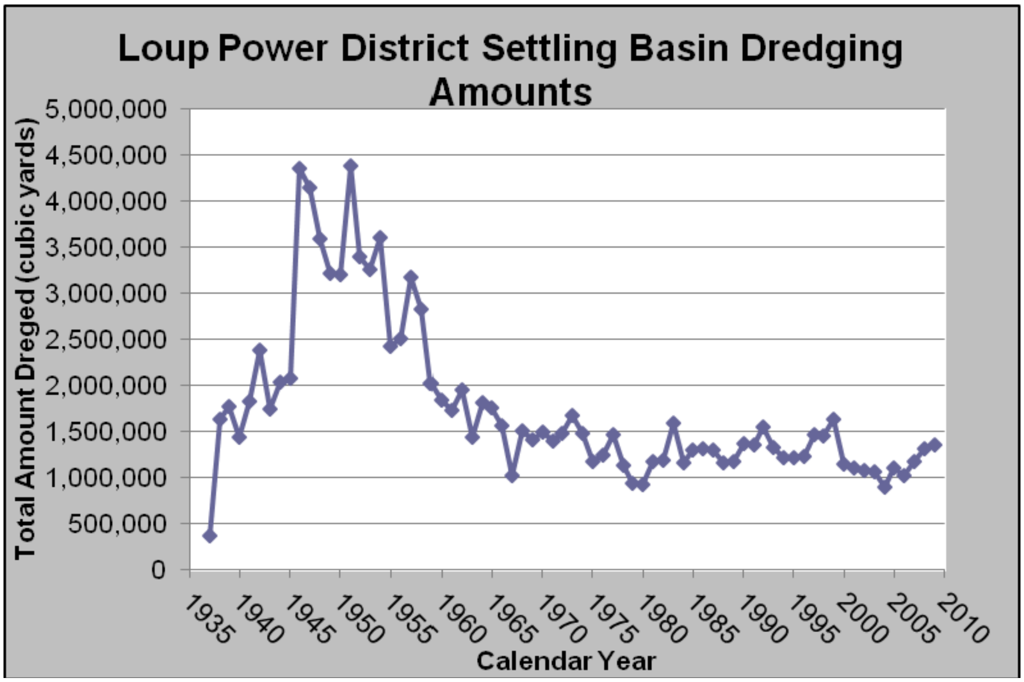
6 U.S. Geological Survey (USGS) data is not yet available for the 2010 water year.

Water diverted from the Loup River enters the Settling Basin. The Settling Basin is designed for very slow flow velocity to allow heavier sediment materials to settle out of the water before it enters the much narrower, faster flowing Upper Power Canal. Design flow velocity through the Settling Basin is less than 1 foot per second. The Settling Basin is approximately 2 miles long and has a bottom width of 200 feet and a nominal depth of 16 feet. Hydraulic capacity of the Settling Basin varies depending on the accumulation of sand, silt, and sediment within the basin. Maximum hydraulic capacity, when the Settling Basin is largely free of sediment, is 3,500 cfs.

A floating Hydraulic Dredge is employed to remove accumulated sediment from the Settling Basin. Without frequent dredging, the Settling Basin would quickly become choked with sand and cause the Project to shut down. Each year, the Hydraulic Dredge removes approximately 1 million to 1.5 million cubic yards of sediment from the Settling Basin. Sediment (in the form of silt, sand, and gravel) pumped by the dredge is carried through an articulated steel pipeline to a series of fixed steel discharge pipes spaced along both sides of the Settling Basin. These pipes lead to the North and South SMAs, located on either side of the Settling Basin (see Appendix E-1, Figure E-8). The North SMA is approximately 320 acres in size and is located north of the Settling Basin. The South SMA is approximately 400 acres in size and is located south of the Settling Basin, adjacent to the Loup River. Although designed for the same purpose—to receive and decant dredged material—the two areas have evolved quite differently.

As part of the original Project development, a concrete flume was constructed adjacent to the south bank of the Settling Basin. Its purpose was to convey the dredged material to a point downstream of the Skimming Weir, where it discharged material back into the Loup River bypass reach. However, the flume did not have sufficient capacity to convey the dredged material and, as a result, silted in within the first year of operation. Subsequently, all dredged material was pumped to the South SMA from 1937 to 1960. The quantity dredged during that period averaged approximately 2.6 million cubic yards annually. In the mid- to late 1950s, riparian property owners adjacent to the Loup River south of the South SMA expressed concern that immediately downstream of the Diversion Weir, the Loup River bypass reach was migrating south. To remediate this situation, in 1961, the District began pumping dredged material to the North SMA as well as the South SMA. From Project inception, most of the sediment dredged was pumped to the South SMA. However, once the North SMA was developed, the majority of sediment has been dredged to the North SMA. Prior to 1973, approximately 75 percent of the sediment dredged was pumped to the South SMA. Since then, only about 28 percent of dredged sediment has been pumped to the South SMA.

Graph E-1 shows the amount of material dredged since Project inception. The graph shows a reduction in dredged material after approximately 1974. Prior to 1974, the amount of dredged material was approximately 2.34 million cubic yards per year (3.75 million tons per year). Since 1975, that amount has been reduced to approximately 1.24 million cubic yards per year (2 million tons per year). The reason for this disparity is not clear, but it may be related to development of upstream reservoirs or other changes in the upper Loup River Basin.



Graph E-1. Loup Power District Settling Basin Dredging History

As previously stated, the material is dredged from the Settling Basin and is distributed to the North and South SMAs through fixed 28-inch-diameter discharge pipes on either side of the Settling Basin. There are 13 discharge pipes for the South SMA, evenly spaced from the most northeast corner to the approximate center of the South SMA. The North SMA has 15 discharge pipes evenly spaced along its entire length. The discharge pipe locations are shown in Appendix E-1, Figure E-8.

Coarser sediment materials settle out in the upstream portion of the Settling Basin, while the finer sediment deposits settle out nearer the downstream end. Sediment accumulates in the greatest quantity at the upstream end of the Settling Basin, and the accumulation quantity decreases in the downstream direction.

The annual dredging operation is initiated in the spring after the winter ice cap melts in early March. Dredging begins at pipe #1 of the South SMA (see Appendix E-1, Figure E-8) because the downstream end of the Settling Basin has the lowest quantity of accumulated sediment and thus the greatest depth of water to float the dredge. Prior to 1988, the dredging operation would progress from downstream to upstream from March through November. However, since 1988, the dredging operation is suspended from early June to mid-August to accommodate the interior least tern and piping plover nesting season.

Currently, dredged material is pumped to the South SMA from pipe #1 to pipe #13, and to the North SMA from pipe #1 up to approximately pipe #8 between March and June 1 (see Appendix E-1, Figure E-8). In mid-August, dredging begins again at the downstream end of the Settling Basin and progresses upstream toward the headgates. Typically, dredging is suspended in mid- to late November when ice begins to form on the Settling Basin. Prior to 1988, when the dredging schedule was modified to accommodate nesting, the entire Settling Basin was dredged at least once annually. However, since 1998, it is rare that the entire basin gets dredged annually. Maintenance on the dredge is typically conducted in the winter between late November and early March, and is conducted as necessary during the nesting season shutdown between June 1 and mid-August.

After dredged material is deposited at the South SMA, the sand and water are conveyed adjacent to the Settling Basin in a northeasterly direction; a majority of the sand and water eventually flows back into the Loup River, as evidenced by establishment of large trees and only small changes in the elevation of the South SMA. However, since the material dredged to the North SMA stays on site, the North SMA eventually covered approximately 320 acres and extended over 80 feet above natural grade.

In 2006, the District was approached by a materials processing company that wanted to purchase and remove sand from the North SMA. The District subsequently entered into an agreement with Preferred Sands[7] to remove sand from the North SMA and process it at Preferred Sands' facility located north of and outside of, the Project Boundary. As a condition of sand removal, the District required that Preferred Sands coordinate with USFWS and NGPC to ensure that sand removal operations would not adversely affect interior least terns and piping plovers. As a result, a Memorandum of Understanding (MOU) was developed by Preferred Sands, USFWS, and NGPC that includes an adaptive management plan to protect the threatened and endangered birds.

The District anticipates that Preferred Sands will continue to remove and process sand from the North SMA for a substantial period of time; however, the length of this operation, and whether it will continue for the entire period of a new license, cannot be estimated because Preferred Sands' operation is dependent on the demand for sand in the marketplace. However, if sand removal operations were to cease, the District would continue to use the North SMA for sand disposal and would evaluate potential expansion if necessary.

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[7] The District's original agreement in 2006 was with Harwest. Through transfers and acquisitions, Preferred Rocks of Genoa and then Preferred Sands took over this operation. Each of these companies has accepted and abided by the conditions of the original agreement.

After sediment is removed at the Settling Basin, diverted flows are routed to the Monroe and Columbus Powerhouses to generate electricity.

Normal Project operating conditions are associated with Loup River flows below 10,000 cfs. All river flow above 3,500 cfs continues down the Loup River bypass reach because 3,500 cfs is the District's water right limit as well as the hydraulic capacity of the canal. During normal operation, the Headworks are operated to divert the maximum practical amount of water (and the least amount of sediment) from the Loup River into the Settling Basin. The amount of flow that can be diverted at any given time is a function of Loup River stage and flow, sediment accumulation in front of the Intake Gate Structure, settings of the 11 fully adjustable gates comprising the Intake Gate Structure, Settling Basin stage, and the sediment situation in the Settling Basin on that particular day. These continuously variable factors make it difficult for operators to deliver a pre-selected rate of diverted flow. There is no automation at the Headworks; the Intake Gates and Sluice Gates are frequently manually adjusted to keep water flow and sediment movement within acceptable ranges.

The long-term average for diverted flow is 1,630 cfs, or 3,233 acre-feet per day. Over the available period of record, the Project has diverted approximately 69 percent of the total Loup River flow at the point of diversion.

The hydraulic capacity of the Loup Power Canal is 3,500 cfs, or 6,942 acre-feet per day. This flow is also the maximum diversion rate allowed under the District's water right. In practice, the District is able to divert the maximum flow for only short periods of individual days when conditions are just right.

The Monroe Powerhouse operates in a traditional run-of-river mode, passing all water coming to it in the Upper Power Canal with no regulation. Water level sensors at the station intake are used to initiate minor adjustments to the turbine wicket gates to maintain a constant canal elevation. Control of the Monroe Powerhouse turbine generating units is normally dispatched remotely by the Columbus Powerhouse operator. Generation of each unit is determined by water levels in the Upper Power Canal and the wicket gate settings on the unit. A radial bypass gate at the Monroe Powerhouse can be operated in manual or automatic mode and is fitted with a floatation device that automatically opens the gate in response to high water levels. This gate will automatically open to a pre-determined position to pass any flow that exceeds the capacity of the turbine generating units on-line. Operation with water level control maintains a steady headwater level at the Monroe Powerhouse.

Water exiting the Monroe Powerhouse enters the Lower Power Canal. Level control in this canal segment is provided by the Sawtooth Weir located at the entrance to Lake Babcock. Water level in the regulating reservoirs is controlled by adjusting incoming canal flow and/or turbine releases at the Columbus Powerhouse.

Project generation is dispatched from the Nebraska Public Power District (NPPD) Control Center in Doniphan, Nebraska. The NPPD dispatcher will request that the District bring generation on- or off-line as system demand changes within the NPPD system. When the NPPD dispatcher issues an order, the Columbus Powerhouse Operator makes wicket gate adjustments, brings turbine generating units on-line, or takes turbine generating units off-line, depending on the order.

The turbines are capable of operating in the following four modes:

- Flow control – The flow through the unit remains constant.
- Headwater level control – The headwater elevation is maintained within a narrow band by adjusting turbine wicket gates.
- Power control – The flow is adjusted to maintain a steady generation rate.
- Tailwater control – Wicket gates are adjusted to maintain within a narrow band of a specified tailwater elevations.

The Columbus Powerhouse is generally operated as a daily hydrocycling plant by the NPPD dispatcher. This involves ponding some of the canal inflow in the regulating reservoirs and then drawing the level of the reservoirs down, generally about 2 to 3 feet during certain times of the day by generating more power during peak demand. In the off-peak hours, when there is less electrical demand, the turbine generating units are turned down or shut off, and the regulating reservoirs are allowed to refill for hydrocycling the following day.

E.4.23 Dependable Capacity and Average Annual Generation

The dependable capacity of the Project is 45 megawatts (MW) based on the NPPD Columbus hydro accreditation, which includes all Monroe and Columbus powerhouse generating units. The capacity value is verified once each summer by operating the Columbus Powerhouse generating units for a duration of 4 hours. During verification, the Monroe Powerhouse operates in a run-of-river mode, and the Columbus Powerhouse operates in hydrocycling mode. Dependable capacity values are not specified for the individual powerhouses because they are operated together as a single entity using the same water, with the two connected regulating reservoir between them.

Average annual power generation since Project construction (1938 to 2010) is 136,405 MWh. Average total monthly power and average total annual power produced by the Project from 1938 through 2010 are provided in Table E-9. The Columbus Powerhouse is the primary power-generating element of the Project. With 3.5 times the head and 1.4 times the flow capacity of the Monroe Powerhouse, it generates approximately 80 percent of total Project power.

Table E-9. Average Total Project Power Production (1938-2010)

Period	Total Project Average Power (MWh)[a]
January	8,093
February	9,818
March	13,105
April	14,723
May	14,203
June	13,290
July	9,456
August	8,840
September	10,848
October	14,129
November	13,082
December	6,819
Annual	136,405

Note:
[a] MWh = megawatt hour

E.4.24 Project Flows

Project operation is heavily dependent on flow conditions in the Loup River. Since the Project began operating in 1938, numerous external factors have affected the amount of water that can be diverted into the Loup Power Canal; non-Project storage dams and reservoirs and diversion dams have been constructed in the headwater streams, and hundreds of water appropriations and consumptive use permits have been issued by the State of Nebraska for domestic, agricultural, and industrial depletions of the natural river flow. Seasonal crop irrigation has the most noticeable impact on flow depletion at the point of diversion for the Project.

The quantity of flow diverted for power generation is dependent on river flow and sediment conditions at the Project Headworks. Diverted flow is measured and recorded at USGS Gage 06792500, Loup River Power Canal near Genoa, NE, at the outlet of the Settling Basin. The flow rate ranges from a low of 0 cfs to a maximum of 3,500 cfs. The average diversion rate, as measured at the USGS gage, has been 1,630 cfs (based on USGS data from 1937 through 2009).

Average daily flows at the point of diversion were quantified by adding the flows at USGS Gage 06793000, Loup River near Genoa, NE, and USGS Gage 06792500, Loup River Power Canal near Genoa, NE, and are presented in Table E-10. These combined flows approximate the flow in the Loup River immediately upstream of the point of diversion. Flow duration statistics were calculated by adding average daily flows at these two gages and then adjusting for losses/reductions in flow, as discussed below. Flow adjustments related to non-gate inflows, dredging activities, evaporation, and seepage were determined to be negligible.

Additionally, average flow information and flow duration statistics are presented for USGS Gage 06792500, Loup River Power Canal near Genoa, NE, in Table E-11. These flows represent the flow diverted into the Loup Power Canal and used by the Project to produce electricity.

Table E-10. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup River at the Point of Diversion, Water Year 1950 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	304	2,180	7,270
February	367	2,930	26,520
March	293	3,530	33,080
April	1,290	2,930	18,650
May	854	2,710	18,570
June	283	3,010	69,320
July	133	1,810	29,940
August	64	1,590	72,560
September	398	1,880	11,530
October	957	2,220	11,420
November	164	2,390	7,210
December	66	2,090	5,120

Note:

[a] Calculated for period October 1, 1943, through September 30, 2010, using flow records from USGS Gage 06793000 on the Loup River near Genoa and USGS Gage 06792500 on the Loup Power Canal near Genoa. Flows at the point of diversion were calculated by adding the flows at these two gages.

Table E-11. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup Power Canal near Genoa, Water Year 1950 to Water Year 2007[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	4	1,160	2,790
February	9	1,520	2,990
March	12	1,840	3,160
April	93	2,140	3,410
May	12	1,990	3,430
June	94	1,950	3,290
July	56	1,390	3,340
August	0	1,280	3,140
September	0	1,580	3,320
October	4	1,950	3,220
November	3	1,870	3,560
December	1	980	3,050

Note:

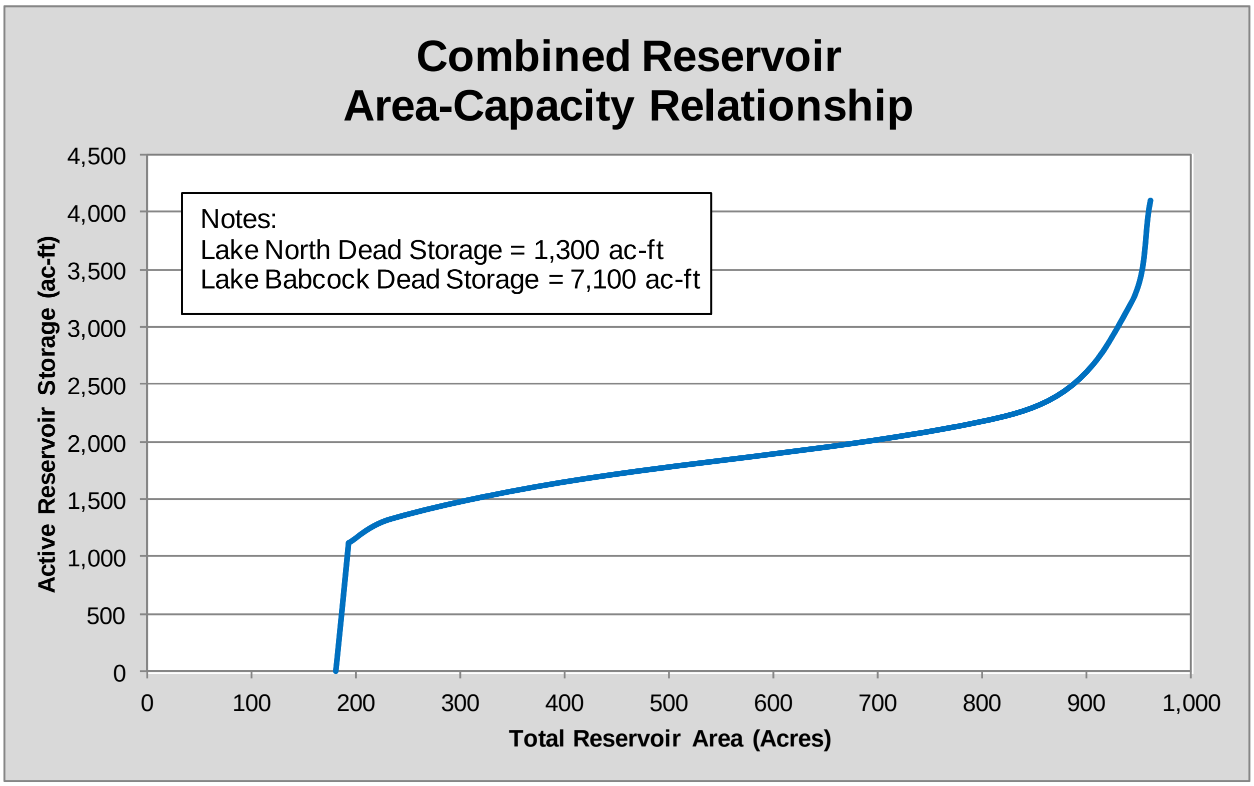
[a] Calculated for period October 1, 1949, through September 30, 2010, using flow records from USGS Gage 06792500 on the Loup Power Canal near Genoa.

E.4.25 Area Capacity Relationship

There is no effective storage capacity in the Upper Power Canal upstream of the Monroe Powerhouse. Power is generated in a run-of-river mode using those variable flows (up to 3,500 cfs) that can be diverted into the Loup Power Canal at the Headworks. From the Monroe Powerhouse, all flows are immediately discharged to the Lower Power Canal and flow on to the regulating reservoirs.

The Project includes two connected reservoirs, Lake Babcock and Lake North, located between the Lower Power Canal and the Intake Canal for the Columbus Powerhouse. Both constructed impoundments function as shallow regulating reservoirs, not as storage reservoirs. The volume of water flowing into them is essentially released for generation on a daily basis. The majority of the time, daily fluctuation of the reservoir surface is about 2 feet; however, during periods of low flow and high electrical demand, reservoir drawdown often increases to 3 feet and on occasion can be as great as 5 feet.

Lake Babcock was the original Project regulating reservoir. When sedimentation substantially reduced its ponding capacity, an adjacent off-channel impoundment, Lake North, was constructed in 1962. Together, these two interconnected lakes form the current regulating reservoir for the Project, which has a normal maximum surface area of 960 acres at an elevation of 1,531 feet MSL. The gross storage capacity of this two-reservoir impoundment is approximately 4,100 acre-feet. An area capacity curve for the two-reservoir impoundment is shown in Graph E-2. The abrupt change in the area capacity curve indicates where Lake Babcock's effective storage is exhausted (1,426 feet MSL). Lake North is less impacted by sediment accumulation and technically provides storage down to its outlet sill at elevation 1,420 feet MSL. However, as explained above, the impoundment is only rarely drawn down below elevation 1,427 feet MSL.



Graph E-2. Reservoir Area Capacity Curve

There is no specific "rule curve" for operating the regulating reservoirs. However, they are normally operated to fluctuate between elevations 1,529 and 1,531 feet MSL. The usable ponding capacity between these elevations is estimated to be about 1,840 acre-feet. This volume is equivalent to about 14 hours at the 1,630 cfs average inflow rate from the Lower Power Canal, or approximately 5 hours at the 4,800 cfs design discharge rate from the Columbus Powerhouse.

E.4.26 Hydraulic Capacity of Power Plants

The Monroe Powerhouse is equipped with three vertical axis Francis turbines. Each unit is rated at a maximum hydraulic capacity of 1,000 cfs at a net head of 28.6 feet. Minimum hydraulic capacity is 300 cfs.

The Columbus Powerhouse is equipped with three vertical axis Francis turbines. Each unit is rated at a maximum hydraulic capacity of 2,060 cfs at a net head of 113.5 feet. Minimum hydraulic capacity is 1,000 cfs.

E.4.27 Proposed Facilities and Operational Changes

The Project is considered to be fully developed and capable of efficiently generating electrical power using all of the water available under its established Nebraska water right. No major power generation facilities have been added since the Project was last relicensed in 1984.[8] Furthermore, the District has no plans for future generation capacity development or other material expansion of the Project, and the District currently has no plans to make any substantive changes in its operation of the Project.

E.5 PROPOSED ACTION AND ALTERNATIVES

This section describes the District's relicensing proposal for the continued operation of the Project. This section also describes the no-action alternative and other alternatives considered but eliminated from detailed study.

E.5.1 No-Action Alternative

Under no action, the Project would continue to operate as required by the current Project license. No new protection, mitigation, or enhancement measures would be implemented. This alternative is used to establish baseline environmental conditions for comparison with other alternatives.

E.5.2 Loup Power District's Proposed Action

The District is seeking a new license for the continued operation and maintenance of the Loup River Hydroelectric Project. With the exception of new and improved recreation amenities, detailed in Section E.6.7.3, the District is proposing no new Project facilities and no changes to existing Project operations.

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[8] The turbine rehabilitation completed in 2007 increased total Project capacity by approximately 7 percent.

E.5.3 Alternatives Considered but Eliminated from Detailed Study

Consistent with FERC's Scoping Document 2 (Section 3.4, pages 17 and 18), the following alternatives were eliminated from further analysis because they do not appear applicable or reasonable to this relicensing process (FERC, March 27, 2009). These alternatives include:

- Federal government takeover of the Project
- Issuing a nonpower license
- Decommissioning the Project

E.5.3.1 Federal Government Takeover

In accordance with 18 CFR §16.14 of FERC's regulations, a Federal department or agency may file a recommendation that the United States exercise its right to take over a hydroelectric power project with a license that is subject to sections 14 and 15 of the Federal Power Act (FPA) (16 USC 791(a)-825(r)). Federal takeover of the Project is not a reasonable alternative and would require congressional approval. While that fact alone would not preclude further consideration of this alternative, there is currently no evidence showing that Federal takeover should be recommended to Congress. No party has suggested that Federal takeover would be appropriate, and no Federal agency has expressed interest in operating the Project (FERC, March 27, 2009).

E.5.3.2 Nonpower License

A nonpower license is a temporary license that FERC would terminate whenever it determines that another governmental agency will assume regulatory authority and supervision over the lands and facilities covered by the nonpower license. Hence, issuing a nonpower license for the Project would not provide a long-term solution to the issues presented. To date, no party has sought a nonpower license, and there is no basis for concluding that the Project should no longer be used to produce power. Thus, a nonpower license is not a reasonable alternative (FERC, March 27, 2009).

E.5.3.3 Project Decommissioning

Decommissioning of the Project could be accomplished with or without Diversion Weir removal. Either alternative would require denying the relicense application and surrender or termination of the existing license with appropriate conditions. There would be significant costs involved with decommissioning the Project and/or removing any Project facilities. The Project provides a viable, safe, and clean renewable source of power (about 134,192 MWh annually) to the region. With decommissioning, the Project would no longer be authorized to generate power.

At this time, no party has suggested that Project decommissioning would be appropriate in this case. Thus, Project decommissioning is not a reasonable alternative to relicensing the Project.

E.6 AFFECTED ENVIRONMENT AND ENVIRONMENTAL ANALYSIS

For each resource located in the vicinity of the Project, the existing environment is described below. In addition, existing data, existing Project facilities or operations, potential impacts, and management activities are described as applicable.

As part of Project relicensing, the District conducted the following studies[9]:

- Study 1.0, Sedimentation
- Study 2.0, Hydrocycling
- Study 4.0, Water Temperature in the Project Bypass Reach
- Study 5.0, Flow Depletion and Flow Diversion
- Study 7.0, Fish Passage
- Study 8.0, Recreation Use
- Study 9.0, Creel Survey
- Study 10.0, Land Use Inventory
- Study 11.0, Section 106 Compliance
- Study 12.0 – Ice Jam Flooding on the Loup River
- PCB Fish Tissue Sampling

Each of these studies was conducted in accordance with FERC's Study Plan Determination (August 26, 2009) and subsequent Determinations on Requests for Study Modifications (December 20, 2010, and June 10, 2011). The final study reports for each of these studies were submitted to FERC on August 26, 2011, in the District's Updated Study Report. Results of each of these studies as they relate to Project effects on environmental resources are discussed throughout this section as appropriate.

[9] Studies 3.0 and 6.0 were considered initially but determined to not be needed, as reflected in FERC's Study Plan Determination (August 26, 2009).

E.6.1 Geology and Soils

E.6.1.1 Existing Environment

Geological Features

The Project is located in Platte and Nance counties, Nebraska, in the Great Plains physiographic province (Flowerday, Kuzelka, and Pederson, 1998). This province is the result of a series of mountain-building events to the west, referred to as the Laramide orogeny, during the Late Cretaceous and Early Tertiary time (approximately 66.4 million years ago [mya]) (Encyclopedia Britannica, 1998). One of the resulting structures of the Laramide orogeny is the Rocky Mountains. During the uplifting of the mountains, material was eroded from the surface and deposited across the Great Plains physiographic province, creating an east-tilted surface (North Plains Groundwater Conservation District, May 5, 2008).

In the vicinity of the Project, the two uppermost bedrock formations that are encountered are the Niobrara Formation and the Ogallala Formation (U.S. Department of Agriculture [USDA] Soil Conservation Service, September 1988). The Niobrara Formation, the older of the two formations, underlies the Project in Platte County and in the far eastern portion of Nance County. In general, the Niobrara Formation lithology varies from limestone to chalk to slightly calcareous shale that was deposited during a major transgression and regression of the Cretaceous epicontinental seaway, which extended from the Hudson Bay in the north to the Gulf of Mexico in the south (Anderson, January 2006). In the vicinity of the Project, the Niobrara Formation consists of chalky shale and lime-cemented bedrock. The formation also contains large fossilized inoceramid bivalve shells, ostracods, and foraminifers (Pabian, January 1987).

The Ogallala Formation, the younger of the two formations, underlies the Project in Nance County. The Ogallala Formation was deposited during the late Miocene Epoch (10 mya) and early Pliocene Epoch (5.3 mya) and continued into the late Pliocene Epoch (approximately 2 mya). The Ogallala Formation is the result of the retreating epicontinental seaway discussed above, which led to eastward flowing rivers that carved valleys into the land surface. Sand, gravel, silt, and clay eroded from upland areas to the west and were deposited into these valleys, resulting in what is presently known as the Ogallala Formation. In general, the formation consists of heterogeneous sequences of coarse-grained sand and gravel grading upward into fine clay, silt, and sand (USDA Soil Conservation Service, September 1988). The Ogallala Formation in the vicinity of the Project consists of partly consolidated fine sands, silt, and clay with some limy zones.

Recent alluvial sedimentary deposits, consisting of clay through sand-sized particles, overlie the Niobrara and Ogallala formations.

The bedrock in the vicinity of the Project is shown in Appendix E-1, Figure E-9. In addition to the Niobrara and Ogallala formations, the Carlile Formation may also be present in the vicinity of the Project. The Carlile Formation is similar in composition and depositional environment to the Niobrara but is slightly older.

Soils

Soil Properties

The Project is located in the Valleys Topographic Region of Nebraska (Flowerday, Kuzelka, and Pederson, 1998). The land in the vicinity of the Project slopes from west to east at an approximate elevation of 1,580 feet above sea level at the start of the Loup Power Canal to 1,410 feet above sea level at the end of the Loup Power Canal. The Valleys Topographic Region consists of areas with low relief along major streams that are underlain by alluvial deposits of clays, silts, sands, and gravels that are stream-deposited. The stream-deposited materials in the vicinity of the Project are within the Loup River floodplain, defined in Section E.6.5.1.

The soils in the vicinity of the Project consist of silt loam, fine sandy loam, or silty clay loam material (USDA Soil Conservation Service, September 1988). The soils have a slow to moderate permeability with a moderate to high water capacity. Soils in the vicinity of the Project are also deep, well drained, and level to gently sloped. The specific soil associations that occur in the vicinity of the Project are shown in Appendix E-1, Figure E-10.

The parent material for the majority of the soils in the vicinity of the Project consists of alluvium, calcareous alluvium, and alluvium/colluvium. The remaining soil parent material is either upland loess or stockpiled material from the construction of the Loup Power Canal (USDA Soil Conservation Service, September 1988).

The soils in the vicinity of the Project have soil erodibility (K) factors varying from 0.28 to 0.43 (USDA Soil Conservation Service, September 1988). The K factor is a unit of measure for the susceptibility of soil to erosion and rate of runoff. Soils high in clay content or soils with intermixed sand will have a low K value ranging from 0.05 to 0.2 while soils with a high silt content will have a K factor greater than 0.4 and are most susceptible to erosion and runoff. The soils with the highest K factor are encountered at depths greater than 6 inches and are overlain by soils with K factors of 0.32 and lower (USDA Soil Conservation Service, September 1988).

Sediment Supply

The Loup and Platte rivers both carry a large sediment load. To this end, USACE conducted a study titled "Platte River Cumulative Impacts Analysis" to quantify impacts on, and predict reach reactions from, proposed or existing activities on the Platte River system. USACE concluded that the supply of sediment throughout the Platte River Basin, including the Loup River Basin, is "virtually unlimited" (USACE, July 1990) and is significantly greater than both the Loup and Platte rivers' capacities to move the sediment. This means that the Loup River bypass reach and the lower Platte River can be considered to be in a dynamic equilibrium condition, with supplies in excess of transport capacity with no evidence of aggradation or degradation in the channel. USACE noted that an excess of supply over transport capacity exists, as manifested by sand and gravel deposits along banks and in the stream as sandbars (USACE, July 1990).

Associated Project Operations

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 stated in Section E.4.22, Project Operations, a hydraulic dredge is used to remove sediment from the Settling Basin. Currently, sediment (in the form of silt, sand, and gravel) pumped by the dredge is carried through an articulated steel pipeline to a series of fixed steel pipes that discharge to the North and South SMAs. In the early years of Project operation, from 1937 to 1960, approximately 2.6 million cubic yards of sediment were dredged and discharged to the South SMA annually. In 1961, the District began pumping dredged material to the North SMA as well, though initially it was considerably less material than was pumped to the South SMA. However, once the North SMA was fully developed, the majority of sediment has been dredged to the North SMA. Total material dredged from 1975 to 2010 has averaged 1.24 million cubic yards annually. The reason for this disparity is not clear, but it may be related to development of upstream reservoirs or other changes in the upper Loup River Basin.

Conditions of Shorelines

Canal and Reservoir

The segments of the Loup Power Canal were constructed by excavating trapezoidal channel sections and raising embankment sections using soils that existed at, or very near to, the canal alignment. Bottom widths of the canal segments are as follows:

- Upper Power Canal from the Settling Basin to Looking Glass Creek Siphon – 73 feet
- Upper Power Canal from Looking Glass Creek Siphon to the Monroe Powerhouse – 39 feet
- Lower Power Canal – 39 feet
- Intake Canal near Lake Babcock Outlet – 108 feet

- Intake Canal near the Columbus Powerhouse – 94 feet
- Tailrace Canal (general) – 42 feet
- Tailrace Canal at Outlet Weir – 600 feet

When constructed, the original canal side slopes ranged from 3:1 to 2:1 (horizontal:vertical). Flow velocities through the Loup Power Canal are low because the average gradient is only about 3 inches per mile. However, the unlined bed and banks are continually subjected to scouring forces from water and ice. In many places, the canal banks are well vegetated and quite stable, but in many other places, the canal banks are prone to erosion. Sediment bars can form on the inside of canal bends, which can cause undermining and sloughing of the outer bank.

To protect and maintain the canal slopes and prevent erosion, District personnel work throughout the year using brush bundles and riprap, as follows. At numerous locations along the canal, small trees and bundles of woody vegetation that have been cleared from embankment sections are secured with cables along eroding or undermined shorelines. These brush bundles reduce local flow velocity and induce sediment to settle out and "naturally" re-establish the shoreline. In other locations, large riprap must be used to control bank erosion. Over the decades, broken concrete riprap has been applied along much of the Loup Power Canal to control erosion. Additional shore protection measures employed on the Loup Power Canal include the selective removal of trees and woody growth and the plugging and repair of rodent holes.

Two short segments of the Loup Power Canal have been designated by FERC as high-hazard reaches because an embankment failure could put nearby residential areas at risk. These reaches are in Genoa and just upstream of the Columbus Powerhouse. The District maintains stockpiles of riprap and fill material near both high-hazard reaches to quickly respond to any embankment erosion or shore protection issues.

The two connected regulating reservoirs, Lake Babcock (in-channel) and Lake North (off-channel), were constructed by compacting successive layers of soil to raise embankment dikes to the specified elevation. Frequent water level fluctuation, wind driven waves, and ice are all shoreline erosion concerns in the impoundment. The south shores of both Lake Babcock and Lake North are lined with concrete riprap to control erosion.

Photo E-25. Riprap shore protection on Lake Babcock.

On the north and east dikes forming Lake Babcock, innovative “reversed concave” concrete wave walls were constructed to handle wind-generated waves. On the east, south, and west dikes forming Lake North, vertical steel and concrete wave walls were constructed. These capital-intensive measures have been effective in controlling shoreline erosion in the two connected regulating reservoirs.

Photo E-26. "Reversed concave" concrete wave walls along dike which separates Lake Babcock and Lake North.

The embankments forming the two connected regulating reservoirs are reviewed periodically as part of FERC's Part 12(d) dam safety inspection. These embankments are considered to be stable and require only nominal monitoring. Furthermore, there has never been any mass soil movement associated with the Project.

Loup and Platte Rivers

Both the Loup and Platte rivers are considered braided rivers, where the water flows around deposited bars and islands. Braiding occurs when the steep slopes create high energy for sediment transport, where the river is wide and shallow, and where banks may be easily eroded (Mayhew, 2004).

As stated in E.4.22, Project Operations, in the mid- to late 1950s, riparian property owners adjacent to the Loup River south of the South SMA expressed concern that immediately downstream of the Diversion Weir, the Loup River bypass reach was migrating south. At that time, the District pumped all sediment dredged from the Settling Basin exclusively to the South SMA. As a result of the expressed concern about southward channel migration and the associated concern that discharge to the contiguous South SMA may be a contributing factor, the District began discharging dredged material to the North SMA in 1961. Prior to 1973, approximately 75 percent of the sediment dredged was discarged to the South SMA. Since then, the average amount of sediment dredged to the South SMA has been reduced to approximately

28 percent. In addition to altering their dredging practice, the District has also maintained a series of jetties[10] in the Loup River bypass reach to prevent further channel migration.

Beyond the area immediately downstream of the Diversion Weir, the length of the Loup River bypass reach appears to be a stable braided channel and contains a contiguous mature riparian corridor beyond the river banks. The canopy of the riparian zone is dominated by mature cottonwood trees, while the understory consists of grasses and forbs typical of the region.

As noted previously, the lower Platte River is a wide, shallow, braided river with steep slopes where banks may be easily eroded. As such, it has been estimated that nearly 39 percent of the channel from the Loup River confluence to the Missouri River confluence has been armored by others with some form of bank stabilization structures (Runge and Harms, July 13, 2006).

E.6.1.2 Environmental Analysis

Resource agencies and stakeholders did not request studies to address direct Project effects on geology or soils. Conversely, resource agencies did request studies to determine whether District dredging operations affect sediment transport, morphology, or potential threatened or endangered species habitat in the Loup River bypass reach and/or the lower Platte River. In 1990, USACE concluded that the supply of sediment throughout the Platte River Basin, including the Loup River Basin, is "virtually unlimited" (USACE, July 1990) and is significantly greater than both the Loup and Platte rivers' capacities to move the sediment. Consistent with those findings, the District's Study 1.0, Sedimentation, concluded that sediment availability and yield throughout the study area far exceed the capacity of the flow to transport sediment. That is, the Loup River bypass reach and lower Platte River are not supply limited, but rather are flow limited.

Project Effects on Geology and Soils

The District's relicensing proposal includes no modifications to existing sediment removal operations; as a result, Project relicensing would not alter the sediment supply and transport capacity that have been common to the lower Platte River since Project implementation. The relationship between supply and capacity, shown in the District's Study 1.0, Sedimentation, and in studies by others, is one in which the supply exceeds the river's capacity to transport it. Continued hydraulic dredging from

[10] Four jetties were constructed on the south bank of the Loup River in conjunction with Project construction. The south bank jetties have been reconstructed and extended as warranted since then. Additionally, seven jetties were constructed on the north bank of the Loup River in 1993 and 1994 and have been maintained since then.

the Loup Power Canal would not affect this relationship. Therefore, the sediment that the Loup River bypass reach and lower Platte River transport would be unaffected by the continuation of current Project operations.

Watson, Biedenharn, and Scott (July 1999) state that a stable river, "from a geomorphic perspective, is one that has adjusted its width, depth, and slope such that there is no significant aggradation or degradation of the stream bed or significant plan form changes (meandering to braided, etc.) within the engineering time frame (generally less than about 50 years). By this definition, a stable river is not in a static condition, but rather is in a state of dynamic equilibrium where it is free to adjust laterally through bank erosion and bar building." Studies by USGS and USACE showed that there was no evidence of any trend in aggradation or degradation in the Loup River at Genoa, Platte River at Duncan, Platte River at North Bend, and Platte River at Ashland (Chen et al., 1999; USACE, October 2009). Analysis conducted in association with the District's Study 1.0, Sedimentation, determined that both the Loup River bypass reach and lower Platte River are in dynamic equilibrium and well-seated in the braided morphology regime for flow hydrographs representing a range of operating scenarios—including current operations, run-of-river operations, and a no diversion scenario—despite the long-standing District operations relative to sediment removal. Because no trend toward a different morphology is occurring or will occur under the District's proposed operating scenario (that is, current operations) under a new license, the proposed Project would not impact morphology.

The District anticipates that Preferred Sands will continue to remove and process sand from the North SMA for a substantial period of time; however, the length of this operation, and whether it will continue for the entire period of a new license, cannot be estimated because Preferred Sands' operation is dependent on the demand for sand in the marketplace. However, if sand removal operations were to cease, the District would continue to use the North SMA for sand disposal and would evaluate potential expansion if necessary.

Continued operation of the Project, including continuation of hydrocycling as currently implemented, is not anticipated to result in increased shoreline erosion. In association with the District's Study 1.0, Sedimentation, collected cross-section data revealed that the channel geometry of both rivers is not only widely diverse over a few hundred feet of length, but highly subject to dramatic changes over a few months' time. Cross sections in the Platte River, both upstream and downstream of the Tailrace Return, exhibited similar cross-section changes. Any measured or calculated adjustment in geometry cannot be readily attributed to any other cause than the natural dynamics of a braided river.

Within the Project Boundary, the District will continue to monitor the Loup Power Canal for potential erosion concerns and promptly address any noted problem areas using current shoreline management procedures. Additionally, the District's proposed inclusion of a no-wake zone on the southern end of Lake North would lessen wave action, although the extent to which this would affect shoreline stability is minimal because the majority of Lake North's shoreline is stabilized with sheet piling or rock rip rap.

The District's proposed recreation improvements, detailed in Section E.6.7.3, include the construction of a wheelchair-accessible fishing pier on Lake North, a permanent restroom facility at Headworks Park, and a 2,000-foot trail for pedestrians and bicyclists along the southeast side of Lake Babcock. During construction, the District will incorporate best management practices (BMPs) to avoid and minimize erosion and sedimentation. Following construction, disturbed areas would be stabilized and drainage patterns would be unaltered.

E.6.1.3 Proposed Environmental Measures

No adverse Project effects on the geology and soils associated with the Project Boundary have been identified; therefore, the District is not proposing any new measures related to geology and soils. The District will continue to use BMPs to minimize erosion and sedimentation during construction activities and normal operations.

E.6.1.4 Unavoidable Adverse Impacts

Temporary and unavoidable sedimentation impacts may result from the recreation improvements that require ground disturbance. Similar impacts also may result from necessary maintenance activities that arise during the term of the license. These impacts would result in minimal sedimentation to receiving streams and would be avoided to the extent practicable via BMPs, as stated above.

E.6.1.5 Cumulative Impacts

Aside from the negligible and unavoidable sedimentation that may result from recreation improvements and necessary Project maintenance, no Project impacts have been identified. When the neglible sedimentation impacts resulting from the Project and implemented BMPs are considered cumulatively with non-Project-related ground-disturbing activities within the Loup and Platte river basins, the District has determined that the Project results in neither beneficial nor adverse cumulative impacts on soils or geology.

E.6.2 Water Resources

E.6.2.1 Existing Environment

As noted in Section E.1, General Description of the River Basin, the Project is located in the Loup River Basin, which is part of the larger Platte River Basin (see Appendix E-1, Figure E-2). Because flows released from the Columbus Powerhouse are returned to the Platte River, water resources information for both the Loup and Platte river basins is provided in this section.

Drainage Area

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. At the point of diversion on the Loup River, the Loup River Basin has a total drainage area of approximately 14,300 square miles of total land area. The Platte River Basin upstream of the Loup River and the Project has a total drainage area of approximately 59,300 square miles of total land area (USGS, 2008).

Flows

Available Data

Eleven stream gages were used to evaluate streamflows for the purposes of Project relicensing; these 11 gage locations are shown in Appendix E-1, Figure E-11. Additional information for each stream gage is provided below. For USGS stream gages, information was obtained from the USGS website (USGS, 2011).

Flow in the Loup River at the point of diversion was quantified using two USGS gages:

- USGS Gage 06793000, Loup River near Genoa, NE – This gage is located on the Loup River approximately 6 miles downstream of the point of diversion, 2 miles south of Genoa on the Nebraska State Highway 39 bridge. The total and contributing drainage areas at this gage are approximately 14,320 and 5,620 square miles, respectively. The period of record for approved data is April 1929 through September 2010[11]; however, data between July 1932 and October 1943 are not available on the USGS website.
- USGS Gage 06792500, Loup River Power Canal near Genoa, NE – This gage is located on the Loup Power Canal at the downstream extent of the Settling Basin. The gage is located approximately 2 miles downstream of the point of diversion, and the period of record for approved data is January 1937 to October 2010.

Flow in the vicinity of the Project was also quantified using the following gages:

- Nebraska Department of Natural Resources (NDNR) Gage 00082100, Loup River Power Canal Return [Tailrace Canal] at Columbus, NE – This gage is located on the Tailrace Canal at the 8th Street bridge in Columbus. The gage is located approximately 4 miles downstream of the Columbus Powerhouse, and the period of record for approved data is October 2002 to September 2009.

[11] For the majority of the gages, 2010 data were the latest USGS approved data available for evaluation.

- USGS Gage 06794500, Loup River at Columbus, NE – This gage is located on the Loup River approximately 28 miles downstream of the point of diversion, 1 mile south of Columbus on the U.S. Highway 30/81 bridge. The total and contributing drainage areas at this gage are approximately 15,200 and 6,230 square miles, respectively. The period of record for approved data is April 1934 to October 1978. This gage was restarted by NDNR on September 23, 2008, and is currently maintained by NDNR. The period of record for approved data is September 23, 2008 to September 30, 2009.
- USGS Gage 06794000, Beaver Creek at Genoa, NE – This gage is located on Beaver Creek at the Nebraska State Highway 39 bridge in Genoa. The total and contributing drainage areas at this gage are approximately 677 and 429 square miles, respectively. The period of record for approved data is October 1940 to October 2010.
- USGS Gage 06770500, Platte River near Grand Island, NE – This gage is located on the Platte River approximately 66 miles upstream of the confluence of the Loup and Platte rivers, approximately 5.2 miles southeast of Grand Island, Nebraska, on the Nebraska State Highway 34 bridge. The total and contributing drainage areas at this gage are approximately 57,650 and 52,940 square miles, respectively. The period of record for approved data is April 1934 to November 2010.
- USGS Gage 06774000, Platte River near Duncan, NE – This gage is located on the Platte River approximately 9 miles upstream of the confluence of the Loup and Platte rivers, approximately 1.5 miles south of Duncan, Nebraska, on the 287th Avenue bridge. The total and contributing drainage areas at this gage are approximately 59,300 and 54,630 square miles, respectively. The period of record for approved data is May 1895 to November 2010; however, data between 1895 and 1928 is incomplete. Therefore, the period of record for continuous approved data is October 1928 to November 2010.
- USGS Gage 06796000, Platte River at North Bend, NE – This gage is located on the Platte River approximately 30 miles downstream of the confluence of the Loup and Platte rivers, approximately 1 mile south of North Bend, Nebraska, on the Nebraska State Highway 79 bridge. The total and contributing drainage areas at this gage are approximately 70,400 and 57,800 square miles, respectively. The period of record for approved data is April 1949 to October 2010.

- USGS Gage 06796500, Platte River near Leshara, NE – This gage is located on the Platte River approximately 55 miles downstream of the confluence of the Loup and Platte rivers; approximately 1 mile southeast of Leshara, Nebraska, on the Nebraska State Highway 64 bridge. The total and contributing drainage areas at this gage are not currently provided by USGS. The period of record for approved data is June 1994 to October 2010.
- USGS Gage 06801000, Platte River near Ashland, NE – This gage is located on the Platte River approximately 74 miles downstream of the confluence of the Loup and Platte rivers, approximately 4 miles northeast of Ashland, Nebraska, on the U.S. Highway 6 bridge. The total drainage area at this gage is approximately 83,600 square miles; the contributing drainage area is 69,300 square miles. The period of record for approved data is September 1928 to October 2010.
- USGS Gage 06805500, Platte River at Louisville, NE – This gage is located on the Platte River approximately 85 miles downstream of the confluence of the Loup and Platte rivers, approximately 1 mile north of Louisville, Nebraska, on the Nebraska State Highway 50 bridge. The total and contributing drainage areas at this gage are approximately 85,370 and 71,000 square miles, respectively. The period of record for approved data is June 1953 to October 2010.

Because the 11 gages listed above have varying periods of record for approved data, it was necessary to establish a consistent period of record to compare flows at various gage locations, such as comparing diverted flows off of the Loup River to returned flows into the Platte River. The earliest consistent date for which approved data were available for a majority of the gages was October 1949. The latest consistent date for which approved data were available for a majority of the gages was September 2010; stream gage data from October 1, 2010 to the present are considered preliminary.

The accuracy of USGS streamflow data depends primarily on both of the following factors (USGS, April 11, 2008):

1. Stability of the stage-discharge relationship or, if the control is unstable, frequency of the discharge measurements
2. Accuracy of observations of stage, measurements of discharge, and interpretations of records

For each stream gage, USGS describes the degree of accuracy of the streamflow records on an annual basis as follows (USGS, April 11, 2008):

- Excellent – Approximately 95 percent of the daily discharges are within 5 percent of the true value.
- Good – Approximately 95 percent of the daily discharges are within 10 percent of the true value.
- Fair – Approximately 95 percent of the daily discharges are within 15 percent of the true value.
- Poor – Daily discharges have less than “fair” accuracy.

Different accuracies may be attributed to different parts of an individual stream gage’s annual record (USGS, April 11, 2008).

The accuracy of each stream gage is available on only an annual basis, not for the entire period of record established for evaluation in this Exhibit E, Environmental Report. Therefore, it is difficult to categorize the overall accuracy of each stream gage for the period of record. However, the typical accuracy for the majority of the annual stream gage records reviewed was described as “good” to “fair,” with a small portion of annual records described as “poor.” This indicates that the majority of the streamflows discussed in this Exhibit E are within 10 to 15 percent of the actual value.

Flow Statistics

In accordance with USGS methods (USGS, April 11, 2008), daily mean discharges presented in this Exhibit E are reported as whole numbers up to 1,000 cfs and to three significant figures for discharges above 1,000 cfs.

Point of Diversion

Average daily flows at the point of diversion were estimated by adding the flows at USGS Gage 06793000 on the Loup River near Genoa and USGS Gage 06792500 on the Loup Power Canal near Genoa and adjusting for non-gate inflows, dredging activities, evaporation, and seepage. Flow information for the Loup River near Genoa and the Loup Power Canal near Genoa is presented below, with the flow adjustments and combined flow information for the point of diversion presented thereafter.

Monthly flow duration curves for the Loup River near Genoa were developed for Water Year 1944 through Water Year 2010. This was done by ranking the average daily flows for each month over the period of record in descending order, calculating percent exceedance[12] for each average daily discharge, and plotting the average daily discharges versus percent exceedance. Average daily minimum, mean, and maximum

[12] The percent exceedance is the percentage of time that a given average daily discharge is equaled or exceeded.

flows on the Loup River near Genoa were also calculated for the period of record for each month and are provided in Table E-12. The daily mean flow varied between 193 cfs in October and 1,620 cfs in March.

Table E-12. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup River near Genoa, Water Year 1944 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	8	998	5,200
February	7	1,430	25,000
March	17	1,620	31,700
April	4	715	17,300
May	0	655	16,200
June	0	1,010	66,300
July	0	366	27,500
August	0	262	70,800
September	0	270	8,880
October	0	193	8,550
November	2	455	6,460
December	3	1,110	5,000

Note:

[a] Calculated for the period October 1, 1944, through September 30, 2010, using flow records from USGS Gage 06793000 on the Loup River near Genoa.

Monthly flow duration curves for Loup Power Canal near Genoa were developed for Water Year 1938 through Water Year 2010 using the same procedures described above. Average daily minimum, mean, and maximum flows on the Loup Power Canal near Genoa were also calculated for the period of record for each month and are provided in Table E-13. The daily mean flow varied between 980 cfs in December and 2,140 cfs in April.

Table E-13. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup Power Canal near Genoa, Water Year 1938 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	5	1,160	2,790
February	9	1,520	2,990
March	12	1,840	3,160
April	93	2,140	3,410
May	12	1,990	3,430
June	94	1,950	3,290
July	56	1,390	3,340
August	0	1,280	3,140
September	0	1,580	3,320
October	4	1,950	3,220
November	3	1,870	3,560
December	1	980	3,050

Note:

[a] Calculated for the period October 1, 1938, through September 30, 2010, using flow records from USGS Gage 06792500 on the Loup Power Canal near Genoa.

No substantial inflows exist between the point of diversion and the USGS gage on the Loup Power Canal near Genoa (within the Settling Basin). Average annual flow removed from the Settling Basin for dredging activities was estimated by using the average annual hours during which dredging occurs (3,400 hours per year) and the dredging capacity (61 cfs). Using the percentage of time dredging occurs for the year (39 percent), the average daily flow removed from the Settling Basin for dredging activities was estimated at 24 cfs, which is negligible relative to the amount of flow diverted and within the measuring tolerance of the stream gage. A portion of flow diverted for dredging activities returns via seepage to the Loup Power Canal downstream of the Settling Basin and to the Loup River both upstream and downstream of the point of diversion.

Flow losses between the point of diversion and the USGS gage on the Loup Power Canal near Genoa as well as between the point of diversion and the USGS gage on the Loup River near Genoa include evaporation and seepage. These evaporation losses were estimated using average daily pan evaporation data. The nearest available weather station with evaporation data was used. This station is at Grand Island, Nebraska, approximately 40 miles southwest of the Project diversion. The period of record was 1963 to 1994. Net pan evaporation data were computed by subtracting the daily precipitation data from the daily pan evaporation. The daily precipitation was obtained from the National Weather Service gage at Columbus for a period of record of 1949 to 2001 (National Oceanic and Atmospheric Administration [NOAA] National Climatic Data Center [NCDC], August 2002). Evaporation and precipitation data for the month of July were used for estimating conservatively high net pan evaporation. The net pan evaporation estimates were converted to lake evaporation using *The Climate Atlas of the United States* (NOAA NCDC, 1983).

Average daily net evaporation rates were then estimated using the lake evaporation estimates and the total surface area of the Settling Basin (approximately 330 feet wide and 10,000 feet long) and the Loup River between the point of diversion and the respective gages (approximately 100 feet wide and 6.1 miles long). The losses associated with evaporation were calculated to be approximately 1.1 acre-feet per day (0.6 cfs), which is 0.04 percent of the average daily flow for July in the Settling Basin. The losses associated with evaporation for the Loup River between the point of diversion and the USGS gage on the Loup River near Genoa were calculated to be approximately 1.1 acre-feet per day (0.5 cfs), which is 0.16 percent of the average daily flow for July of the Loup River near Genoa; therefore, evaporation losses were considered negligible with respect to the quantity of flow and not used for reduction of average daily discharges.

Sediment is dredged from the Settling Basin from late March to early June and from mid-August to November each year. Given the amount of sediment accumulation and the high percentage of fines in the sediment, the Settling Basin likely reseals between periods of dredging, and seepage would be minimal relative to the quantity of flow diverted and likely within the gage accuracy tolerance. In addition, seepage losses from the Settling Basin likely return to the Loup River through groundwater flows. Therefore, seepage losses between the point of diversion and the USGS gage on the Loup Power Canal near Genoa were considered negligible and not used for reduction of average daily discharges.

Flow duration statistics were calculated by adding average daily flows at these two gages and then adjusting for losses/reductions in flow. Monthly flow duration curves for Loup River flows at the point of diversion for Water Year 1943 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Average daily minimum, mean, and maximum flows on the Loup River at the point of diversion were also calculated for the period of record for each month and are provided in Table E-14. Daily mean flow varied between 1,590 cfs in August and 3,530 cfs in March. Average daily minimum and maximum flows on the Loup River near Genoa and on the Loup Power Canal near Genoa may not occur on the same day; therefore, average daily minimum and maximum flows on the Loup River at the point of diversion may not result from directly adding the values shown in Tables E-12 and E-13.

Table E-14. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup River at the Point of Diversion, Water Year 1944 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	304	2,180	7,270
February	367	2,930	26,500
March	293	3,530	33,100
April	1,290	2,930	18,700
May	854	2,710	18,600
June	283	3,010	69,300
July	133	1,810	29,900
August	64	1,590	72,600
September	398	1,880	11,500
October	957	2,220	11,400
November	164	2,390	7,210
December	66	2,090	5,120

Note:

[a] Calculated for the period October 1, 1943, through September 30, 2010, using flow records from USGS Gage 06793000 on the Loup River near Genoa and USGS Gage 06792500 on the Loup Power Canal near Genoa. Flows at the point of diversion were calculated by adding the flows at these two gages.

The dependable capacity of the Project is 45 megawatts (MW). This capacity is not based on a specific streamflow, rather it is based on the NPPD Columbus hydro accreditation, which includes all Monroe and Columbus powerhouse generating units. The capacity value is verified once each summer by operating the Columbus Powerhouse generating units for a duration of 4 hours. During verification, the Monroe Powerhouse operates in a run-of-river mode, and the Columbus Powerhouse operates in hydrocycling mode. Dependable capacity values are not specified for the individual powerhouses since they are operated together as a single entity using the same water, with the two connected regulating reservoirs between them.

Tailrace Canal

Monthly flow duration curves for the Tailrace Canal at Columbus for Water Year 2003 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge), except real-time discharge data (in 15-minute intervals) was used rather than average daily flows. Minimum, mean, and maximum flows on the Tailrace Canal at Columbus were also calculated for the period of record for each month and are provided in Table E-15. Mean flow varied between 780 cfs in December and 2,100 cfs in April.

Table E-15. Minimum, Mean, and Maximum Flows by Month on the Tailrace Canal at Columbus, Water Year 2003 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	52	1,120	2,420
February	43	1,460	2,420
March	35	1,890	3,360
April	576	2,100	3,400
May	588	1,820	2,900
June	65	2,020	3,120
July	86	1,380	2,920
August	46	1,490	2,910
September	18	1,660	2,970
October	110	2,070	3,220
November	65	2,080	3,070
December	36	780	3,100

Note:

[a] Calculated for the period October 1, 2002, through September 30, 2010, using flow records from NDNR Gage 00082100 on the Tailrace Canal at the 8th Street bridge in Columbus.

Loup River

Monthly flow duration curves for the Loup River at Columbus for April 1934 through October 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Loup River at Columbus were also calculated for the period of record for each month and are provided in Table E-16. The daily mean flow varied between 430 cfs in October and 2,090 cfs in March.

Table E-16. Average Daily Minimum, Mean, and Maximum Flows by Month on the Loup River at Columbus, April 1934 to September 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	46	1,110	6,090
February	20	1,630	25,500
March	105	2,090	37,400
April	60	1,130	27,600
May	77	1,100	19,500
June	68	1,560	50,000
July	9	678	28,900
August	2	465	77,100
September	2	509	14,700
October	28	430	9,260
November	31	664	6,630
December	30	1,240	5,140

Note:

[a] Calculated for the period April 1, 1934, through September 30, 1978, using flow records from USGS Gage 06794500 on the Loup River at Columbus. Calculated for the period October 1, 1978, through September 30, 2010, using synthetic flows calculated from reach gain/loss analysis.

Beaver Creek

Monthly flow duration curves for Beaver Creek at Genoa for Water Year 1941 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on Beaver Creek at Genoa were also calculated for the period of record for each month and are provided in Table E-17. The daily mean flow varied between 81 cfs in September and 247 cfs in June.

Table E-17. Average Daily Minimum, Mean, and Maximum Flows by Month on Beaver Creek at Genoa, Water Year 1941 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	15	85	800
February	32	139	4,400
March	30	195	4,820
April	55	170	1,650
May	55	187	5,940
June	24	247	7,010
July	0	137	10,000
August	1	93	7,220
September	3	81	1,150
October	33	86	942
November	30	91	1,070
December	17	87	680

Note:

[a] Calculated for the period October 1, 1940, through September 30, 2010, using flow records from USGS Gage 06794000 on Beaver Creek at Genoa.

Platte River

Monthly flow duration curves for the Platte River at Duncan for Water Year 1942 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Platte River at Duncan were also calculated for the period of record for each month and are provided in Table E-18. The daily mean flow varied between 653 cfs in August and 2,840 cfs in June.

Table E-18. Average Daily Minimum, Mean, and Maximum Flows by Month on the Platte River at Duncan, Water Year 1942 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	0	1,500	8,400
February	33	2,220	10,400
March	130	2,760	22,900
April	133	2,380	18,600
May	2	2,500	18,200
June	0	2,840	23,700
July	0	1,380	23,800
August	0	653	7,100
September	0	899	9,150
October	0	1,300	8,840
November	0	1,470	6,510
December	0	1,440	8,200

Note:

[a] Calculated for the period October 1, 1941, through September 30, 2010, using flow records from USGS Gage 06774000 on the Platte River near Duncan.

Monthly flow duration curves for the Platte River at North Bend for Water Year 1949 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Platte River at North Bend were also calculated for the period of record for each month and are provided in Table E-19. The daily mean flow varied between 2,510 cfs in August and 7,050 cfs in March.

Table E-19. Average Daily Minimum, Mean, and Maximum Flows by Month on the Platte River at North Bend, Water Year 1949 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	324	3,370	11,000
February	706	5,240	22,000
March	700	7,050	82,300
April	1,670	5,890	31,000
May	814	5,800	34,500
June	250	6,730	64,900
July	36	3,620	46,000
August	126	2,510	57,600
September	153	3,020	25,700
October	846	3,760	18,400
November	450	4,080	11,000
December	228	3,530	11,900

Note:

[a] Calculated for the period October 1, 1948, through September 30, 2010, using flow records from USGS Gage 06796000 on the Platte River at North Bend.

Monthly flow duration curves for the Platte River at Leshara for Water Year 1994 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Platte River at Leshara were also calculated for the period of record for each month and are provided in Table E-20. The daily mean flow varied between 3,260 cfs in August and 8,460 cfs in June.

Table E-20. Average Daily Minimum, Mean, and Maximum Flows by Month on the Platte River at Leshara, Water Year 1994 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	450	3,890	9,400
February	901	5,780	33,000
March	980	6,020	18,000
April	2,040	6,130	20,700
May	863	6,170	34,900
June	582	8,460	41,400
July	356	4,080	20,000
August	199	3,260	16,400
September	400	3,380	11,000
October	1,230	4,230	19,400
November	1,490	4,550	10,500
December	234	4,140	10,900

Note:

[a] Calculated for the period October 1, 1993, through September 30, 2010, using flow records from USGS Gage 06796500 on the Platte River at Leshara.

Monthly flow duration curves for the Platte River at Ashland for Water Year 1989 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Platte River at Ashland were also calculated for the period of record for each month and are provided in Table E-21. The daily mean flow varied between 4,420 cfs in September and 12,000 cfs in June.

Table E-21. Average Daily Minimum, Mean, and Maximum Flows by Month on the Platte River at Ashland, Water Year 1989 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	967	4,650	11,200
February	1,230	7,010	45,000
March	1,500	9,020	110,000
April	2,940	8,360	32,000
May	1,830	8,560	69,300
June	1,190	12,000	91,100
July	596	6,690	99,100
August	416	4,670	41,700
September	381	4,420	29,800
October	1,360	5,390	30,600
November	1,590	5,690	17,900
December	428	5,050	9,880

Note:

[a] Calculated for the period October 1, 1988, through September 30, 2010, using flow records from USGS Gage 06801000 on the Platte River at Ashland.

Monthly flow duration curves for the Platte River at Louisville for Water Year 1953 through Water Year 2010 were developed using the same procedures described above (that is, ranking average daily flows in descending order and calculating percent exceedance for each average daily discharge). Daily minimum, mean, and maximum flows on the Platte River at Louisville were also calculated for the period of record for each month and are provided in Table E-22. The daily mean flow varied between 4,220 cfs in August and 12,000 cfs in June.

Table E-22. Average Daily Minimum, Mean, and Maximum Flows by Month on the Platte River at Louisville, Water Year 1953 to Water Year 2010[a]

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	500	4,840	15,000
February	1,490	7,690	54,500
March	2,710	10,900	116,000
April	2,690	9,760	73,300
May	1,700	9,820	84,600
June	922	12,000	123,000
July	373	6,260	138,000
August	150	4,220	47,900
September	131	4,330	39,900
October	1,020	5,270	46,500
November	476	5,590	17,500
December	300	4,950	17,000

Note:

[a] Calculated for the period October 1, 1952, through September 30, 2010, using flow records from USGS Gage 06805500 on the Platte River at Louisville.

Reservoirs

The Project includes two connected regulating reservoirs, Lake Babcock (in-channel) and Lake North (off-channel), located between the Lower Power Canal and the Intake Canal. Both reservoirs function as regulating reservoirs, not storage reservoirs, of Project waters for hydropower generation at the Columbus Powerhouse. Therefore, the volume of water flowing into the reservoirs essentially equals the volume of water released from the reservoirs on a daily basis. Data for Lake Babcock and Lake North are presented in Table E-23.

Table E-23. Reservoir Data

	Lake Babcock	Lake North
Surface Area (acres at noted stage, MSL)	760 @ 1,531	200 @ 1,531
Volume (acre-feet at noted stage, MSL)	2,270 @ 1,531	2,080 at 1,531
Maximum Depth (feet)	12[a]	15
Mean Depth (feet)	3	11
Shoreline Length (miles)	7.5[b]	2.4[b]
Flushing Rate (cfs)	4,800[c]	4,800[c]
Substrate Composition	Silt	Silt/gravel

Notes:

[a] Lake Babcock is a very shallow lake; however, a deeper channel has developed as water flows through the lake to the Intake Canal. Maximum depth is of the channel.

[b] Shoreline length includes 1.6 miles of shoreline along the common dike separating Lake Babcock and Lake North.

[c] Maximum capacity of the Intake Canal to the Columbus Powerhouse is 4,800 cfs, which would be a combination of Lake Babcock and Lake North.

Downstream Reaches

The long-term morphology trends of the Loup and lower Platte rivers, including the Loup River bypass reach, have been the subject of several scientific studies independent of Project relicensing. Without variation, these studies conclude that the Loup and lower Platte rivers in the vicinity of the Project are neither aggrading nor degrading and have remained "in regime" (that is, in a state of dynamic equilibrium) since the early 1950s (USACE, July 1990) or even longer (U.S. Department of the Interior, Bureau of Reclamation [USBR], April 2004). Further, these studies have determined that the Loup River bypass reach and the lower Platte River are well seated within regime zones considered as braided streams, are not supply limited, and display no indications of channel geometry characteristic (width and depth) changes over time.

A braided river is defined as a river channel in which water flows around deposited bars and islands. It has been shown that for a given discharge, braided channels slope more steeply than meandering channels, which exist on relatively flat ground and tend to form relatively broad channels that wander back and forth like a snake. Braiding occurs when the steep slopes create high energy for sediment transport, when discharge fluctuates frequently, when the river cannot carry its full sediment load, where the river is wide and shallow, where banks and bed may be easily eroded, and where there is abundant bed material available for transport. 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).

Both the Loup and Platte rivers are considered braided rivers. The Loup River bypass reach immediately downstream of the Project (see Photo E-27) has a relatively mild gradient of approximately 0.1 percent (0.001 foot/foot). Upstream of the Loup Power Canal, the Loup River has a slightly shallower gradient of approximately 0.08 percent (0.0008 foot/foot).

Photo E-27. Aerial view of the Loup River, south of Nebraska State Highway 22 in Platte County, showing braided characteristics.

The Platte River downstream of the Tailrace Canal (see Photo E-28) also has a relatively mild slope of approximately 0.09 percent (0.0009 foot/foot). Upstream of the Tailrace Canal and the Loup River, the Platte River is a braided channel with a slightly steeper gradient of approximately 0.12 percent (0.0012 foot/foot).

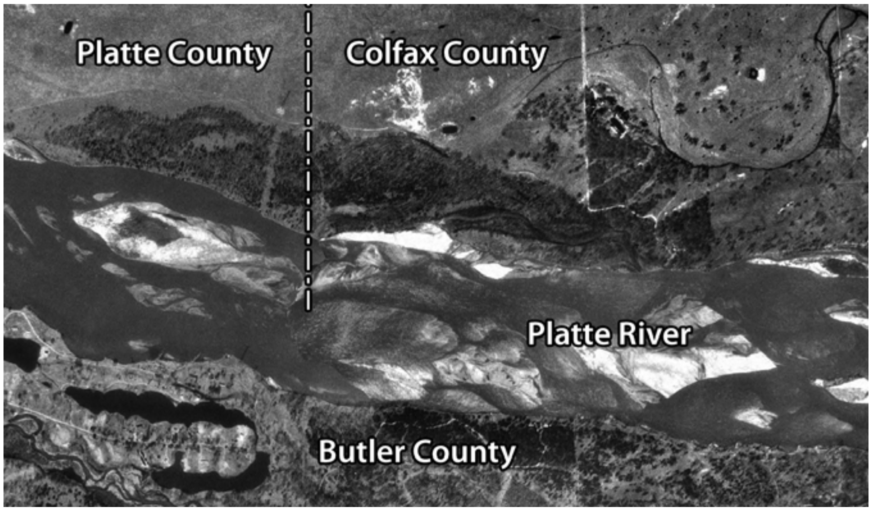

Photo E-28. Aerial view of the Platte River, near the Platte/Colfax county line, showing braided characteristics.

Uses of Project Water

Project waters consist of flows diverted from the Loup River at the Headworks into the Settling Basin and ultimately into the Loup Power Canal. Existing uses of Project waters include hydropower generation, irrigation, habitat for fish and wildlife, and recreation. Hydropower generation at the Monroe Powerhouse occurs in a run-of-river mode. Project waters are temporarily ponded in Lake Babcock and Lake North for optimal hydropower generation at the Columbus Powerhouse. Lake Babcock and Lake North function as regulating reservoirs, not storage reservoirs. This means that the volume of water flowing into the reservoirs essentially equals the volume of water released from the reservoirs on a daily basis. Other than evaporation of water directly from the Loup Power Canal, Lake Babcock, and Lake North, water taken from the Loup Power Canal for irrigation purposes (by irrigators with authorized water appropriations from the state) is the primary consumptive use of diverted flow. Project waters in the Loup Power Canal and the regulating reservoirs also serve aquatic habitat and recreational purposes, which are discussed in Sections E.6.3 and E.6.7, respectively. No new uses of Project waters are proposed by the District.

In the vicinity of the Project, groundwater and surface water are primarily used for seasonal irrigation. In addition, a substantial amount of groundwater is used for domestic and industrial purposes in Genoa and Columbus (U.S. Environmental Protection Agency [EPA], June 2008; City of Columbus, 2007).

Flow Uses of Streams in the Vicinity of the Project

Instream Flows

No instream flow appropriations exist for the Loup River; however, administration of Loup River instream flows is impacted by the instream flow appropriations on the Lower Platte River, downstream of the confluence of the Loup and Platte rivers (NDNR, December 30, 2005). Downstream flow appropriators include NGPC for fish and wildlife purposes and the Metropolitan Utilities District for induced groundwater recharge. These two existing instream flow appropriations on the Lower Platte River are measured at USGS Gage 06796000 on the Platte River at North Bend and at USGS Gage 06805500 on the Platte River at Louisville.

Water Rights

As of October 2011, a total of 110 water right claims, applications, and appropriations existed within the Project Boundary, including the District's appropriations for power generation and raise dam, as shown in Table E-24 (NDNR, 2011). Claims are identified and based on one of the following: Nebraska state law of 1877, Nebraska state law of 1889, or actual and beneficial use prior to April 4, 1895 (NDNR, January 20, 2005). Beneficial use includes reasonable and efficient use of water for domestic, municipal, agricultural, industrial, commercial, power production, subirrigation, fish and wildlife, groundwater recharge, interstate compact, water quality maintenance, or recreational purposes (NDNR, August 2007). Separate applications must be filed with NDNR for each new water appropriation to obtain a permit (NDNR, January 20, 2005). Appropriations are permits to use water that have been achieved in accordance with the terms stipulated by NDNR's "Rules for Surface Water" (NDNR, January 20, 2005).

Table E-24. Summary of Water Right Claims, Applications, and Appropriations by NDNR within the Project Boundary

Type of Use	Number of Water Right Holdings[a]	Total Allocated Annual Diversion (cfs)
Power Generation	1	3,500
Raise Dam	1	N/A
Irrigation	105	70.7
Domestic	1	0.17
Manufacturing	2	6.68

Source: NDNR, 2011, *Nebraska Surface Water Rights Data Retrieval*, retrieved on November 7, 2011, http://dnrdata.dnr.ne.gov/SWRCombined/SelectSearchOptions.aspx.

Note:

[a] As of November 2011, the NDNR database included no applications for water rights within the Project Boundary.

The District currently holds surface water rights from NDNR for use of 3,500 cfs for power generation (Appropriation No. A-2287). The hydropower appropriation for the Project is dated September 15, 1932[13] (NDNR, 2011).

Nebraska water law (Nebraska Revised Statutes 70-668, 70-669, and 46-204) uses a priority and preference system to determine order of use for water. Priority is typically based on date of application, and preference is based on type of use. There are 919 water rights claims on the Loup River upstream of the point of diversion, with 37 being senior in priority to the District (NDNR, November 14, 2011). Under Nebraska's water preference system, domestic and agricultural water use outranks water used for industrial and power generation purposes. Therefore, although the District has the senior water right in most cases, it cannot prevent consumptive uses upstream of the point of diversion for water uses with a higher preference. If a junior priority user receives waters from a senior priority user based on preference, the junior priority user must pay just compensation to the senior priority user.

Water Quality

Water Quality Standards

All Federally approved water quality standards for the State of Nebraska are included in Sections 303(d) and 305(b) of the CWA and in Title 117 of the Nebraska Administrative Code (33 USC 1251 et seq.; NDEQ, March 22, 2009).

[13] The District's water right is based on the date of application.

Section 303(d) of the CWA requires states to identify and establish a priority ranking for all waterbodies in which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, to establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and to submit, from time to time, the (revised) list of impaired waterbodies and TMDLs to EPA. The requirements to identify and establish TMDLs apply to all waterbodies, regardless of whether a waterbody is impaired by point sources, nonpoint sources, or a combination of both (NDEQ, April 1, 2010).

Section 305(b) of the CWA directs states to prepare a report every 2 years that describes the status and trends of existing water quality, the extent to which designated uses are supported, pollution problems and sources, and the effectiveness of the water pollution control programs (NDEQ, April 1, 2010).

Title 117 includes three types of water quality standards—narrative criteria, numeric criteria, and an antidegradation clause—as described below:

- Narrative criteria – The narrative criteria that apply to the waters that are affected by the Project include the following (NDEQ, March 22, 2009):
  - Aesthetics – "This use applies to all surface waters of the state. To be aesthetically acceptable, waters shall be free from human-induced pollution which causes: 1) noxious odors; 2) floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits; and 3) the occurrence of undesirable or nuisance aquatic life (e.g., algal blooms). Surface waters shall also be free of junk, refuse, and discarded dead animals."
  - Biological Criteria – "Any human activity causing water pollution which would significantly degrade the biological integrity of a body of water or significantly impact or displace an identified 'key species' shall not be allowed except as specified in Chapter 2 [of Title 117]."
  - Total Dissolved Gases – "Not to exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures."
  - Toxic Substances – "Surface waters shall be free from toxic substances, alone or in combination with other substances, in concentrations that result in acute or chronic toxicity to aquatic life, except as specified in Chapter 2 [of Title 117]. Toxic substances shall not be present in concentrations that result in objectionable tastes or significant bioaccumulation or biomagnification in aquatic organisms which renders them unsuitable or unsafe for consumption."

- Numeric criteria – The numeric criteria that apply to the waters that are affected by the Project are presented in Appendix E-3, Tables 1 through 4. In addition, the State of Nebraska has developed nutrient criteria, which are a subset of numeric criteria, for lakes and impounded waters. The nutrient criteria standard applies to Lake Babcock and Lake North. The total phosphorus standard is 564 micrograms per liter (µg/L), the total nitrogen standard is 2,300 µg/L, and the chlorophyll *a* standard is 29 µg/L (NDEQ, March 22, 2009).
- Antidegradation clause – Under the antidegregation clause, the water quality of surface waters, consistent with uses applied in Title 117, shall be maintained and protected. Water quality degradation that would adversely affect existing uses will not be allowed (NDEQ, March 22, 2009).

Waterbody Segments and Assigned Beneficial Uses

NDEQ has segmented all waterbodies in the State of Nebraska and has assigned beneficial uses to each designated segment (NDEQ, March 22, 2009). Segment reaches and lakes in the vicinity of the Project and their assigned beneficial uses are identified in Table E-25. Descriptions of the use classifications follow the table. The locations of the segment reaches and lakes are shown in Appendix E-1, Figure E-12.

Table E-25. Assigned Beneficial Uses for Waters in the Vicinity of the Project

Waterbody	Segment Name	Basin	Segment ID	Use Classification						
				Recreation	Warmwater Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Key Species
Loup Power Canal	Diversion (Sec 6-16N-4W) to Sec 28-18N-2W (exits Loup River Basin into Lower Platte River Basin)	Loup River	LO1-20200	●	A		A		●	i,j
	Sec 28-18N-2W to Sec 35-17N-1E (enters Lower Platte River Basin from Loup River; exits into Middle Platte River Basin)	Lower Platte	LP1-21800	●	A		A	●	●	i,j
	Sec 35-17N-1E to Platte River (enters Middle Platte River Basin from Lower Platte River Basin)	Middle Platte	MP1-10200	●	A		A		●	i,j
Lake North	(Sec 31-18N-1E, Platte County)	Lower Platte	LP1-L0440	●	A		A	●	●	
Lake Babcock	(Sec 31-18N-1E, Platte County)	Lower Platte	LP1-L0450	●	A		A	●	●	

Waterbody	Segment Name	Basin	Segment ID	Use Classification						
				Recreation	Warmwater Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Key Species
Headgate Ponds	Loup Power District Headgate Pond No. 1	Loup	LO1-L0060	●	A		A		●	
	Loup Power District Headgate Pond No. 2	Loup	LO1-L0070	●	A		A		●	
	Loup Power District Headgate Pond No. 3	Loup	LO1-L0080	●	A		A		●	
	Loup Power District Headgate Pond No. 4	Loup	LO1-L0090	●	A		A		●	
	Loup Power District Headgate Pond No. 5	Loup	LO1-L0100	●	A		A		●	
Loup River	Loup River Canal Diversion (Sec 6-16N-4W) to Beaver Creek	Loup	LO1-20000	●	A*		A		●	i,j
	Beaver Creek to Platte River	Loup	LO1-10000	●	A*		A		●	i
Platte River	Wood River to Loup Power Canal (Sec 35-17N-1E)	Middle Platte	MP1-20000	●	A*		A		●	i,j

Waterbody	Segment Name	Basin	Segment ID	Use Classification						
				Recreation	Warmwater Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Key Species
	Loup Power Canal (Sec 35-17N-1E) to Clear Creek	Middle Platte	MP1-10000	●	A*		A		●	i,j
	Clear Creek to Elkhorn River	Lower Platte	LP1-20000	●	A*	●	A		●	18,i, j,w

Source: NDEQ, March 22, 2009, Nebraska Administrative Code, Title 117, Nebraska Surface Water Quality Standards, available online at http://www.deq.state.ne.us/RuleAndR.nsf/pages/117-TOC.

Notes:

A = Class A waters (defined below)

i = Channel catfish

j = Flathead catfish

18 = Sturgeon chub

w = Walleye

* = Site-specific water quality criteria for ammonia are assigned.

The waters identified in Table E-25 are all listed as Class A. Class A waters "are surface waters … which constitute an outstanding State or National resource, such as waters within national or state parks, national forests or wildlife refuges, and waters of exceptional recreational or ecological significance. Waters which provide a unique habitat for [F]ederally designated endangered or threatened species and rivers designated under the Wild and Scenic Rivers Act are also included. The existing quality of these surface waters shall be maintained and protected" (NDEQ, March 22, 2009).

The use classifications for the segment reaches and lakes in the vicinity of the Project are defined as follows (NDEQ, July 31, 2006):

- Primary Contact Recreation – "This use applies to surface waters which are used, or have a high potential to be used, for primary contact recreational activities. Primary contact recreation includes activities where the body may come into prolonged or intimate contact with the water, such that water may be accidentally ingested and sensitive body organs (e.g., eyes, ears, nose, etc.) may be exposed. Although the water may be accidentally ingested, it is not intended to be used as a potable water supply unless acceptable treatment is applied. These waters may be used for swimming, water skiing, canoeing, and similar activities. These criteria apply during the recreational period of May 1 through September 30."
- Warmwater Aquatic Life – "These are waters which provide, or could provide, a habitat consisting of sufficient water volume or flow, water quality, and other characteristics such as substrate composition which are capable of maintaining year-round populations of warmwater biota. Warmwater biota are considered to be life forms in waters where temperatures frequently exceed 25°C (77°F)." Waters designated as Class A – Warmwater "provide, or could provide, a habitat suitable for maintaining one or more identified key species on a year-round basis. These waters also are capable of maintaining year-round populations of a variety of other warmwater fish and associated vertebrate and invertebrate organisms and plants."
- Public Drinking Water – "These are surface waters which serve as a public drinking water supply. These waters must be treated (e.g., coagulation, sedimentation, filtration, chlorination) before the water is suitable for human consumption. After treatment, these waters are suitable for drinking water, food processing, and similar uses."
- Agriculture – "These are waters used for general agricultural purposes (e.g., irrigation and livestock watering) without treatment."

- Industrial – "These are waters used for commercial or industrial purposes such as cooling water, hydroelectric power generation, or nonfood processing water; with or without treatment. Water quality criteria to protect this use will vary with the type of industry involved. Where water quality criteria are necessary to protect this use, site-specific criteria will be developed."
- Aesthetics – "This use applies to all surface waters of the state. To be aesthetically acceptable, waters shall be free from human-induced pollution which causes: 1) noxious odors; 2) floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits; and 3) the occurrence of undesirable or nuisance aquatic life (e.g., algal blooms). Surface waters shall also be free of junk, refuse, and discarded dead animals."
- Key Species – Key species are "identified endangered, threatened, sensitive, or recreationally important aquatic species associated with a particular water body and its aquatic life use class."

Available Water Quality Data

NDEQ water quality data are available both directly from NDEQ and from data stored on EPA's STORET Database (EPA, March 9, 2006). Every NDEQ segment in the vicinity of the Project, shown in Table E-23, has some NDEQ data associated with it. Data collected at these sites include pH, chloride, turbidity, conductance, dissolved oxygen (DO), and E. coli. NDEQ has a set 5-year rotation schedule for water quality sampling in each basin in Nebraska. The Loup River Basin was sampled in 2003 and again in 2008. However, there are additional sample dates in 2007, 2009, and 2010.

The only data that could be found for Lake North, the off-channel regulating reservoir, were E. coli and microcystin[14] data; there are no vertical profiles of temperature, pH, or DO for either of the two connected regulating reservoirs, Lake Babcock or Lake North. The Lake North data were collected for public health reasons at the swimming beach and are presented in Appendix E-3, Tables 5 through 7. The Lake North E. coli data were collected from 2004 through 2011 for a total of 170 samples, with 159 samples above zero and 14 exceedances of the instantaneous recreational E. coli standard of 235 (number of organisms per 100 milliliters [mL]). The seasonal geometric means of E. coli from 2004 through 2011 were all below the 30-day geometric mean standard of 126 (no. per 100 mL).

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[14] Microcystin is a toxin generated from certain strains of blue-green algae. The term "blue-green algae" is a misnomer; it is actually a type of bacteria called cyanobacteria. Only some strains of cyanobacteria can produce the toxin Microcystin. The NDEQ Health Alert monitoring for lakes does not measure algal or bacterial biomass; it measures a toxin that can be produced by that biomass that is directly harmful to human health.

Microcystin data were collected 107 times between 2007 and 2011, with 67 of those samples yielding a result greater than zero. All 67 of those samples were below the NDEQ Health Advisory Threshold of 20 parts per billion (ppb); therefore, there were no health advisories listed for Lake North from 2007 through 2011.

The only data that could be found for Lake Babcock, the in-channel regulating reservoir, were E. coli and fish tissue sampling. The fish tissue sampling is discussed later in this section. The Lake Babcock E. coli data were collected in 2004 for a total of 21 samples, with all 21 samples above zero and 7 exceedances of the instantaneous recreational E. coli standard of 235 (no. per 100 mL). The seasonal geometric mean in 2004 was 169, which is greater than the 30-day geometric geometric mean standard of 126 (no. per 100 mL).

Loup Power District Headgate Pond No. 2 was sampled in 2008 for Microcystin. Microcystin data were collected 20 times in 2008, with 14 of those samples yielding a result greater than zero. All 14 of those samples were below the NDEQ Health Advisory Threshold of 20 parts per billion (ppb).

As stated previously, NDEQ divided the Loup Power Canal into three segments (see Table E-25). The only data available for segments LP1-21800 and MP1-10200 are E. coli data, which are presented in Appendix E-3, Tables 8 and 9, respectively. The E. coli data available for segment LP1-21800 were collected from May 2004 through September 2007. Of the 61 samples that were taken, 12 exceeded the standard of 235 (no. per 100 mL). The E. coli data available for segment MP1-10200 were collected from May 2005 through September 2007. Of the 40 samples that were taken, 15 exceeded the standard of 235 (no. per 100 mL).

Segment LO1-20200 has substantially more data associated with it. This segment has been sampled for temperature, DO, pH, conductivity, ammonia, and chloride, and these data are provided in Appendix E-3, Table 10. Additional data, including metals, nutrients, and pesticide data, have been collected at this site but are not shown here. The data were collected approximately monthly from 2001 through 2009. Of the 145 samples taken of DO in this segment, there was only one result below the standard of 5.0 mg/L. There were five pH measurements of the 146 collected that exceeded the pH standard of 9. Conductivity and chloride had 147 and 146 measurements collected, respectively, with no exceedances of their respective standards. There were 142 samples taken of ammonia, and only 76 were above non-detect; none of these 76 samples was greater than the ammonia standard. Nitrite plus nitrate was measured 146 times, with only 89 measurements above the detection limt and with no values above the state criteria. Temperature was measured 145 times from 2001 through 2009, at times when other constituents were measured. The average temperature measured was 58 °F with one measurement of 92 °F, which is above the 90°F state temperature standard.

The Loup River was sampled extensively in 2003 and in 2008. The 2003 and 2008 water quality data collected within segment LO1-10000 of the Loup River are provided in Appendix E-3, Table 11. During these 2 years, there were 43 measurements of DO recorded, none of which was below the standard of 5.0 mg/L. There were 42 measurements of pH, none of which were below the 6.5 pH standards or above the pH standard of 9. There were 43 measurements of conductivity, none of which exceeded the standard. E. coli was measured 23 times, 17 of which exceeded the standard of 235 (no. per 100 mL). There were 57 samples taken of ammonia and 40 samples taken of nitrate plus nitrite. Of these samples, 20 were above the detection limit for ammonia and 35 were above the detection limit for nitrate plus nitrite, none of which exceeded acute standards. Temperature was measured 43 times in 2003 through 2008, at times when other constituents were measured. The average temperature measured was 69 °F, with no temperature measurements above the 90 °F state temperature standard. Finally, there were 40 measurements of chloride, none of which exceeded the chloride standard.

Water quality data were collected on the three segments of the Platte River in the vicinity of the Project, as discussed below. Water quality data from Platte River segment MP1-20000 are available from 2001 through 2009 and are presented in Appendix E-3, Table 12. During this time, there were 138 measurements of DO recorded, one of which was below the standard of 5.0 mg/L. There were 135 measurements of pH, none of which were below the 6.5 pH standards, and 13 of which were above the pH standard of 9. There were 139 measurements of conductivity, none of which exceeded the standard. There were 35 measurements of E. coli taken, 10 of which were measured at zero. Of the 25 remaining samples, three were greater than the standard of 235 (no. per 100 mL). There were 133 samples taken of ammonia and 135 samples taken of nitrate plus nitrite. Of these samples, 80 were above the detection limit for ammonia and 112 were above the detection limit for nitrate plus nitrite, none of which exceeded acute standards. Temperature was measured 140 times from 2001 through 2009, at times when other constituents were measured. The average temperature measured was 60 °F with five temperature measurements above the 90 °F state temperature standard, with a maximum of 95 °F. Finally, there were 135 measurements of chloride, none of which exceeded the chloride standard.

Water quality data from Platte River segment MP1-10000 were only collected in 2006. There were 22 measurements of DO, none of which were below the standard of 5.0 mg/L. There were 21 measurements of pH, three of which exceeded the pH standard of 9. There were 21 measurements of conductivity and 23 measurements of chloride, none of which exceeded standards. There were 23 samples taken of ammonia and 23 samples taken of nitrate plus nitrite. Of these samples, 18 were above the detection limit for ammonia and 9 were above the detection limit for nitrate plus nitrite, none of which exceeded acute standards. Finally, there were 22 measurements of E. coli, seven of which exceeded the standard of 235 (no. per 100 mL).

Water quality data from Platte River segment LP1-20000 are available from 2002 through 2009 and are presented in Appendix E-3, Table 13. During this time, there were 143 measurements of DO recorded, none of which was below the standard of 5.0 mg/L. There were 143 measurements of pH, none of which were below the 6.5 pH standards, and one of which was above the pH standard of 9. There were 143 measurements of conductivity, none of which exceeded the standard. There were 20 samples of E. coli taken, half of which exceeded the standard of 235 (no. per 100 mL). There were 141 samples taken of ammonia and 141 samples taken of nitrate plus nitrite. Of these samples, 113 were above the detection limit for ammonia and 140 were above the detection limit for nitrate plus nitrite, none of which exceeded acute standards. Finally, there were 141 measurements of chloride, none of which exceeded the chloride standard. Temperature was measured 143 times from 2001 through 2009, at times when other constituents were measured. The average temperature measured was 60 °F with a maximum of 89 °F. In addition, Atrazine sampling data for segment LP1-20000 is provided in Appendix E-3, Table 14. There were 82 samples taken for Atrazine during the time period from 2001 thorugh 2006, 16 of which were non-detects. Of the remaining measured values, zero exceeded the acute criteria and 12 exceeded the chronic criteria. In addition, 11 Atrazine measurements and 10 seasonal Atrazine measurements exceeded the drinking water standard of 3 μg/L. During the time period from 2007 through 2009 there were 40 additional samples of Atrazine taken. None of these measurements were greater than the chronic toxicity standard of 12 μg/L.

In addition to water quality data available from NDEQ, there are water quality data associated with three USGS gages that are in the vicinity of the Project. The first, USGS Gage 06774000, is on the Platte River near Duncan, Nebraska. The gage has 245 sampling days between the years 1973 and 2011. The data available at this site include water temperature, nutrients, specific conductance, DO, pH, bacteriological, radiological, alkalinity, chlorophyll and algal species, sediment data, and organic chemical data (USGS, 2011).

The second gage, USGS Gage 06796000, is on the Platte River at North Bend. This gage has 220 sampling days between the years 1973 and 2011. The data available at this site include water temperature, nutrient, specific conductance, DO, pH, bacteriological, radiological, alkalinity, chlorophyll and algal species, sediment, and organic chemical data (USGS, 2011).

The third gage, USGS Gage 06793000, is on the Loup River near Genoa. This gage has 48 sampling days between the years 1975 and 1986 and one sampling day in 2010. The data available at this site include water temperature, nutrient, specific conductance, DO, pH, bacteriological, alkalinity, chlorophyll and algal species, and sediment data (USGS, 2011).

On August 11 and 12, 2009, NDEQ took fish tissue samples from Lake Babcock and the Loup Power Canal near Columbus. The tissue was analyzed for PCB congeners, pesticides, heavy metals, and mercury. In the fish tissue samples from the Loup Power Canal, no PCB congeners, pesticides, or heavy metals were detected. Mercury was detected in the sample at a concentration below the state standard for mercury in fish tissue. In the fish tissue sample from Lake Babcock, only one PCB congener was detected, one pesticide was detected, and as with the canal, mercury was detected below the state mercury standard in fish tissue.

As part of the District's Study 4.0, Water Temperature in the Project Bypass Reach, water temperature data were collected at several locations. The District coordinated with USGS regarding installation of water temperature sensors at two locations: 1) Loup River upstream of the Diversion Weir (USGS Gage 06792490, Loup River at Merchiston, NE), and 2) USGS Gage 06793000, Loup River near Genoa, NE. Water temperature data collection began at the USGS sensors at the Loup River at Merchiston on May 3, 2010, and at the Loup River near Genoa on May 5, 2010. At the Loup River at Merchiston, there is a slight data gap from June 28 to 30, 2010, that is unexplained but is likely due to the probe being exposed to the atmosphere. At the Loup River near Genoa, the temperature sensor was washed away by high flows on June 10, 2010. A replacement sensor was installed on July 19, 2010. Consequently, a data gap exists from June 10 to July 18, 2010. USGS also added a temperature data logger in the Loup River at the gage site at Columbus.

The District installed paired temperature data loggers and collected temperature data from August 13 to 22, 2010, at the following sites:

- Loup River at Columbus, coincident with NDNR Gage 06794500, Loup River at Columbus, NE (Columbus A and B)
- Platte River upstream of the Loup River confluence (Platte A and B)
- Platte River bypass reach (Tailrace A and B)

Table E-26 below shows information about the water temperature data that was collected by USGS. Table E-27 shows information about the water temperature data that was collected by the District using the data loggers.

Table E-26. Descriptive Statistics for Hourly USGS Data

Parameter	Water Temperature (°F)		
Location	Merchiston	Genoa	Columbus
Dates (2010)	5/3 to 8/23	5/5 to 8/30	5/2 to 8/30
Count	2,576	1,788	1,885
Data Completeness (%)	96	65	88
Mean	75.8	74.2	72.3
Minimum	48.0	48.2	46.0
Maximum	93.2	94.8	95.0
Standard Deviation	9.2	10.5	8.5

Table E-27. Descriptive Statistics for Hourly Data for August 13-22, 2010, Special Study Conducted by the District

Parameter[a]	Water Temperature[b] (°F)					
Location	Columbus A	Columbus B	Platte A	Platte B	Tailrace[c] A	Tailrace[c] B
Count	210	211	217	218	190	190
Mean	78.4	78.5	80.2	80.1	80.1	79.9
Minimum	68.4	68.5	70.2	70.3	70.2	69.9
Maximum	90.8	90.9	92.6	92.4	92.3	92.2
Standard Deviation	5.5	5.5	5.3	5.3	5.2	5.2

Notes:

[a] Data completeness is >99% for all parameters at all locations.

[b] Water temperature data were collected from paired temperature data loggers on the Loup River at Columbus (Columbus A and B), the Platte River upstream of the Loup River confluence (Platte A and B), and the Platte River bypass reach (Tailrace A and B). The paired data loggers are two data loggers placed at the same location for redundancy.

[c] "Tailrace" designates the probe located in the Platte River bypass reach, just upstream of the Tailrace Return.

Impairments

Data used for the impairment assessment can be from any agency that meets the state's data quality objectives. Water quality data assessments and defined impairments are based on the state's surface water quality standards. Where numeric criteria are defined or narrative criteria can be quantified, NDEQ uses the percent of samples exceeding criteria to define whether a waterbody is supporting its assigned beneficial uses. In line with past EPA guidance, NDEQ uses a rate of 10 percent as an indicator of an impaired waterbody. The 2004, 2006, 2008, and 2010 Integrated Report Assessment Methodology reports describe how the state determines a designation of Supporting, Impaired, or Not Assessed for each beneficial use each time the Integrated Report is published. If no additional data have been collected in the time between assessments, the category will not be changed. The 2004, 2006, 2008, and 2010 Integrated Reports are summarized in Tables E-28 through E-31, respectively.

Using the available water quality data described above, and according to the procedures outlined in the 2004, 2006, 2008, and 2010 Integrated Reports, NDEQ first determines whether there is enough information to make an assessment at all. If it is determined that there is indeed enough information available to make an assessment, NDEQ will determine if a waterbody is supporting (S) its designated uses; if not, NDEQ will label the segment as impaired (I). Tables E-28 through E-31 show the results of this process, which occurs every other year.

Table E-28. 2004 Integrated Report

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
LO1-20200	Loup Power Canal	Loup not in report								
LP1-21800		I	I					5	Fecal coliform & PCBs	Fish tissue advisory
MP1-10200								3		
LP1-L0440	Lake North		I		S	I	S	5	pH, Nutrients	
LP1-L0450	Lake Babcock						S	2		
LO1-20000	Loup River	Loup not in report								
LO1-10000		Loup not in report								
MP1-20000	Platte River	I	S		S			4A	E. coli & Fecal coliform	Fecal coliform TMDL approved May 2003
MP1-10000		I	S					4A	E. coli & Fecal coliform	Fecal coliform TMDL approved May 2003

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
LP1-20000		I	I		S			5	Fecal coliform & PCBs	Fish tissue advisory

Source: NDEQ, March 2004, "2004 Surface Water Quality Integrated Report," Nebraska Department of Environmental Quality, Water Quality Division, available online at http://www.deq.state.ne.us/Publica.nsf/0/9b20b5698c99413106256ac7007266c9/$FILE/200%20IR-Final.pdf.

Notes:

[a] I = Impaired; S = Supporting

[b] Category 1 = Waterbodies where all designated uses are met.

Category 2 = Waterbodies where some of the designated uses are met but there is insufficient information to determine if all uses are being met.

Category 3 = Waterbodies where there is insufficient data to determine if any beneficial uses are being met.

Category 4 = Waterbody is impaired, but a TMDL is not needed. Sub-category 4A outlines the rationale for the waters not needing a TMDL.

Category 4A = Waterbody assessment indicates the waterbody is impaired, but all of the required TMDLs have been completed.

Category 5 = Waterbodies where one or more beneficial uses are determined to be impaired by one or more pollutants and all of the TMDLs have not been developed. Category 5 waters constitute the Section 303(d) list subject to EPA approval/disapproval.

Table E-29. 2006 Integrated Report

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
LO1-20200	Loup Power Canal	NA	S	NA	S		NA	2		
LP1-21800	Loup Power Canal	S	I	NA	S		NA	4B	PCBs (fish tissue)	Fish consumption advisory in effect; PCB production banned
MP1-10200	Loup Power Canal	NA		NA			NA	3		
LP1-L0440	Lake North	S	I	NA	S	S	NA	5	pH	De-list for nutrients - growing season averages for N, P, Chlor-a < criteria; List for pH
LP1-L0450	Lake Babcock	I		NA			NA	5	E. coli	
LO1-20000	Loup River	NA	S	NA			NA	2		
LO1-10000	Loup River	I	S	NA	S		NA	4A	E. coli	TMDL completed for E. coli

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
MP1-20000	Platte River	S	S	NA	S		NA	4A		TMDL completed for Fecal coliform, E. coli
MP1-10000		S	S	NA			NA	4A		TMDL completed for Fecal coliform
LP1-20000		I	I	NA	S		NA	5	E. coli, PCBs (fish tissue)	Fish consumption advisory in effect

Source: NDEQ, March 2006, "2006 Surface Water Quality Integrated Report," Nebraska Department of Environmental Quality, Water Quality Division, available online at http://www.deq.state.ne.us/Publica.nsf/0/17ddb685e0238e1d862571320063a1e2/$FILE/The%202006%20Integrated%20Report.pdf.

Notes:

[a] NA = Not Assessed; I = Impaired; S = Supporting

[b] Category 1 = Waterbodies where all designated uses are met.

Category 2 = Waterbodies where some of the designated uses are met but there is insufficient information to determine if all uses are being met.

Category 3 = Waterbodies where there is insufficient data to determine if any beneficial uses are being met.

Category 4 = Waterbody is impaired, but a TMDL is not needed. Sub-categories 4A and 4B outline the rationale for the waters not needing a TMDL.

Category 4A = Waterbody assessment indicates the waterbody is impaired, but all of the required TMDLs have been completed.

Category 4B = Waterbody is impaired, but "other pollution control requirements" are expected to address the water quality impairment(s) within a reasonable period of time. Other pollution control requirements include but are not limited to, National Pollutant Discharge Elimination System (NPDES) permits and best management practices.

Category 5 = Waterbodies where one or more beneficial uses are determined to be impaired by one or more pollutants and all of the TMDLs have not been developed. Category 5 waters constitute the Section 303(d) list subject to EPA approval/disapproval.

Table E-30. 2008 Integrated Report

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
LO1-20200	Loup Power Canal	NA	S		S	S		2		
LP1-21800		S	I		NA	S	S	5	PCBs	Fish consumption advisory in effect
MP1-10200		I	NA		NA	NA			E. coli	
LP1-L0440	Lake North	S	S		S	S	S	1		
LP1-L0450	Lake Babcock	I					S	5	E. coli	
LO1-20000	Loup River							3		2006 IR misidentified segment
LO1-10000		I	S		S	S		4A	E. coli	E. coli TMDL approved 1/06
MP1-20000	Platte River	S	S		S	S		1		Fecal coliform TMDL approved 5/03
MP1-10000		I	S		S	S		4A	E. coli	

Waterbody ID	Waterbody Name	Beneficial Uses[a]							Parameter Impairing Use	Comments
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Aesthetics	Industrial Supply	303(d) Category[b]		
LP1-20000		I	I	I	S	S		5	E. coli, Atrazine, PCBs	E. coli TMDL approved 9/07; Fish consumption advisory in effect

Source: NDEQ, March 2008, "2008 Water Quality Integrated Report," Nebraska Department of Environmental Quality, Water Quality Division, available online at http://www.deq.state.ne.us/Publica.nsf/0/9d72c74655475f658625741700741ad3/$FILE/2008%20final%20IR.pdf.

Notes:

[a] NA = Not Assessed; I = Impaired; S = Supporting

[b] Category 1 = Waterbodies where all designated uses are met.

Category 2 = Waterbodies where some of the designated uses are met but there is insufficient information to determine if all uses are being met.

Category 3 = Waterbodies where there is insufficient data to determine if any beneficial uses are being met.

Category 4 = Waterbody is impaired, but a TMDL is not needed. Sub-category 4A outlines the rationale for the waters not needing a TMDL.

Category 4A = Waterbody assessment indicates the waterbody is impaired, but all of the required TMDLs have been completed.

Category 5 = Waterbodies where one or more beneficial uses are determined to be impaired by one or more pollutants and all of the TMDLs have not been developed. Category 5 waters constitute the Section 303(d) list subject to EPA approval/disapproval.

Table E-31. 2010 Integrated Report

Waterbody ID	Waterbody Name	Beneficial Uses[a]							303(d) Category	Impairments	Parameters of Concern	Comments/ Action
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Overall Assessment				
LO1-20200		I	S	S			S	I	5	E. coli	E. coli	
LP1-21800	Loup Power Canal	S	I		NA	S	S	I	5	Fish consumption advisory	Hazard index compounds*	Fish consumption assessment
MP1-10200		I	NA		NA		NA	I	5	E. coli	E. coli	
LP1-L0440	Lake North	S	I		S	S	S	I	5	High pH	Unknown	Fish consumption assessment, Delist nutrients - insufficient data for assessment procedures
LP1-L0450	Lake Babcock	I	S			S	S	I	5	E. coli		Fish consumption assessment
LO1-L0060	Loup Power District Headgate Pond No. 1	NA	NA		NA		NA		3			
LO1-L0070	Loup Power District Headgate Pond No. 2	NA	NA		NA		NA		3			

Waterbody ID	Waterbody Name	Beneficial Uses[a]							303(d) Category	Impairments	Parameters of Concern	Comments/ Action
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Overall Assessment				
LO1-L0080	Loup Power District Headgate Pond No. 3	NA	NA		NA		NA		3			
LO1-L0090	Loup Power District Headgate Pond No. 4	NA	NA		NA		NA		3			
LO1-L0100	Loup Power District Headgate Pond No. 5	NA	NA		NA		NA		3			
LO1-20000	Loup River	NA	NA		NA		NA		3			
LO1-10000	Loup River	I	S		S		S	I	4a	E. coli	E. coli	E. coli TMDL approved 1/06, Fish consumption assessment
MP1-20000	Platte River	S	S		S		S	S	1			Fecal coliform TMDL approved 5/03
MP1-10000	Platte River	I	S		S		S	I	4A	Fecal - E. coli	E. coli	Fecal coliform TMDL approved 5/03

Waterbody ID	Waterbody Name	Beneficial Uses[a]							303(d) Category	Impairments	Parameters of Concern	Comments/ Action
		Recreation	Aquatic Life	Public Drinking Water Supply	Agriculture Supply	Industrial Supply	Aesthetics	Overall Assessment				
LP1-20000		I	I	I	S		S	I	5	E. coli, Atrazine - water supply, Fish consumption advisory	E. coli, Atrazine, Cancer risk & Hazard index compounds*	E. coli TMDL approved 9/07; Fish consumption assessment

Source: NDEQ, April 1, 2010, "2010 Water Quality Integrated Report," Nebraska Department of Environmental Quality, Water Quality Division, available online at http://www.deq.state.ne.us/Publica.nsf/23e5e39594c064ee852564ae004fa010/9c42324285ffd2d186257829006b285a/$FILE/NE%202010%20WQ%20Integrated%20Report%20(2).pdf.

Notes:

[a] NA = Not Assessed; I = Impaired; S = Supporting

[b] Category 1 = Waterbodies where all designated uses are met.

Category 2 = Waterbodies where some of the designated uses are met but there is insufficient information to determine if all uses are being met.

Category 3 = Waterbodies where there is insufficient data to determine if any beneficial uses are being met.

Category 4 = Waterbody is impaired, but a TMDL is not needed. Sub-category 4A outlines the rationale for the waters not needing a TMDL.

Category 4A = Waterbody assessment indicates the waterbody is impaired, but all of the required TMDLs have been completed.

Category 5 = Waterbodies where one or more beneficial uses are determined to be impaired by one or more pollutants and all of the TMDLs have not been developed. Category 5 waters constitute the Section 303(d) list subject to EPA approval/disapproval.

* Cancer risk compounds = Aroclor-1248 (PCB-1248), Aroclor-1254 (PCB-1254), Aroclor-1260 (PCB-1260), cis-chlordane, Chlordane, trans-chlordane, DDD, DDE, DDT, Dieldrin, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, cis-nonachlor, trans-nonachlor, Oxychlordane, Pentachloroanisole, Trifluralin

As shown in Tables E-28 through E-31, there are four TMDL reports relating to waters in the vicinity of the Project. Each of the four reports addresses the impairment of recreational uses of the respective waterbody from bacteria. The first TMDL report was written for the Middle Platte River for fecal coliform bacteria. This report was written before the E. coli standard was enacted (NDEQ, April 2003). The second, third, and fourth TMDL reports address E. coli concentrations in the Loup River and in the Lower Platte River (NDEQ, December 2005; NDEQ, June 2007; NDEQ, April 1, 2010). All four TMDLs show that both point and nonpoint sources contribute to the bacteria loading to the waterbodies. All point sources must meet the numeric criteria at the end-of-pipe as Title 117 allows no mixing zone for bacteria. The nonpoint source load comes from a combination of human-related activities and natural background.

E.6.2.2 Environmental Analysis

Four studies related to water resources were conducted as part of Project relicensing:

- Study 1.0, Sedimentation
- Study 2.0, Hydrocycling
- Study 4.0, Water Temperature in the Project Bypass Reach
- Study 5.0, Flow Depletion and Flow Diversion

Each of these studies was conducted in accordance with FERC's Study Plan Determination (August 26, 2009) and subsequent Determinations on Requests for Study Modifications (December 20, 2010, and June 10, 2011). The results of each of these studies as they relate to Project effects on water resources are discussed below under the appropriate headings.

These studies analyzed a substantial amount of information that is not included in the CFR requirements for the Water Resources, Existing Environment section of this Draft License Application, Exhibit E. The complete analyses and results for each of these studies were published in the District's Updated Study Report (August 26, 2011).

Common Study Parameters and Analyses

The following parameters and analyses were common to one or more of the conducted studies. Brief descriptions are provided below.

Ungaged Sites

In addition to the eleven stream gages (gaged sites) used to evaluate streamflows, five "ungaged" sites also were evaluated for the various studies in accordance with FERC's Study Plan Determination dated August 26, 2009. The following five ungaged sites were evaluated; these sites are shown in relation to the gaged sites in Appendix E-1, Figure E-13:

- Loup River upstream of the Diversion Weir (Site 1)
- Loup River immediately downstream of the Diversion Weir (Site 2)
- Lower Platte River downstream of the Loup River confluence and upstream of the Tailrace Return confluence (Site 3)
- Lower Platte River within 5 miles downstream of the Tailrace Return confluence (Site 4)
- Lower Platte River near the USGS North Bend gage (Site 5)

Synthetic Hydrographs

Synthetic hydrographs were created to estimate flows at ungaged sites (study sites where no USGS gage exists). Synthetic hydrographs were also developed to evaluate alternative Project operations.

Flow Classification

Project effects related to water resources can vary depending on the amount of natural flow available in a given year. To account for this variation, study analyses considered three different flow classifications: wet, dry, and normal.

Each year for the period of record was classified as wet, dry, or normal for both the gaged and ungaged sites based on an approach developed by Anderson and Rodney (October 2006). This approach ranks the mean annual discharge in descending order. The highest 33 percent of the mean annual flows recorded during the period of record were classified as wet years. The lowest 25 percent of the mean annual flows recorded during the period of record were classified as dry years. The remaining flows were classified as normal years.

Sedimentation

The goal of the sedimentation study was 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 that is used by various threatened and endangered species that exist in the vicinity of the Project.

In addition to review and analysis of work performed by others in the Platte River Basin, the District adopted the following qualitative and quantitative methods that are considered by the scientific community to be state-of-the-art practices used in characterizing a river's morphology and assessing impacts of alternative operations on channel morphology and habitat:

- Sediment Budgets
- Effective and Dominant Discharge Calculations
- Hydraulic Geometry Relationships and Spatial Analysis
- Regime Analysis
- Specific Gage and Kendall Tau Analyses
- Cross-Section Comparison

No one single method was used to evaluate sediment processes and stream morphology. Rather, a "body of evidence" approach was used by applying these state-of-the-art practices to the Loup and Platte rivers.

Literature Review

Several relatively recent studies, described below, were conducted by others to evaluate aggradation/degradation and cross-sectional changes in the Loup and Platte rivers. Some studies had a limited focus on middle-Platte locations upstream of Duncan, while others studies focused on the entire Platte River Basin, evaluating channel profiles all the way to the Missouri River confluence. Some of the more recent investigations focused on conditions in the lower Platte River.

By examining conditions in 1900 and contrasting them with conditions in 1990, USACE (July 1990) found that all reaches in the basin (including the lower Platte River) had no notable ongoing long-term aggradation or degradation. USACE's primary conclusion was that "the river within the study reaches is in a state of quasi-equilibrium" (July 1990). For the Platte River, USACE (July 1990) found that all reaches had no notable long-term aggradation or degradation or channel geometry trends.

Both sediment availability (yield or supply) and transport capacity in the Platte River were evaluated by USACE (July 1990). USACE affirmed that bed material transport throughout the study area is not supply limited due to a "virtually unlimited source" of sediment. Elliott, Huhmann, and Jacobson (2009) also concluded that there is unlimited supply of sediment based on the "extent and persistence of emergent sand bars on the lower Platte River."

Citing scientific study reports by Peters and Parham (2008) and Parham (2007), NGPC (December 2008) concluded that even though the lower Platte River has been "highly altered" and that centuries-old characteristics have been "tempered" due to development and use of the water resource, the lower Platte River "retains most geomorphic characteristics of the [centuries-old] historic Platte River."

Probably the most relevant publication addressing the question of aggradation or degradation is the USGS report on its study of trends in channel gradation in Nebraska streams, including both the lower Platte River and the Loup River upstream and downstream of the Diversion Weir (Chen, Rus, and Stanton, 1999). By evaluating extensive sets of longitudinal, cross section, and water surface elevation data collected at 145 gaging stations between 1913 and1995, Chen, Rus, and Stanton reported the following conclusions:

- Channel degradation was generally found at gaging stations downstream of dams.
- No such degradation was found downstream of the Project Diversion Weir.
- A slight aggrading trend was noted at the Loup River at Columbus; however, Chen, Rus, and Stanton pointed out that it did not have the same data set as the other gages. (Gaging at the site was discontinued in 1978 and not resumed until 2008).
- There was no evidence of any trend in aggradation or degradation in the Loup River at Genoa, Platte River at Duncan, Platte River at North Bend, and Platte River at Ashland.
- A slight degrading trend was noted at Louisville, which was attributed to site-specific circumstances and not considered to be generic.

In a channel stability study, USACE (USACE, October 2009) studied a section of the Platte River near Fremont, Nebraska. Using specific gage analysis on the USGS gages in the area, USGS sediment data, bank line migration information from photographs, and site-specific data, the following three USACE conclusions are relevant to the Project (USACE, October 2009):

- "No information was discovered to indicate an ongoing change in Platte River dynamic equilibrium within the study reach.
- Specific gage analysis at four gage locations did not indicate a clear increase or decrease in channel stages over time.
- Specific gage plots illustrated stages vary from year to year reflecting natural channel dynamics."

The following conclusions from other investigators are particularly relevant to the analysis performed by the District and should be considered in relation to the findings of the District's Study 1.0, Sedimentation.

It is important to note that the channel of a river in regime[15] can and will be "continually changing" (USACE, July 1990), and yet remains in regime as long as there is no long-term change in mean values of the channel geometry indicators. Elliott, Huhmann, and Jacobson (2009) found that the lower Platte River "is an especially dynamic river channel with braid bars and shifting channels that change rapidly at the scale of 10's to 100's of meters…."

This is an important aspect in the assessment of impacts of alternative operations on channel morphology (cross section geometry and planform alignment). Before drawing any conclusions, short term morphologic changes predicted in these assessments need to be contrasted with the normal ranges of deviation around the long-term, stable (in-regime) mean values.

Analyses

The following sections describe the results of the various analyses performed to determine the effect of Project operations on stream morphology and sediment transport in the Loup River bypass reach and in the lower Platte River.

Sediment Budget

A sediment budget was developed comparing the sediment yield from the basin to the river's capacity to convey the sediment, as detailed in the District's Updated Study Report, Study 1.0, Sedimentation. This analysis was used to help determine if the Loup and Platte River bypass reaches and the Platte River below the tailrace canal had more or less sediment available to carry than the rivers were actually carrying.

Sediment yields for the Loup and Platte river watersheds were developed using information from the Missouri River Basin Commission and District dredging records. Sediment transport capacities were developed for the gaged locations using the station-specific sediment discharge rating curves (developed using Yang's (1972) Unit Stream Power method) and the gaged hydrographs, while capacities for the ungaged sites were developed using the sediment discharge rating curves derived from recent data collected at the sites and the synthetic hydrographs.

The resulting yields and capacities for the gaged and ungaged sites are listed in Table E-32. As shown in the table, average annual capacities increase in the downstream direction consistent with natural river processes. Additionally, Table E-32 shows that all capacities fall below the adjusted MRBC yields, revealing that the rivers are not supply limited throughout the study reaches.

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15 "In regime" is also defined as being in dynamic equilibrium

Table E-32. Sediment Capacity and Sediment Yield at Gaged and Ungaged Sites

Site or USGS Gage Number	Site Description or Gage Name and Location	Drainage Area (square miles)	Annual Sediment Data (tons/year)		
			Capacity (1985–2009)	Capacity (2009 only)	Updated MRBC Average Annual Yield
Site 1	Loup River Upstream of the Diversion Weir	14,320[a]	NA	2,870,000	4,180,000
Site 2	Loup River Downstream of the Diversion Weir	14,320[a]	NA	890,000	2,030,000
06793000	Loup River near Genoa, NE	14,320	1,760,000	1,280,000	2,030,000
06794500	Loup River at Columbus, NE	15,200	1,260,000[b]	950,000	2,960,000
06774000	Platte River near Duncan, NE	59,300	747,000	410,000	1,870,000
Site 3	Platte River Upstream of the Tailrace Return	74,500	NA	1,160,000	4,900,000
Site 4	Platte River Downstream of the Tailrace Return	74,500	NA	2,960,000	5,250,000
06796000	Platte River at North Bend, NE	70,400	2,890,000	2,050,000	5,770,000
Site 5	Platte River near North Bend	70,400	NA	2,026,000	5,770,000
06796500	Platte River at Leshara, NE	NA	2,800,000[c]	2,240,000	5,850,000
06801000	Platte River near Ashland, NE	84,200	4,080,000[d]	3,720,000	10,610,000
06805500	Platte River at Louisville, NE	85,370	4,930,000	4,590,000	12,780,000

Notes:

NA = Not available.

[a] The drainage area for the Loup River near Genoa was used.

[b] Channel geometry for Columbus was measured only in 2008 and 2009; flows at Columbus from 1985 to 2009 were synthesized as detailed in in detailed in the District's Updated Study Report, Study 1.0, Sedimentation.

[c] The capacity at Leshara is based on data from 1995 to 2009.

[d] The capacity near Ashland is based on data from 1989 to 2009.

The results reveal that the adjusted MRBC yields greatly exceed the transport capacity of the flows. This readily answers the question of flow versus supply limitations. Because sediment supplies and transport capacities at all locations are not balanced at all times, conclusions regarding potential aggradation or degradation trends must be assessed by other means such as using long-term measurements if available, effective discharge calculations, applications of equilibrium (regime) methodologies, or combinations of all methods.

Effective and Dominant Discharge Calculations

State-of-the-art tools to quantify and characterize flow and sediment transport or issues of aggradation and degradation in any river include effective and dominant discharge and regime methods. Generally, a small range of daily flows transports the largest fraction of total sediment load. These flows are widely accepted in geomorphologic literature as the flows that result in the average morphologic characteristics of the channel. These are called “effective” or “dominant” discharges.

Most investigators define the effective discharge as the modal (peak) value of a histogram developed from a class analysis of a number of equal increments of discharge (or logs of discharge) versus total long-term sediment transported by each class of flows. The effective discharge, defined in this study as the mid-value of the narrow range of flows that transports the most sediment (and therefore shapes the channel), is found by developing a collective sediment discharge curve. The effective discharge was determined for each gaged and ungaged study site for Project operations for the study period (2003 to 2009) and are presented in Table E-33 and are detailed in the District’s Updated Study Report, Study 1.0, Sedimentation.

The dominant discharge is defined as the flow rate that, if continued constantly for the long term, would transport the same total load as the actual hydrograph. It is an equally effective measure of geomorphic characteristics of the river, without the subjectivity involved in estimating the effective discharge from a histogram. The dominant discharge is found by first dividing the total sediment transported over time by the number of days in that time period to obtain the tons of sediment transported per day. Then, that sediment discharge rate can be entered into the calculated sediment discharge rating curve to find the flow rate associated with that sediment discharge, which is defined as the dominant discharge. In addition to effective discharge rates, the dominant discharge rates were determined for each gaged and ungaged study site for Project operations for the study period (2003 to 2009) and are presented in Table E-33.

Table E-33. 2003 to 2009 Effective and Dominant Discharges for the Loup and Platte Rivers Study Sites

Site or USGS Gage Number	Site Description or Gage Name and Location	Qe	Qd
Site 1	Loup River Upstream of the Diversion Weir	2,300	2,500
Site 2	Loup River Downstream of the Diversion Weir	1,700	1,100
06793000	Loup River near Genoa, NE	1,700	1,200
06794500	Loup River at Columbus, NE	1,800	1,300
06774000	Platte River near Duncan, NE	900	1,200
Site 3	Platte River Upstream of the Tailrace Return	2,100	2,400
Site 4	Platte River Downstream of the Tailrace Return	3,600	3,900
06796000	Platte River at North Bend, NE	3,400	4,100
Site 5	Platte River near North Bend	3,500	3,650
06796500	Platte River at Leshara, NE	4,400	4,400
06801000	Platte River near Ashland, NE	7,300	6,400
06805500	Platte River at Louisville, NE	7,000	7,700

Note:
Qe = effective discharge; Qd = dominant discharge.

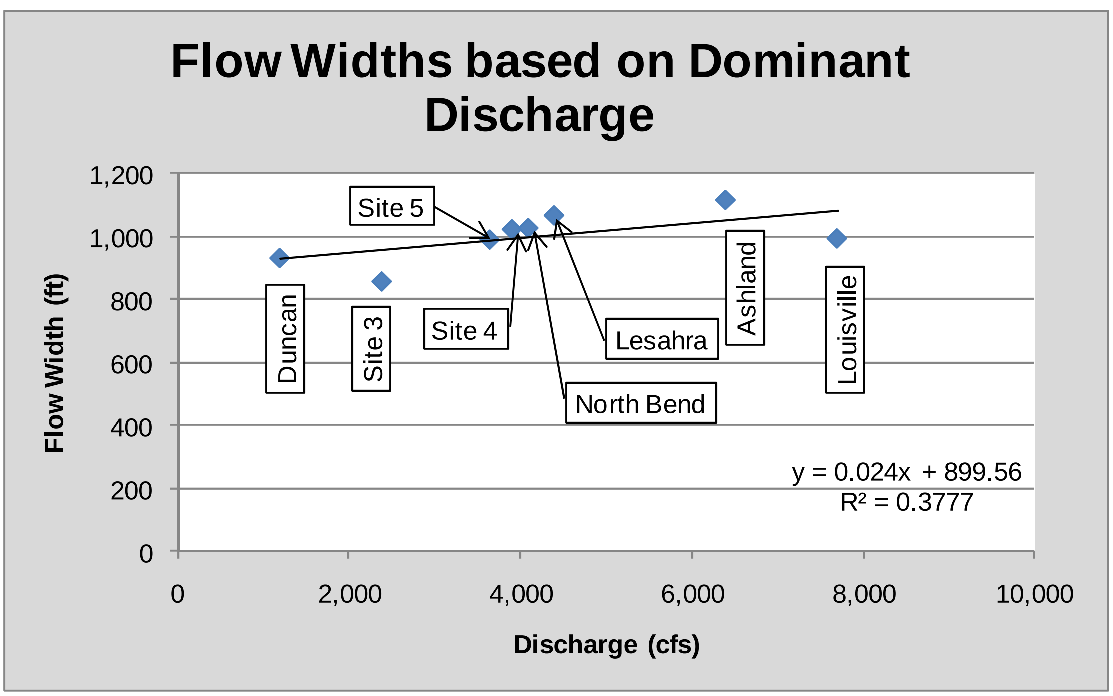
Hydraulic Geometry Relationships and Spatial Analyses

The characteristic channel morphology associated with the effective discharges was assessed according to the methodology described by Leopold and Maddock (1953) for the Loup and Platte rivers and by Karlinger et al. (1983) for the 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.

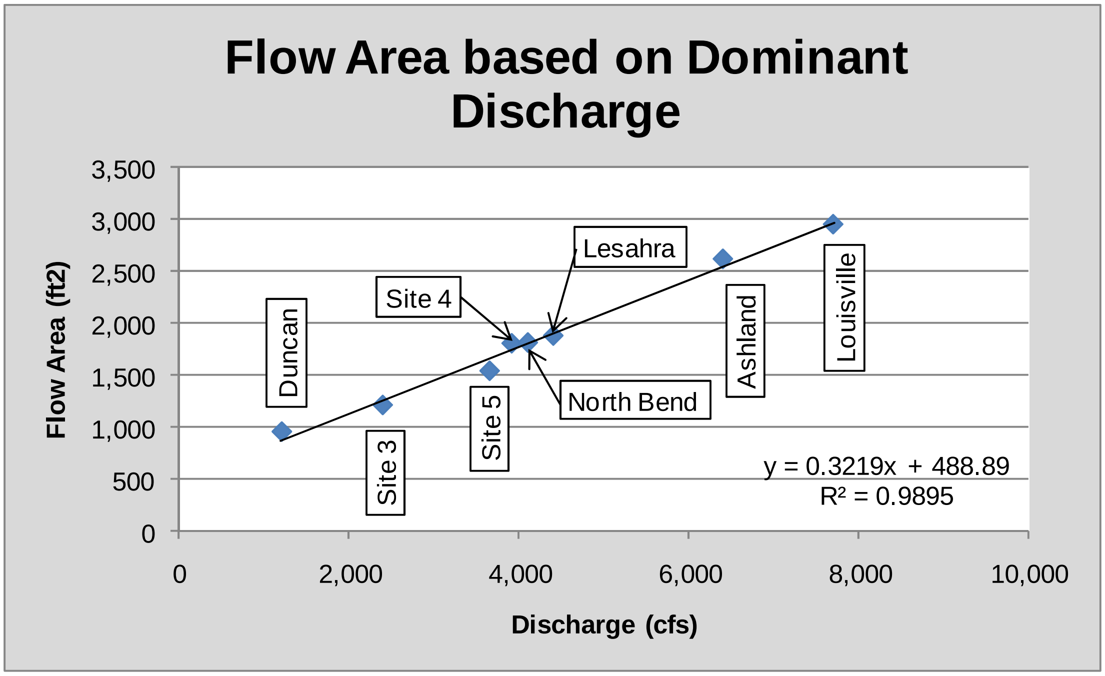
A spatial analysis was conducted to compare effective and dominant discharge with four channel geomorphologic characteristics—flow depth (D), mean velocity (V), flow width (W), and flow area (A)—on a paired-site basis, starting upstream and proceeding downstream in both the Loup River bypass reach and the Lower Platte River as detailed in the District's Updated Study Report, Study 1.0, Sedimentation. The four channel geomorphologic characteristics were defined by FERC in its June 10, 2011, "Determination on Requests for Modifications to the Loup River Hydroelectric Project Study Plan." The results are presented graphically in Appendix E-1, Figure E-14.

Kircher (1981) surmised that a relationship between effective (or dominant) discharge and channel width exists in the Platte River. Graph E-3 shows the relationship between channel width and dominant discharge rates for the eight study sites on the lower Platte River. The data points generally plot from left to right on the graph in geographic order, moving downstream, with minor exceptions at the three data points clustered around 3,500 cfs (Site 4, Site 5, and North Bend). Dominant discharge generally increases in the downstream direction from Duncan to Louisville, so the data points in Graph E-3 are in geographical order from left to right. If channel widths were not constrained in the lower Platte River, the trend lines developed by this method would "best" explain the average lower Platte River morphology. Sites 4 and 5, as well as the North Bend gage, are all relatively close together in Graphs E-3 and E-4. This is reasonable in that the hydrology between Sites 4 and 5 is similar. There are no large tributaries between the Tailrace Return and North Bend.

Graph E-4 shows that the relationship between flow area and dominant discharge is uniform and does not exhibit the anomalies at Site 3 or Ashland to Louisville described for the flow width relationship. Instead, a strong relationship, with high coefficients of linear regression, exists. As a result, the Project has no discernable impact on flow area due to the Tailrace return flows. Flow area is not substantially impacted by bank revetments while channel width is, so the apparent "narrowing" of channel width at Site 3, indicated by a slightly smaller width there than upstream or downstream, should not be attributed to Project impacts.



Graph E-3. Channel Width versus Dominant Discharges at all Eight Lower Platte River Study Sites based on 2003 to 2009 Actual or Synthetic Hydrographs



Graph E-4. Channel Area versus Dominant Discharges at all Eight Lower Platte River Study Sites based on 2003 to 2009 Actual or Synthetic Hydrographs

Regime Analysis

When combined with effective discharge calculations, a methodology known as "regime analysis" provides a potent method of assessing stability of, and impacts of alternative operations on river morphology (and habitat). In its assessment of Platte River channel morphology, USACE (July 1990) adopted a definition of "in regime" that is typical of standards of the industry. The definition adopted by USACE was that a river is in regime "when a balance exists between all of the variables that affect it, and there is no net change in the river conditions." However, USACE adds that regime is "a state of quasi-equilibrium in which there are fluctuations about a mean value for each of the variables, but there are no long-term changes in mean values." Finally, USACE adds, "It is a good indication that a river reach is in regime when there is no aggradation, degradation, or change in channel pattern" (USACE, July 1990).

Watson, Biedenharn, and Scott (July 1999) state that a stable river, "from a geomorphic perspective, is one that has adjusted its width, depth, and slope such that there is no significant aggradation or degradation of the stream bed or significant plan form changes (meandering to braided, etc) within the engineering time frame (generally less than about 50 years). By this definition, a stable river is not in a static condition, but rather is in a state of dynamic equilibrium where it is free to adjust laterally through bank erosion and bar building."

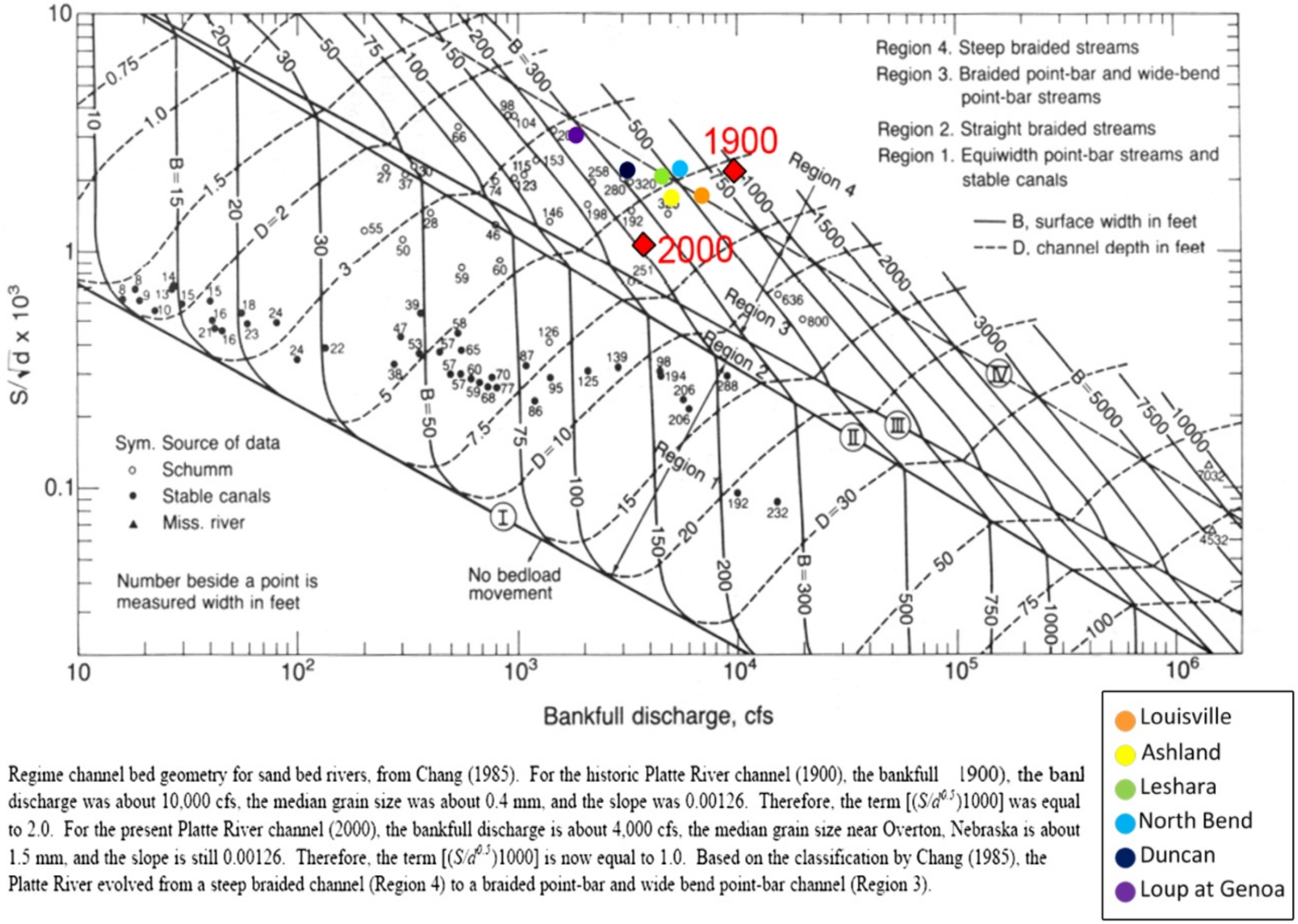
USBR tested three widely adopted regime diagrams (Chang, March 1985; Leopold and Wolman, 1957; Lane, 1957), showing that all three are applicable to assessing the stability of the braided Platte River morphology as well as to assessing impacts of alternative conditions in the Platte River. Even though the horizontal axes of the graphs are either "bankfull" or "mean" discharge, it is clear from the original source documents that the intent was that the user would input the channel-forming discharge.

As detailed in the District's Updated Study Report, Study 1.0, Sedimentation, the data points on Chang's graph (see Graph E-5) show that all six stations for this study are along the borderline between Chang's braided river Regions 4 and 3, with all locations being well-distanced from proximity to any threshold to a different morphology. The two dots labeled 1900 and 2000 were graphed by Chang at Overton, which is in the central Platte River and should be disregarded.

Although the data points for the six stations shown on Leopold and Wolman's graph (see Graph E-6) suggest that the Loup and Platte rivers have shifted from a braided stream over the threshold to a meandering morphology, their method does not incorporate grain size and does not include data from streams similar to the Platte River. USBR chose not use this graph to evaluate its 1900 and 2000 conditions for the central Platte River.

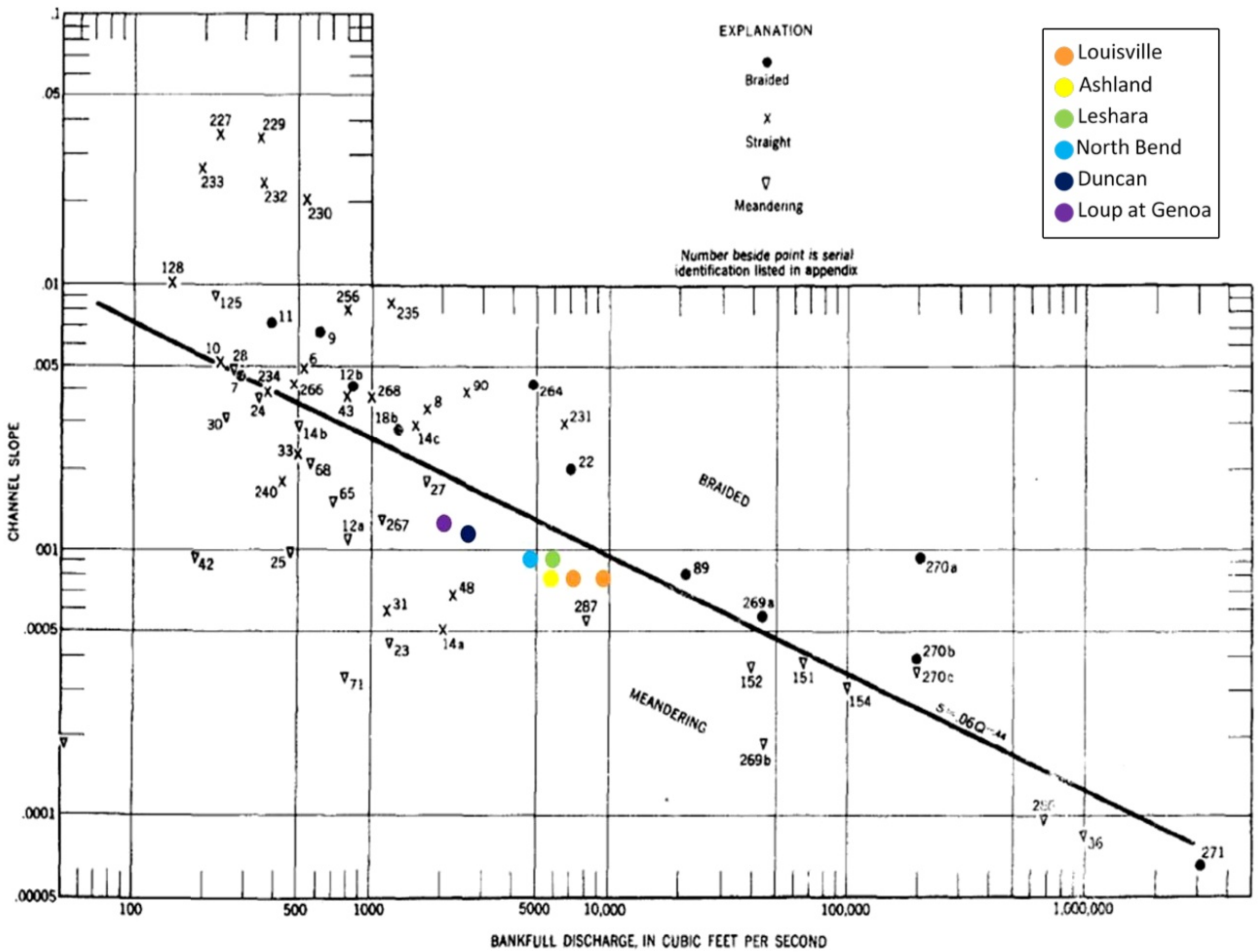
The data points on Lane's graph (see Graph E-7) lead to the same conclusion indicated by Chang's regime method. All graphed values are well-positioned away from any threshold to a different morphology.

This combined use of effective discharge and regime theory is state of the art and supports the consensus among investigators that the Loup and Platte rivers are in regime. Further, it is the best available technology for determining whether any changes, whether climatic or operational, could impact any river's morphology.



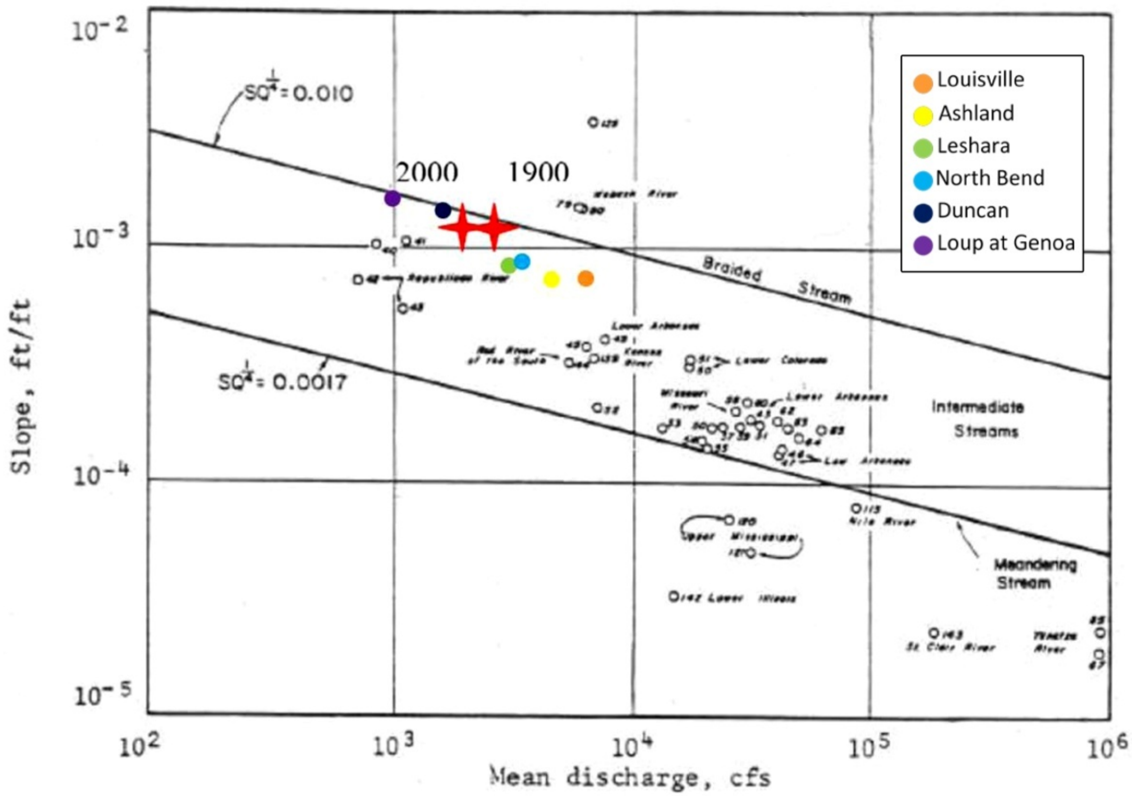
Regime channel bed geometry for sand bed rivers, from Chang (1985). For the historic Platte River channel (1900), the bankfull 1900), the banl discharge was about 10,000 cfs, the median grain size was about 0.4 mm, and the slope was 0.00126. Therefore, the term $[(S/d^{0.5})1000]$ was equal to 2.0. For the present Platte River channel (2000), the bankfull discharge is about 4,000 cfs, the median grain size near Overton, Nebraska is about 1.5 mm, and the slope is still 0.00126. Therefore, the term $[(S/d^{0.5})1000]$ is now equal to 1.0. Based on the classification by Chang (1985), the Platte River evolved from a steep braided channel (Region 4) to a braided point-bar and wide bend point-bar channel (Region 3).

Graph E-5. Chang's (March 1985) Regime Morphology Chart for Sand Bed Rivers with Results from the District's Study 1.0, Sedimentation



Values of slope and bankfull discharge for various natural channels and a line defining critical values which distinguish braided from meandering channels.

Graph E-6. Leopold and Wolman's (1957) Threshold Chart for Meandering and Braided Rivers with Results from the District's Study 1.0, Sedimentation



Lane's (1957) regime diagram for sandbed streams based on slope and mean discharge, taken from Richardson, et al. (1990). Red points shown are for the central Platte River with a slope of 0.0026 ft/ft and a mean discharge of 3,700 cfs for the year 1900, and a mean discharge of 2,100 cfs for the year 2000.

Graph E-7. Lane's (1957) Regime Morphology Chart for Sand Bed Rivers with Results from the District's Study 1.0, Sedimentation

Specific Gage Analysis

A specific gage analysis was performed using the Platte River gages near Duncan, North Bend, Ashland, and Louisville and on the Loup River at Genoa as detailed in the District's Updated Study Report, Study 1.0, Sedimentation. The mean daily discharge versus the stage was graphed for each year for each gage. A trend line was established by determining a best fit using a power equation (Stage = a x Flow^b). Specific rating curves were generated for each gage based on the stage versus discharge curves. Specific rating curves for all gages for a given discharge were also graphed.

The following trends and observations are noted at each gage location:

- Genoa gage – The trend is stable at flows between 500 and 10,000 cfs. For flows between 15,000 and 30,000 cfs, the data become insufficient to create meaningful trend lines.
- Duncan gage – The trend is stable for flows ranging between 500 and 5,000 cfs for the 13 years previous to 2009. However, at higher discharges (10,000 to 15,000 cfs), where there are fewer available data and the data are more unstable, the trend has shifted from degradational to aggradational.
- North Bend and Ashland gages – The stage trend has remained fairly stable, with aggradational and degradational trends less than 0.5 foot for discharges ranging between 500 and 30,000 cfs.
- Louisville gage – There trend is slightly degradational – less than 0.5 foot for the 20 years previous to 2009.

In a few instances, a temporary decline or increase occurred at a gage site. This is attributed to extrapolating the stage discharge curve for that given year. For example, in 2002, the maximum discharge at North Bend was approximately 8,000 cfs. Extrapolating the best fit line for discharges in excess of 10,000 cfs seemed to under-predict the corresponding stage.

Kendall Tau Analysis

While the above discussion of the specific gage analysis includes qualitative descriptions, in accordance with FERC's "Determination on Requests for Modifications to the Loup River Hydroelectric Project Study Plan" (December 20, 2010), a quantitative analysis was performed via a Kendall tau trend analysis for all of the gages analyzed via specific gage analysis as detailed in the District's Updated Study Report, Study 1.0, Sedimentation.. For each site and for each flow rate (500 to 30,000 cfs), where more than one data point was available, a Kendall tau trend was calculated. Using a p-value of 0.01 to test for significance, only two significant trends were identified from the Kendall Tau analysis:

- The North Bend gage had a slight negative trend for the 1,000 cfs flow rate but no statistically significant trend for any of the other flow rates.
- The Louisville gage had a slight negative trend for the 30,000 cfs flow rate but no statistically significant trend for any of the other flow rates.

The Kenadall Tau analysis identified statistically significant negative trends for specific flow rates at two gages; however, when reviewing the analysis as a whole, there are no consistent aggradational or degradational trends at any of the analyzed gages. Therefore, it is concluded that at all gages analyzed, there is no overall aggradational or degradational trend.

Cross Section Comparison

Cross sections for ungaged sites 3, 4 and 5 were surveyed in the spring and fall of 2010. A detailed description of the survey and survey dates is provided in the District's Updated Study Report, Study 2.0, Hydrocycling. The cross sections were plotted for each survey date as shown in the Updated Study Report, Study 2.0, Attachment A. The change in in-channel cross-section area between surveys was determined and is listed in Tables E-34 through E-36; overall changes for each site are listed in Table E-37. In general, the average in channel cross-sectional area decreased, suggesting that the reaches aggraded between surveys. Consistent with findings in the Lower Platte River Stage Change Study (HDR et al., December 2009), following high flow events, the channel typically becomes deeper generally consolidating flow into one deep channel. However, after sustained lower or normal flows, the channel begins to shallow, filling in the deeper channel, breaking down the high ground, with flow separating into several channels. This is consistent between Sites 3 and 4, upstream and downstream of the Tailrace Return, and Site 5, near North Bend.

For the same discharge, there was typically an increase in water surface elevation of approximately 0.4 foot between the early and late summer surveys.

Table E-34. Cross Sections for Site 3, Platte River Upstream of the Tailrace Return

Cross Section	Approximate Area (ft^2)			Change in Flow Area					
	May	August	September	May to August		August to September		May to September	
				(ft^2)	(%)	(ft^2)	(%)	(ft^2)	(%)
1	6,602	7,200	6,856	597	9%	-344	-5%	253	4%
2	8,505	8,488	8,166	-16	0%	-322	-4%	-338	-4%
3	5,974	5,269	5,139	-704	-12%	-130	-2%	-834	-14%
4	7,573	6,907	7,091	-665	-9%	183	3%	-482	-6%
5	5,259	5,260	4,515	1	0%	-745	-14%	-744	-14%
6	4,761	4,781	4,415	19	0%	-366	-8%	-346	-7%
7	4,983	5,011	4,729	27	1%	-282	-6%	-255	-5%
8	5,460	5,319	5,328	-141	-3%	9	0%	-132	-2%
9	6,689	6,825	6,534	136	2%	-291	-4%	-155	-2%

Table E-35. Cross Sections for Site 4, Platte River Downstream of the Tailrace Return

Cross Section	Approximate Area (ft^2)		Change in Flow Area	
	June	September	June to September	
			(ft^2)	(%)
1	6,497	6,585	88	1%
2	10,902	11,286	384	4%
3	7,039	6,676	-363	-5%
4	10,851	9,895	-957	-9%
5	6,522	6,060	-462	-7%
6	7,812	7,283	-529	-7%
7	7,433	6,809	-624	-8%
8	8,703	7,992	-711	-8%
9	9,034	8,491	-543	-6%
10	7,640	7,930	290	4%

Table E-36. Cross Sections for Site 5, Platte River near North Bend

Cross Section	Approximate Area (ft^2)		Change in Flow Area July to September	
	July	September	(ft^2)	(%)
1	8,343	7,914	-429	-5%
2	7,230	6,914	-316	-4%
3	6,471	6,643	172	3%
4	8,542	8,327	-215	-3%
5	7,250	7,149	-101	-1%
6	8,122	7,746	-376	-5%
7	7,331	7,055	-275	-4%
8	9,678	9,533	-144	-1%
9	6,999	6,597	-402	-6%

Table E-37. Overall Change in Channel Area at Each Ungaged Site

Location	No. of Cross Sections	Current Operations		
		Average Change[s] in Area	Max. Change in Area	Min. Change in Area
Site 3 – Upstream of the Tailrace Return	9	(6%)	4%	(14%)
Site 4 – Downstream of the Tailrace Return	10	(4%)	4%	(9%)
Site 5 – Near North Bend	9	(3%)	3%	(6%)

Note:

[a] The change in cross-sectional area was measured from the spring to the fall. A negative value, shown in parentheses, means that the cross-sectional area was smaller in the fall than in the spring. This suggests a shallower channel.

The change in cross sections at Site 4, consistent with the change in cross sections at Site 3, would indicate a general increase (or aggradation) of the channel bottom and a reduction in some of the bar heights between the June and September surveys. However, the macroforms in various cross sections that existed in June were still prevalent in September. The same can be said for the cross sections at Site 5, near North Bend.

Sedimentation Conclusions

The body of literature cited and the supplemental analyses at the gaged and ungaged sites detailed in the District's Updated Study Report, Study 1.0, Sedimentation, demonstrates that the Loup River bypass reach and the lower Platte River are in regime and are seated well within regime zones considered as braided streams. Further, the analyses and other supporting literature cited clearly indicate that both the Loup River bypass reach and the lower Platte River at all locations studied are clearly not supply limited, and not aggrading or degrading, with no indications of channel geometry characteristic (width and depth) changes over time.

Existing literature, including Platte River studies by USACE, USBR, and USGS; calculations of effective discharges; regime analysis; literature on the channels' profiles; and physical observations indicate that the Loup River bypass reach and the lower Platte River are not experiencing aggradation or degradation. Instead, these analyses, particularly the bed gradation studies by others and the effective discharge and regime analysis, clearly indicate that both the Loup and lower Platte rivers are well within parameters establishing them as dynamically stable, non-aggrading and non-degrading, braided rivers.

The District's Study 1.0, Sedimentation, including the collection and analysis of data at both gaged and ungaged sites, supports the conclusion that the sediment availability and yield throughout the study area by far exceed the capacity of the flow to transport sediment as well as greatly exceed the actual measured amounts of suspended sediment being transported. The results of the collection and analysis of data at both gaged and ungaged sites show that both the Loup River bypass reach and the lower Platte River at all locations studied are clearly not supply limited.

USACE (July 1990) came to the same conclusion. The supply of sediment throughout the Platte River Basin, including the Loup River Basin, is "virtually unlimited" and is significantly greater than both the Loup and Platte rivers' capacities to move the sediment. This means that the Loup River bypass reach and the lower Platte River can be considered to be in an equilibrium condition, with supplies in excess of transport capacity with no evidence of degradation in the channel. USACE noted that an excess of supply over transport capacity exists, as manifested by sand and gravel deposits along banks and in the stream as sand bars.

Effective discharge and other sediment transport and hydraulic geometry calculations, combined with river regime theory, clearly show that the channel geometries are "in regime" with the long-term flows shaping them. The current channel hydraulic geometries match the width, depth, and velocity calculations for flow rates matching the effective and dominant discharge rates. Nothing appears to be constraining either the Loup or the Platte River from maintaining the braided river hydraulic geometry associated with the effective discharges.

The spatial analysis shows that the morphologies and subsequent habitat, as measured by comparing the channel geomorphologic characteristics with effective and dominant discharge, is consistent with natural river processes. No identifiable Project impacts on the morphology occur at any individual study site or between any sets of two or more adjacent study sites.

The specific gage and associated Kendall Tau analysis for the USGS gages evaluated showed that there was no overall aggradational or degredational trend. In addition, the cross-section data at the ungaged sites reveal that the braided channel geometry of both rivers is not only widely diverse over a few hundred feet of length, but highly subject to dramatic changes over a few months' time. The cross sections both upstream and downstream of the Tailrace Return exhibited similar cross-section changes. Any measured or calculated adjustment in geometry cannot be readily attributed to any other cause than the natural dynamics of a braided river. The "body of evidence" at the gaged and ungaged sites demonstrate that the Loup River bypass reach and the lower Platte River are in regime and are seated well within zones considered as braided streams. In addition, the Loup River bypass reach and the lower Platte River at all locations are not supply limited, are in dynamic equilibrium, and show no indications of channel geometry characteristic (width and depth) changes over time.

Hydrocycling

As discussed in Section E.4.22, Project Operations, the Columbus Powerhouse is operated as a hydrocycling plant. Typically, power is generated for one, or sometimes two, periods of several hours during the day; the amount and duration of power production varies each day according to both electrical demand and available water. The accompanying opening and closing of turbine gates creates flow pulses in the Tailrace Canal that then translate 5.5 miles downstream and influence discharge into the Platte River at the Outlet Weir. To evaluate Project effects on the Platte River, the District conducted Study 2.0, Hydrocycling.

The goal of the hydrocycling study was to determine if Project hydrocycling operations benefit or adversely affect the habitat used by interior least terns, piping plovers, and pallid sturgeon in the lower Platte River. The physical effects of hydrocycling (current operations) were quantified and compared to an alternative condition (run-of-river operations). Run-of-river operations are defined as simulated conditions that would exist without regulation for hydrocycling.

The District conducted the following analyses to evaluate the impacts of Project hydrocycling (current operations) on various hydraulic parameters against alternative operations and their affect on channel morphology and habitat:

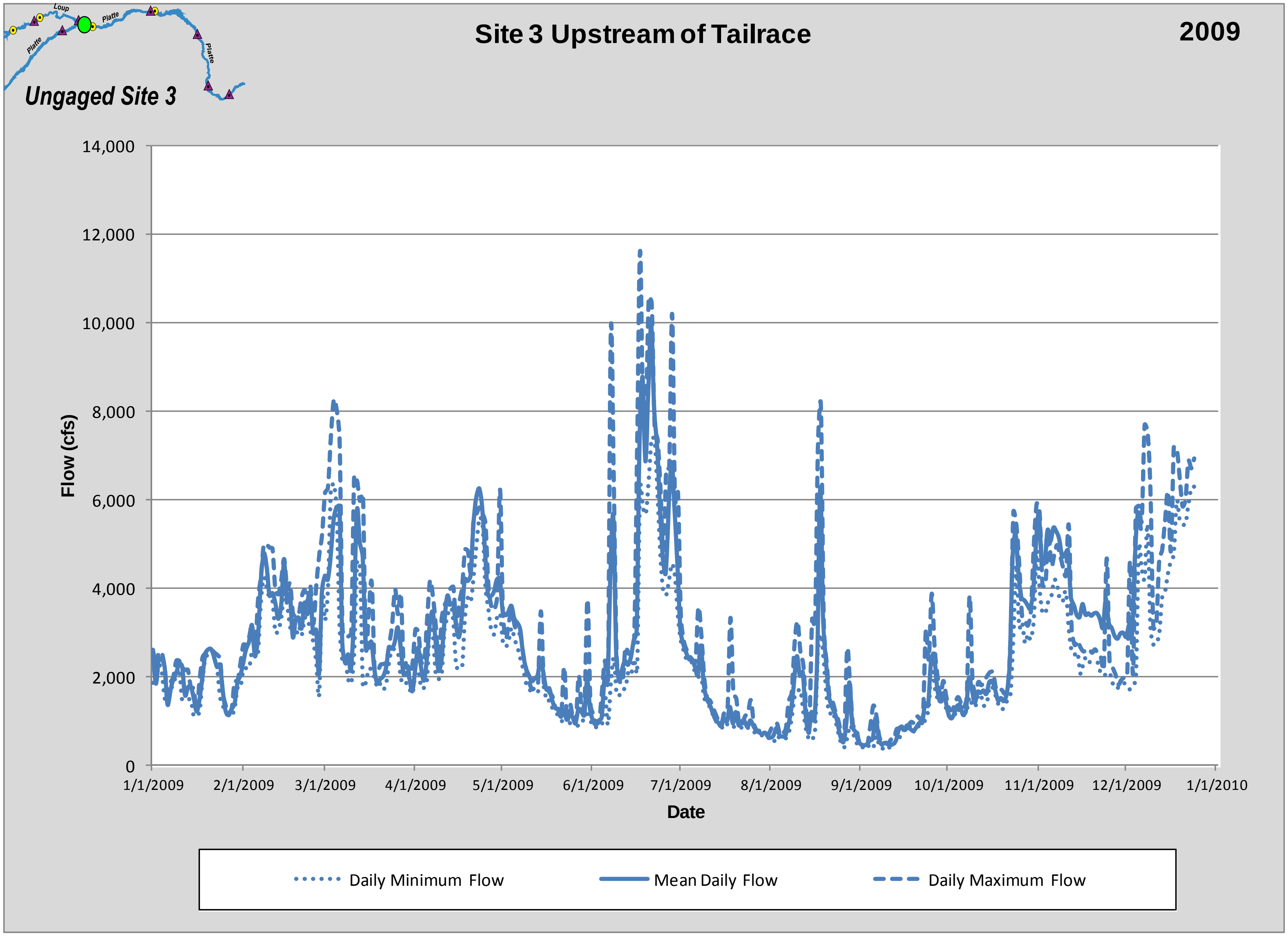
- River Stage Analysis
- Comparison of effective and dominant discharge for alternative operating scenarios
- HEC-RAS Sediment Transport Modeling

The following sections describe the results of these analyses.

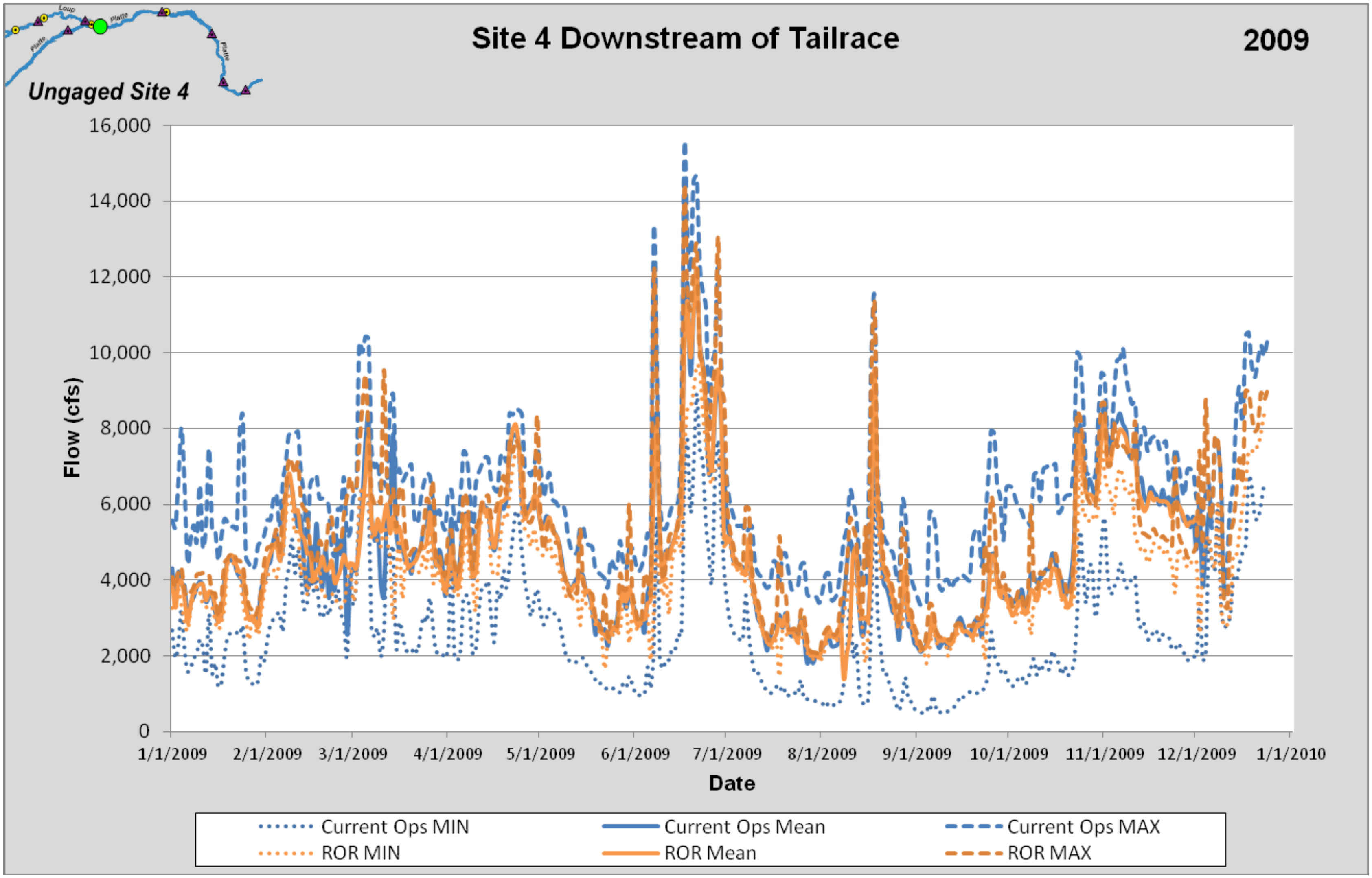
River Stage Analysis

As detailed in the District's Updated Study Report, Study 2.0, Hydrocycling, flows in a river are naturally variable throughout the year and the Platte River is no exception. Flows on the Platte River upstream of the Project Tailrace (Site 3) were evaluated to get an idea of the natural variability in flow that exists regardless of Project hydrocycling operations. Graph E-8 shows the Site 3 hydrograph for 2009. Hydrocycling operations result in changes in minimum and maximum daily flow as compared to non-hydrocycling (run-of-river) operations. Graph E-9 shows the Site 4 hydrograph for 2009. Visual inspection of the hydrographs shows the natural seasonal flow variability was equal to or greater than the daily flow variability during operations unaffected by storm events. For example, the daily variability at Site 4 for current operations between May 1 and May 15, 2009, was approximately 3,000 cfs (see Graph E-9). For the same time period, the flow under run-of-river operations decreased from 6,000 to 3,000 cfs, which is also a variability of 3,000 cfs.

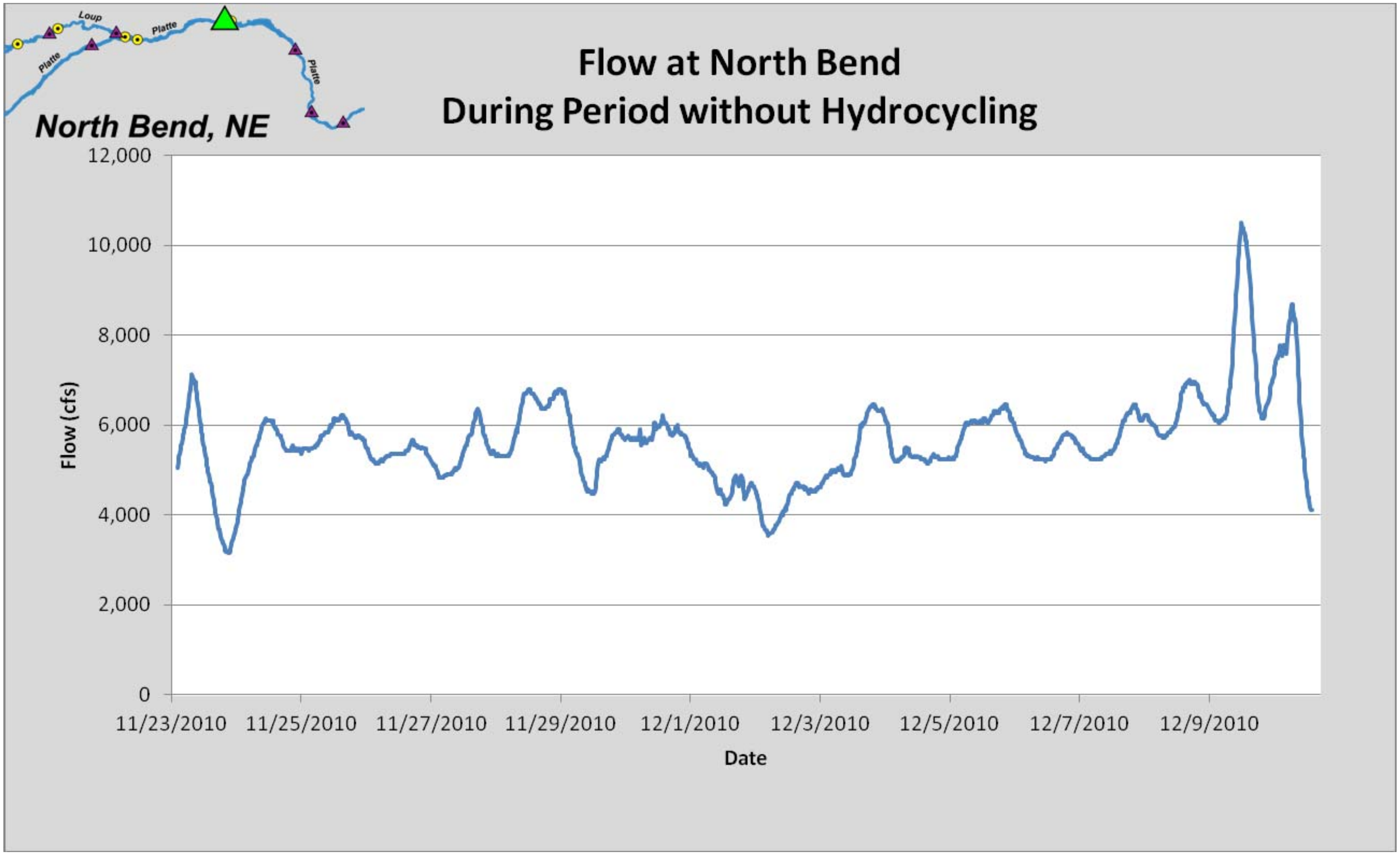
Additionally, Graph E-10 shows the hydrograph at North Bend during a period in 2010 when the Project was not in operation due to frazil ice conditions in the river (November 25 through December 11) . Flows during this time period exhibit a similar variability of 3,000 cfs.



Graph E-8. Daily Mean, Maximum, and Minimum Flows at Site 3 for Current and Run-of-River Operations



Graph E-9. Daily Mean, Maximum, and Minimum Flows at Site 4 for Current and Run-of-River Operations



Graph E-10. Flow at North Bend During a Period with No Hydrocycling

The magnitude of the differences in flow and stage resulting from hydrocycling was also evaluated by plotting flow and stage hydrographs and calculating the average annual differences in flow and stage (water surface elevation) at the following gaged and ungaged sites for wet, dry, and normal years for current operations as well as for the synthetic run-of-river operations (see the District's Updated Study Report, Study 2.0, Attachment E):

- Site 3 – Upstream of the Tailrace Return
- Site 4 – Downstream of the Tailrace Return
- Platte River at North Bend
- Platte River at Leshara
- Platte River near Ashland
- Platte River at Louisville

Table E-38 shows the flow and stage values for a normal year, the remaining years and the seasonal values can be found in the District's Updated Study Report, Study 2.0, Attachment E. As shown in Table E-38, the average annual flow and stage difference for a typical normal hydrologic year for current operations at Site 3, upstream of the Project Tailrace Return, is 840 cfs and 0.41 foot, respectively. The flow and stage differences are greater at Site 4, downstream of the Project Tailrace Return, at 3,750 cfs and 1.30 feet, respectively, due to hydrocycling. At North Bend, the difference in flow is similar but the difference in stage is reduced to 0.94 foot. As shown in Table E-38, the differences in stage are generally attenuated with distance from the Tailrace Return.

The natural variability of the water surface elevation (WSEL), as well as upstream influences, was also investigated. Graph E-11 shows WSEL at Site 4 for a normal hydrologic year. Visual inspection of the stage hydrograph shows daily fluctuations in WSEL. From Graph E-11, the natural variability from May 1 to May 21 was equal to or greater than the daily flow variability during operations unaffected by storm events.

Table E-38. 2009 (Normal) Average Annual Differences in Flow and Water Surface Elevation between Current and Run-of-River Operations

Location	Flow Difference (cfs)			Water Surface Elevation Difference (feet)		
	Current Operations Max - Min Difference[a]	Run-of-River Operations Max - Min Difference[a]	Current Operations Max - Run-of-River Max Difference[b]	Current Operations Max - Min Difference[c]	Run-of-River Operations Max - Min Difference[c]	Current Operations Max - Run-of-River Max Difference[d]
Site 3 – Upstream of the Tailrace Return	840	840	0	0.41	0.41	0.00
Site 4 – Downstream of the Tailrace Return	3,750	1,020	1,210	1.30	0.26	0.30
Platte River at North Bend	3,760	1,020	1,090	0.94	0.21	0.23
Platte River at Leshara	3,490	1,040	1,030	0.87	0.21	0.21
Platte River near Ashland	3,610	1,150	1,080	0.83	0.21	0.21
Platte River at Louisville	3,540	1,130	1,010	0.69	0.19	0.18

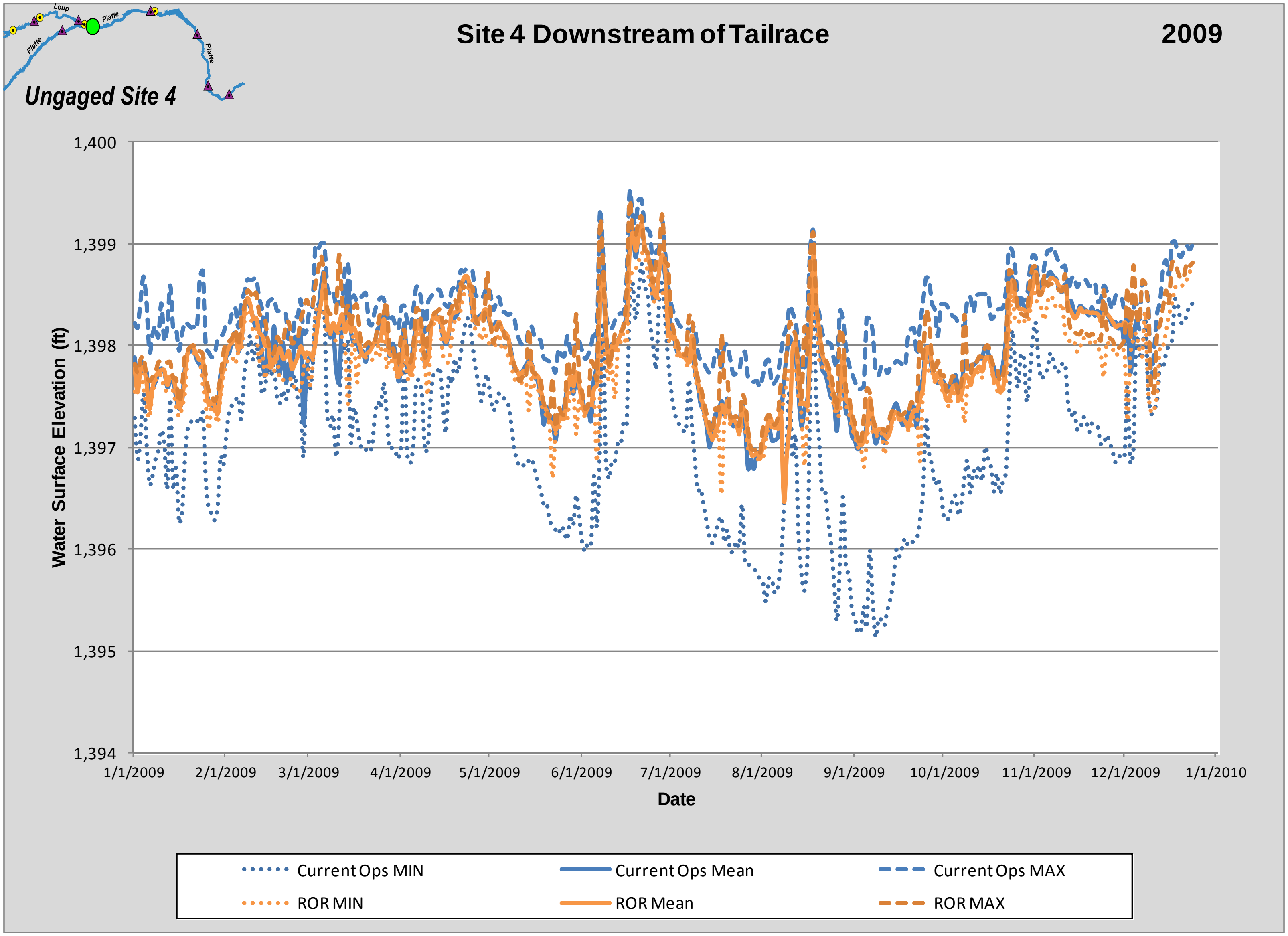
Notes:

[a] Calculated by taking the average of the difference between the daily maximum and minimum flow.

[b] Calculated by taking the average of the difference between the daily maximum current operations flow and run-of-river operations flow.

[c] Calculated by taking the average of the difference between the daily maximum and minimum gage height.

[d] Calculated by taking the average of the difference between the daily maximum current operations gage height and run-of-river operations gage height.



Graph E-11. Daily Mean, Maximum, and Minimum WSELs at Site 4 for Current and Run of River Operations

Comparison of Effective and Dominant Discharge for Alternative Operating Scenarios

The variable daily flows associated with hydrocycling have the potential to impact sediment transport compared to natural flows. To quantify this potential impact, the District determined effective and dominant discharges[16] and total sediment transported for Sites 3, 4, and 5 as well as the USGS gage at North Bend. The analysis assumed transport at capacity for current operations and run-of-river operations, and used sub-daily hydrographs as detailed in the District's Updated Study Report, Study 2.0, Hydrocycling. These calculations allowed evaluation of the daily fluctuations under current operations and under run-of-river operations. The time period evaluated was 2003 to 2009, which is the period during which the Tailrace Canal at Columbus gage (8th Street bridge) has been in operation (providing 15-minute incremental flow data).

The results show that the run-of-river operations would transport less sediment, assuming all sediment is transported at capacity. The effective discharges for current operations are larger than the effective discharges for run-of-river operations. The dominant discharges are only slightly larger for current operations, by about 100 cfs. These differences in dominant and effective discharges would likely result in the channel area being smaller under run-of-river operations.

Table E-39 reveals that the average 2003 to 2009 synthesized sub-daily values of all three of the sedimentation indicators at Site 4 (immediately downstream of the Tailrace and the location of highest interest in relation to the effects of hydrocycling) are equal or nearly equal (within 3 percent) to the values determined using daily synthesized flows. Both the effective discharge and total sediment transport values are essentially unchanged, but the dominant discharge is 100 cfs larger when using sub-daily values. Because the sediment rating curves are parabolic, calculated values of transport during 15-minute increments of each day when the flows exceeded the average daily values do not completely offset the reduced amounts of transport during portions of each day when the flows were below the average daily value. Although the difference is small, this is probably the cause of this small difference in dominant discharges at Site 4. These differences in dominant and effective discharges would likely result in the channel area being slightly smaller under run-of-river operations.

The effective discharge results were used in conjunction with Chang's and Lane's regime morphology graphs (see Section E.6.2.2) to determine if the minor changes in effective discharge associated with hydrocycling are affecting the Platte River's morphology. All of the effective discharge points plot well within braided river morphology zones, with none being near any threshold of transitioning to another morphology (graphs were presented in the District's Updated Study Report, Study 2.0, Figures 5-13 and 5-14).

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16 Effective and dominant discharge calculations were performed using the same methodology described in the Sedimentation Study.

Table E-39. Sediment Transport Indicator Results for Hydrocycling Analysis, 2003-2009

Location on the Platte River	Current Operations						Run-of-River Operations (Sub-daily)		
	Daily			Sub-daily					
	Q_d (cfs)	Q_e (cfs)	Sediment Capacity (1,000 tons)	Q_d (cfs)	Q_e (cfs)	Sediment Capacity (1,000 tons)	Q_d (cfs)	Q_e (cfs)	Sediment Capacity (1,000 tons)
Site 3 – Upstream of the Tailrace Return	2,400	2,100	1,040	2,400	2,400	1,040	2,400	2,400	1,040
Site 4 – Downstream of the Tailrace Return	3,900	3,600	2,440	4,000	3,800	2,530	3,900	3,400	2,440
USGS gage at North Bend	4,100	3,400	1,880	4,200	3,900	2,000	4,100	3,400	1,940
Site 5 – Near North Bend	3,600	3,200	2,030	3,800	3,900	2,120	3,700	3,400	2,080

Notes:

Q_d = dominant discharge; Q_e = effective discharge.

HEC-RAS Sediment Transport Modeling

A sediment transport analysis for ungaged Sites 3, 4, and 5 was conducted using the USACE HEC-RAS model (USACE, January 2010), as detailed in the District's Updated Study Report, Study 2.0, Hydrocycling. HEC-RAS version 4.1 includes a sediment transport module that performs mobile boundary, sediment transport modeling. According to the HEC-RAS Hydraulic Reference Manual, "Sediment transport modeling is notoriously difficult. The data utilized to predict bed change is fundamentally uncertain and the theory employed is empirical and highly sensitive to a wide array of physical variables. However, with good data, a skilled modeler can utilize a calibrated sediment model to predict regional, long term trends that can inform planning decisions and can be used to evaluate project alternatives" (USACE, January 2010). As such, only regional, long-term trends for current and alternative operations can be evaluated using this model.

Model Development

Based on the number of cross sections required to adequately model the study sites and the computer processing time necessary to execute a simulation, two sediment transport models were developed. One model included Sites 3 and 4 (upstream and downstream of the Tailrace Canal), and the other included Site 5 (approximately 29 miles downstream of the Tailrace Canal near the USGS North Bend gage. The study reach that includes Sites 3 and 4 encompasses 2.5 river miles (RMs) of the Loup River immediately upstream of the Platte River confluence, and the Platte River from RM 105 to RM 97. The upstream model limits were established so that sediment contributions from the Loup and Platte rivers could be incorporated into the model. The sediment transport model that includes Site 5 extends from RM 73.5 to RM 70.0.

Several sources were used to develop the HEC-RAS model:

- USACE developed model of the Loup River for the District's study of ice jam flooding on the Loup River. The model extends from just downstream of the Diversion Weir at the Headworks to approximately 1 mile downstream of the Platte River confluence.
- USACE updated Flood Insurance Study (FIS) model of the Platte River from the U.S. Highway 81 bridge in Columbus to the Missouri River confluence.
- District developed site-specific models for Sites 3, 4, and 5.
- Additional cross sections were interpolated within each model as necessary to provide consistent cross-section spacing for model stability.

HEC-RAS calculates sediment transport based on the computed hydraulics and bed-material gradation. Bed-material gradations for this analysis were developed from long-term USGS records for gages on the Loup River near Genoa and the Platte River near Duncan and at North Bend. The resulting gradations are described in the District's Updated Study Report, Study 1.0, Section 4.3.1.

According to the Missouri River Basin Commission (MRBC) Platte River Basin study (MRBC, September 1975) approximately 700,000 tons per year of sediment are transported down the Loup Power Canal, of which 350,000 tons per year are returned to the Platte River at the Tailrace Return. In order to evaluate the worst case degradation scenario at Site 4, it was assumed in the model that the Tailrace Return flows did not contain any sediment load. Therefore, the model computed the sediment transport load for Site 4 based on the flow and sediment load from Site 3, the additional Tailrace Return flows, and the channel hydraulics and bed gradation at Site 4. However, the District believes that the Tailrace Return does have a sediment load.

As previously stated, the sediment transport module within HEC-RAS can be used to evaluate regional, long-term trends. A long (multi-year) simulation time period is recommended because the model requires sufficient time to "warm up." For purposes of this hydrocycling study, a 3-year warm-up period was incorporated using the computed dominant discharges. To evaluate current operations, typical wet, dry, or normal years were incorporated at the end of the simulation for both operating scenarios. For example, the long-term simulation for current operations consisted of a 3-year warm-up period using the dominant discharges; the 16-year long-term hydrologic record consisting of wet, dry, and normal years (1990 to 2005); and one real-time wet, dry, or normal year, for a total simulation of 20 years.

The number of flow ordinates in a model is limited to approximately 30,000 due to internal limitations of the HEC-RAS program. For example, mean daily flows for 1 year constitute 365 ordinates. However, 15-minute flow data for 1 year would require 35,040 ordinates. For this model, daily flow values were entered for the warm-up period and from 1990 to 2005. The final year of the simulation, which evaluates current operations or run-of-river operations, used real-time data in 30-minute increments (17,520 ordinates). The 20-year simulation was required for model stability to allow the channel to respond to various flow regimes and then respond to a real-time operating scenario. In addition, it provided sufficient time to evaluate model response as compared to historic gage data.

Model Calibration/Validation

The sediment transport model that included Site 5 was calibrated using long-term USGS measurements at the North Bend gage and 2010 USGS bed material measurements (Schaepe and Alexander, 2011). Model inputs and computational tolerances including time step, cross-section spacing, and ineffective flow areas were adjusted until model stability was achieved and the modeled mean channel invert trend matched the historic gage trend at North Bend. In addition, the modeled sediment transport rate was compared to the measured suspended sediment samples at the North Bend gage. Finally, a comparison was made between the gradation of sediment in transport computed by the model versus measurements taken by USGS. All tolerances and inputs are well within acceptable limits for hydraulic and sediment transport modeling, in accordance with the HEC-RAS Hydraulic Reference Manual (USACE, January 2010).

Because there is no gage information at Sites 3 and 4, existing data upstream of Sites 3 and 4, as well as survey data collected as part of this hydrocycling study and gradation data collected by USGS in 2010 (Schaepe and Alexander, 2011), was used to qualitatively assess the model's performance. The historic stage trends of the gages on the Loup River near Genoa and the Platte River near Duncan were compared to the modeled trends for the Loup and Platte reaches upstream of the confluence. The channel's response to high flows was also evaluated. In addition, the modeled mean channel invert elevation change was compared to the field survey results at Sites 3 and 4. Finally, the gradation of sediment in transport computed by the model versus 2010 measurements taken by USGS were compared.

The modeled mean channel invert elevation at North Bend over the simulation period reveals a similar trend to the measured trend, which is a stable channel. Several comparisons were made between modeled and measured data to qualitatively assess the model at Sites 3, 4, and 5. Modeled Loup and Platte river trends upstream of the confluence were compared to the historic trends at the USGS gages on the Loup River near Genoa and the Platte River near Duncan. In addition, the trend between the surveyed cross sections in Sites 3 and 4, were compared to the modeled trend. Finally, the modeled sediment transport gradation on the Loup and Platte rivers upstream of the confluence and on the Platte River downstream of the confluence was compared to the 2010 measured gradation (Schaepe and Alexander, 2011). The results of the qualitative analysis are presented the District's Updated Study Report, Study 2.0, Section 5.4.5.

Detailed discussion of model development and calibration/validation is included in the District's Updated Study Report, Study 1.0, Section 4.3.1.

Results of the HEC-RAS sediment transport modeling were mixed. As discussed below, at Site 4, the operating scenario that transported the most sediment was dependent on the flow classification; whereas, at Site 5, the operating scenario that transported the most sediment was consistent across flow classifications.

Comparing the mean channel invert elevation for current operations to run-of-river operations at Site 4 showed differing results for different hydrologic flow classifications as noted below:

- During a normal year, there is essentially no change in sediment transport between operating scenarios.
- During a dry year, there is more sediment transported for current operations than for run-of-river operations.
- During a wet year, there is less sediment transported for current operations than for run-of-river operations.

An increase or decrease in sediment transport should not be interpreted as aggradation or degradation, especially in a system that has been shown historically to be flow limited and not supply limited. Because transport in the analysis occurs at capacity in all cases, and because the river is not supply limited at Site 4, no degradation occurs under current operations. Complete discussion of these results is presented in the District's Updated Study Report, Study 2.0, Hydrocycling.

At Site 4, the model trended between aggradational and degradational, and ultimately showed a stable condition, suggests that the Tailrace Return flows do not have a negative effect on the sediment transport or the channel being in dynamic equilibrium. It suggests that the increased flows in the channel downstream of the Tailrace Return have been balanced by the inflowing sediment from Site 3 and the change in channel hydraulic characteristics between Sites 3 and 4.

Comparing the mean channel invert elevation for current operations to run-of-river operations at Site 5 showed that less sediment is transported during run-of-river operations than during current operations for all flow classifications. Again, because transport occurs at capacity in both cases, and because the river is not supply limited at Site 5, no degradation occurs under current operations. These results are consistent with the analysis of effective and dominant discharge that indicated that current operations transport slightly more sediment than run-of-river operations. As was noted in relation to the effective discharge analysis, an increase or decrease in sediment transport should not be interpreted as aggradation or degradation, especially in a system that has been shown historically to be flow limited and not supply limited. Complete discussion of these results is presented in the District's Updated Study Report, Study 2.0, Hydrocycling.

Hydrocycling Conclusions

The analysis of Project hydrocycling provides the following conclusions:

- Stage fluctuations due to hydrocycling are greatest immediately downstream of the Tailrace Canal and are attenuated with distance from the Tailrace Canal.
- The average daily change in WSEL is 1.30 ft for the current operating condition for a normal hydrologic year. Also for a normal hydrologic year, the average daily change in WSEL is 0.26 ft for a run of river operating condition. Therefore, the difference between the average daily change in water surface elevation between current and run of river operations is approximately 1 ft for a normal hydrologic year. However, this current operations daily WSEL fluctuation is similar to the fluctuation that typically occurs over a two-week period under run-of-river conditions for a normal hydrologic year.
- Effective and dominant discharge analyses identified that hydrocycling results in transport of slightly more sediment than under run-of-river operations; however, this slight increase in transport would only negligibly affect Platte River channel geometry (width, depth). Increased sediment transport resulting from hydrocycling does not result in aggradation or degradation of the Platte River channel. Additionally, the channel is considered well-seated within the braided river morphology under either run-of-river or hydrocycling operations.
- The results of the HEC-RAS sediment transport modeling show that under each operating scenario, the system is transporting sediment at capacity. Because the system is flow limited and not supply limited, no aggradation degradation occurs under current operations.
- HEC-RAS analysis of sediment transport and channel aggradation/degradation provide essentially the same conclusions as the other sediment transport analyses in the District's Updated Study Report, Study 1.0, Sedimentation, regarding sediment transport, channel geometry, and aggradation/degradation.

Flow Depletion and Flow Diversion

The goals of the flow depletion and flow diversion study were to determine if Project operations result in flow depletion on the lower Platte River and to what extent the magnitude, frequency, duration, and timing of flows affect the Loup River bypass reach. The results were used to determine if Project operations (current operations) relative to flow depletion and flow diversion adversely affect the habitat used by interior least tern and piping plover populations, the fisheries, and the riverine habitat in the Loup River bypass reach and the lower Platte River compared to an alternative condition (the no diversion condition[17]).

The District conducted the following analyses:

- Flow Trends
- Consumptive Use for Current Operations and No Diversion
- River Stage Differences
- Sedimentation Analysis

Flow Trends

Historic flow records and long-term streamflow studies by other investigators as well as additional analyses by the District were combined to determine the general flow trend (increasing, decreasing, or relatively constant) in the Loup and Platte rivers.

USGS gages on the Loup River near Genoa and at Columbus and USGS gages on the Platte River near Duncan, at North Bend, and at Louisville were evaluated. Two USGS reports (Ginting, Zelt, and Linard, 2008; Dietsch, Godberson, and Steele, 2009) were used to assess long-term flow changes in the Platte River along with the District's evaluation of the 25-year trend from 1985 to 2009 (detailed results of the District's analysis are provided in the Updated Study Report, Study 1.0, Sedimentation). This information was used as the baseline to evaluate Project-related effects.

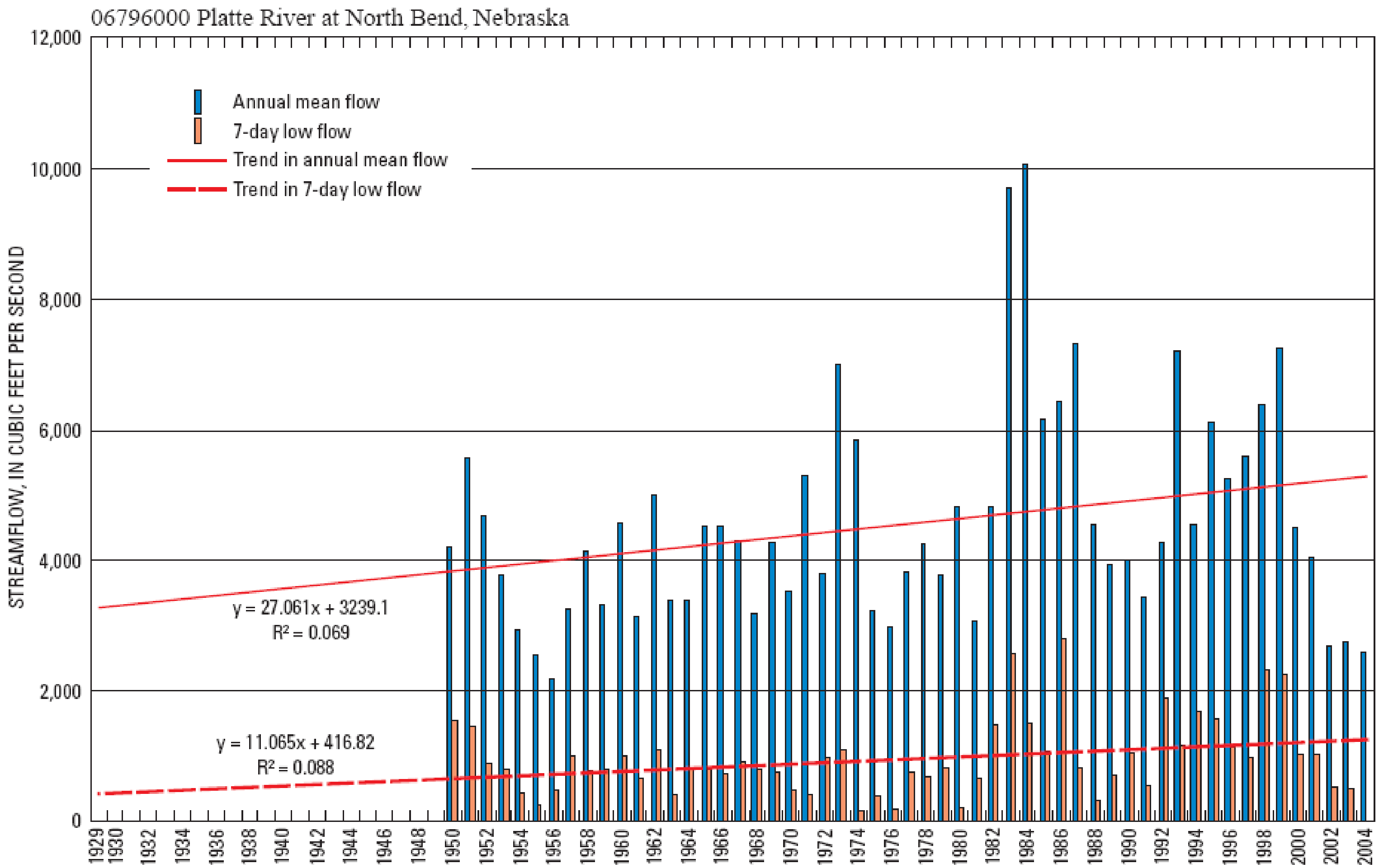
The most comprehensive recent study regarding historic flow trends since Project inception, is provided by Dietsch, Godberson, and Steele (2009). Their analysis of streamflow records from 1928 through 2004 in the Platte River Basin revealed the existence of "significant positive temporal trends" in annual flow for the period of record for the Platte River near Duncan, at North Bend, and at Louisville.

[17] No diversion was defined as no water being diverted into the Project but does not represent a case of Project decommissioning.

An example of their results for the North Bend gage is shown in Graph E-12. Similar, relatively steep upward trends in both the mean annual flows and 7-day low flows were discovered near Duncan and at Louisville as well as at a number of other gages on other tributary streams (Dietsch, Godberson, and Steele, 2009). The sharp decline in flows since around 2000 is evident at all three gages. In relation to the Project, the Duncan and North Bend gage locations bracket the Loup River confluence (as well as the Project), revealing that no declines in streamflow have occurred in the Platte River above or below the confluence since Project inception. The dry period starting around 2000 is the second lowest on record at North Bend.

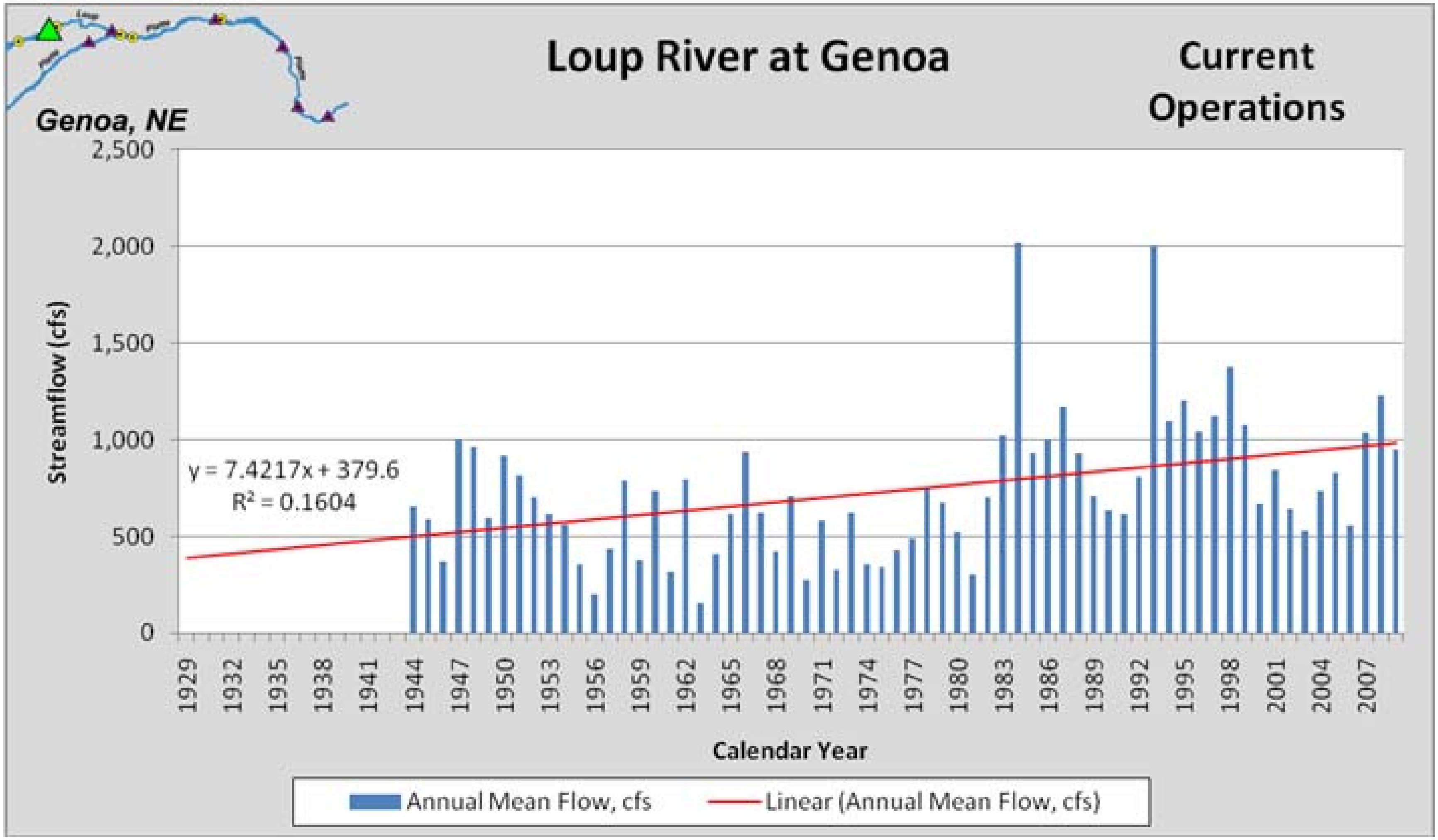
Both the fluctuations in annual flows as well as the positive trends are largely related to climate. In an earlier USGS study (Ginting, Zelt, and Linard, 2008) the authors compiled, analyzed, and summarized hydrologic information from long-term gage stations on the lower Platte River to determine any significant temporal differences among six discrete periods during 1895 to 2006 and to interpret any significant changes in relation to changes in climatic conditions or other factors. The study included the most downstream station within the central Platte River segment that flowed to the confluence with the Loup River and all four active streamflow gage stations (2006) on the lower Platte River mainstem extending from the confluence of the Loup River and Platte River to the confluence of the Platte River and Missouri River.

Neither of the USGS studies cited above evaluated Loup River trends. To assess whether the data for the Loup River near Genoa gage would demonstrate similar trends, annual mean flow data were compiled and are plotted in Graph E-13, which provided a similar positive temporal trend. Insufficient data were available at the Loup River at Columbus gage to establish trends.



Source: Dietsch, Benjamin J., Julie A. Godberson, and Gregory V. Steele, 2009, "Trends in Streamflow Characteristics of Selected Sites in the Elkhorn River, Salt Creek, and Lower Platte River Basins, Eastern Nebraska, 1928–2004, and Evaluation of Streamflows in Relation to Instream-Flow Criteria, 1953–2004," USGS Scientific Investigations Report 2009-5011, available online at http://pubs.usgs.gov/sir/2009/5011/pdf/SIR2009-5011.pdf, Appendix 2, Figure 2-2.

Graph E-12. USGS Graph of Annual Mean Flow, 7-day Low Flow, Trend in Annual Mean Flow, and Trend in 7-day Low Flow of the Platte River at North Bend



Graph E-13. District's Graph of Annual Mean Flow and Trend in Annual Mean Flow for the Loup River at Genoa

Consumptive Use for Current Operations and No Diversion

Consumptive uses, based on evaporation and evapotranspiration, were evaluated for both current operations and the no diversion condition. Evaporation losses were determined by calculating the area of open water under current operations and the no diversion condition and multiplying by the appropriate pan evaporation rate found in National Weather Service data. Both open-water evaporation and riparian vegetation evapotranspiration (ET) losses were determined using methodology developed and used by USFWS.

Analysis of the no diversion condition assumed that the Loup Power Canal and associated regulating reservoirs, though not operating, would continue to store water, and thus result in consumptive losses. Much of that water would come from riparian aquifers as the groundwater mound created over more than 80 years of operation would likely maintain open water in the canal and reservoirs. The water in the canal and reservoirs would continue to support the adjacent bands of riparian vegetation; thus open-water evaporation and ET losses would continue as well. Losses due to channel evaporation would increase in the Loup River bypass reach under the no diversion condition because of wider top widths of open water associated with higher daily discharges.

The consumptive loss analysis, summarized in Table E-40, shows that flow depletions under current operations are less than would occur under the no diversion condition. This is largely due to the reduction in open water area in the bypass reach under current operations.

An additional analysis for the no diversion condition was conducted assuming that the regulating reservoirs would contain no water. This provides a lower-end bracket for the no diversion condition consumptive use. The results, provided in Table E-41, show that flow depletions due to consumptive use are lower for current operations than for the no diversion condition without regulating reservoirs.

Consumptive use of irrigation water withdrawn from the Loup Power Canal was calculated per FERC's Study Plan Determination (August 26, 2009). It was determined that 71 percent of applied irrigation water is lost to consumptive uses. However, since irrigation withdrawals from the canal would continue under a no diversion condition, these losses were considered to be the same for both current operations and the no diversion condition and are not included in Tables E-40 and E-41.

Table E-40. Summary of Consumptive Losses for Wet, Dry, and Normal Years With Regulating Reservoirs

		Current Operations	No Diversion Condition
Normal Year – 2005			
Loup Power Canal	Total Mean Open Water Evaporation (acre-feet [AF])	6,030	5,400
	Total Mean ET (AF)	870	870
	Total Consumptive Loss	6,900	6,270
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	9,070	16,150
	Total Mean ET (AF)	2,110	2,110
	Total Consumptive Loss	11,180	18,260
	Total Depletion	18,080	24,530
Dry Year – 2006			
Loup Power Canal	Total Mean Open Water Evaporation (AF)	6,010	5,380
	Total Mean ET (AF)	870	870
	Total Consumptive Loss	6,880	6,250
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	6,530	13,860
	Total Mean ET (AF)	2,100	2,100
	Total Consumptive Loss	8,630	15,960
	Total Depletion	15,510	22,210
Wet Year – 2008			
Loup Power Canal	Total Mean Open Water Evaporation (AF)	5,670	5,080
	Total Mean ET (AF)	810	810
	Total Consumptive Loss	6,480	5,890
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	10,440	17,650
	Total Mean ET (AF)	1,960	1,960
	Total Consumptive Loss	12,400	19,610
	Total Depletion	18,880	25,500

Table E-41. Summary of Consumptive Losses for Wet, Dry, and Normal Years Without Regulating Reservoirs

		Current Operations	No Diversion Condition
Normal Year – 2005			
Loup Power Canal	Total Mean Open Water Evaporation (AF)	6,030	1,090
	Total Mean ET (AF)	870	870
	Total Consumptive Loss	6,900	1,960
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	9,070	16,150
	Total Mean ET (AF)	2,110	2,110
	Total Consumptive Loss	11,180	18,260
	Total Depletion	18,080	20,220
Dry Year – 2006			
Loup Power Canal	Total Mean Evaporation (AF)	6,010	1,090
	Total Mean ET (AF)	870	870
	Total Consumptive Loss	6,880	1,960
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	6,530	13,860
	Total Mean ET (AF)	2,100	2,100
	Total Consumptive Loss	8,630	15,960
	Total Depletion	15,510	17,920
Wet Year – 2008			
Loup Power Canal	Total Mean Evaporation (AF)	5,670	1,030
	Total Mean ET (AF)	810	810
	Total Consumptive Loss	6,480	1,840
Loup River Bypass Reach	Total Mean Open Water Evaporation (AF)	10,440	17,650
	Total Mean ET (AF)	1,960	1,960
	Total Consumptive Loss	12,400	19,610
	Total Depletion	18,880	21,450

Consumptive use of water released via the Lost Creek Siphon was also evaluated as a consumptive use based on concerns raised by resource agencies. This analysis determined that water released to Lost Creek via the Lost Creek Siphon is essentially equal to flow entering the Tailrace Canal via the USACE Lost Creek Flood Control Channel. Therefore, no consumptive use of Lost Creek flows occurs relative to Project operations.

The consumptive loss analysis shows that flow depletions under current operations are less than would occur under the no diversion condition (with or without the existing regulating reservoirs). Therefore, it is concluded that Project operations do not adversely impact fisheries and aquatic habitat in the lower Platte River relative to flow depletions.

Details of the consumptive loss analysis are provided in the District's Updated Study Report, Study 5.0, Flow Depletion and Flow Diversion.

River Stage Differences

The stage in the Loup River bypass reach at Genoa and Columbus was evaluated using current and historic USGS rating curves and the flow duration relationships. The stage for current operations was calculated for the 25 (high-flow), 50 (medium-flow), and 75 (low-flow) percent exceedance flows for a typical wet, dry, and normal year. The results for the USGS stations at Genoa and Columbus are found in Tables E-42 and E-43.

The increase in flow in the Loup River bypass reach between current operations and the simulated no diversion condition results in an increase in stage, which is to be expected. In general, the magnitude of the stage change decreases for higher flows due to flattening of the rating curves. In addition, both the flow and associated stage change are greater under a dry year classification than a wet year classification.

As an example, for the Loup River near Genoa median discharge (50^{th} percentile) for a normal year (2005) increased from 573 cfs under current operations to 2,288 cfs under the no diversion condition. As expected, this results in an increase in stage, amounting in this case to 1.18 feet.

As a similar example, Table E-43 shows that the Loup River at Columbus median discharge for a normal year (2005) increased from 745 cfs under current operations to 2,456 cfs under the no diversion condition. This results in an increase in stage of 1.02 feet. Similar increases in flow rates and stages occur for other percentiles and flow classifications.

Table E-42. Loup River Stage (Loup River near Genoa Gage)

Year	Flow Classification	Operation	Percent Exceedance	Flow	Gage Height	Water Surface Elevation
2005	Normal	Current Operations	25	1,110	5.95	1,546.76
2005	Normal	Current Operations	50	573	5.42	1,546.23
2005	Normal	Current Operations	75	112	4.29	1,545.10
2006	Dry	Current Operations	25	794	5.68	1,546.49
2006	Dry	Current Operations	50	153	4.49	1,545.30
2006	Dry	Current Operations	75	47	3.79	1,544.60
2008	Wet	Current Operations	25	1,540	6.24	1,547.05
2008	Wet	Current Operations	50	642	5.51	1,546.32
2008	Wet	Current Operations	75	173	4.57	1,545.38
2005	Normal	No Diversion Condition	25	2,713	6.76	1,547.57
2005	Normal	No Diversion Condition	50	2,288	6.60	1,547.41
2005	Normal	No Diversion Condition	75	1,824	6.39	1,547.20
2006	Dry	No Diversion Condition	25	2,510	6.69	1,547.50
2006	Dry	No Diversion Condition	50	2,080	6.51	1,547.32
2006	Dry	No Diversion Condition	75	1,251	6.06	1,546.87
2008	Wet	No Diversion Condition	25	3,251	6.94	1,547.75
2008	Wet	No Diversion Condition	50	2,487	6.68	1,547.49
2008	Wet	No Diversion Condition	75	1,935	6.45	1,547.26

Table E-43. Loup River Stage (Loup River at Columbus Gage)

Year	Flow Classification	Operation	Percent Exceedance	Flow	Gage Height	Water Surface Elevation
2005	Normal	Current Operations	25	1,354	4.54	1,433.43
2005	Normal	Current Operations	50	745	4.05	1,432.95
2005	Normal	Current Operations	75	251	3.31	1,432.20
2006	Dry	Current Operations	25	943	4.25	1,433.14
2006	Dry	Current Operations	50	320	3.46	1,432.35
2006	Dry	Current Operations	75	197	3.16	1,432.05
2008	Wet	Current Operations	25	1,741	4.75	1,433.64
2008	Wet	Current Operations	50	892	4.19	1,433.08
2008	Wet	Current Operations	75	426	3.65	1,432.54
2005	Normal	No Diversion Condition	25	2,952	5.25	1,434.14
2005	Normal	No Diversion Condition	50	2,456	5.07	1,433.96
2005	Normal	No Diversion Condition	75	1,946	4.85	1,433.74
2006	Dry	No Diversion Condition	25	2,708	5.16	1,434.05
2006	Dry	No Diversion Condition	50	2,235	4.98	1,433.87
2006	Dry	No Diversion Condition	75	1,435	4.58	1,433.47
2008	Wet	No Diversion Condition	25	3,482	5.41	1,434.30
2008	Wet	No Diversion Condition	50	2,732	5.17	1,434.06
2008	Wet	No Diversion Condition	75	2,156	4.95	1,433.84

Sedimentation Analysis related to Differences between Current Operations and No Diversion

To assess the effects of flow diversion on sediment transport in the Loup River bypass reach, sediment transport indicators were determined for wet, dry, and normal years for both current operations and the no diversion condition. The methods applied were consistent with the methodology outlines in the District's Updated Study Report, Study 1.0, Sedimentation.

Effective and dominant discharges and total sediment transport for current operations at the gaged and ungaged sites were developed as part of the sedimentation analysis discussed above. Effective discharges for the no diversion hydrology were derived from the daily transport rates. Dominant discharges and total sediment transport for the no diversion condition were calculated using identical methods described in the District's Updated Study Report, Study 1.0, Sedimentation.

The average values of the sediment transport indicators for the study period from 2003 to 2009 are shown in Table E-44. Under a no diversion condition, the effective and dominant discharges for Sites 1 and 2 (upstream and downstream of the Diversion Weir), are relatively unchanged. This indicates that under a no diversion condition, the surveyed channel geometries and associated sediment transport characteristics downstream of the Diversion Weir would be similar to those upstream of the Diversion Weir. Calculation of channel width and depth using the no diversion effective and dominant discharges reveals that the values of both parameters would be larger under a no diversion condition than under current operations. It is important to note that for the effective and dominant discharges (and associated channel geometry characteristics) to be essentially equal upstream and downstream of the diversion weir, these reaches would have to be subjected to nearly identical flows for a period of many years.

For current operations, reductions in effective end dominant discharge downstream of the Diversion Weir are consistent with diversions averaging 1,600 cfs, which is about equal to the difference in dominant discharge between Sites 1 and 2 for current operations.

Table E-44. Sediment Transport Indicator Results for Flow Depletion and Flow Diversion Analysis, 2003-2009

Location on the Loup or Platte River	Current Operations			No Diversion Condition		
	Q_d (cfs)	Q_e (cfs)	Sediment Capacity (1,000 tons)	Q_d (cfs)	Q_e (cfs)	Sediment Capacity (1,000 tons)
Site 1 – Loup River Upstream of the Diversion Weir	2,500	2,300	2,585	2,500	2,300	2,585
Site 2 – Loup River Downstream of the Diversion Weir	1,100	1,700	996	2,600	2,300	2,570
Loup River near Genoa gage	1,200	1,700	1,400	2,700	2,300	3,670
Loup River at Columbus gage	1,300	1,800	1,030	2,900	2,700	2,500
Site 3 – Platte River Upstream of the Tailrace Return	2,400	2,100	1,040	3,900	3,300	2,110

Note:

Q_d = dominant discharge; Q_e = effective discharge.

The current morphologies of sites affected by the Project, as well as sites not affected by the Project, are the result of long-term variations in discharge and sediment transport leading up to the present. Today's widths and depths are not the result of today's flows, but instead are the average result of an indefinite period of prior discharge and transport conditions. On the other hand, it is true that the effective or dominant discharges calculated over sufficiently long periods of time will provide reliable estimates of the equilibrium (but not necessarily present) channel geometry because these are measures of the flow rates that transport the greatest amount of sediment and thereby shape the channel.

The final measure of the differences in impacts of the Project's current operations and the no diversion condition is whether the morphology, as measured by regime analysis, is impacted by current operations compared with the no diversion condition.

The effective discharge results were used in conjunction with Chang's and Lane's regime morphology graphs (see Section E.6.2.2) to determine if the changes in effective discharge associated with diversion of flow into the Loup Power Canal are affecting the Loup River bypass reach's morphology. All of the effective discharge points for both current operations and the no diversion condition plot well within braided river morphology zones, with none being near any threshold of transitioning to another morphology (graphs were presented in the District's Updated Study Report, Study 5.0, Figures 5-12 and 5-13).

Flow Depletion and Flow Diversion Conclusions

The long-term historic trends indicate that annual Platte River flows upstream (at Duncan) and downstream (at North Bend and Louisville) of the Loup River confluence have been well-documented as increasing throughout the period that the Project has been in operation. As shown in two USGS reports (Ginting, Zelt, and Linard, 2008; Dietsch, Godberson, and Steele, 2009) and additional analyses by the District, no adverse flow impacts of Project operations are evident. Although flows are highly fluctuating and cyclic, this natural positive long-term trend in flows is statistically significant and, according to USGS, is attributed largely to natural climatic cycling. The positive trend should be neither credited to nor charged against the Project because the Project does not impact flows at Duncan, yet the same trends identified at Duncan also occur downstream.

The consumptive loss analysis shows that flow depletions under current operations are less than would occur under the no diversion condition. Therefore, it is concluded that Project operations do not adversely impact fisheries and aquatic habitat relative to flow depletions.

The increase in flow in the Loup River bypass reach between current operations and the no diversion condition results in an increase in stage, which is to be expected. In general, the magnitude of the stage change decreases for higher flows. In addition, both the flow and associated stage change are greater under a dry year classification than a wet year classification.

The body of literature and the supplemental calculations clearly demonstrate that the Loup River bypass reach is in regime and is seated well within regime zones considered as braided streams. Further, the analyses and other supporting literature discussed above in the sedimentation analysis, clearly indicate that the Loup River bypass reach:

- Is in regime
- Is not supply limited
- Is not aggrading or degrading
- Has no indications of adverse channel geometry changes over time

This combined use of effective discharge and regime theory at both the gaged and ungaged sites is state-of-the-art technology and supports the consensus among investigators that the Loup and Platte rivers are in regime and would continue to be in regime under the no diversion condition. Further, this combination of analytical tools is the best available technology for determining whether any changes, whether climatic or operational, could impact a river's morphology. This means that existing Project operations do not meaningfully affect river morphology and habitat.

Water Quality

As of 2010, NDEQ listed several Project-related waterbodies as impaired for *E. coli*. The following waterbodies, all of which contain watersheds that range beyond the Project Boundary, contain this impairment: two of the three NDEQ-segmented portions of the Loup Power Canal, Lake Babcock, portions of the Loup River, and portions of the Platte River. Sources of *E. coli* include watershed runoff and waterfowl excrement and are in no way related to Project operations.

Project scoping identified that the potential exists for Project dredging operations to mobilize PCB-laden sediments if they are present in the Settling Basin. This potential was stated due to the (now relinquished) impairment for PCBs applied to the Loup Power Canal on the state's Clean Water Act Section 303(d) list and the (now relinquished) fish consumption advisory placed on the Loup Power Canal by the Nebraska Department of Health and Human Services, in association with NDEQ.

The District facilitated NDEQ PCB fish tissue sampling in Lake Babcock on August 11, 2009, in association with NDEQ's regularly scheduled 2009 PCB fish tissue sampling in the Tailrace Canal at the U.S. Highway 30 bridge, which occurred on August 12, 2009. Five common carp were collected at each location, in accordance with existing PCB sampling protocols developed by NDEQ under the U.S. Environmental Protection Agency (EPA) Region VII Ambient Fish Tissue Monitoring Program (RAFTMP). The fillets from each collected sample were composited into a single sample and were provided to the EPA Region VII laboratory in Kansas City, Kansas, for PCB analysis.

Analytical results for PCB (Aroclor 1248, 1254, and 1260) concentrations at each sample/site were below the reporting limit for each contaminant. For parameters where analytical results were above the reporting limit, NDEQ ran the data through its risk assessment calculation tables. Neither sample/site exceeded current state risk criteria; results are documented in NDEQ's "Findings of the 2009 Regional Ambient Fish Tissue Program in Nebraska" (May 2011). As a result of the 2009 sample results, the fish consumption advisory that was previously in effect for the Loup Power Canal has been rescinded (NDEQ, May 25, 2011). Based on the analytical study results, it is determined that Project operations are not mobilizing PCBs.

Water temperature in both the Loup River bypass reach and the Platte River bypass reach was studied extensively in the summer of 2010 as part of the relicensing process to determine if Project diversions of Loup River flows result in excursions of state water quality standards related to temperature and in potentially associated fish kills. Details of the study are presented in the District's Updated Study Report, Study 4.0, Water Temperature in the Project Bypass Reach. In summary, study analysis found no statistically significant relationship between river flow and water temperature at sample locations both upstream and downstream of the Diversion Weir. Conversely, statistically significant relationships were found between: 1) water temperature readings collected upstream and downstream of the Diversion Weir; and 2) air temperature and water temperature both upstream and downstream of the Diversion Weir. These findings demonstrate that Project diversions of Loup River flows do not result in water temperature excursions, or associated fish kills, in either the Loup River bypass reach or the Platte River bypass reach.

E.6.2.3 Proposed Environmental Measures

Because the District's exhaustive relicensing studies have identified no adverse Project impacts on water resources, the District is proposing no new environmental measures relative to water resources.

The District will continue to discharge the majority of dredged material from the Settling Basin to the North SMA. This measure is intended to deter migration of the Loup River's south bank, immediately downstream of the Diversion Weir.

E.6.2.4 Unavoidable Adverse Impacts

Considering the results of the detailed and comprehensive water resource studies performed in association with relicensing, and the lack of operational modification proposed by the District in its Draft License Application, the District concludes that Project relicensing would result in no unavoidable adverse impacts to water resources.

E.6.2.5 Cumulative Impacts

Past, Present, and Future Actions

In addition to federal regulation via the Clean Water Act and Federal Power Act, relevant water resources, and corresponding water appropriations, are stringently regulated by the three states within the Platte River Basin (Colorado, Nebraska, and Wyoming). Water uses in the Platte River Basin, including the Loup River Subbasin, are various and consist of domestic, industrial, livestock, irrigation, hydroelectric power generation (including the Project), and others. One specifically notable past and present action is the Platte River Recovery Implementation Program (PRRIP). On July 1, 1997, PRRIP was formed via a multi-state cooperative agreement to manage Platte River flows for the benefit of four Federally-listed endangered species in the central and lower Platte River. Continued Project operations and PRRIP river management represent reasonably foreseeable future actions within the Platte River Basin.

Impact Analysis

The cumulative impacts of past water uses in the Platte River Basin, including Project construction and operation, are reflected in the water resources that exist today. As demonstrated in the District's Study 5.0, Flow Depletion and Flow Diversion, Project relicensing would not result in increased consumptive water use. Further, Project operation results in less consumptive use when compared to run-of-river operations. Considering this finding, and the lack of other Project impacts strictly tied to water resource impacts,[18] the District has determined that Project operations, including the diversion of Loup River flows, do not present direct or cumulatively significant adverse impacts on water resources.

E.6.3 Fish and Aquatic Resources

E.6.3.1 Existing Environment

Loup River Basin

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 carry heavy loads of sediment, which prevents the establishment of pools and adversely affects production of benthic organisms upon which fish depend (Bliss and Schainost, October 1973). These conditions tend to reduce production of all fishes, particularly the more desirable game fish. As a result, the bulk of stream fish populations are made up of more tolerant species, including carp and various suckers (Bliss and Schainost, October 1973). In addition, when compared to streams in more

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[18] Threatenend and endangered species habitat and fishery suitability are discussed in Sections 6.6.6 and 6.3.5, respectively.

humid, heavily soiled areas of the Midwest, the Loup River is considered low in productivity (Rupp, 1981). The very nature of the shallow, braided and meandering stream, coupled with the large "bed load" of rolling sand, makes for an unstable aquatic habitat (Rupp, 1981). There are virtually no undercut banks along the Loup River due to caving, there is little underwater habitat, and the deeper holes are shifting locations constantly (Rupp, 1981).

In 1996 and 1997, NGPC conducted creel surveys along three river reaches within the Loup River Basin: 1) a 161.25-mile reach of the Loup River from the mouth near Columbus to the upstream confluence with the South Loup River near Boelus, Nebraska; 2) the 35-mile-long Loup Power Canal; 3) a 203.00-mile reach of the Middle Loup River from the confluence with the South Loup River near Boelus upstream to its headwaters in Cherry County. During the survey period, anglers expended more effort, caught more fish, and harvested greater numbers and weight of fish in the Loup Power Canal than in the Loup River. Furthermore, fewer species were recorded in the Loup River than in the Loup Power Canal, and Catch per Unit Effort (CPUE) estimates for both angler catch and harvest were higher in the canal (NGPC, June 1997; NGPC, April 1998).

Loup Power Canal

When the Loup Power Canal was constructed in the 1930s, it was mechanically dug and did not use any natural streambed (Rupp, May 1973). However, benthic organisms and larval fishes may be found in the canal in the calm areas of undercut banks or in areas of bank stabilization. Willow trees were originally planted along the entire shoreline. Bundles of trees have been used to stabilize some areas of the bank, creating a sort of "calm water" area with substrate production (Rupp, May 1973).

Several fish species have been physically sampled in the Loup Power Canal during various sampling exercises, the most recent of which occurred in the late 1960s and early 1970s.[19] In the late 1960s, freshwater drum (*Aplodinotus grunniens*), white crappie (*Pomoxis annularis*), channel catfish (*Ictalurus punctatus*), and "five species of rough fishes" (probably species of bullhead and carp) were found in the canal (Rupp, May 1973). In the early 1970s, freshwater drum, white crappie, channel catfish, carpsucker (family Catostomidae), carp (*Cyprinus carpio*), flathead catfish (*Pylodictus olivaris*), walleye (*Stizostedion vitreum*), black bullhead (*Ictalurus melas*), and white bass (*Morone chrysops*) were captured in the canal (Rupp, May 1973). Also in the 1970s, the above-listed species were found in the canal as well as goldeye (*Hiodon alosoides*) and smallmouth bass (*Micropterus salmoides*) (Bliss and Schainost, October 1973).

[19] Discussions with resource agencies during Project study development determined that the referenced studies are still recognized and that no fish sampling was necessary to support Project relicensing.

Historically, NGPC actively stocked Project fisheries, including walleye in Lake North. Currently, NGPC has no regular stocking programs in Project waters; however, on June 3, 2009, NGPC stocked 34,840 sauger in the Loup Power Canal (NGPC, June 3, 2009).

On August 12, 2005, a fish kill was documented in the Loup Power Canal. The event was the unintended result of unusual maintenance activity at the Monroe Powerhouse and resulted in an estimated 12,000 to 15,000 dead fish (the vast majority of which were non-game river carpsuckers). In order for District personnel to gain access to the normally submerged work area, the water level in the canal was purposely lowered. Hot weather and diminished water volume resulted in low dissolved oxygen levels in the Loup Power Canal. To minimize the possibility of a similar event, the District has implemented protocols that no longer allow maintenance drawdowns on the Loup Power Canal during hot summer conditions.

Lower Platte River

Downstream of the Columbus Powerhouse, the Tailrace Canal discharges into the lower Platte River. According to *Fish and Wildlife Resources of Interest to the U.S. Fish and Wildlife Service on the Platte River*, a FERC-listed Comprehensive Plan for Nebraska, this river reach is considered to be one of the best warm-water river fisheries in the state (USFWS, May 15, 1987). Highly varied river flows in the lower Platte River account for a great diversity of habitats and fish species. Since 1987, approximately 48 fish species, including the Federally endangered pallid sturgeon, have been documented in the lower Platte River (Lower Platte River Corridor Alliance, 2008).

Basin-wide Sampling

In the Loup River Basin and the lower Platte River, fish were inventoried during two separate and distinct sampling exercises (Bliss and Schainost, October 1973; Peters and Parham, 2007). The fish species found are listed in Table E-45. Each of these species has the potential to be found in the Loup River, the Loup Power Canal, and the lower Platte River.

Table E-45. Fish Sampled in the Loup River Basin and the Lower Platte River

Common Name	Scientific Name	Loup River Basin	Lower Platte River
Hiodontidae			
goldeye	*Hiodon alosoides*	X	X
Salmonidae			
brown trout	*Salmo trutta*	X	
Cyprinidae			
bighead carp	*Hypophthalmichthyes nobilis*		X
bigmouth shiner	*Notropis dorsalis*	X	X

Common Name	Scientific Name	Loup River Basin	Lower Platte River
brassy minnow	*Hybognathus hankinsoni*	X	X
common carp	*Cyprinus carpio*	X	X
common shiner	*Notropis cornutus*	X	
creek chub	*Semotilus atromaculatus*	X	X
emerald shiner	*Notropis atherinoides*	X	X
fathead minnow	*Pimephales promelas*	X	X
finescale dace	*Phoxinus neogaeus*	X	
flathead chub	*Hybopsis gracilis*	X	X
golden shiner	*Notemigonus crysoleucas*	X	
grass carp	*Ctenopharyngodon idella*		X
longnose dace	*Rhinichthys cataractae*	X	X
pearl dace	*Semotilus margarita*	X	
plains minnow	*Hybognathus placitus*	X	X
red shiner	*Notropis lutrensis*	X	X
river shiner	*Notropis blennius*		X
sand shiner	*Notropis stramineus*	X	X
shoal chub	*Macrhybopsis hystoma*		X
sicklefin chub	*Macrhybopsis meeki*		X
silver carp	*Hypophthamichthyes molitrix*		X
silver chub	*Macrhybopsis storeriana*		X
silvery minnow	*Hybognathus nuchalis*	X	
speckled chub	*Hybopsis aestivalis*	X	
spotfin shiner	*Cyprinella spiloptera*		X
stoneroller	*Campostoma anomalum*	X	
sturgeon chub	*Macrhybopsis gelida*		X
suckermouth minnow	*Phenacoiuis mirabilis*		X
Catostomidae			
bigmouth buffalo	*Ictiobus cyprinellus*		X
blue sucker	*Cycleptus elongatus*		X
longnose sucker	*Catostomus catostomus*		X
quillback carpsucker	*Carpiodes cyprinus*	X	X
river carpsucker	*Carpiodes carpio*	X	X
shorthead redhorse	*Moxostoma macrolepidotum*	X	X
smallmouth buffalo	*Ictiobus bubalus*		X
white sucker	*Catostomus commersoni*	X	X
Ictaluridae			
black bullhead	*Ictalurus melas*	X	X
blue catfish	*Ictaluras furcatus*		X
channel catfish	*Ictalurus punctatus*	X	X
flathead catfish	*Pylodictis olivaris*	X	X
stonecat	*Noturus flavus*	X	
yellow bullhead	*Ictalurus natalis*	X	
Cyprinodontidae			
plains killifish	*Fundulus kansae*	X	X
plains topminnow	*Fundulus sciadicus*	X	X

Common Name	Scientific Name	Loup River Basin	Lower Platte River
Gasterosteidae			
brook stickleback	*Culaea inconstans*	X	X
Centrarchidae			
black crappie	*Pomoxis nigromaculatus*	X	X
bluegill	*Lepomis macrochirus*	X	X
green sunfish	*Lepomis cyanellus*	X	X
largemouth bass	*Micropterus salmoides*	X	X
orangespotted sunfish	*Lepomis humilis*		X
smallmouth bass	*Micropterus dolomieui*	X	
white crappie	*Pomoxis annularis*	X	X
Atherinidae			
brook silverside	*Labidesthes sicculus*		X
Peociliidae			
western mosquitofish	*Gambusia affinis*		X
western blacknose dace	*Rhinichthys obtusus*		X
western silvery minnow	*Hybognathus argyritis*		X
Percidae			
Iowa darter	*Etheostoma exile*	X	
Johnny darter	*Etheostoma nigrum*		X
sauger	*Sander canadensis*		X
walleye	*Sander vitreus*		X
yellow perch	*Perca flavescens*		X
Acipenseridae			
lake sturgeon	*Acipenser fluvescens*		X
pallid sturgeon	*Scaphirhynchus albus*		X
shovelnose sturgeon	*Scaphirhynchus platorynchus*		X
Sciaenidae			
freshwater drum	*Aplodinotus grunniens*	X	X
Polyodontidae			
paddlefish	*Polyodon spathula*		X
Lepisosteidae			
longnose gar	*Lepisosteus osseus*		X
shortnose gar	*Lepisosteus platostomus*		X
Moronidae			
white bass	*Morone chrysops*		X
white perch	*Morone americana*		X
Clupeidae			
gizzard shad	*Dorosoma cepedianum*		X

Sources: Bliss, Quentin P., and Steve Schainost, October 1973, "Loup Basin Stream Inventory Report," Nebraska Game and Parks Commission, Bureau of Wildlife Services, Aquatic Wildlife Division;
Peters, Edward J., and James E. Parham, 2007, "Draft Ecology and Management of Sturgeon in the Lower Platte River, Nebraska," Nebraska Technical Series No. 18, Nebraska Game and Parks Commission, Lincoln, Nebraska.

NGPC Fishing Guide

NGPC's fishing guide, titled *2011-2012 Fishing Regulations and Public Waters*, lists the following fish species as being accessible to anglers in the Project fisheries (NGPC, 2011):

- Loup Power Canal and Loup River – carp, channel and flathead catfish, freshwater drum, and sauger
- Lake Babcock – bullhead, carp, channel and flathead catfish
- Lake North – carp, channel catfish, crappie, freshwater drum, walleye, and sauger

NGPC's fishing guide states that the Nebraska-state-record flathead catfish, which weighed 80 pounds, was caught in the Loup Power Canal on June 14, 1988 (NGPC, 2011).

E.6.3.2 Environmental Analysis

With regard to the Project's consistency with State of Nebraska fishery management goals, the following input, collected in 1981 at the time of the District's previous relicensing effort, is believed still accurate today:

- "In general, the Loup Power system fishery could be described as excellent, and of regional importance to east-central Nebraska" (Rupp, 1981).
- "Concerning the overall resources of both the canal and river and project effects on these resources, in my judgment, the power project has substantially improved the fishery resource and greatly enhanced recreational opportunities" (Rupp, 1981).

Beyond these observations, the environmental analysis to follow is a summary of District study results intended to determine whether Project operations affect fish and aquatic resources. Because Project scoping did not identify concerns related to macroinvertebrate communities, no macroinvertebrate analysis is provided.

Water Temperature in the Project Bypass Reach

Water temperature in the Project bypass reach was identified as a potential Project issue because it is suspected to have been a factor in three documented fish kills in the Loup River bypass reach between the Diversion Weir at RM 34.2 and the confluence with Beaver Creek at RM 25.0: one in July 1995, one in July 1999, and one in July 2004 (NDEQ, 2007). NDEQ cited low flows and thermal stress as suspected causes. Furthermore, during scoping and study development, resource agencies identified the portion of the Loup River bypass reach from the Diversion Weir to the confluence with Beaver Creek as the "main affected area for fish kills" (NGPC, February 6, 2009).

Analysis conducted in association with the District's Study 4.0, Water Temperature in the Project Bypass Reach, determined that water temperature in the Loup River bypass reach fluctuates on a synchronous daily cycle at both the Merchiston station (upstream of the Project's point of diversion) and Genoa station (downstream of the point of diversion), regardless of Loup River discharge conditions. This suggests that the parameter that influences water temperature also varies on a daily basis.

Study results found a significant correlation between air temperature and water temperature in both the Loup River above the Diversion Weir and in the Loup River bypass reach. Conversely, no statistically significant correlation was found between water temperature in the Loup River bypass reach and the following parameters:

- Loup River flow discharge
- Relative humidity
- Radiative flux

Direct comparisons of water temperatures between the Merchiston (upstream of the Project's point of diversion) and Genoa (downstream of the point of diversion) stations found a statistically significant relationship between the two stations. This suggests that potential temperature excursions are the result of factors not associated with Project diversions of Loup River flows.

Water temperature data collected in the Platte River (both upstream of the Loup River confluence and in the Platte River bypass reach) displayed higher hourly mean temperatures compared to the Loup River sampling locations (Genoa and Columbus). Further analysis, conducted in association with the District's Study 4.0, Water Temperature in the Project Bypass Reach, concluded that the higher flow volumes supplied by the Platte River upstream more greatly influence the water temperature of the Platte River bypass reach than the flows contributed by the Loup River. That is, the diversion of Loup River flows by the District is not the driver behind higher water temperatures within the Platte River between the Loup River confluence and the Tailrace Return.

Based on these findings, it was determined that Project operations (diversion of Loup River flow) do not promote water temperature excursions in the Loup or Platte river bypass reaches. Furthermore, these data support the conclusion that Project operations are not the cause of the thermal-stress-related fish kills documented within the Loup River bypass reach.

Flow Depletion and Flow Diversion

The Project-associated diversion of Loup River flows was identified during Project scoping as: 1) potentially impacting fish and aquatic habitat, including habitat connectivity and distribution, within the Loup River bypass reach due to diminished flows resulting from diversion; and 2) potentially impacting fish and aquatic habitat within the lower Platte River resulting from potentially increased depletions to contributing flows.

Analysis conducted in association with the District's Study 5.0, Flow Depletion and Flow Diversion, determined that the consumptive use (evaporation and evapotranspiration) is greater under the no diversion condition than under current operations and that the Project results in no measurable flow depletions to the lower Platte River. Therefore, the Project does not adversely impact fisheries and habitat within the lower Platte River when compared to a no diversion condition.

The Montana method was used to evaluate fish and aquatic habitat in the Project bypass reach, including the Loup and Platte rivers. This method uses various percentages of the mean annual discharge to describe aquatic conditions for a given period in a stream. The results of the analysis of the Loup and Platte river bypass reaches are provided below.

Loup River Bypass Reach

Mean annual discharge for the period of analysis (1956 to 2009) for the Loup River bypass reach is 743 cfs; however, the standard deviation of the mean annual discharge was 378 (51 percent of the mean), indicating substantial variability in mean annual discharge. Based on the mean annual discharge, the mean daily flow for each month of the period of record was evaluated on a yearly basis and compared to the following Montana method flow descriptions: degraded, poor, fair, and satisfactory.[20]

Based on the Montana method assessment, in July, August, September, and October, fish and aquatic habitat in the Loup River bypass reach is rated as "Poor" or "Degraded" for the majority of years. Although flows are naturally lower during this time period, these ratings could be attributed, at least in part, to the diversion of water, as the analysis above the Diversin Weir indicated a majority of years with a "Satisfactory" rating, and yearly fluctuations in streamflow did not seem to affect habitat conditions. From October through March, flows below the Diversion Weir have a majority of years in the "Satisfactory" or "Fair" category, although above the Diversion Weir, the total of years within the "Satisfactory" category was greater.

Using the Montana method, it appears that habitat below the Diversion Weir is somewhat degraded compared to upstream habitat. However, it is likely that fish are still using this reach for the majority of the year, as many months still exhibit suitable habitat, especially during key spawning and migration months between April and June. Furthermore, the NGPC fish data collection report (NGPC, June 1997 and April 1998) found similar fish communities both upstream and downstream of the Diversion Weir, suggesting that habitat is available for fish both above and below the weir.

[20] Montana method descriptions of good, excellent, and outstanding were grouped together and categorized as "satisfactory."

Platte River Bypass Reach

Mean annual discharge for the period of of analysis (1956 to 2009) for the Platte River bypass reach is 2,830 cfs; however, the standard deviation of the mean annual discharge was 1,620 (57 percent of the mean), indicating substantial variability in mean annual discharge. Based on the mean annual discharge, the mean daily flow for each month of the period of record was evaluated on a yearly basis and compared to the following Montana method flow descriptions: degraded, poor, fair, and satisfactory.

Based on the Montana method assessment, it appears that the Platte River is meeting adequate flow requirements for satisfactory biological conditions for nearly all months. July, August, and September are the only months where the Platte River has a "Poor" or "Severely Degraded" stream rating, and this is exhibited both at the Platte River near Duncan gage (upstream of the Loup River confluence) and at ungaged Site 3 (between the Loup River confluence and Tailrace Return). Because these ratings are exhibited both upstream and downstream of the Loup River confluence, lower ratings on the Platte River are likely due to natural seasonal fluctuations in flow and other upstream factors. Because conditions at the Platte River near Duncan gage and Site 3 were very similar, it is unlikely that the diversion of water from the Loup River is adversely affecting fisheries habitat in the Platte River.

Fish Passage

The ability of Loup River fish species to migrate upstream, past the Diversion Weir and Sluice Gate Structure, was identified as a potential Project issue due to potential hydraulic restrictions (flow, velocity, and stage) at the Diversion Weir. The District's Study 7.0, Fish Passage, was conducted to determine if, to what degree, and during what periods of the year the Diversion Weir and Sluice Gate Structure impede riverine fish passage on the Loup River.

Analysis performed in association with Study 7.0, Fish Passage, determined the following:

- The Diversion Weir is submerged and provides a potential pathway for upstream migrating fish during less than 1 percent of the spawning season (defined as April through June for the analysis). During the 1 percent of the spawning season in which the Diversion Weir is submerged, the resulting flow velocities over the Diversion Weir are higher than the critical swimming speeds of all analyzed fish species. With the exception of the white sucker and walleye, the flow velocities that result from Diversion Weir submergence are also too great to allow fish passage of the analyzed fish species when burst swimming speeds are considered.

- The Sluice Gate Structure is typically closed during normal operations; no fish passage occurs during closure. District studies determined that when the structure is open, the flow velocities passing through it are generally too great to allow passage of any analyzed fish species. However, it was acknowledged by NGPC fisheries biologists during the September 9, 2010, Initial Study Results Meeting that fish passage of the Diversion Weir is occurring and that it is likely the result of lower velocities near boundary layers near solid surfaces and hydraulic shadows associated with the Sluice Gate Structure. This statement is supported by the documented species diversity that occurs both above and below the Diversion Weir.
- An alternative fish pathway around the Diversion Weir on the right bank of the Loup River (looking downstream) exists (on average) less than 1 day out of every spawning season. The findings summarized for the Diversion Weir above are also applicable to an alternative fish pathway around the Diversion Weir.

As summarized above, NGPC fisheries biologists stated during the September 9, 2010, Initial Study Results Meeting that study findings are not conclusive. The biologists further stated that fish passage of the Diversion Weir is occurring and likely results from lower velocities near boundary layers near solid surfaces and hydraulic shadows associated with the Sluice Gate Structure, particularly at the interface of corners of the wall and floor. The velocity in these areas is very slow compared to the calculated average velocity through the gate. A fish could work its way up near the gate, rest in a hydraulic shadow, and then burst through, following the concrete along the gate housing. This type of behavior has been documented at hydraulic structures on the Mississippi River (USACE, May 2000). Given these hydraulic conditions and the known species diversity above and below the Diversion Weir, fish passage is likely occurring at the Project Headworks, particularly by larger and stronger adult fish.

Creel Survey Summary

In efforts to determine what fish species anglers target, what fish species anglers catch, and associated catch rates within Project fisheries, the District conducted a progressive count bus-route creel survey along the entire length of the Loup Power Canal,[21] from the Diversion Weir on the Loup River to the canal's confluence with the Platte River. The survey was conducted by District representatives, in collaboration with NGPC's Northeast District Office, and spanned the 2010 open water fishing season (May 1 through October 31).

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[21] For purposes of creel survey analysis only, all references to the Loup Power Canal include the Loup River at the Headworks and the lower Platte River at the mouth of the Loup Power Canal. Anglers fishing in the Loup and Platte rivers at only these locations were surveyed in incorporation of the District's 2010 creel survey.

Table E-46 illustrates that anglers surveyed along the Loup Power Canal between May 1 and October 31, 2010, targeted a diverse array of fish species and that the majority of these anglers (64.5 percent) were specifically targeting channel catfish. Anglers not targeting a specific fish species (those fishing for "anything") were the second most prevalent (9.7 percent), while those targeting walleye or sauger accounted for 9.3 percent of the surveyed anglers. Beyond the three most common targets of angling parties, other targeted fish species were freshwater drum, flathead catfish, crappie, carp, striped hybrid bass, largemouth bass, white bass, and bluegill.

Table E-46. Fish Species Sought

	Channel Catfish	Anything	Walleye/ Sauger	Freshwater Drum	Flathead Catfish	Crappie	Other[a]	White Bass	Bluegill	Total
Anglers Targeting Species	460[b]	69	66	39	28	23	15	11	2	713
Percent of Total	64.5	9.7	9.3	5.5	3.9	3.2	2.1	1.5	0.3	100.0

Notes:

a "Other" includes carp and minnow family, hybrid striped bass, and largemouth bass.

b Includes 20 anglers who were seeking catfish but did not specify channel catfish or flathead catfish.

Table E-47 provides catch values for notable species by month. As shown, catch values were highest in May; more than 29 percent of the total estimated catch occurred during this month alone.

Table E-47. Estimated Catch by Month

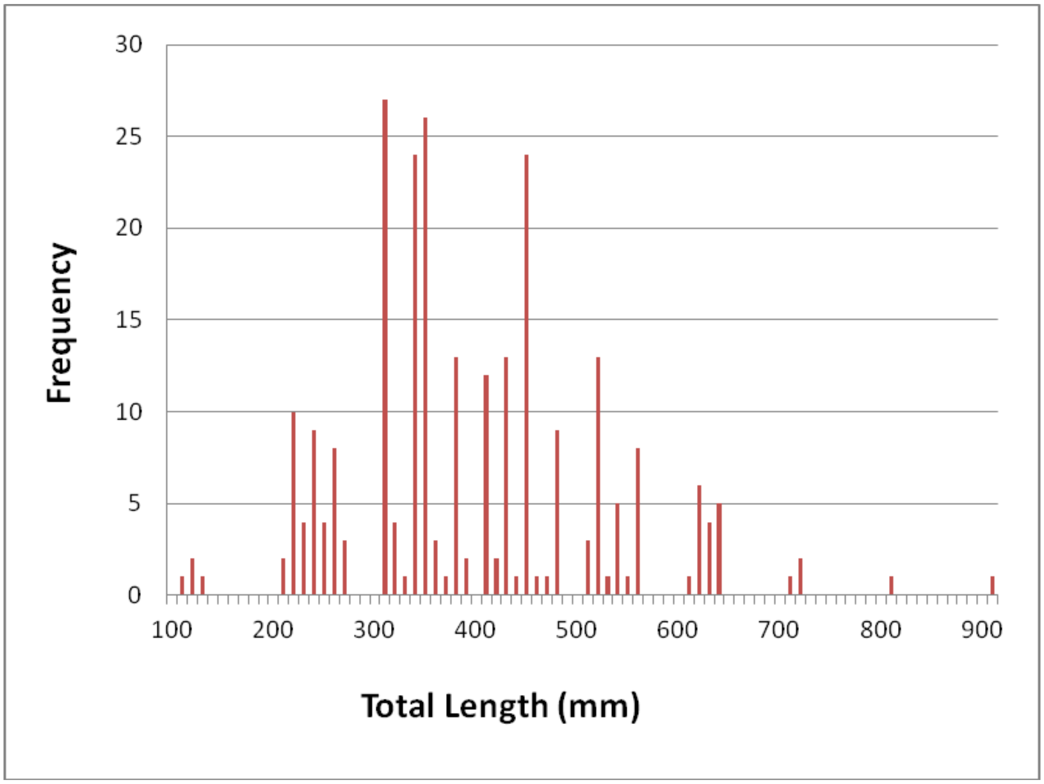
Fish Species	Value[a]						
	May	June	July	August	September	October	Total
Channel Catfish	766 (161.2)	1,205 (228.0)	2,778 (1,003.1)	1,468 (175.5)	1,484 (281.3)	1,987 (500.3)	9,688 (1,201.9)
Freshwater Drum	1,102 (289.7)	1,003 (209.9)	497 (107.7)	604 (122.7)	479 (195.6)	450 (256.3)	4,135 (508.5)
Crappie	3,902 (2,220.4)	39 (27.4)	0	59 (34.6)	28 (23.8)	123 (70.4)	4,151 (2,222.1)
White Bass	81 (36.9)	43 (25.5)	0	45 (23.7)	525 (169.4)	335 (151.2)	1,029 (232.6)
Other[b]	109	155	254	61	145	112	836
Bluegill	0	0	81 (45.7)	0	85 (47.0)	200 (168.8)	366 (181.1)
Flathead Catfish	61 (27.7)	122 (62.9)	73 (32.6)	9 (7.4)	73 (41.3)	0	338 (86.9)
Walleye	156 (24.6)	27 (23.2)	0	9 (7.4)	0	0	192 (34.6)
Sauger	0	0	0	0	76 (42.0)	0	76 (42.0)
Totals	6,177	2,594	3,683	2,255	2,895	3,207	20,811

Notes:

[a] Standard error provided in parentheses for those values to which it applies.

[b] "Other" includes goldeye, gizzard shad, common and bighead carp, buffalo, yellow bullhead, northern pike, and striped bass hybrid.

The length frequencies of angler-harvested channel catfish were developed and are presented in Graph E-14. Channel catfish of a preferred length (greater than 610 millimeters [mm]), including large channel catfish over 700 millimeters, were harvested.



Graph E-14. Length Frequencies of Harvested Channel Catfish

PCB Fish Tissue Sampling

Project scoping identified that the potential exists for Project dredging operations to mobilize PCB-laden sediments if they are present in the Settling Basin. This potential was stated due to the (now relinquished) impairment for PCBs applied to the Loup Power Canal on the state's CWA 303(d) list and the (now relinquished) fish consumption advisory placed on the Loup Power Canal by the Nebraska Department of Health and Human Services, in association with NDEQ.

The District facilitated NDEQ PCB fish tissue sampling in Lake Babcock on August 11, 2009, in association with NDEQ's regularly scheduled 2009 PCB fish tissue sampling in the Tailrace Canal at the U.S. Highway 30 bridge, which occurred on August 12, 2009. Five common carp were collected at each location, in accordance with existing PCB sampling protocols developed by NDEQ under the U.S. Environmental Protection Agency (EPA) Region VII Ambient Fish Tissue Monitoring Program (RAFTMP). The fillets from each collected sample were composited into a single sample and were provided to the EPA Region VII laboratory in Kansas City, Kansas, for PCB analysis.

Analytical results for PCB (Aroclor 1248, 1254, and 1260) concentrations at each sample/site were below the reporting limit for each contaminant. For parameters where analytical results were above the reporting limit, NDEQ ran the data through its risk assessment calculation tables. Neither sample/site exceeded current state risk criteria; results are documented in NDEQ's "Findings of the 2009 Regional Ambient Fish Tissue Program in Nebraska" (May 2011). As a result of the 2009 sample results, the fish consumption advisory that was previously in effect for the Loup Power Canal has been rescinded (NDEQ, May 25, 2011). Based on the analytical study results, it is determined that Project operations are not mobilizing PCBs that could affect fishery resources.

Fish Entrainment and Mortality

Although the District did not conduct studies in association with Project relicensing regarding fish entrainment and mortality, previous fisheries research determined that the Loup Power Canal is a healthy fishery that supports a large and healthy channel catfish population. More specifically, several thousand channel catfish ranging from 8 to 29 inches in length were captured in the Loup Power Canal using a hoop net and were marked (Rupp, May 1973). "This leaves no doubt of the much higher standing crop [of channel catfish] in the power canal when compared to the Loup River, even above the point of diversion at the headgates" (Rupp, May 1973).

The Rupp study also determined that reproduction and recruitment are excellent in the Loup Power Canal due in large part to a substantial amount of habitat not normally present in streams of this type. Undercut banks supported by extensive tree root systems as well as rip-rapped banks provide large areas of sanctuary from the current. This increases both survival of larval fishes and production of benthic organisms (Rupp, May 1973).

More recently, and in association with Project relicensing, the District conducted a creel survey on all Project fisheries that demonstrated healthy abundance and diversity of desirable riverine fish species of the region. Details of the creel survey are provided earlier in the section.

E.6.3.3 Proposed Environmental Measures

In association with this Draft License Application, during hot summer conditions, the District will continue to defer non-emergency maintenance procedures that require substantial curtailment of Loup Power Canal flows. This measure would minimize the potential for low dissolved oxygen levels in the Loup Power Canal and potential fish kills that could result.

In 2011, the District implemented measures to increase awareness of invasive species, including zebra mussels, in efforts to minimize the chance of infestation at Lake North and to ensure that the existing recreational opportunities afforded by Lake North continue. Specifically, the District posted signs, developed in association with NGPC, that outline the threat posed by invasive aquatic species and measures that can be taken to minimize risk.

The District has initiated discussions with fish and wildlife agencies related to the potential need for enhanced flow in the Loup River bypass reach to provide improved aquatic conditions. Results of these discussions will be included in the License Application.

E.6.3.4 Unavoidable Adverse Impacts

Aquatic Habitat in the Loup River Bypass Reach

Based on the Montana method, habitat below the Diversion Weir is somewhat degraded compared to upstream habitat. However, it is likely that fish are still using the reach of the Loup River downstream of the Diversion Weir for the majority of the year, as many months still exhibit suitable habitat, especially during key spawning and migration months between April and June.

NGPC angler use and fish community reports (NGPC, June 1997 and April 1998) found similar fish communities both upstream and downstream of the Diversion Weir, suggesting that fish habitat is available both above and below the weir. In addition, throughout the relicensing process, NGPC fisheries biologists have maintained that fish habitat within the Loup River supports a viable fishery. This is supported by the investment that NGPC makes to stock desirable sport fish in the Loup River and its major tributaries. Since 2001, NGPC has stocked 244,614 fish collectively within the North Loup River, Middle Loup River, South Loup River, and Loup Power Canal. Included in this stocking effort were 128,337 channel catfish, 94,465 sauger, 14,500 rainbow trout, and 5,250 brown trout (NGPC, October 25, 2011).

Fish Passage

Based on the environmental analysis summarized above, the Diversion Weir acts as a partial barrier to fish migration along the Loup River. Regardless of relicensing study findings, this impact is not a substantial concern to NGPC fisheries biologists. Discussions with these biologists during the September 9, 2010, Initial Study Results Meeting determined that fish passage of the Diversion Weir is likely occurring, as is evident by documented Loup River fish species diversity and abundance both above and below the Diversion Weir and the study-associated hydraulic model's inability to isolate low flow velocities sought out and used by fish when attempting to pass partial barriers.

E.6.3.5 Cumulative Impacts

Past, Present, and Future Actions

As detailed in Section E.1.7, water uses in the Loup River Basin are various and consist of domestic, industrial, livestock, irrigation, hydroelectric power generation, and others. In addition to the District's hydroelectric project, a hydroelectric project owned and operated by the Village of Spalding, Nebraska, exists on the Cedar River. Three non-Project storage dams and reservoirs and three non-Project diversion dams are also located in the Loup River Basin, as discussed in Section E.1.8. These activities and developments represent past and present actions that could be considered during cumulative impacts analysis. Aside from continued Project operations, no reasonably foreseeable future actions have been identified within the Loup River Basin.

Impact Analysis

The cumulative impacts of past water uses in the Loup River Basin, including Project construction and operation, are reflected in the fish and aquatic resources that exist today. Documentation of Loup River fishery conditions, along with associated statements and actions of NGPC fisheries biologists, suggest that the Loup River fishery is viable and productive. Based on these conditions and the lack of reasonably foreseeable future actions in the Loup River Basin, the District has determined that Project diversion of Loup River flows does not have a cumulatively significant adverse impact on fish and aquatic resources.

E.6.4 Wildlife and Botanical Resources

E.6.4.1 Existing Environment

Upland Habitat(s) and Plant and Animal Species

In the vicinity of the Project, upland habitats are limited. The majority of upland areas immediately surrounding the Project Boundary are currently managed and used for agricultural production. In most of these areas, agricultural practices extend within close proximity to Project components, with little or no native vegetative buffer. These conditions are typical for eastern Nebraska as the landscape of Nebraska was altered dramatically in the decades after European settlement (mid-1800s) primarily because of agricultural practices (Fleharty and Channell, 1997, as cited in Benedict, Genoways, and Freeman, June 1, 2000).

Vegetation

Prior to European settlement and the associated controlled fire regime, the uplands in the vicinity of the Project would have consisted of upland tallgrass prairie (NGPC, August 2005). Accordingly, the Project lies in the Tallgrass Prairie Ecoregion, as designated by The Nebraska Natural Legacy Project as covering approximately the eastern quarter of the state (NGPC, August 2005). Over 95 percent of tallgrass prairie in Nebraska has been converted to agricultural fields and other anthropogenic habitats (Kaul and Rolfsmeier, 1993; Noss et al., 1996, as cited in Benedict, Genoways, and Freeman, June 1, 2000). In tallgrass prairies, remaining patches of habitat are typically small and isolated, are grazed by non-native herbivores, and/or are being invaded by woody vegetation (Benedict et al., 1996; Bogan et al., 1995; Kaul and Rolfsmeier, 1993, as cited in Benedict, Genoways, and Freeman, June 1, 2000). The small pockets of undisturbed ground in the vicinity of the Project are likely typical of these conditions; however, portions of these areas may contain the vegetation historically typical of the Tallgrass Prairie Ecoregion, as discussed in the following paragraph and shown in Table E-48.

Upland tallgrass prairie is dominated by big bluestem (*Andropogen gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and Canada wildrye (*Elymus canadensis*) (NGPC, August 2005). These grass species can reach 6 feet or taller, especially when rooted in rich, moist stream valleys. Tallgrass prairies also include hundreds of species of wildflowers and other forbs that support a diversity of other prairie species. Examples of these include showy goldenrod (*Solidago speciosa*), prairie blazing star (*Liatris pycnostachya*), skyblue aster (*Symphyotrichum oolentangiense*), and purple coneflower (*Echinacea sp*) (NGPC, August 2005). A more detailed list of vegetation typical of the region is provided in Table E-48.

Table E-48. Vegetation of the Region

Common Name	Scientific Name	Common Name	Scientific Name
American basswood	*Tilia americana*	pale purple coneflower	*Echinacea pallida*
American elm	*Ulmus americana*	peachleaf willow	*Salix amygdaloides*
annual buckwheat	*Eriogonum annuum*	Platte lupine	*Lupinus plattensis*
Arrowhead	*Sagittaria* spp.	poison ivy	*Toxicodendron radicans*
barnyard grass	*Echinochloa crus-galli*	prairie blazing star	*Liatris pycnostachya*
big bluestem	*Andropogon gerardii*	prairie cordgrass	*Spartina pectinata*
black medick	*Medicago lupulina*	prairie Junegrass	*Koeleria macrantha*
black walnut	*Juglans nigra*	prairie sandreed	*Calamovilfa longifolia*
blue grama	*Bouteloua gracilis*	prairie spiderwort	*Tradescantia occidentalis*
box elder	*Acer negundo*	purple prairie-clover	*Dalea purpurea*
buffalograss	*Bouteloua dactyloides*	red mulberry	*Morus rubra*
Bur oak	*Quercus macrocarpa*	red-osier dogwood	*Cornus stolonifera*
bur-reed	*Sparganium* spp.	river-bank grapevine	*Vitis riparia*
Canada goldenrod	*Solidago canadensis*	roughleaved dogwood	*Cornus drummondii*
Canada wildrye	*Elymus canadensis*	sand bluestem	*Andropogon hallii*
cattail	*Typha* spp.	sand dropseed	*Sporobolus cryptandrus*
cocklebur	*Xanthium strumarium*	sandbar willow	*Salix exigua*
common ragweed	*Ambrosia artemisiifolia*	sedge	*Carex* spp.
common threesquare bulrush	*Schoenoplectus pungens*	showy goldenrod	*Solidago speciosa*
dotted blazing star	*Liatris punctata*	sideoats grama	*Bouteloua curtipendula*
downy brome	*Bromus tectorum*	silver maple	*Acer saccarinum*
Eastern cottonwood	*Populus deltoides*	silverleaf scurfpea	*Pediomelum argophyllum*
false boneset	*Brickellia eupatorioides*	skyblue aster	*Symphyotrichum oolentangiense*

Common Name	Scientific Name	Common Name	Scientific Name
false indigo	*Amorpha fruticosa*	small white lady's slipper	*Cypripedium candidum*
field brome	*Bromus arvensis*	Smartweed	*Polygonum* spp.
fringed loosestrife	*Lysimachia ciliata*	smooth sumac	*Rhus glabra*
green ash	*Fraxinus pennsylvanica*	spikerush	*Eleocharis* spp.
hairy goldaster	*Heterotheca villosa*	stiff sunflower	*Helianthus pauciflorus*
hairy grama	*Bouteloua hirsuta*	switchgrass	*Panicum virgatum*
Indiangrass	*Sorghastrum nutans*	western prairie fringed orchid	*Platanthera praeclara*
lanceleaf fogfruit	*Phyla lanceolata*	western snowberry	*Symphoricarpos occidentalis*
lead plant	*Amorpha canescens*	western wheatgrass	*Pascopyrum smithii*
little bluestem	*Schizachyrium scoparium*	white sweet clover	*Melilotus officinalis*
Invasive Species			
Kentucky bluegrass	*Poa pratensis*	Russian olive	*Elaaeagnus angustifolia*
red cedar	*Juniperus virginiana*	smooth brome	*Bromus inermis*
reed canarygrass	*Phalaris arundinacea*		

Sources: Sidle, John G., and Craig A. Faanes, July 16, 1997, "Platte River Ecosystem Resources and Management, with Emphasis on the Big Bend Reach in Nebraska," Northern Prairie Wildlife Research Center, retrieved on August 5, 2008, http://www.npwrc.usgs.gov/resource/habitat/plrivmgt/index.htm;
NGPC, August 2005, *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*, Lincoln, Nebraska, available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp.

Invasive vegetative species are identified in Table E-48. The District understands the detrimental effects that the establishment of invasive species can have on the vegetative communities and the overall biological integrity of land within the Project Boundary; therefore, the District actively monitors land within the Project Boundary for invasive species. If invasive species are found, the District implements active management practices to promptly eradicate the invasive plants.

Birds

More than 300 species of resident and migratory birds have been documented in the Tallgrass Prairie Ecoregion. The region supports populations of greater prairie chicken (*Tympanuchus cupido*) and a full complement of grassland birds, including Henslow's sparrow (*Ammodramus henslowii*), dickcissel (*Spiza americana*), grasshopper sparrow (*Ammodramus savannarum*), bobolink (*Dolichonyx oryzivorus*), vesper sparrow (*Pooecetes gramineus*), and Swainson's hawk (*Buteo swainsoni*). Although woodlands are mostly confined to stream corridors, woodland species such as Bell's vireo (*Vireo bellii*), black-and-white warbler (*Mniotilta varia*), rose-breasted grosbeak (*Pheucticus ludovicianus*), and orchard oriole (*Icterus spurius*) are common breeding species (NGPC, August 2005). A more detailed list of bird species typical of the region is provided in Table E-49.

Table E-49. Birds of the Region

Common Name	Scientific Name	Common Name	Scientific Name
American crow	*Corvus brachyrhynchos*	house wren	*Troglodytes aedon*
American goldfinch	*Carduelis tristis*	indigo bunting	*Passerina cyanea*
American tree sparrow	*Spizella arborea*	interior least tern	*Sterna antillarum athalassos*
bald eagle	*Haliaeetus leucophalus*	killdeer	*Charadrius vociferus*
Baltimore oriole	*Icterus galbula*	lapland longspur	*Calcarius lapponicus*
barn swallow	*Hirundo rustica*	mallard	*Anas platyrynchos*
Bell's vireo	*Vireo bellii*	mourning dove	*Zenaida macrooura*
black-and-white warbler	*Mniotilta varia*	northern bobwhite	*Colinus virginianus*
black-capped chickadee	*Poecile atriacapillus*	northern cardinal	*Cardinalis cardinalis*
blue jay	*Cyanocitta cristata*	northern flicker	*Colaptes auratus*
blue-winged teal	*Anas discors*	northern pintail	*Anas acuta*
bobolink	*Dolichonyx oryzivorus*	orange-crowned warbler	*Vermivora celata*
brown thrasher	*Toxostoma rufum*	orchard oriole	*Icterus spurius*
brown-headed cowbird	*Molothrus ater*	pied-billed grebe	*Podilymbus podiceps*
cackling goose	*Branta hutchinsii*	piping plover	*Charadrius melodus*
Canada goose	*Branta canadensis*	purple martin	*Progne subis*
clay-colored sparrow	*Spizella pallida*	red-bellied woodpecker	*Melanerpes carolinus*
common grackle	*Quiscalus quiscula*	red-eyed vireo	*Vireo olivaceus*
common nighthawk	*Chordeiles minor*	red-headed woodpecker	*Melanerpes erythrocephalus*
common yellowthroat	*Geothlypis trichas*	red-winged blackbird	*Agelaius phoeniceus*
dark-eyed junco	*Junco hyemalis*	ring-necked pheasant	*Phasianus colchicus*
dickcissel	*Spiza americana*	rock pigeon	*Columbia livia*
Downy woodpecker	*Picoides pubescens*	rose-breasted grosbeak	*Pheucticus ludovicianus*
eastern kingbird	*Tyrannus tyrannus*	song sparrow	*Melospiza melodia*
eastern meadowlark	*Sturnella magna*	Swainson's hawk	*Buteo swainsoni*
eastern phoebe	*Sayornis phoebe*	Swainson's thrush	*Catharus ustulatus*
eastern wood-pewee	*Contopus virens*	Tennessee warbler	*Vermivora peregrina*
European starling	*Sturnus vulgaris*	vesper sparrow	*Pooecetes gramineus*
grasshopper sparrow	*Ammodramus savannarum*	warbling vireo	*Vireo gilvus*
gray catbird	*Dumetella carolinensis*	western kingbird	*Tyrannus verticalis*
great crested flycatcher	*Myiarchus crinitus*	western meadowlark	*Sturnella neglecta*
greater prairie chicken	*Tympanuchus cupido*	white-breasted nuthatch	*Sitta carolinensis*

Common Name	Scientific Name	Common Name	Scientific Name
green heron	*Butorides virescens*	white-throated sparrow	*Zonotrichia albicollis*
hairy woodpecker	*Picoides villosus*	whooping crane	*Grus americana*
Harris's sparrow	*Zonotrichia querula*	wild turkey	*Meleagris gallopavo*
Henslow's sparrow	*Ammodramus henslowii*	wood duck	*Aix sponsa*
horned lark	*Eremophila alpestris*	yellow-rumped warbler	*Dendroica coronata*
house finch	*Carpodacus mexicanus*	yellow warbler	*Dendroica petechia*
house sparrow	*Passer domesticus*		

Sources: NGPC, August 2005, *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*, Lincoln, Nebraska, available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp;
Sidle, John G., and Craig A. Faanes, July 16, 1997, "Platte River Ecosystem Resources and Management, with Emphasis on the Big Bend Reach in Nebraska," Northern Prairie Wildlife Research Center, retrieved on August 5, 2008, http://www.npwrc.usgs.gov/resource/habitat/plrivmgt/index.htm;
Johnsgard, Paul A, 2007, "A Guide to the Tallgrass Prairies of Eastern Nebraska," University of Nebraska – Lincoln, School of Biological Sciences, available online at http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1038&context=biosciornithology.

Mammals

The Tallgrass Prairie Ecoregion is home to more than 55 mammal species (NGPC, August 2005). The small mammal fauna of the region includes plains pocket gopher (*Geomys bursarius*), prairie vole (*Microtus ochrogatser*), plains pocket mouse (*Perognathus flavescens*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), and Franklin's ground squirrel (*Spermophilus franklinii*) (NGPC, August 2005). White-tailed deer (*Odocoileus virginianus*) are common big game animals, and mule deer (*Odocoileus hemionus*) are infrequently found in upland grasslands. The most abundant large predator of the region is the coyote (*Canis latrans*), but other predators such as the red fox (*Vulpes vulpes*) and badger (*Taxidea taxus*) can be found as well (NGPC, August 2005). To a lesser degree, the bobcat (*Lynx rufus*), least weasel (*Mustela nivalis*), long-tailed weasel (*Mustela frenata*), and mink (*Neovison vison*) are present but generally occur in wooded areas, wetlands, and along river valleys. A more detailed list of mammals typical of the region is provided in Table E-50.

Table E-50. Mammals of the Region

Common Name	Scientific Name	Common Name	Scientific Name
badger	*Taxidea taxus*	Merriam's shrew	*Sorex maerriami*
beaver	*Castor canadensis*	mink	*Neovison vison*
big brown bat	*Eptesicus fuscus*	mule deer	*Odocoileus hemionus*
black-tailed jackrabbit	*Lepus californicus*	muskrat	*Ondatra zibethicus*
bobcat	*Lynx rufus*	North American river otter	*Lontra canadensis*
Brazilian free-tailed bat	*Tadarida brasiliensis*	northern grasshopper mouse	*Onychomys leucogaster*
bushy-tailed woodrat	*Neotoma cinerea*	northern pocket gopher	*Thomomys talpoides*
cottonrat	*Sigmodon hispidus*	northern short-tailed shrew	*Blarina brevicauda*
coyote	*Canis latrans*	Norway rat	*Rattus norvegicus*
dwarf shrew	*Sorex nanus*	plains harvest mouse	*Reithrodontomys montanus*
eastern cottontail	*Sylvilagus floridanus*	plains pocket gopher	*Geomys bursarius*
eastern mole	*Scalopus aquaticus*	plains pocket mouse	*Perognathus flaveescens*
eastern woodrat	*Neotoma floridana*	porcupine	*Erethrizon dorsatum*
Elliot's short-tailed shrew	*Blarina hylophaga*	prairie vole	*Microtus orchrogaster*
ermine	*Mustela erminea*	raccoon	*Procyon lotor*
fox squirrel	*Sciurus niger*	red bat	*Lasiurus borealis*
Franklin's ground squirrel	*Spermophilius franklinii*	red fox	*Vulpes vulpes*
gray fox	*Urocyon cinereogenteus*	silver-haired bat	*Lasionycteris noctivagans*
gray squirrel	*Sciurus carolinensis*	small-footed myotis	*Myotis ciliolabrum*
hoary bat	*Lasiurus cinereus*	southern bog lemming	*Synaptomys cooperi*
house mouse	*Mus musculus*	striped skunk	*Mephitis mephitis*
Keen's myotis	*Myotis septentionalis*	thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
least chipmunk	*Tamias talpoides*	Townsend's big-eared bat	*Plecotus townsendii*
least shrew	*Cryptotis parva*	Virginia opossum	*Didelphis virginiana*
least weasel	*Mustela nivalis*	western harvest mouse	*Reithrodontomys megalotis*
long-tailed weasel	*Mustela frenata*	white-footed mouse	*Peromyscus leucopus*
masked shrew	*Sorex cinereus*	white-tailed deer	*Odocoileus virginianus*
meadow jumping mouse	*Zapus hudsonicus*	white-tailed jackrabbit	*Lepus townsendii*
meadow vole	*Microus pennsylvanicus*	woodchuck	*Marmota monax*

Sources: NGPC, August 2005, *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*, Lincoln, Nebraska, available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp;
Sidle, John G., and Craig A. Faanes, July 16, 1997, "Platte River Ecosystem Resources and Management, with Emphasis on the Big Bend Reach in Nebraska," Northern Prairie Wildlife Research Center, retrieved on August 5, 2008, http://www.npwrc.usgs.gov/resource/habitat/plrivmgt/index.htm.

Amphibians and Reptiles

Fifty-three species of amphibians and reptiles are found in the Tallgrass Prairie Ecoregion, including two salamanders, five toads, six frogs, eight turtles, up to eight lizard species, and twenty-four snakes (NGPC, August 2005). Although all of the amphibians use wetlands for breeding, the Great Plains toad (*Bufo cognatus*), plains spadefoot toad (*Spea bombifrons*), and Woodhouse toad (*Bufo woodhouseii*) spend most of their adult life in uplands (NGPC, August 2005). The six-lined racerunner (*Cnemidophorus sexlineatus*) and northern prairie skink (*Eumeces septentrionalis*) inhabit dense grasslands and are relatively common but seldom seen (NGPC, August 2005). The five-lined skink (*Eumeces fasciatus*) also inhabits the Tallgrass Prairie Ecoregion but is rare (NGPC, August 2005). The bull snake (*Pituophis catenifer*), fox snake (*Elaphe vulpina*), yellow-bellied racer (*Coluber constrictor*), and plains garter snake (*Thamnophis radix*) are the most common snakes. The timber rattlesnake (*Crotalus horridus*), and copperhead (*Agkistrodon contortrix*) are venomous snakes with highly limited distributions (NGPC, August 2005). A more detailed list of amphibians and reptiles typical of the region is provided in Table E-51.

Table E-51. Amphibians and Reptiles of the Region

Common Name	Scientific Name	Common Name	Scientific Name
Amphibians			
bullfrog	*Rana catesbeiana*	plains spadefoot toad	*Spea bombifrons*
Great Plains toad	*Bufo cognatus*	tiger salamander	*Ambystroma tigrinum*
northern leopard frog	*Rana pipens*	western striped chorus frog	*Pseudacris triseriata*
plains leopard frog	*Rana blairi*	Woodhouse toad	*Bufo woodhousii*
Reptiles			
bull snake	*Pituophis catenifer*	painted turtle	*Chrysemys picta*
copperhead	*Agkistrodon contortrix*	plains garter snake	*Thamnophis radix*
eastern hognose	*Heterodon platyrhinos*	prairie racerunner	*Cnemiodophorus sexlineatus*
five-lined skink	*Eumeces fasciatus*	prairie rattlesnake	*Crotalus viridis*
fox snake	*Elaphe vulpina*	red-sided garter snake	*Thamnophis sirtalis*
lined snake	*Tropidoclonion lineatum*	ringneck snake	*Diadophis punctatus*
many-lined skink	*Eumeces multivirgatus*	six-lined racerunner	*Cnemidophorus sexlineatus*
milk snake	*Lampropeltis triangulum*	snapping turtle	*Chelydra serpentina*
northern earless lizard	*Hobrookia maculata*	spiny softshell turtle	*Apalone spinifera*
northern prairie lizard	*Sceloporus undulatus*	timber rattlesnake	*Crotalus horridus*
northern prairie skink	*Eumeces septentrionalis*	western hognose	*Heterodon nasicus*
northern water snake	*Nerodia sipedon*	yellow-bellied racer	*Coluber constrictor*
ornate box turtle	*Terrapene ornata*		

Sources: University of Nebraska, Lincoln, 2007, *Amphibians and Reptiles of Nebraska*, retrieved on September 22, 2008, http://snrs.unl.edu/herpneb/;
Central Nebraska Public Power and Irrigation District, April 17, 2008, “Reptiles and Amphibians of Lake McConaughy,” *The Central Nebraska Public Power and Irrigation District*, retrieved on August 5, 2008, http://www.cnppid.com/Reptiles_amphibians.htm;
NGPC, August 2005, *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*, Lincoln, Nebraska, available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp.

Distribution of Species

The following wildlife species exist in the vicinity of the Project and are of either commercial, recreational, or cultural importance:

- Bald eagle (*Haliaeetus leucocephalus*) – Nesting or wintering bald eagles are found in close association with water and prefer rivers, lakes, or reservoirs that provide a reliable food source and isolation from disturbing human activities. Large trees and snags along shorelines provide feeding and loafing perches and potential nest sites. Larger stands of mature trees that are free from disturbance provide adequate perches and protection from the winter elements and are needed for communal winter roosting. During the fall and spring migration, when most water areas are ice-free and milder weather conditions are predominate, bald eagles may be seen along virtually any waterway or impoundment in Nebraska. Specific to the Project and during the critical wintering period (December 15 to February 20), bald eagles are commonly seen downstream of the Columbus Powerhouse, where waters remain free of ice and food is available. Recreational viewing of bald eagles is enjoyed by many, and minor commercial value may be seen by communities near bald eagle concentrations; however, the primary importance of the bald eagle is cultural as the bald eagle is a symbol of national pride.
- Beaver (*Castor canadensis*) – Throughout Nebraska, including the immediate vicinity of the Project, beavers are found along streamcourses, rivers, small lakes, and marshes. The significance of the beaver in Nebraska centers on the income generated by the harvest of beaver meat and fur as well as the related recreational value derived from their pursuit. From 1942 to 1986, nearly 400,000 beavers were taken by fur harvesters in Nebraska. Harvest totals from 1981 to 1989 indicate an average annual harvest of 14,850 beavers, valued at $255,000 (NGPC, 2008a).
- Mink (*Neovison vison*) – In Nebraska, including the immediate vicinity of the Project, mink are found where suitable riparian habitat, such as riverbanks and lake shores, occur. Mink are commonly noted along the state's major river systems, including the Lower Platte River. The pelts of wild mink are highly valued. From 1941 to 1989, Nebraska trappers took nearly 390,000 mink. Harvest totals from 1980 to 1989 indicate an average annual harvest of 6,400 mink, valued at over $121,000. In Nebraska, most mink are likely taken in traps set for other furbearers, such as muskrat, raccoon, and beaver (NGPC, 2008a).

- Muskrat (*Ondatra zibethicus*) – Muskrats are found throughout Nebraska wherever suitable aquatic habitat exists, and they are among the most abundant furbearers in Nebraska. In general terms, muskrats require readily accessible water, food, and secure lodging throughout the year, though these requirements vary with the season. In the case of water, the muskrat can tolerate minimal water conditions during summer and fall; however, muskrats are virtually entombed under a layer of ice in the winter and need at least 3 feet of water to survive. Economic value centers on the income generated by the harvest of muskrats by trappers for their meat and fur as well as the recreational value derived from their pursuit. From 1942 to 1989, an estimated 6.1 million muskrats were taken by fur trappers in Nebraska. Harvest totals from 1980 to 1989 indicate an average annual harvest of 95,900 muskrats, valued at over $283,000. Muskrat is highly desirable for the manufacture of women's coats. In addition, musk dried from the animal's glands is used to make perfumes and as a scent for trapping other animals (NGPC, 2008a).
- Northern bobwhite (*Colinus virginianus*) – Although Nebraska lies in the northwest corner of the northern bobwhite quail's range, good populations of northern bobwhite exist in the immediate vicinity of the Project. The northern bobwhite is a popular game bird in the area.
- Raccoon (*Procyon lotor*) – In Nebraska, raccoons are common statewide and are most abundant in eastern Nebraska. The raccoon is an important and valuable furbearer in Nebraska. From 1941 to 1989, more than 1.7 million raccoons were taken by fur hunters and trappers in Nebraska. Harvest totals from 1980 to 1989 indicate an average annual harvest of 73,000 raccoons, with a total value of $1,281,000. This represents over 50 percent of the average annual value of all furbearers harvested in Nebraska from 1980 to 1989. Raccoon pelt prices influence the harvest of all other furbearers as high raccoon pelt prices stimulate harvest of raccoons and other species. The raccoon's durable fur is used in the manufacture of coats, hats, and trimming (NGPC, 2008a).
- Ring-necked pheasant (*Phasianus colchicus*) – Consistent with several states nationwide, the ring-necked pheasant is considered one of the premier upland game birds in Nebraska and in the immediate vicinity of the Project. The ring-necked pheasant could potentially inhabit all uplands in the vicinity of the Project and is readily hunted for its meat. The commercial and recreational importance of the ring-necked pheasant is substantial statewide.

- White-tailed deer (*Odocoileus virginianus*) – The white-tailed deer is the most abundant and most widely distributed game animal in North America. Accordingly, this species is a year-round inhabitant of both the natural and agricultural lands in the vicinity of the Project. Annual harvest in Nebraska has been about 28,000 since 1987. Nebraska hunters spend about 300,000 hunter-days hunting for white-tailed deer each year. The monetary impact of white-tailed deer hunting is substantial as hunters spent about $1.2 million for white-tailed deer hunting permits in 1990. The total amount spent on white-tailed deer hunting in Nebraska is $7 million to $8 million annually (NGPC, 2008a).
- Wild turkey (*Meleagris gallopavo*) – Nebraska's wild turkey range includes most major river drainages, including the Lower Platte River, and the Pine Ridge country in the northwest corner of the state. Turkeys have also adapted to many small, isolated woodlands, shelterbelts, and thinly wooded stream courses. Nebraska ranks 48th in the nation in woodland acreage but 19th in the harvest of wild turkeys. Since Nebraska's first wild turkey season in 1962, about 286,000 permit holders have taken more than 124,000 birds. The 1995 statewide harvest for the spring and fall shotgun and archery seasons was about 8,000 birds (NGPC, 2008a).

In efforts to promote wildlife habitat and conservation, the District has worked with NGPC to develop the Loup Lands Wildlife Management Area[22] (WMA). This is a 485-acre parcel located near the Headworks that is owned by the District and leased to NGPC (see Appendix E-4, Attachment A, Figures A-1 and A-2). The Loup Lands WMA consists of river-bottom habitat/riparian habitat and is open to the public for both wildlife viewing and hunting. All of the above-noted species may inhabit the Loup Lands WMA.

In addition, the Lake Babcock Waterfowl Refuge is partially located within the Project Boundary and is the direct result of Project construction and ongoing operation. The refuge consists of Lake Babcock, Lake North, and adjoining lands and is regulated by NGPC (see Appendix E-4, Attachment A, Figure A-3). The refuge was established in the 1940s to provide and conserve waterfowl habitat. At the refuge, hunting is prohibited, boating is restricted during open waterfowl season, and fishing is restricted in Lake Babcock but allowed year-round in Lake North (163 Nebraska Administrative Code [NAC] 4-019).

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[22] Nebraska's state wildlife areas are managed by NGPC's Wildlife Division for the enhancement of wildlife habitat and for public hunting and fishing. However, they are open to many other activities, including hiking, bird watching, nature study, and primitive camping.

E.6.4.2 Environmental Analysis

Resource agencies and stakeholders did not request studies to address Project effects on wildlife and botanical resources (that are not protected under the authority of the Endangered Species Act) or invasive species. Consequently, specific studies to assess Project effects on these resources were neither included in FERC's August 26, 2009, Study Plan Determination, nor conducted by the District.

Because the District's Draft License Application includes minimal deviations from existing operations (generally limited to recreation improvements), the District anticipates no adverse effects on wildlife or botanical resources resulting from the following:

- Habitat clearing or development – The District's only planned development includes the construction of a wheelchair-accessible fishing pier on Lake North, a permanent restroom facility at Headworks Park, and a 2,000-foot trail for pedestrians and bicyclists along the southeast side of Lake Babcock. None of these plans occur in locations noted for wildlife habitat or as containing notable botanical communities.
- Habitat fragmentation – The District is planning no new development that would fragment wildlife habitat. As currently located, the Loup Power Canal would continue to fragment agricultural land that constitutes little terrestrial habitat value. This does not represent an adverse effect on terrestrial wildlife, by way of fragmentation or entrapment, as resident populations are well adapted to an environment that includes this feature.
- Impacts on feeding, reproduction, or migration – The District is planning no operational changes that would adversely affect wildlife feeding, reproduction, or migration. The District would continue to comply with regulations applicable to the NGPC-managed Lake Babcock Waterfowl Refuge.
- Transmission line collision – All power produced at the Project is sold at the on-site substations to NPPD. For this reason, the Project includes no overhead transmission voltage lines. Furthermore, no overhead transmission voltage lines are proposed under the District's Draft License Application.
- Recreational activities – Project-related recreational activities are largely concentrated at the District's five developed recreation areas. Because the District's Draft License Application includes improvements only within these previously developed areas, and because these areas represent a small fraction of the cumulative Project area, no adverse effects on wildlife and botanical resources are anticipated. Consistent with current NGPC hunting regulations and area management strategies, public hunting opportunities would continue at the Loup Lands WMA.

- Invasive species – The District's Draft License Application includes no activities or developments that would promote the spread of invasive species. Conversely, in 2011, the District posted educational signage to deter the spread of these species (see Section E.6.7.3).

Bald eagles are noted as concentrating themselves in areas where waters remain free of ice and where food is available during the critical wintering period of December 15 to February 20 (NGPC, 2008a). The Project provides such an area downstream of the Columbus Powerhouse; as a result, bald eagles are commonly observed in this location. The District recognizes the species' protected status established by the Bald and Golden Eagle Protection Act (16 USC 668a-d) and the Migratory Bird Treaty Act (16 USC 703-712). District operations comply with these acts, including surveys associated with the Migratory Bird Treaty Act, as appropriate, during the licensing period (see Section E.6.4.3).

E.6.4.3 Proposed Environmental Measures

The District understands that the Migratory Bird Treaty Act (16 USC 703-712) regulates the take of migratory birds, eggs, young, and/or active nests and that most migratory bird nesting activity in Nebraska occurs during the period from April 1 to July 15. In order to maintain compliance, the District will continue to employ the following procedure when initiating any action that could result in a potential take. Furthermore, associated documentation would be provided to FERC and/or USFWS, as appropriate:

- A qualified biologist would conduct a field survey of the affected habitats and structures to determine the absence or presence of nesting migratory birds.
- Survey documentation would be prepared and would include biologist qualifications, survey methods, date and time of survey, species observed/heard and location, avoidance measures implemented, and circumstances where it has been determined that one or more active bird nests cannot be avoided.

The District proposes to continue its recently executed public outreach initiative related to invasive species. More specifically, the District will maintain the recently placed signage specific to invasive species control and will evaluate additional outreach methods, if determined necessary.

The District proposes its continued compliance with regulations applicable to the NGPC-managed Lake Babcock Waterfowl Refuge.

E.6.4.4 Unavoidable Adverse Impacts

Considering the District's Draft License Application, including the above-stated proposed environmental measures, no Project-induced adverse impacts on wildlife and botanical resources have been identified.

E.6.4.5 Cumulative Impacts

No Project-specific impacts on wildlife and botanical resources have been identified; therefore, the Project does not contribute to the cumulative resource impact resulting from past, present, and reasonably foreseeable future actions.

E.6.5 Wetlands, Riparian, and Littoral Habitat

E.6.5.1 Existing Environment

Floodplain

A floodplain is the area adjacent to a watercourse that is inundated by a particular flood event. It includes the floodway, which consists of the channel and any adjacent areas that carry flood flows. The 100-year floodplain is that which has a 1 percent annual chance of being flooded. The Project, however, has no defined flood flows, no floodplain, and no floodway. The 35-mile-long Loup Power Canal is an artificial conduit, not a natural watercourse. It is completely gated at the upstream end and was designed to accommodate all inflow from its insignificant drainage area. Natural flood hydrology and analysis are neither appropriate nor relevant to the Loup Power Canal.

Natural floodways and floodplains do exist along the Loup River and lower Platte River at either end of the Project. Flood studies have been performed for both rivers, and Federal Emergency Management Agency (FEMA) flood insurance maps are available for both Nance and Platte counties. A 100-year flood event on the Loup River would overtop, and probably damage, the Diversion Weir, but it would not otherwise impact the Project Headworks or disrupt Project operations. A 500-year flood event, similar to that experienced in 1966, could inundate much of the Headworks area and impact water levels in the Upper Power Canal downstream to Genoa. An event of this magnitude would disrupt Project operations. A 100-year flood event on the Platte River at Columbus would overtop the Outlet Weir and raise the water level in the Tailrace Canal upstream to the Columbus Powerhouse. Project operations would not be disrupted, but the Tailrace Park area would likely be inundated.

Project operations in winter include special procedures to deal with cold temperatures and ice conditions. Frazil ice, also known as slush ice because of its appearance, is formed only in turbulent supercooled water. When frazil ice is observed in the Loup River at the Diversion Weir, District operating procedures require gate operators to close the intake gates and cease admitting water to the canal. When conditions change and frazil ice is no longer observed near the Diversion Weir, the operators open the intake gates and resume diversion of water into the canal.

Historical records show that severe ice jams have occurred in the lower Loup River and the lower Platte River with some regularity since long before District hydroelectric operations began in the late 1930s. These events prompted two related studies by USACE on ice jam formation and resultant flooding in the lower Platte River Basin. The two USACE reports are titled "Lower Platte River Ice Jam Flooding" (July 1994) and "Ice Jam Flooding and Mitigation: Lower Platte River Basin, Nebraska" (January 1996). Neither report identified responsible parties, structures, or events related to the ice jam formation or resultant flooding.

Wetlands

Wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR §328). Neither wetland delineations (in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual* [Environmental Laboratory, January 1987]) nor vegetative surveys have been conducted in the vicinity of the Project. Instead, wetlands have been identified and their areas approximated through the use of National Wetlands Inventory (NWI) mapping[23] and aerial imagery.

Based on NWI maps, there are approximately 3,110 acres of wetlands in the vicinity of the Project. The wetland systems along the Loup Power Canal are classified as primarily lacustrine and riverine because of the canal and regulating reservoirs (see Table E-52). The NWI maps also show sporadic patches of palustrine, forested/scrub shrub, emergent, aquatic bed, and other unclassified wetland types in the vicinity of the Project. The specific wetland types and areas are listed in Table E-52 and are shown in Appendix E-1, Figure E-15, Sheets 1 through 14.

[23] NWI digital data files are records of wetland locations and classifications as developed by USFWS. The data provide consultants, planners, and resource managers with information on wetland locations and types. It is not the intent of NWI to produce maps that show exact wetland boundaries comparable to boundaries derived from ground surveys. Boundaries are therefore generalized in most cases. The quality of the wetland data is variable mainly due to source photography, ease or difficulty in interpreting specific wetland types, and survey methods. Wetland types and areas (boundaries) in the vicinity of the Project are also subject to the NWI variability described by USFWS.

Table E-52. Wetland Types in the Vicinity of the Project

Wetland Type		Area (acres)	Percent
Lacustrine[a]	unconsolidated bottom[d]	1,310	42.1
Riverine[b]	lower perennial[e] with an unconsolidated bottom	840	27.1
Palustrine[c]	forested/scrub shrub	660	21.1
	emergent	230	7.5
	aquatic bed[f]	40	1.4
Other	unclassified	30	0.8
Total		3,110	100.0

Source: USFWS, 1992, "National Wetlands Inventory – Nebraska." St. Petersburg, FL: USFWS, NWI.

Notes:

[a] Lacustrine – a system that includes wetland and deepwater habitats that are situated in a topographic depression or dammed river channel, lacking persistent vegetation with greater than 30 percent aerial coverage, and with a total area exceeding 20 acres (Cowardin et al., December 1979).

[b] Riverine – a system including all wetlands and deepwater habitats contained within a channel excluding wetlands dominated by persistent vegetation or wetlands containing oceanic salts in excess of 0.5 parts per thousand (Cowardin et al., December 1979).

[c] Palustrine – a system that includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, mosses, or lichens; the area is less than 20 acres and water depth in the deepest part of the basin is less than 2 meters at low water (Cowardin et al., December 1979).

[d] Unconsolidated bottom – At least 25 percent of the bottom is covered with particles smaller than stones and has a vegetative cover of less than 30 percent.

[e] Lower perennial – a system where the gradient is low and the water velocity is slow. There is no tidal influence, and some water flows throughout the year. The substrate consists or rock, cobbles, or gravel with occasional patches of sand (Cowardin et al., December 1979).

[f] Aquatic bed – wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years (Cowardin et al., December 1979).

The Project has created substantial wetland areas and several wetland types along the Settling Basin, the Upper and Lower Power Canals, Lake Babcock, Lake North, and the Tailrace Canal. The American lotus (*Nelumbo lutea*), part of the lily family, can be found in Lake Babcock. This American lotus population is the furthest west population until California (USDA NRCS, 2008).

Photo E-29. American lotus at Lake Babcock.

Without the continual supply of water, diverted from the Loup River in association with Project operations, the lacustrine and riverine systems present within the Project Boundary would no longer function as classified. Potential reductions in water diversion may cause the existing wetlands to transition to either a palustrine wetland system or upland environment.

Riparian Habitat

Riparian habitat is defined as the "transition zone between aquatic and upland habitat. These habitats are related to and influenced by surface or subsurface waters, especially the margins of streams, lakes, ponds, wetlands, seeps, and ditches" (National Water Quality Monitoring Council, August 8, 2007).

The only obvious riparian habitat within the Project Boundary occurs near the Headworks, along the Loup River; however, there has been no systematic survey conducted that documents riparian habitat within the Project Boundary. Due to the close proximity of agricultural practices along the majority of the Loup Power Canal, adjacent riparian habitat is limited.

Littoral Habitat

Littoral habitat is defined as a zone that extends from the bank of a waterbody to a depth of 6.6 feet or to the maximum extents of non-persistent vegetation if found at depths greater then 6.6 feet (Cowardin et al., December 1979). There is littoral habitat near and around the Headworks as well as Lake Babcock and Lake North; however, there has been no systematic survey conducted that documents littoral habitat within the Project Boundary.

Plant and Animal Species

Plant species commonly found in the wetland, riparian, and littoral habitat in the vicinity of the Project are listed in Table E-53 and in Section E.6.4, Wildlife and Botanical Resources, above.

Table E-53. Common Wetland Plants

Common Name	Scientific Name	Indicator Status[b]
American elm	*Ulmus americana*	FAC
black medick	*Medicago lupulina*	FAC
box elder	*Acer negundo*	FAC
Eastern cottonwood	*Populus deltoides*	FAC
prairie blazing star	*Liatris pycnostachya*	FAC
river-bank grapevine	*Vitis riparia*	FAC
roughleaved dogwood	*Cornus drummondii*	FAC
Russian olive[a]	*Elaaeagnus angustifolia*	FAC
switchgrass	*Panicum virgatum*	FAC
barnyard grass	*Echinochloa crus-galli*	FACW
fringed loosestrife	*Lysimachia ciliata*	FACW
green ash	*Fraxinus pennsylvanica*	FACW
peachleaf willow	*Salix amygdaloides*	FACW
prairie cordgrass	*Spartina pectinata*	FACW
red-osier dogwood	*Cornus stolonifera*	FACW
reedcanary grass[a]	*Phalaris arundinacea*	FACW
salt cedar[a]	*Tamarix ramosissima*	FACW
silver maple	*Acer saccarinum*	FACW
American lotus	*Nelumbo lutea*	OBL
arrowhead	*Sagittaria spp.*	OBL
bur-reed	*Sparganium spp.*	OBL
cattail	*Typha spp.*	OBL
common threesquare bulrush	*Schoenoplectus pungens*	OBL
false indigo	*Amorpha fruticosa*	OBL
lanceleaf fogfruit	*Phyla lanceolata*	OBL
purple loosestrife[a]	*Lythrum salicaria*	OBL
sandbar willow	*Salix exigua*	OBL
sedge	*Carex spp.*	OBL/FACW
spikerush	*Eleocharis spp.*	OBL/FACW
smartweed	*Polygonum spp.*	OBL/FACW/FAC
leafy spurge[a]	*Euphorbia esula*	NI

Sources: Sidle, John G., and Craig A. Faanes, July 16, 1997, "Platte River Ecosystem Resources and Management, with Emphasis on the Big Bend Reach in Nebraska," Northern Prairie Wildlife Research Center, retrieved on August 5, 2008, http://www.npwrc.usgs.gov/resource/habitat/plrivmgt/index.htm;
NGPC, August 2005, *The Nebraska Natural Legacy Project: A Comprehensive Wildlife Conservation Strategy*, Lincoln, Nebraska, available online at http://www.ngpc.state.ne.us/wildlife/programs/legacy/review.asp.

Notes:

[a] Invasive species.

[b] Indicator status – the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetlands versus non-wetlands across the entire distribution of the species (USDA NRCS 2008):

FAC = Facultative; equally likely to occur in wetlands or non-wetlands (estimated probability 34 to 66 percent).

FACW = Facultative Wetland; usually occurs in wetlands (estimated probability 67 to 99 percent), but occasionally found in non-wetlands.

OBL = Obligate Wetland; occurs almost always (estimated probability 99 percent) under natural conditions in wetlands.

NI = Not Indicated

Invasive wetland plant species that may occur in the vicinity of the Project include, Russian olive (*Elaaeagnus angustifolia*), reedcanary grass (*Phalaris arundinacea*), leafy spurge (*Euphorbia esula)*, purple loosestrife (*Lythrum salicaria)*, common reed (*Phragmites australis*), and salt cedar (*Tamarix ramosissima)* (Sidle and Faanes, July 16, 1997; NGPC, August 2005). The District periodically applies appropriate treatment to *Phragmites* in Lake Babcock. The most recent application occurred in 2009.

Several species of fish, birds, mammals, amphibians, and reptiles are known to inhabit wetland, riparian, and littoral habitat similar to that in the vicinity of the Project. Some of the more common species include the largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), plains topminnow (*Fundulus sciadicus*), red-winged blackbird (*Agelaius phoeniceus*), mallard (*Anas platyrynchos*), Canada goose (*Branta canadensis*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), beaver (*Castor canadensis*), bullfrog (*Rana catesbeiana*), tiger salamander (*Ambystroma tigrinum*), Great Plains toad (*Bufo cognatus*), snapping turtle (*Chelydra serpentine*), painted turtle (*Chrysemys picta*), and the fox snake (*Elaphe vulpine*) (NGPC, August 2005). For a more comprehensive list of animal species in the vicinity of the Project, see Sections E.6.3, Fish and Aquatic Resources, and E.6.4, Wildlife and Botanical Resources, above.

Clean Water Act Section 404 Permit

The District has received ongoing authorization from USACE to discharge dredged material from the Settling Basin to the South SMA. Most recently, the District was provided CWA Section 404 Permit (Permit No. 2007-3190-KEA) on January 8, 2010.

As documented in the referenced permit, USACE has determined that a CWA Section 404 permit is not necessary for Project discharges to the North Sand Management Area (USACE January 8, 2010). The District's Section 404 permit is provided in Appendix E-5.

E.6.5.2 Environmental Analysis

Resource agencies and stakeholders did not request specific studies to address Project effects on wetland, riparian, and littoral habitat. Consequently, specific studies to assess Project effects on these resources were neither included in FERC's August 26, 2009, Study Plan Determination, nor conducted by the District.

Resource agencies did request evaluation of Project operations on ice jam flooding in the Loup River bypass reach. To address this request, the District commissioned the USACE Omaha District to perform relicensing Study 12.0, Ice Jam Flooding on the Loup River, to determine whether Project operations promote ice-induced flooding downstream of the Project. Study findings are summarized as follows:

- A review of flood history shows that the occurrence of significant ice jam flooding has not increased since the Loup Power Canal commenced operations.
- A lack of historical data precludes a similar comparison of minor ice-affected flooding; however, a thorough review of climatological data and use of hydraulic models does not show a difference in the occurrence of minor ice-affected flooding due to operation of the Loup Power Canal.
- Other factors, such as climatic variability and floodplain developments, may lead to an increased flood risk during an ice jam; however, as these factors are often subtle over time, they may be overlooked as a cause of increased flood risk.
- USACE concluded that the Loup Power Canal has not significantly changed the ice regime of the Loup River between the Headworks and its confluence with the Platte River, nor has it increased the risk of significant ice jam flooding.

In association with the District's Study 5.0, Flow Depletion and Flow Diversion, an aerial photo interpretation exercise was conducted for areas above and below the Diversion Weir. This analysis has relevance to a consideration provided in FERC's Scoping Document 2 (Section 4.2.3, page 20) regarding the effects of Project diversions and flow fluctuations on wetland and riparian vegetation establishment and composition in the Loup River bypass reach. The analysis determined that Loup River sandbars located upstream of the Diversion Weir are less frequently vegetated than those downstream of the Diversion Weir.[24] Similar analysis was not conducted for the Platte River; however, detailed relicensing-associated consumptive use analysis determined that Project diversions do not result in flow depletions to the lower Platte River (see Section E.6.2.2); therefore, the Project does not diminish the availability of hydrology adequate to sustain wetland conditions along the lower Platte River.

Regarding potential effects of hydrocycling on wetland development along the lower Platte River, the District has determined that the daily flow, and associated stage, fluctuations that result from the Project do not adversely impact this resource. For regulatory purposes under the CWA, the term wetlands is defined as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (40 CFR §230.3(t)). When considering that the Project operates on a daily cycle, the flow peaks occur at an interval frequent enough (daily) to maintain adequate wetland hydrology in riparian or riverine floodplain areas prone to wetland development.

E.6.5.3 Proposed Environmental Measures

The District understands the function that floodplains, wetlands, and riparian and littoral habitat have related to water quality, wildlife habitat, and flood storage. With this understanding, the District will do the following:

- Avoid and minimize impacts on these resources during construction activities associated with the planned recreation improvements and throughout normal operations.
- Comply with the conditions provided in its existing CWA Section 404 Permit (Permit No. 2007-3190-KEA). This permit was most recently issued on January 8, 2010, and authorizes dredging activities at the Settling Basin that discharges to the South SMA.[25]
- Continue periodic treatment of undesirable *Phragmites* in Lake Babcock.

E.6.5.4 Unavoidable Adverse Impacts

Considering the District's Draft License Application, including the above-stated proposed environmental measures, no Project-induced adverse impacts on wetlands, riparian, and littoral habitat have been identified.

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[24] Unvegetated sandbars do not meet USACE wetland criteria. Vegetated sandbars may meet wetland criteria, depending on the plant species present, available hydrology, and hydric soil indicators.

[25] USACE has determined that a CWA Section 404 permit is not necessary for Project discharges to the North SMA.

E.6.5.5 Cumulative Impacts

No Project-specific impacts on wetlands, riparian, and littoral habitat have been identified; therefore, the Project does not contribute to the cumulative resource impact resulting from past, present, and reasonably foreseeable future actions.

E.6.6 Rare, Threatened, and Endangered Species

E.6.6.1 Existing Environment

Federal and state agencies list a number of species that occur in the vicinity of the Project as rare, threatened, or endangered (RTE). The RTE species that are known to occur in Nance and Platte counties as well as in adjacent counties with tributaries to the Loup River or with portions of the Lower Platte River are listed in Table E-54. For each species, the Federal status under the Endangered Species Act of 1973 (ESA) and state status under Nebraska's Nongame and Endangered Species Conservation Act (NESCA) are shown. In addition, the NatureServe conservation status global and state ranks are provided for each species. These ranks provide an estimate of extinction risk and are based on a one-to-five scale, ranging from critically imperiled (1) to demonstrably secure (5). These status assessments are based on the best available information and consider a variety of factors, such as abundance, distribution, population trends, and threats (NatureServe, 2008). Detailed descriptions, including species occurrence, history, and habitat requirements, of the species listed in Table E-54 are provided in Section 5.6.3, below.

Table E-54. RTE Species that May Occur in the Vicinity of the Project or May Be Affected by the Project[a]

Common Name	Scientific Name	Federal Status[a]	State Status[a]	Global Rank[b]	State Rank[b]	Nearest County of Known Occurrence
Birds						
interior least tern	*Sterna antillarum athalassos*	E	E	G4T2Q	S2	Nance and Platte
piping plover	*Charadrius melodus*	T	T	G3	S2	Nance and Platte
whooping crane	*Grus americana*	E	E	G1	S1	Nance
Mammals						
North American river otter	*Lontra canadensis*		T	G5	S2	Boone

Common Name	Scientific Name	Federal Status[a]	State Status[a]	Global Rank[b]	State Rank[b]	Nearest County of Known Occurrence
Fish						
pallid sturgeon	*Scaphirhynchus albus*	E	E	G2	S1	Platte
lake sturgeon	*Acipenser fulvescens*		T	G3G4	S1	Colfax
sturgeon chub	*Macrhybopsis gelida*		E	G3	S1	Nance and Platte
Plants						
small white lady's slipper	*Cypripedium candidum*		T	G4	S1	Platte
western prairie fringed orchid	*Platanthera praeclara*	T	T	G3	S3	Boone

Sources: Associated General Contractors – Nebraska Chapter, 2007, "Nebraska Threatened and Endangered Species Identification Guide," available online at http://www.nlc.state.ne.us/epubs/R6000/H053-2007.pdf;
NatureServe, 2008, *NatureServe Explorer: An Online Encyclopedia of Life* [web application], Version 4.6, Arlington, VA: NatureServe, retrieved on May 9, 2008, http://www.natureserve.org/explorer/.

Notes:

[a] E = endangered; T = threatened.

[b] G = global

S = state

1 = Critically imperiled because of extreme rarity (5 or fewer occurrences)

2 = Imperiled because of rarity (6 to 20 occurrences)

3 = Rare or uncommon (on the order of 21 to 100 occurrences)

4 = Apparently secure

5 = Demonstrably secure

T = Infraspecific taxon (trinomial), refers to a subspecies or variety and is used only in global ranks (for example, G2T2)

Q = Questionable taxonomy (either the taxon is not generally recognized as valid or there is reasonable concern about its validity or identity, globally or at the state level)

Available Reports Pertaining to RTE Species

The most recent, available reports (including biological assessments, biological opinions, conservation assessments, management plans, and recovery plans) that have been written about the species identified in Table E-54 are listed in Table E-55. These reports were developed by or in cooperation with Federal and state agencies to provide detailed, site-specific management actions for private, Federal, and state cooperation in conserving listed species and their ecosystems (USFWS, April 2008).

Table E-55. Reports Pertaining to Federally and State-listed RTE Species

Species	Report	Report Type
interior least tern	U.S. Fish and Wildlife Service. September 1990. "Recovery Plan for the Interior Population of the Least Tern (*Sterna antillarum*)." Twin Cites, MN: U.S. Fish and Wildlife Service.	Management plan
piping plover	U.S. Fish and Wildlife Service. June 28, 1994. "Draft Revised Recovery Plan for Piping Plovers (*Charadrius melodus*) Breeding on the Great Lakes and Northern Great Plains." Twin Cites, MN: U.S. Fish and Wildlife Service.	Management plan
piping plover	67 Federal Register (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.	Management plan
whooping crane	Canadian Wildlife Service and U.S. Fish and Wildlife Service. March 2007. International Recovery Plan for the Whooping Crane (*Grus americana*). Ottawa: Recovery of Nationally Endangered Wildlife (RENEW) and U.S. Fish and Wildlife Service, Albuquerque, New Mexico.	Management plan
whooping crane	43 FR 20938-20942. May 1978. "Endangered and Threatened Wildlife and Plants, Determination of Critical Habitat for the Whooping Crane; Final Rule." Department of the Interior, Fish and Wildlife Service.	Management plan
North American river otter	Boyle, Steve. September 2, 2006. "North American River Otter (*Lontra canadensis*): A Technical Conservation Assessment." USDA Forest Service, Rocky Mountain Region.	Conservation assessment
pallid sturgeon	U.S. Fish and Wildlife Service. 1993. "Pallid Sturgeon (*Scaphirhynchus albus*) Recovery Plan." Bismarck, ND: U.S. Fish and Wildlife Service.	Management plan

Species	Report	Report Type
pallid sturgeon	Peters, Edward J., and James E. Parham. 2007. "Draft Ecology and Management of Sturgeon in the Lower Platte River, Nebraska." Nebraska Technical Series No. 18. Nebraska Game and Parks Commission. Lincoln, NE.	Management plan
sturgeon chub	U.S. Fish and Wildlife Service. March 2001. "Updated Status Review of the Sicklefin and Sturgeon Chub in the United States." Denver: U.S. Fish and Wildlife Service.	Status review
western prairie fringed orchid	U.S. Fish and Wildlife Service. 1996. "*Platanthera praeclara* (Western Prairie Fringed Orchid) Recovery Plan." Ft. Snelling, MN: U.S. Fish and Wildlife Service.	Management plan

Federally Designated Critical Habitat

Federally designated critical habitat is defined as specific geographic areas that contain physical or biological features essential to the conservation of the species that may require special management considerations or protection under the ESA (National Research Council, 2005). Although there is Federally designated critical habitat for the whooping crane in central Nebraska (discussed in detail below), there is currently no Federally designated critical habitat for any of the RTE species in the vicinity of the Project.

Critical habitat was designated for piping plovers on September 11, 2002 (67 FR 57638-57717). The critical habitat designation in Nebraska included the Platte River from Lexington, Nebraska, to the confluence 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, U.S. District Judge Lyle Strom vacated and remanded all critical habitat designation in Nebraska (that is, on the Loup, Platte, and Niobrara rivers). 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.

Federally Listed Threatened or Endangered Species

For each Federally listed RTE species that may occur in the vicinity of the Project or may be affected by Project relicensing, the species occurrence, life history, and habitat requirements are discussed below.

Interior Least Tern

Interior least tern and eggs. Copyright © Nebraska Game and Parks Commission. All rights reserved.

The interior population of the least tern was Federally listed as endangered on May 28, 1985 (50 FR 21784-21792). In 1990, USFWS issued a recovery plan for the interior least tern (USFWS, 1990). On April 22, 2008, USFWS initiated a 5-year review of this species (73 FR 21643-21645). The 5-year review for this species is ongoing, and no report has been published to date. No critical habitat has been designated for the interior least tern.

Least terns (all currently recognized subspecies/populations) are the smallest members of the subfamily Sterninae and family Laridae of the order Charadriiformes. Adults measure approximately 8 to 9.5 inches long, with a 20-inch wingspan. The birds have a black cap, a white forehead, grayish back and dorsal wing surfaces, and a black-tipped bill (USFWS, September 1990).

The interior least tern is a migratory species, breeding along large rivers within the interior of the United States. They typically begin arriving in Nebraska in early May to mid-June and spend approximately 4 to 5 months at their breeding sites (Faanes, 1983; USFWS, September 1990). Pairs form after arrival to the nesting areas. Courtship typically lasts approximately 2 to 3 weeks from late April to late May (Thompson et al., 1997). Arrival and courtship of interior least terns in the Northern Great Plains region generally occurs later than in other areas due to high river water levels during this time period (Hardy, 1957, as cited in Thompson et al., 1997).

Interior least terns nest in shallow depressions with small stones, twigs, or other debris nearby. Interior least terns nest in colonies, or terneries, and nests can be as close as just a few feet apart or widely scattered up to hundreds of feet. Egg-laying typically begins in late May, with the female laying one to three eggs in a nest (Thompson et al., 1997; USFWS, September 1990; Szell and Woodrey, 2003). Incubation typically lasts 17 to 28 days (Thompson et al., 1997; USFWS, September 1990).

Interior least tern chicks are able to walk upon hatching, but are brooded for approximately 1 week and fledged after 3 weeks, although parental care continues until fall migration (USFWS, September 1990). Departure from colonies by both adults and fledglings varies, but is usually complete by early September.

Interior least terns are associated with the piping plover (*Charadrius melodus*) at nesting sites in the Loup, Platte, Niobrara, Elkhorn, and Missouri rivers. Interior least terns typically use the same habitat for nesting and nest in the same areas as piping plovers; therefore, interior least terns and piping plovers are considered nesting associates.

Interior least terns are opportunistic feeders and feed on a variety of small fishes found in the shallow waters of rivers, streams, and lakes. Adult terns usually consume fish longer than 1.6 inches and bring smaller fish to the nest for the chicks (Mitchell, March 1998). Interior least terns are categorized as surface plungers because they search for prey while flying or hovering above the surface of the water and plunge into the water to capture detected prey (Mitchell, March 1998).

Meandering rivers with broad flat floodplains, high sedimentation rates, and slow currents resulting in the formation of sandbars and shallow water areas offer the most suitable habitat for nesting and feeding (Whitman, 1988, as cited in Lott, November 2006). Typical riverine nesting habitat for interior least terns is unvegetated or sparsely vegetated sand and gravel bars within a wide unobstructed river channel (USFWS, September 1990). The braided lower Platte River in Nebraska contains habitat that is consistent with these typical riverine nesting conditions and appears to be of a higher quality and suitability than other nesting locations in Nebraska (NGPC, 2008). The Loup River, also braided below the diversion weir, while narrower in width than the lower Platte River, also provides sparsely vegetated sand and gravel bars that are used for nesting.

An important factor for nest site selection of interior least terns is continuous exposure of the site above water for at least 100 days during the nesting period from mid-May to early August (Smith and Renken, 1993) to allow sufficient time for nesting and fledging of young. The sandbar habitats in the lower Platte River used by interior least terns are ephemeral (Kirsch, 1996; Thompson et al., 1997); thus, interior least tern nests are susceptible to loss of nests, eggs, or chicks caused by storm and flood events. Nesting is usually initiated during high-flow periods, causing interior least terns to nest on higher areas of sandbars.

Another important factor for nesting habitat for interior least terns is lack of vegetation at the nest site. Suitable nesting areas often contain little vegetation (less than 25 percent) (Ziewitz et al., 1992), and the vegetation that is present is typically less than 3.9 inches tall (Dirks et al., 1993). Wilson et al. (1993) and Dirks et al. (1993) found that nesting interior least terns on sand pits preferred areas of less than 10 percent vegetative cover. Smith and Renken (1993) found that a common feature of nesting habitat is the presence of large amounts of sticks, twigs, and bark (driftwood) deposited by receding river levels near nesting colonies.

Nesting sites on river sandbars are often found within relatively wide channels with a large area of dry, sparsely vegetated sand (Kirsch, 1996). Nest sites in the lower Platte River had an average of 3.58 acres of dry, sparsely vegetated sand (Ziewitz et al., 1992). Ziewitz et al. (1992) also found that birds nested in areas where the channel was wider with a greater area of sandbars. That study recommended that sandbars be at least 3.58 acres in size and be 2.99 feet above river level for maximum flooding protection and at a minimum 1.48 feet in height. In a preliminary study, Brown and Jorgensen (2008) looked at river nesting habitat used by interior least terns in the lower Platte River in Nebraska. They found that the average sandbar area used was 12.18 acres. The average elevation of sandbars selected by interior least terns for nesting was 2.29 feet above the surface of the water.

Additional research (Elliot, 2009 and 2011) was conducted that developed a geomorphic classification of the lower Platte River. This research identified discrete reaches of the Platte River with processes necessary for the maintenance of nesting habitat. The analysis included an evaluation (based on July 2006 National Aerial Imagery Program [NAIP] aerial photography) of river channel width, valley width, channel curvature (sinuosity), and in-channel habitat features. A multivariate classification was performed to determine the classification of reaches based on clustering of geomorphic features. The geomorphic variables are valley width, channel width, 1.25-mile sinuosity, and 5-mile sinuosity. Results from these analyses showed that the section from the Loup River to the Elkhorn River was dominated by intermediate valley width, low to medium sinuosity, and high channel widths. The widest reaches of the lower Platte River are located in the segment from the Loup River to the Elkhorn River.

In addition, total channel width and habitat measures were analyzed to develop relations between channel width and habitat features. The segment of the Platte River from the Loup River to the Elkhorn River has the widest valley width and highest degree of braiding, with many large, vegetated islands. However, while there is considerable variation in channel width between reaches, the mean active channel width is similar throughout the lower Platte River (1,500 feet).

General conclusions were that interior least tern and piping plover nest sites from 2006 to 2008 occurred in reaches that were narrower than reaches with large percentages of dark vegetation (indicating vegetatated mid-channel or point bars) or that were highly braded. These areas were predominantly downstream of the Elkhorn River confluence as there were more river nests per mile in the segement of the lower Platte River dowsnstream from the Elkhorn River. This reach was also represented by narrow valley widths with low to medium sinuosity.

The Project has no effect on valley width or high flow events. Channel narrowing was not identified in the District's Study 5.0, Flow Depletion and Flow Diversion, below the Loup River confluence.

In some areas, sand/gravel pits and lakeshore housing developments provide the most suitable nesting habitat available when the interior least terns arrive in the spring (Lingle, 1988, as cited in NGPC, December 2008). These sand-pit lakes are often found in close proximity to the river and, if managed, produce a higher nesting-to-fledgling ratio than human-created river sandbars and unmanaged sandpits (Jenniges and Plettner, 2008); however, these habitats may be temporary as vegetation re-growth or reclamation occurs on abandoned pits and their suitability for nesting diminishes when no longer managed (Brown et al., 2008; Sidle and Kirsch, 1993).

Nesting areas at sand-pit sites have been characterized by expansive areas of sand with large areas of surface water (Kirsch, 1996). When Kirsch (1996) examined interior least tern preference of habitat between river sandbar habitat and man-made sand-pit habitat, four out of five criteria for judging habitat preference suggested that interior least terns did not prefer one habitat over the other. Additionally, mortality of young and productivity did not differ between these two habitats (Kirsch, 1996). The results of that study suggested that bare sand and proximity to other important resources may be enough for interior least terns to colonize a site, and interior least terns may not differentiate between sandbars and sand pits as suitable nesting habitat (Kirsch, 1996). Jenniges and Plettner (2008) found that interior least terns preferred managed sand-pit sites over human-created river sandbars, with 473 birds observed at managed sand pits versus 49 birds observed at constructed river islands over a 15-year study period. Sidle and Kirsch (1993) found classified suitable sand pits on the Platte River as ranging in size from 1.48 to 496.79 acres. The sand and gravel areas of these sites ranged from 0.49 to 425.50 acres, and the surface area of water ranged from 0.99 to 149.75 acres. The Project's North and South SMAs, near the Diversion Weir on the Loup River, were considered as one site during that study, and this area was the largest site reviewed at 496.79 acres, with 425.50 acres of sand and gravel and 70.67 acres of water.

Interior least terns winter in South America, where little is known about their wintering habits and habitats, and they reproduce in the summer months in North America. Historically, the interior least tern's breeding range extended from Montana to Texas and from southern Indiana to New Mexico, and this breeding range has not changed. This species breeds, nests, and forages along the Missouri, Mississippi, Arkansas, Ohio, Red, and Rio Grande river systems (USFWS, September 1990).

A range-wide census for this species was not implemented until 2005. However, least terns were previously counted during the International Piping Plover Census. In 2003, the population of the interior least tern across this species' entire range was estimated to be 12,000 individuals (USFWS, September 2003). The 2005 range-wide census determined a population total of 17,591 across the interior least tern's entire range (Lott, November 2006). This number is considerably higher than the previous range-wide estimate. To meet the recovery goals set in the USFWS recovery plan, the aforementioned numbers of birds and their geographic distribution need to be maintained for over 10 years (USFWS, 1990).

Lott found that the lower Mississippi River is the most important breeding area for this species, with approximately 62.3 percent of all interior least terns surveyed occurring on the lower Mississippi (Lott, November 2006). Four additional river systems accounted for 33.3 percent of the remaining interior least terns. The overall results of the census are as follows:

- Lower Mississippi River system – 62.3 percent
- Arkansas River system – 11.6 percent
- Red River system – 10.4 percent
- Missouri River system – 6.9 percent
- Platte River system – 4.4 percent

Less than 5 percent of the population was 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 the river systems known to be used by interior least terns, including some of the most populated such as the Missouri, Red, and Arkansas, have power or flood control facilities that practice hydrocycling operations or the manipulation of flows in a way that mimics hydrocycling.

In the Loup River system, breeding interior least terns occur as far west as Valley and Howard counties, Nebraska (Sharpe et al., 2001). Currently, interior least tern use of the Loup River in relation to use of other Nebraska rivers is minimal. For example, during the 2005 range-wide census of interior least terns, only 7 percent of the total number of interior least tern adults counted in Nebraska were recorded on the Loup River (Lott, November 2006). Based on nest counts from 1983 to 2006, obtained from the NGPC Nongame Bird Program's Nebraska Least Tern and Piping Plover database, relatively few interior least terns have been recorded nesting on the Loup River (NGPC, 2009). On average, 10 interior least tern nests are recorded along the entire 69-mile stretch of the Loup River in a year. In 2010, the USFWS recorded 17 interior least tern nests on the Loup River, eight of which were located in an area where the river had migrated into an abandoned sand and gravel mine (USFWS, 2011). Most recorded nesting along the Loup River system occurs at off-river sites (NGPG, 2009). In 2010, the Tern and Plover Conservation Partnership (TPCP) recorded 22 interior least tern nests at the North SMA alone (Bomberger-Brown, 2010). Interior least terns only use the Loup River and adjacent sandpit lakes during the summer breeding and nesting season (May through August).

Consistently, one of the largest colonies of nesting interior least terns along the Loup River is located within the Project Boundary on the North SMA. This site is where sand dredged from the adjacent Settling Basin is stockpiled, creating a large sandy area with adjacent wetted areas. Although only a few years of productivity data are available for this site, fledge ratios in 2008 and 2009 were at or above the fledging rate of 0.71, which is currently recommended for population maintenance (TPCP, 2009[26] and January 8, 2010[27]). Interior least terns also use other sand and gravel pits and lakeshore housing developments along the Loup and North Loup rivers (NGPC, February 23, 2009). However, very little data have been gathered on the Loup and North Loup rivers because the Loup River system has rarely had large numbers of interior least terns and therefore has not been surveyed regularly. Sand and gravel mines and housing developments adjacent to the Loup River system were last surveyed by NGPC and TCPC in 2011. The Loup River was last surveyed for interior least terns by USFWS in 2010. Prior to these most recent surveys, the Loup River system was surveyed for interior least terns in 2005 during the range-wide survey (Lott, November 2006).

Interior least terns are routinely seen on the lower Platte River. A review of adult count survey information from 1987 to 2009 indicated that interior least tern numbers have remained relatively stable along the lower Platte River during this period (Brown and Jorgensen, 2009). These numbers included both on-river and off-river sites along the lower Platte River.

Piping Plover

Piping plover on nest with eggs. Photo courtesy of the Tern and Plover Conservation Partnership.

The piping plover (*Charadrius melodus*) was Federally listed as threatened throughout most of the species range on December 11, 1985 (50 FR 50726-50734) and Federally listed as endangered throughout the Great Lakes region. In 1988, USFWS issued a recovery plan for the piping plover. On September 30, 2008, USFWS initiated a 5-year review of this species (73 FR 56860-56862), and the results were published on September 29, 2009. The review concluded that no change is warranted in the listing status of the piping plover and that the species should remain listed as endangered in the watershed of the Great Lakes and listed as threatened in the remainder of the species' range (USFWS, September 2009).

Critical habitat was designated for this species on September 11, 2002 (67 FR 57638-57717), but this designation in Nebraska was vacated and remanded by the U.S. District Court in Nebraska on October 13, 2005. No critical habitat is currently designated in Nebraska for the piping plover.

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[26] TPCP. 2009. Tern and Plover Conservation Partnership Annual Monitoring Report to Preferred Rocks of Genoa – 2008.

[27] TPCP. January 8, 2010. Tern and Plover Conservation Partnership Annual Monitoring Report to Preferred Rocks of Genoa – 2009.

The piping plover is a small migratory shorebird with a short, stout bill, pale underparts, and orange legs. Both sexes are sand-colored. During the breeding season, adults acquire single black forehead and breast bands, and orange bills (USFWS, 1988). Adult birds weigh between approximately 1.5 and 2.2 ounces, are approximately 6.7 to 7 inches long, and have a 4.3- to 5-inch wingspan (NGPC 2008).

The piping plover is a migratory species, breeding along large rivers within the interior of the U.S. and Canada, and along the Atlantic coast. Piping plovers typically begin arriving at their breeding areas in the northern U.S. and southern Canada in mid- to late-April and early May (Sharpe et al., 2001); however, they have been known to arrive as early as late March (TPCP, 2009). Once the birds arrive, the males begin establishing territories with aerial displays and calls (Aron, 2005). Courtship behavior includes aerial flights, digging of several nest scrapes, and a ritualized stone-tossing behavior (Cairns, 1982; Haig, 1992). Nest scrapes may appear in territories up to 2 weeks before a female selects a scrape and lays eggs (Cairns, 1982). Piping plovers spend approximately 3 to 4 months at their breeding sites (Sharpe et al., 2001).

Nesting habitat on the Loup, Platte, Niobrara, Elkhorn, and Missouri rivers typically consists of dry sandbars located midstream in wide open channels, with less than 25 percent vegetative cover (Faanes, 1983; Ziewitz et al., 1992). Nests are small scrapes or shallow depressions frequently lined with small pebbles or shell fragments (Cairns, 1982; USFWS, 1988). Egg-laying typically begins the second or third week of May. Piping plovers lay three to five eggs (generally four) (Greer, 2003), and incubation lasts 25 to 31 days (Wilcox, 1959; Cairns, 1982; Haig and Oring, 1988a, as cited in NGPC, 2008; USFWS 2000). Both males and females actively share incubation duties (Cairns, 1982; Wilcox, 1959, as cited in Aron, 2005). If the early nesting attempts fail, piping plovers will attempt to renest up to three times; however, they will typically raise only one clutch per season (Haig, 1987).

Piping plover chicks are precocial, leaving the nest almost immediately. The chicks begin foraging and feeding themselves within a few hours of hatching and leaving the nest (Cairns, 1982). Fledging typically occurs approximately 28 days after hatching. Departure from nesting areas by both adults and fledglings varies, but is usually complete by early August (Cairns, 1982; Prindiville Gaines and Ryan, 1988).

Piping plovers are breeding associates of the interior least tern in the Loup, Platte, Niobrara, Elkhorn, and Missouri river systems. Nesting piping plovers are commonly found within or near nesting interior least tern colonies at sand and gravel pits and on riverine sandbars.

Piping plovers forage visually for invertebrates in shallow water and associated moist substrates (Cuthbert et al., 1999; Whyte, 1985, as cited in NGPC, December 2008). Along the Platte River, piping plovers primarily feed on beetles and small soft-bodied invertebrates from the riverine waterline (Lingle, 1988, as cited in NGPC, December 2008).

Piping plovers 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. Piping plovers reproduce in the summer months in the northern U.S. and Canada. The piping plover breeding range includes: 1) the Northern Great Plains from Alberta to Manitoba and south to Nebraska; 2) the Great Lakes beaches; and 3) Atlantic coastal beaches from Newfoundland to North Carolina. The most recently published results of the International Piping Plover Breeding Census (2006) indicated that over half of these birds were found in the U.S. and Canada Northern Great Plains and Prairie Canada regions (Elliott-Smith et al., 2009).

Piping plovers are relatively short-distance migrants that spend up to 70 percent of their annual cycle on wintering areas. During the nonbreeding period (approximately early September to early April), piping plovers use beaches, sandflats, and dunes along the Gulf of Mexico coastal beaches, adjacent off-shore islands (Haig and Oring, 1985), and the southern Atlantic coast (Nicholls and Baldassarre, 1990). Spoil piles in the Intercoastal Waterway are also used. Despite their broad winter distribution, more than 50 percent of the piping plovers counted during the 2006 International Piping Plover Winter Census (the most recent for which data have been published) occurred along the Texas coast (Elliott-Smith et al., 2009).

The piping plover nests on open to sparsely vegetated sand and gravel beaches along the Atlantic coast, the Great Lakes, and throughout the Great Plains of North America (Cairns, 1982; Prindville Gaines and Ryan, 1988; Haig and Elliot-Smith, 2004). In north-central North America, piping plovers nest on sand and gravel shores and islands of rivers and lakes in the Great Plains (USFWS, 1988).

Piping plovers nesting on the Missouri, Platte, Niobrara, Yellowstone, and other Great Plains rivers use beaches and dry, barren sandbars in wide open channel beds (Kirsch, 1996; USFWS, 1988). Suitable nesting areas often contain minimal vegetative cover of less than 25 percent (Ziewitz et al., 1992). The optimum range for vegetative cover on nesting habitat has been estimated at 0 to 10 percent (Armbuster, 1986, as cited in NGPC, December 2008). Piping plovers often express a strong preference for nests to be initiated near objects, such as driftwood, stones, or plant debris (Haig and Elliot-Smith, 2004).

Sandbar area and height are important factors in nesting habitat selection. Faanes (1983) studied 28 Platte River sandbars occupied by nesting piping plovers. This study found the occupied sandbars averaging 938.32 feet in length and 180.45 feet in width (approximately 3.89 acres). Piping plover nests averaged 52.49 feet from the water’s edge, with the average height above the river level measuring 0.66 foot. Ziewitz et al. (1992) found similar results with nest site sandbars on the lower Platte River averaging 3.58 acres. Nests on the central Platte River were initiated at lower elevations (an average of 1.28 feet) than nests on the lower Platte River (1.61 feet) (Ziewitz et al., 1992). Recommendations based on that study suggest that sandbars should be at least 3.58 acres in size and greater than 1.48 feet in height to be suitable for piping plover nesting.

Along with interior least terns, piping plovers will use alternative habitats such as sand and gravel mine pits and lakeshore housing developments. Operating sand and gravel mines provide a barren to sparsely vegetated substrate suitable for nesting habitat (Sidle, 1993). Sidle (1993) found that most sand pits examined ranged in size from 1.48 to 196.70 acres and averaged 56.83 acres. The sand and gravel component of the sand pits ranged from 0.49 to 92.17 acres, and the water component ranged from 0.99 to 104.53 acres. The Project's North and South SMAs were approximately 496.79 acres (425.50 acres of sand and gravel and 70.67 acres of water) (Sidle, 1993).

Due to recent trends in management of the piping plover, including directing nest sites, monitoring, and excluding and controlling predators, many sand-pit lakes are successfully being used by piping plovers. Brown and Jorgensen (2008) reported a steady increase in both interior least terns and piping plovers nesting on off-river habitat over the past 20 years.

In the Loup River system, breeding piping plovers occur as far west as Valley and Howard counties, Nebraska (Sharpe et al., 2001). Currently, piping plover use of the Loup River in relation to use of other Nebraska rivers is extremely minimal and occurs during only the breeding and nesting season (that is, late-April to late-July). For example, during the 2006 International Piping Plover Census, only 2 percent of the total number of piping plover adults counted in Nebraska were recorded on the Loup River system (Elliott-Smith et al., 2009). Based on nest counts from 1983 to 2006, obtained from the NGPC Nongame Bird Program's Nebraska Least Tern and Piping Plover database, relatively few piping plovers have been recorded nesting on the Loup River (NGPC, 2009). On average, four piping plover nests are recorded along the entire 69-mile stretch of the Loup River in a year. Most recorded nesting along the Loup River system occurs at off-river sites. In 2010, USFWS recorded three piping plover nests on the Loup River, all of which were located upstream of the Diversion Weir (USFWS, 2011). In 2010, TPCP recorded seven piping plover nests at the North SMA alone (Bomberger-Brown, 2010).

Piping plovers along the Loup River consistently use the North SMA within the Project Boundary for nesting, breeding, and foraging. Piping plovers also use other sand and gravel pits and lakeshore housing developments along the Loup and North Loup rivers (NGPC, February 23, 2009). However, very little data have been gathered on the Loup and North Loup rivers because the Loup River system has rarely had large numbers of piping plovers and therefore has not been surveyed regularly. Sand and gravel mines and housing developments adjacent to the Loup River system were last surveyed by NGPC and TPCP in 2011. The Loup River was last surveyed for piping plovers by USFWS in 2010. Prior to these most recent surveys, the Loup River system was surveyed for piping plovers in 2006 for the International Piping Plover Census (Elliott-Smith et al., 2009). The Loup River was also surveyed in 2011 for the International Piping Plover Census, but preliminary results were not yet available when this Draft License Application was written.

Piping plovers are routinely seen on the lower Platte River. A review of adult count survey information from 1987 to 2009 indicated a slight decline in piping plover numbers along the lower Platte River during this period; however, after 2009 monitoring efforts, the numbers spiked in 2009 (Brown and Jorgensen, 2009). These numbers included both on-river and off-river sites along the lower Platte River. While no definitive explanation for the spike in 2009 has been determined, 2008 was a productive year on the Missouri River below Gavins Point Dam, and it is possible that this productivity, in connection with other factors, lead to an increase in piping plover numbers in 2009 on the lower Platte River.

Whooping Crane

Whooping cranes. Photo by Rocky Hoffman, Nebraska Game and Parks Commission. Copyright © Nebraska Game and Parks Commission. All rights reserved.

The whooping crane (*Grus americana*) was Federally listed as endangered on March 11, 1967 (32 FR 4001). A revised recovery plan was finalized for this species on May 29, 2007 (72 FR 29544). On March 29, 2010, USFWS initiated a 5-year review of this species (75 FR 15454-15456). The review is ongoing, and no results have been published to date. A 56-mile-long, 3-mile-wide stretch of the central Platte River between Lexington and Shelton, Nebraska, is designated as critical habitat for this species (Canadian Wildlife Service and USFWS, March 2007).

The historical range of the whooping crane extended from the Arctic coast south to central Mexico and from Utah east to New Jersey, South Carolina, Georgia, and Florida. Although whooping cranes once numbered greater than 10,000, it has been estimated that only 500 to 1,400 whooping cranes inhabited North America in 1870. In the late 1800s, the whooping crane disappeared from the heart of its breeding range in north-central United States. By 1937, only two small breeding populations remained. The last surviving bird of the Louisiana population died in captivity in 1950. The other remaining population had only 18 recorded individuals in 1939.

Currently, whooping cranes occur throughout North America, and the total wild population is estimated at 343 birds in 2011 (Stehn, August 30, 2011). This estimate includes birds in the only self-sustaining Aransas-Wood Buffalo National Park population that winters in coastal marshes in Texas and migrates through Nebraska on its way to Canada to nest in the Wood Buffalo National Park and adjacent areas, as well as captive-raised birds that have been released in Florida and a migratory population between Florida and Wisconsin. Currently, the Aransas-Wood Buffalo flock population is estimated at 278 birds (Stehn, August 30, 2011). Overall, whooping crane population trends throughout the range appear to be experiencing a gradual positive trend.

The whooping crane is a bi-annual migrant across the Great Plains of the central U.S. in the spring and fall of each year, traveling between summer habitat in central Canada and wintering grounds in Texas. The migratory corridor stretches approximately 2,400 miles long and 220 miles wide. This corridor encompasses 95 percent of known sightings of whooping cranes, although occasionally this species may be sighted outside of the main corridor. This species stops daily during migration to feed and rest unless local weather conditions dictate otherwise. Whooping cranes are omnivorous, mainly feeding on insects, frogs, rodents, small birds, minnows, berries, blue crabs, clams, snails, crayfish, and agricultural grains (USFWS, September 27, 2011). Food sources during migration consist of frogs, fish, plant tubers, crayfish, insects, and agricultural grains. Migrating birds use stop-over habitats to meet immediate needs for energy and nutrient provision while waiting for appropriate weather conditions to continue migration.

Whooping cranes can be found in Nebraska during spring and fall migrations. Whooping cranes migrate through Nebraska between October 1 and December 1 in the fall and March 15 and May 15 in the spring. A variety of habitats are used during migration, such as croplands and wetlands for feeding and shallow portions of rivers, lakes, and streams for roost sites (Austin and Richert, 2005). Overnight roosting requires shallow water over submerged sandbars on which the cranes stand and rest. This species has shown a preference for unobstructed channels that are isolated from human disturbance (Armbruster, 1990, as cited in Canadian Wildlife Service and USFWS, March 2007). Large palustrine wetlands are used for roosting and feeding during migration.

Possible threats to the whooping cranes include human settlement, over-utilization of water rights to estuary inflows in Texas, human-caused mortality, disturbance of breeding and wintering grounds, disease (for example, avian tuberculosis), predation, global warming and associated climate change, loss of genetic diversity, chemical spills in the wintering area, and collisions with power lines and fences (Canadian Wildlife Service and USFWS, March 2007; National Research Council, 2005).

The Project is located along the eastern edge of the main whooping crane migration corridor. The majority of whooping crane sightings in Nebraska occur along the central Platte River. Three sightings have been confirmed upstream of the Project in the past 20 years, with only one sighting actually located on the Loup River (USFWS, April 15, 2009). Only one sighting has been documented during the fall migration (in 2010) downstream of the Project on the lower Platte River. This is considered a very rare occurrence because no other sightings have been documented on the lower Platte River. No sightings have been documented within the Project Boundary.

Pallid Sturgeon

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

The pallid sturgeon was Federally listed as endangered on September 6, 1990 (55 Federal Register [FR] 36641-36647). On July 7, 2005, USFWS initiated a 5-year review of this species (70 FR 39326-39327); this review has been completed, and the results were published on June 13, 2007. The review concluded that no change is warranted in the listing status of the pallid sturgeon and that the species should remain listed as endangered throughout the species' range. No critical habitat has been designated for the pallid sturgeon. However, six recovery priority management areas (RPMAs) were identified in the recovery plan for the pallid sturgeon. One of these six areas, RPMA 4, consists of the Missouri River from Gavins Point Dam downstream to the confluence of the Missouri and Mississippi rivers and includes the lower Platte River, from the confluence with the Missouri River upstream to the Elkhorn River confluence (National Research Council, 2005).

The population of pallid sturgeon in RPMA 4 has been and continues to be intensively studied. There are several sites in RPMA 4 where stocking of hatchery-reared fish has taken place. Despite channel alterations and controlled reservoir releases altering habitat along this stretch of the Missouri River, pallid sturgeon are still able to migrate over the whole of this reach. For example, two pallid sturgeon captured in the lower Platte River had traveled 400 miles from their release location near Boonville, Missouri (Peters and Parham, 2008).

The pallid sturgeon is one of the largest fishes found in the Missouri-Mississippi River drainage, with the largest specimens measuring between 30 and 60 inches long and weighing up to 85 pounds. The pallid sturgeon is a large, cylindrical fish with a flattened, shovel-shaped snout and a long, slender, armored peduncle. The tail fin has two lobes, with the top lobe larger than the bottom, and terminates in a long filament. Unlike the shovelnose sturgeon, the pallid sturgeon has no bony plates on the belly. The barbels on the pallid sturgeon are not in line with the outer barbels. Pallid sturgeon coloring is grayish-white above and white below.

Pallid sturgeon life history is not well known, especially in the early life stages (Wildhaber et al., 2007). Although the requirements for reproduction and spawning of the pallid sturgeon are not well understood, pallid sturgeon are thought to spawn in swift water over gravel, cobble, or other hard surfaces (USFWS, 1993). Pallid sturgeon are slow to reach maturity, with males reproducing at 5 to 7 years of age and females first spawning at 15 to 20 years of age (Keenlyne and Jenkins, 1993). Spawning typically occurs between June and August (U.S. Environmental Protection Agency, 2007) with females typically not spawning on an annual basis, but rather on a 3- to 5-year interval. Spawning is thought to occur in the Missouri River in mid-May to early June when water temperatures and flows reach a certain level to allow for increased fish movement (USFWS, 1993). It is not fully understood what cues spawning movements in this species.

Pallid sturgeon are long-lived, with individuals reaching 50 years of age. Little or no pallid sturgeon recruitment is known to be occurring in natural environments, and no observations of pallid sturgeon spawning have been recorded. In 2008, three reproductive female pallid sturgeon were tracked to inferred spawning patches on the outside of river bends with rip rap revetment (DeLonay et al., 2009). Subsequent recapture verified that eggs had been released; however, the specific site of egg deposition was not confirmed.

After the eggs hatch, larval fish begin to drift downstream from the hatching site and settle in the lower portions of the water column. The distance of drift depends on water velocity, but can be more than 120 miles.

In juvenile and adult stages, the pallid sturgeon has few natural predators. The pallid sturgeon primarily forages on invertebrates in the juvenile stage and consumes some smaller fish and macroinvertebrates in the adult stage (Wildhaber et al., 2007). Fish have been noted as important food items for pallid sturgeon (Keenlyne, 1995), and observations of feeding in hatcheries have indicated a strong preference for fish (Bollig, August 2005).

The pallid sturgeon is endemic to the turbid waters of the Missouri and Mississippi River systems from Montana to Louisiana. Pallid sturgeon can be found in the Mississippi River from near Keokuk, Iowa, downstream to the Gulf of Mexico, and in the Achafalaya River in Louisiana. The main part of their range is the Missouri River from its confluence with the Mississippi River upstream to Fort Benton, Montana. The species also uses large tributaries to these larger rivers, such as the Yellowstone and Platte rivers. The states within the pallid sturgeon’s range include Arkansas, Kansas, Kentucky, Illinois, Iowa, Louisiana, Mississippi, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Tennessee. Pallid sturgeon are still found throughout their historic range, though the habitat is considered highly fragmented and reduced (USFWS, June 13, 2007).

Pallid sturgeon are thought to inhabit large, cool (0° to 29° Celsius), turbid, free-flowing riverine habitat and prefer sandy and gravel substrates (USFWS, 1993). The species tend to select main channel habitats in the Mississippi and Missouri rivers, especially those with main channel islands or sandbars (Bramblett, 1996). In the lower Platte River, individuals were documented downstream of sandbars where currents converge (National Research Council, 2005). Pallid sturgeon prefer water velocities between 0.33 to 2.9 feet per second (USFWS, 1993), but slower velocities are used for rest and foraging. Though there is limited data on pallid sturgeon spawning, areas with convergent flow were found to most closely correspond to spawning habitat (Jacobson et al., 2009). These areas are not sensitive to variations in discharge.

Pallid sturgeon are likely to spawn in fast-flowing sections of the main stem portion of rivers (Swigle, 2003). Based on a study by Peters and Parham (2008), pallid sturgeon were theorized to be using the Platte River for spawning, although no definite spawning beds have been located. The estimated spawning area nearest to the Project was in Sarpy County near Ashland, Nebraska, where 7 larval pallid sturgeon were collected during a drift net sampling collection from 1998 to 2004 (Peters and Parham, 2008).

Pallid sturgeon use rivers with sandy substrates, but the species has been captured in other rivers with rocky or gravely substrates, such as the Yellowstone River. It is also thought that pallid sturgeon prefer coarse substrate for spawning (Jacobson et al., 2009). Turbidity preference can also vary, and the USFWS Recovery Plan (1993) states that pallid sturgeon are found in waters ranging between 31 Nephelometric turbidity units (NTUs) and 138 NTUs.

Pallid sturgeon have also been captured in varying water depths. The USFWS Recovery Plan (1993) lists depths ranging from 1 to 8 meters. However, shallower water (0.5 to 1.5 meters) is thought to be important for rearing of larval and juvenile pallid sturgeon (USFWS, December 16, 2003). Jacobson et al. (2009) found that available data suggests that pallid sturgeon do not select strongly for depth. Snook et al. (2002) indicated that hatchery-reared pallid sturgeon in the Platte River used depths averaging 0.84 meter. Swigle (2003) found that wild pallid sturgeon caught in the Platte River used water depths that averaged 1.29 meters. Bramblett (1996) and Bramblett and White (2001) documented that pallid sturgeon in the upper Missouri and Yellowstone rivers used depths that averaged 3.3 meters (or that ranged from 1 to 7 meters), and Hurley (1999) found that pallid sturgeon in the Mississippi River used depths of 6 to 12 meters.

Rapid, long-distance migrations both upstream and downstream may occur during April or May, with little movement in the summer and winter months. A variety of environmental cues, including water temperature and discharge, are important guidance mechanisms for fish migration (Swigle, 2003). According to a study by Swigle (2003), upstream migrations for pallid and shovelnose sturgeon begins in April, when river temperatures ranged from 8.4° to 16.8° Celsius. Increased temperatures may indirectly influence sturgeon movement by triggering increased flows via snowmelt runoff. Previous studies have found positive relationships between discharge and sturgeon movement, possibly indicating that the onset of spawning is initiated by typical spring flooding of rivers (Swigle, 2003). Both shovelnose sturgeon and paddlefish spawning migrations are thought to occur in response to increased flows in June (USFWS, 1993). Although there is no information on pallid sturgeon spawning migrations, it is assumed that these migrations would similarly occur in response to increased June flows. Pallid sturgeon hatcheries have determined that ideal spawning temperatures in the hatchery environment range from 15.5° to 18.5° Celsius immediately prior to spawning. Shovelnose sturgeon, a similar species, are documented to spawn in late May through early June, when water temperatures are between 19° and 21° Celsius (Peters and Parham, 2007).

The lower Platte River provides the best habitat for pallid sturgeon. The lower Platte River maintains its braided channel pattern and provides sandy substrates, slower currents for energy conservation and foraging, shallower feeding areas, and convergent flow areas around sandbars and islands that pallid sturgeon prefer. Habitat availability is greatest in the lower Platte River below the Elkhorn River confluence. This section appears to retain most of the appropriate habitat conditions and the connectivity that reliably allows use by pallid sturgeon (National Research Council, 2005). This is likely due to higher flows resulting from inflows of the Elkhorn River and Salt Creek. However, based on recent findings of the Sturgeon Management Study, the lower Platte River appears to afford pallid sturgeon usable habitat up to the vicinity of the Tailrace Return near Columbus.

Current habitat in the lower Platte River supports a diversity of populations of fish and other species, which form an interacting community that can support populations of adult and juvenile pallid sturgeon (Peters and Parham, 2008). Regular movement and migration of pallid sturgeon into and out of the lower Platte River are indicators that the population is healthy and that the current habitat is suitable for adult and juvenile pallid sturgeon (Peters and Parham, 2008). In the Platte River, the amount and accessibility of habitat for pallid sturgeon are related to discharge (Peters and Parham, 2008). High discharge events produce flow velocities that scour deeper channels and deposit sandbars, which create and maintain the habitats favored by pallid sturgeon.

Since 1997, pallid sturgeon have been stocked in the Platte and Missouri rivers to attempt to augment their recovery from endangered status (Krentz et al., May 12, 2005). In 1997, 401 pallid sturgeon were stocked in the Platte River at the Nebraska Highway 50 bridge. Prior to 2009, there were no known occurrences of pallid sturgeon in the vicinity of the Project. The most recent survey at that time was performed by Peters and Parham (2008) and documented the nearest pallid sturgeon occurrence in the lower Platte River at the confluence of the Elkhorn and Platte rivers, approximately 69 miles downstream of the Project. In 2009, the University of Nebraska-Lincoln began a 5-year sturgeon management study (Hamel et al., 2011). Through this study, as of mid-2011, pallid sturgeon have been captured in the Platte River as far as RM 96, just downstream of the confluence with the Tailrace Return. However, the majority of the captures were located downstream of the confluence with the Elkhorn River at RM 32.3. Prior to 2009, pallid sturgeon had not been documented upstream of RM 32.3. In 2009, 69 pallid sturgeon were captured in the lower Platte River, three of which were located upstream of RM 32.3 (Hamel et al., January 2010). During year two (2010) of the sturgeon management study, 39 pallid sturgeon were documented in the lower Platte River, with five located above RM 32.3 (Hamel et al., August 2011). From March through May 2011, 12 pallid sturgeon were captured in the lower Platte River, with two located upstream of RM 32.3 (Hamel et al., August 2011). The majority of pallid sturgeon captures have been documented in April and May, which is a typical migration time period for this species. The past three years (2009, 2010, and 2011) during which the Sturgeon Management Study in the lower Platte River has been conducted, have been considered to have mostly average to higher-than-average flows, which may explain why pallid are being captured further upstream than previously documented. There are no documented occurrences of pallid sturgeon in the Loup River or the Loup Power Canal. The pallid sturgeon is not currently known to occur within the Project Boundary.

Western Prairie Fringed Orchid

Western prairie fringed orchid. Photo by M. Marinovich, HDR.

The western prairie fringed orchid was Federally listed as threatened on September 28, 1989 (54 FR 39857-39863). On March 30, 2006, USFWS initiated a 5-year review of this species (71 FR 16176-16177); this review has been completed, and the results were published on April 27, 2009. The review concluded that no change is warranted in the listing status of the western prairie fringed orchid and that the species should remain listed as threatened (USFWS, February 2009). No critical habitat has been designated for this species.

The western prairie fringed orchid is restricted to areas west of the Mississippi River and currently occurs in Iowa, Kansas, Minnesota, Nebraska, North Dakota, and in Manitoba, Canada. This species has also been documented in South Dakota and Wyoming (USDA, 2009). The western prairie fringed orchid is found in the eastern two-thirds of Nebraska, from Cherry and Keith counties in the west to the Missouri River in the east. This species is a perennial orchid found in wet-mesic to mesic tallgrass prairie, specifically in unplowed, calcareous prairies and sedge meadows. The soils are usually Udolls or Udic Ustolls (humid to intermittently dry mollisols, or prairie soils) on gentle to moderate slopes. In tallgrass prairies, the western prairie fringed orchid is typically associated with big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and little bluestem (*Schizachyrium scoparium*). In wetter growth sites, the western prairie fringed orchid is commonly associated with tufted hairgrass (*Deschampsia caespitosa*) and switchgrass (*Panicum virgatum*). In sedge meadows, the western prairie fringed orchid is often surrounded by sedges (*Carex* spp.) and spikerushes (*Eleocharis* spp.) (USFWS, 1996). There is evidence that orchid ecology is tied to mycorrhizal associations (a symbiotic relationship between soil fungi and roots of plants) (USFWS, February 2009).

In Nebraska, the western prairie fringed orchid blooms almost exclusively in the last week of June to the first two weeks of July. Flowering may be suppressed by litter accumulation and stimulated by fire (USFWS, 1996). Flowers may be displayed for up to 21 days, with most individual flowers lasting 10 days (USFWS, March 14, 2011). Flowers must be pollinated for seed production, and pollination is only accomplished by hawk moths. Seeds are dispersed by wind and flooding. Western prairie fringed orchids may be threatened by habitat modification or destruction, over-utilization for commercial or scientific purposes, predation, inadequacy of existing regulatory mechanisms such as protection, and decrease of a singular pollinator species (hawk moths) due to pesticide use (USFWS, 1996).

Populations are known to occur in Boone, Cherry, Dodge, Garfield, Grant, Greeley, Hall, Holt, Lancaster, Loup, Madison, Otoe, Pierce, Rock, Saline, Sarpy, Seward, and Wheeler counties, and may occur at other sites in Nebraska. Currently, there are no known populations located in Nance and Platte counties or in the vicinity of the Project. No areas within the Project Boundary contains suitable habitat for this species. Nebraska Natural Heritage Program searches did not identify any known populations of western prairie fringed orchid in the vicinity of the Project. A recent revision of this species' range (Nebraska Natural Heritage Program, May 2011) does not list Nance or Platte counties as being within this species' range.

Nebraska State-listed Threatened or Endangered Species

For each Nebraska state-listed RTE species that may occur in the vicinity of the Project or may be affected by Project relicensing, the species occurrence, life history, and habitat requirements are discussed below.

North American River Otter

North American river otter. Photo courtesy of U.S. Fish and Wildlife Service.

The North American river otter is a long, slender, partially aquatic mammal. This species was listed as endangered by NGPC in 1980. The species was later down-listed to threatened in 2005, after a series of successful reintroductions. This species is not listed as a threatened, endangered, or candidate species by USFWS under the ESA.

Historically, river otters once occupied most major drainages in Canada and the continental U.S. River otters were historically common in all major waterways of Nebraska, including the Loup and Platte rivers (Jones, 1962 and 1964, as cited in Boyle, September 2, 2006). Otters were eventually extirpated from Nebraska as well as Colorado and nearly extirpated from Kansas, South Dakota, and Wyoming in the early 1900s. As a result of conservation measures and reintroductions, small populations of otters have become reestablished in these states. Currently, river otters are distributed throughout North America, with higher population densities in coastal habitats and areas of low human density. Although historically distributed throughout the southwestern United States, populations in this area are sparse or extirpated (Melquist, Polechla, and Toweill, 2003). Inland populations are most abundant in lowland or valley marshes interconnected with meandering streams and small lakes. River otters are relatively common in many major river systems, but they have become less common in heavily settled areas.

NGPC released river otters to seven sites between 1986 and 1991, including sections of the South Loup River (in Custer County), the Calamus River (in Loup County), the North Platte River (above Lake McConaughy), the Platte River (near Kearney), the Cedar River (in Wheeler County, a tributary of the Loup River), the Niobrara River (in Sheridan County), and the Elkhorn River (in Antelope County). Recent observations suggest that river otters have become established in several Nebraska watersheds, with the highest quality and most extensive habitat in the North Platte River (north of Lake McConaughy and from Dawson County to Hamilton County) and the central Platte River and its tributaries (Bischof, 2006; Wilson, August 2011). Otters are highly mobile, moving in response to food availability or environmental conditions, making home range size and location extremely dynamic.

The Nebraska Cooperative Fish and Wildlife Research Unit, in cooperation with NGPC, is currently conducting a study on the home range and habitat use of river otters in the Big Bend area of the Platte River. Data collected in this study, in conjunction with the results of an ongoing river otter health and reproductive survey and results from NGPC's annual otter bridge survey, will help close existing information gaps and contribute to the creation of the Nebraska River Otter Management Plan and the Statewide Comprehensive Conservation Plan. This is one of the largest otter tracking projects in the U.S. and the only current project in the Midwest (UNL, 2011). No abundance estimates are currently available; however, the population of river otters in Nebraska is considered stable and may be increasing (Boyle, 2006).

River otters are social animals that hunt and travel together, using the same resting sites, latrines, and dens. This species is active year-round and does not migrate; however, they are highly mobile and often move in response to food availability, making their home range dynamic (Boyle, 2006). River otters disperse when approximately 12 to 13 months old, with some moving to different parts of a watershed and some leaving the watershed all together (Boyle, 2006). River otters typically remain close to water, but occasionally will travel overland to shortcut meanders and will move between major drainages (Melquist, Polechla, and Toweill, 2003). Breeding season is extremely variable and can occur from December to April (Lariviere and Walton, 1998; as cited in Boyle, 2006). Breeding may take place on land or in water and may occur anywhere within the female's home range. Females give birth and rear young in abandoned dens of other aquatic mammals typically between February and April (Melquist, Polechla, and Toweill, 2003). Natal dens may occasionally be found up to a few hundred feet from water. Kits are born fully furred, blind, and toothless, and females nurse the young until they are approximately 9 to 10 weeks old (Boyle, 2006). Juveniles remain with females until they are 9 to 12 months old and then begin to disperse (Boyle, 2006).

The river otter's diet consists primarily of fish, but may also include crustaceans, mollusks, insects, birds, and small mammals (Melquist, Polechla, and Toweill, 2003). Slower-swimming fish, such as suckers, catfish, and minnows are usually preferred (Boyle, 2006). Bobcat, mountain lion, gray wolf, red fox, and bald eagles have been reported as predators to river otters (Melquist, Polechla, and Toweill, 2003). Threats to the river otter include destruction and degradation of habitat, water pollution, human settlement and recreational use of riparian areas, and incidental trapping and illegal take (Boyle, 2006).

Rangewide, river otters inhabit almost every type of aquatic habitat. In the interior of the U.S., river otters most often use stream-associated habitats; however, lakes, reservoirs, beaver ponds, and floodplain wetlands may also be used as long as shoreline cover and food resources are adequate (Melquist, Polechla, and Toweill, 2003). Riparian vegetation is considered an important habitat attribute for river otters, as it provides secure cover for feeding, denning, and movement over land (Boyle, 2006). Another important habitat element is the existence of objects, such as fallen trees, logjams, undercut banks, and rocks, to provide structural diversity (Boyle, 2006).

Currently, there are no known populations of river otters in the Loup Power Canal or in the Loup River bypass reach; however, the 2010/2011 Annual Fur Harvest Survey conducted by NGPC documented several confirmed otter locations in the Loup River Basin in Nance County (Wilson, August 2011). This species is highly mobile, and the nearest location of release was in Wheeler County, Nebraska, along the Cedar River. The Cedar River drains into the Loup River and is a potential conduit for movement of river otters into the Loup River and its tributaries. Because recent otter sightings have been confirmed within the Loup and Cedar rivers in Nance County and upstream, it is likely that river otters could be found within the Project Boundary.

Lake Sturgeon

Lake sturgeon. Photo by Wayne Davis (http://www.epa.gov/bioiweb1/html/photos_fish_freshwater.html).

The lake sturgeon is currently listed as threatened in the State of Nebraska under NESCA. Historically, lake sturgeon were distributed from the rivers of the Hudson Bay watershed in Saskatchewan and Manitoba, Canada, east to the St. Lawrence estuary, and south throughout the upper and middle Mississippi River and Great Lakes basins and included populations in Tennessee, Ohio, and lower Mississippi drainages (Peterson et al., 2006). It is currently considered rare throughout the species' historic range. Distribution has been extended to the Missouri River and the lower Platte River in Nebraska.

Lake sturgeon mostly inhabit large rivers, lakes, and reservoirs where small benthic organisms, such as snails, crayfish, and aquatic insect larvae, are abundant. Lake sturgeon are bottom feeders (benthic) and prefer moderate currents in large rivers and lakes where abundant rocky substrate and clean cool water exist, but may also be successful along gravel and rocky shores in lakes and impoundments. Lake sturgeon have been documented in the lower Platte River and the Missouri River near gravel and sandbars. The gravelly and sandy substrates may serve as spawning habitat along the edges of sandbars. Lake sturgeon often migrate over large distances, and several studies suggest that adult lake sturgeon prefer water depths of less than 29 feet during cooler months but will move to much deeper water in the summer (Peterson et al., 2006).

The lake sturgeon is a long-lived species and reaches sexual maturity between 7 and 25 years of age. Spawning usually occurs in early spring, from mid-April to early June (Peterson et al., 2006). For most populations, optimal spawning habitat is found in high-gradient reaches of large rivers with current velocities of 1.64 to 4.27 feet per second and substrates of course gravel or cobble (Auer, 1996). Eggs hatch in approximately 8 to 14 days with rate of development dependent on water temperature (Peterson et al., 2006), typically when water temperatures reach 60 to 64 °F (Smith, 1985).

The lake sturgeon diet is very similar to diets of other sturgeon species. They feed primarily on crustaceans, but also eat small fish and insects (Peterson et al., 2006). Threats to this species may include pollution, lack of spawning habitat, fragmentation of habitat by dams, and decreasing water levels in the Platte River (NGPC, August 2005).

The nearest known lake sturgeon occurrence to the Project occurred in the lower Platte River near Schuyler, Nebraska. A 16-pound lake sturgeon was captured at this location in association with a University of Nebraska-Lincoln Shovelnose Sturgeon Population Dynamics Study (NGPC, June 2010). As a riverine species, the lake sturgeon has the potential to migrate nearer to the Project; however, no lake sturgeon have been recorded in the Project Boundary.

Sturgeon Chub

Sturgeon chub. Photo by David Ostendorf, Missouri Department of Conservation.

The sturgeon chub is currently listed as endangered in the State of Nebraska under NESCA. Historically in Nebraska, sturgeon chub were found in the Missouri River along the eastern side of the state and in scattered locations in the lower Niobrara River, the Republican River, Loup River, Elkhorn River, Platte River, and Bazile Creek. Recent records have found sturgeon chub in only the Platte and Missouri rivers.

Sturgeon chub prefer large, free-flowing riverine systems characterized by swift flows, highly variable flow regimes, braided channels, high turbidity, and sand/fine gravel substrates USFWS, March 2001). They have been collected in side chutes and backwater, which they may use for spawning. Sturgeon chub are often captured with a fish of the same genus, a sicklefin chub (*Macrhybopsis meeki*), in water approximately 6 to 16 feet deep (USFWS, March 2001). Welker (2000, as cited in USFWS, March 2001) reported that sturgeon chub at the confluence of the Yellowstone and Missouri rivers primarily use sand substrates, though sturgeon chub densities were also positively influenced by gravel sites.

Extremely limited information exists regarding the reproductive biology of sturgeon chub. Spawning is believed to occur in spring and is likely influenced by water temperature and may also be affected by increasing flows due to snowmelt (USFWS, March 2001).

The sturgeon chub diet consists of small aquatic insects. Reduction of turbidity, channelization, modified water flows, loss of spawning habitat, de-watering, and sediment transport may be threats to this species (NGPC, August 2005).

There are no known occurrences of sturgeon chub within Nance or Platte County or in the vicinity of the Project (NGPC, October 2, 2008b). Hrabik (2000, as cited in USFWS, March 2001) suggests that sturgeon chub in the Platte River are uncommon, but may not be as rare as previously suspected. Sturgeon chub appear to be extirpated from the Loup River (Rahel and Thel, 2004). This species was included in this discussion because it is a riverine species and has the potential to migrate nearer to the Project.

Small White Lady's Slipper

Small white lady's slipper. Photo by T.G. Barnes, USDA-NRCS PLANTS Database.

The small white lady's slipper is listed as threatened in the State of Nebraska under NESCA. The small white lady's slipper is a member of the orchid family. Its range in Nebraska is throughout the Loup River Valley in the Mixedgrass Prairie Ecoregion and in the eastern Sandhills. This species prefers moist to wet sedge meadows, wet prairies, and wet-to-mesic tallgrass prairies.

The small white lady's slipper in Nebraska has been associated with northern sedge fen meadows, northern cordgrass wet prairies, and mesic to wet tallgrass prairies. In addition, some individual small white lady's slipper plants have been identified in roadside ditches and growing in association with bromegrass (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*) although this has not been documented as typical habitat. The small white lady's slipper blooms in the end of May to early June. Threats to this orchid may include conversion of meadows to cropland and development, invasive species, reduced groundwater levels, annual mid-summer haying, and herbicide spraying (NGPC, August 2005).

There are documented occurrences of small white lady's slipper in Platte County (NGPC, October 2, 2008b). Currently, there are no known populations located within the Project Boundary.

E.6.6.2 Environmental Analysis

Based on agency concerns expressed during Project scoping, analysis of potential Project effects on RTE species was focused on interior least tern, piping plover, whooping crane, and pallid sturgeon. A Preliminary Draft BA analyzing these species has been prepared and is located in Appendix E-2. District studies conducted in association with relicensing related to potential species impacts included Sedimentation, Hydrocycling, Flow Depletion and Flow Diversion, Ice Jam Flooding on the Loup River, and PCB Fish Tissue Sampling. Discussions of species are provided as follows.

Federally Listed Threatened or Endangered Species

Interior Least Tern and Piping Plover

Interior least terns and piping plovers are known to occur in the vicinity of the Project. These species nest and forage on the North SMA, along the Loup River bypass reach, and along the lower Platte River.

<u>North Sand Management Area</u>

The District dredges the Settling Basin adjacent to the North SMA every spring and fall in order to maintain flow in the Loup Power Canal. The dredging operations provide an important source of water and food to the North SMA for a variety of species, including interior least terns and piping plovers; however, the potential exists that slurry water from the District's dredging operations could inundate nests if they are present near an outlet pipe. To avoid potential nest inundation from slurry discharge, the District continues to work with USFWS, NGPC, and TPCP to suspend dredging operations to the North and South SMA when the birds arrive in early May and resume dredging after the birds leave in August. If dredging were to cease year-round, the North SMA would no longer be actively managed and would become vegetated and unsuitable for nesting without the addition of new dredged material. Because the District is working cooperatively with the agencies to avoid harm to these species by suspending dredging during the nesting season, the dredging operations at the North SMA are determined to have beneficial effects on the habitat used by interior least terns and piping plovers by providing a source of water and food for these species as well as replenishing nesting substrate. Effects of continued dredging operations would also be beneficial by continuing to provide a large expanse of open, unvegetated sand for these species.

In addition to the District's efforts to protect these species, Preferred Sands,[28] a sand and gravel mining company that leases the North SMA from the District, has entered into a Memorandum of Understanding (MOU) with USFWS and NGPC, to which the District and TPCP are cooperating parties. The MOU requires the development of an Adaptive Management Plan (AMP) for interior least terns and piping plovers, which was developed in 2008 and has been successful in enhancing habitat through the development of foraging ponds, clearing vegetation, and protecting nesting birds while allowing Preferred Sands to continue its mining operations. The MOU and the associated AMP have had a beneficial effect on interior least terns and piping plovers on the North SMA, as demonstrated by above-average fledging ratios in 2008 and 2009 (NGPC, 2011.

Recreational Areas within the Project Boundary

The District provides public access for recreation to several sites within the Project Boundary, including Headworks Park and the associated 1,200-acre Off-Highway Vehicle (OHV) Park south of the Loup Power Canal. Headworks OHV Park operates year-round, with the exception of closures during District dredging activities (generally March 15 to May 15 and August 15 to September 20). The area designated for the OHV Park, while adjacent to the Loup River and North SMA, has no record of nesting occurring. Although large expanses of sandy areas exist, the area may be undesirable nesting habitat due to it being surrounded by tall vegetation (mostly trees and shrubs), has limited sight distance for predators, is distant from water sources, and has considerable human activity during the nesting season. However, OHV use in this area could influence interior least tern and piping plover nest site selection and productivity.

Flow Depletion of the Loup River Bypass Reach

There are some differences in Loup River channel geometry (width, depth, etc.) below the Diversion Weir as compared to above the Diversion Weir. However, there has been very little documented use of the Loup River for interior least tern and piping plover nesting, both above and below the Diversion Weir. Because of the lack of data, it is not possible to make a statistical comparison to determine if the differences in channel geometry are affecting use by interior least terns or piping plovers.

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[28] The District's original agreement in 2006 was with Harwest. Through transfers and acquisitions, Preferred Rocks of Genoa and then Preferred Sands took over this operation. Each of these companies has accepted and abided by the conditions of the original agreement.

Sediment Removal

The results of the District's Study 1.0, Sedimentation, demonstrate that the available supply of sediment far exceeds both the Loup and lower Platte rivers' capacity to transport sediment (that is, the Loup River bypass reach and lower Platte River are not supply limited). Both the Loup River bypass reach and lower Platte River are in dynamic equilibrium and are well-seated in the braided morphology regime. No trend toward a different morphology is occurring or will occur under the District's proposed operating scenario (that is, continued operation of the Project).

In the Loup River bypass reach, the diversion of an average of 69 percent of Loup River flow to the canal has reduced the average capacity of the bypass reach. However, since the diversion structure is not a dam, the remaining water flowing down the Loup River bypass reach is still carrying sediment at capacity, and the Loup bypass reach is able to remain a braided river and in dynamic equilibrium. The Loup River bypass reach has adjusted to the diversion of both water and sediment. The analysis conducted in the District's Study 1.0, Sedimentation, showed there was no aggradational or degradational trend occurring nor will one likely occur in the future. Therefore, current operations, which include flow diversion and sediment removal via dredging of the Settling Basin, do not affect sandbar formation in the Loup River bypass reach.

Downstream of the confluence with the Tailrace Canal, the lower Platte River has the full flow of both the Loup and Platte rivers and is carrying sediment at full capacity. The analysis conducted in the District's Study 1.0, Sedimentation, showed that there was no aggradational or degradational trend occurring nor will one likely occur in the future. The lower Platte River has adjusted to the large sediment supply coming from upstream and the inflow of the Tailrace Canal. Therefore, current Project operations, which include the inflow from the Tailrace Return, do not affect sandbar formation.

Because the Project's sediment removal operations have no effect on the braided channel morphology, which creates sandbars that may be used by interior least terns and piping plovers, the Project's sediment removal operations have no effect on any sandbars associated with the braided regime. Because no trend toward a different morphology is occurring or will occur in both the Loup River bypass reach and in the lower Platte River under the District's proposed operating scenario (that is, continued operation of the Project), the Project would not impact morphology, sandbars, or the suitability of the Loup River bypass reach and the lower Platte River for interior least terns and piping plovers.

E.6.6.3 Sediment Transport

The District's Study 1.0, Sedimentation, included an analysis to determine if a statistically significant relationship between sediment transport parameters and interior least tern and piping plover nest counts existed. Sediment transport parameters included effective and dominant discharge, total sediment transported, and flow-related parameters. The initial results of this analysis indicated no significant relationship between interior least tern and piping plover nest counts and sediment transport indicators. No evidence from this analysis was discovered that would suggest that a relationship exists between nest counts and sediment transport indicators or hydrologic parameters.

Supplemental statistical analysis of interior least tern data by river mile for RM 102 to RM 72 used binary logistic regression, multiple linear regression, nonparametric methods, and one-way ANOVA to evaluate if the hydrologic variables could explain nest count numbers and, as a result, could be an influencing factor in nesting of interior least terns on the lower Platte River. The results of these analyses are as follows:

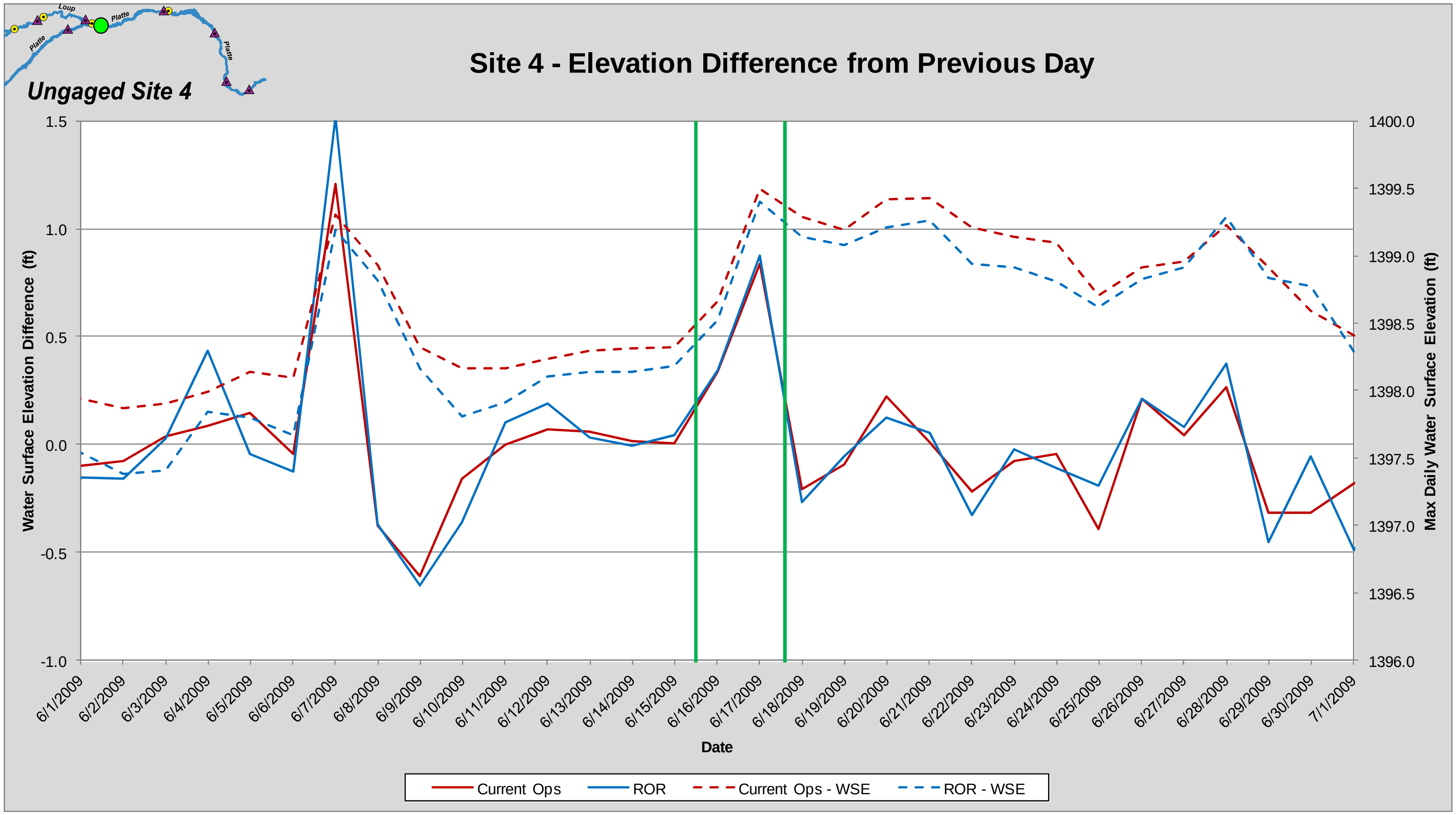
- Nest counts were weakly associated with number of data collection visits per year, but strongly associated with interior least tern adult counts, which were also weakly associated with number of data collection visits.
- No association was detected between summed nest counts and river mile, which indicates that variability in nest counts is not associated with proximity to the Tailrace Return.
- A period of relatively high nest counts from 1987 to 1995 was followed by a period of lower but also static nest counts from 1995 to 2008 between RM 102 and RM 72; this dichotomy is not associated with Project operations.
- Binary logistic regression analysis failed to detect a measurable relationship between presence or absence of interior least tern nests and ranked calendar year, river mile, peak mean daily flow, percent diverted flow, or any combination of these variables.
- Nonparametric correlation studies suggested annual percent diverted flow as a weak but statistically significant predictor of nest counts summed by river mile. This relationship was demonstrated to be spurious following more thorough examination of results of multiple linear regression analyses.
- One-way ANOVA determined that changes in peak mean daily flow between years in relation to nest counts is statistically significant, providing evidence in support of the theory that high flows followed by low flows may be beneficial for interior least tern nesting. However, effect of flow on nest frequency is difficult to gauge from the current data because of extreme variability in the frequency and locations of annual nest counts.
- One-way ANOVA also determined that changes in flow between river miles are not statistically significant in relation to nest counts.

Based on this statistical analysis, Project operations are not statistically related to nest locations or numbers based on the best available nest count data.

Hydrocycling

Hydrocycling operations are known to increase the peak flow of a natural hydrograph. In the District's Study 2.0, Hydrocycling, during dry conditions, the average difference in water surface elevation between the current operations seasonal hydrograph maximum and the run-of-river seasonal hydrograph maximum directly below the Tailrace Return is approximately 0.82 feet. The difference decreases with distance downstream from the Tailrace Return. The difference is less pronounced during normal or wet conditions; however, a difference still exists. Project hydrocycling operations result in higher flows and stage on a daily basis than a run-of-river scenario; however, according to the District's hydrocycling study, a comparison of nesting season flows for run-of-river operations and current operations indicated that exceedances of the pre-nesting season benchmark flows are a result of natural high flow events. The pre-nesting season benchmark flows were used as a surrogate for sandbar elevation and potential maximum nesting elevation (with the understanding that nest locations may, in actuality, be above or below this surrogate elevation). All benchmark exceedances under current operations were due to high flow events that also caused benchmark exceedances under run-of-river operations and that under no circumstance would have been avoided by run-of-river operational changes. In regard to interior least tern and piping plover nesting behavior, interior least terns and piping plovers select their nest locations at some elevation above the daily hydrograph. This elevation is variable and not absolute. Assuming that the daily peak sets the elevation for which a bird will determine an elevation to nest at, the relative elevation above the wetted sand of a sandbar would be the same for current operations and run-of-river operations.

During a storm event, there is a net change in the peak elevation of a daily hydrograph (that is, pre-storm event maximum daily flow to post-storm event maximum daily flow). This is illustrated from June 15 through June 17, 2009, in Graph E-15. This also shows that the magnitude of change from a pre- to post-storm event was typically very similar (within a reasonable range of the accuracy of measurement) for current operations and run-of-river operations, as demonstrated by the water surface elevation difference on June 16, 2009, in Graph E-15.



Graph E-15. Stage Difference and Maximum Stage During June 16, 2009 Storm Event

Consequently, if a bird selects the same nesting location based on the elevation of wetted sand under either current operations or run-of-river operations, based on the years reviewed, there is, under normal circumstances, at least an equal potential of nest inundation due to a storm event under current operations as under run-of-river operations.

This coincides with the generally accepted theory on both the Missouri River and the central Platte River that daily hydrocycling prompts interior least terns and piping plovers to nest at slightly higher elevations on downstream river sandbars than under run-of-river conditions (although the relative height above water level is assumed to be equal). By providing a daily cycle of peaks and troughs, the species locate their nests at a higher elevation, which may prove beneficial when natural storm events occur due to a decrease in the magnitude of effect on the peak stage elevation.

In summary, based on the information available, the potential effects from hydrocycling on nest inundation are not greater than what would occur under run-of-river operations, which would make the potential effects from operation of the Project "discountable."

Daily fluctuations in stage due to hydrocycling affect available nesting habitat in the form of increasing the wetted fringe of a sandbar. This effect is greatest when flows upstream of the Loup-Platte river confluence are the lowest. This may reduce the size of potential nesting habitat of some sandbars. However, nothing in the literature suggests that habitat is a limiting factor on the lower Platte River.

Platte River Flow Depletion

Based on the District's Study 5.0, Flow Depletion and Flow Diversion, the diversion of Loup River flow from the natural channel to the Loup Power Canal does not result in increased water depletions, through evaporative transport or any other means, to the lower Platte River.

PCB Dispersal

Because the interior least tern's diet consists primarily of fish, bioaccumulation of PCBs has the potential for negative effects on interior least tern populations; however, impacts from PCBs on interior least terns are not well understood or quantified (Thompson et al., 1997).

The District facilitated NDEQ PCB fish tissue sampling in Lake Babcock on August 11, 2009, in association with NDEQ's regularly scheduled 2009 PCB fish tissue sampling in the Tailrace Canal at the U.S. Highway 30 bridge, which occurred on August 12, 2009. Five common carp were collected at each location, in accordance with existing PCB sampling protocols developed by NDEQ under the EPA RAFTMP. The fillets from each collected sample were composited into a single sample and were provided to the EPA Region VII laboratory in Kansas City, Kansas, for PCB analysis.

Analytical results for PCB (Aroclor 1248, 1254, and 1260) concentrations at each sample/site were below the reporting limit for each contaminant. For parameters where analytical results were above the reporting limit, NDEQ ran the data through its risk assessment calculation tables. Neither sample/site exceeded current state risk criteria; results are documented in NDEQ's "Findings of the 2009 Regional Ambient Fish Tissue Program in Nebraska" (May 2011). As a result of the 2009 sample results, the fish consumption advisory that was previously in effect for the Loup Power Canal has been rescinded (NDEQ, May 25, 2011). Based on the analytical study results, it is determined that Project operations are not mobilizing PCBs that could affect fishery resources and therefore are not affecting populations of fish consumed by interior least terns.

Ice Jams

Resource agencies expressed concerns regarding the effects of Project operations on ice jam formation and flooding and the associated effects on habitat in the Loup River bypass reach. To address these concerns, the District commissioned the USACE Omaha District to perform relicensing Study 12.0, Ice Jam Flooding on the Loup River, to determine whether Project operations promote ice-induced flooding downstream of the Project. The study concluded that the Project has not significantly changed the ice regime of the Loup River bypass reach, nor has it increased the risk of ice jam flooding. Therefore, the Project was not found to have an effect on the ice regime and does not affect the ability of ice to dynamically alter habitat used by interior least terns and piping plovers.

Conclusion

Suitable nesting habitat exists and is used by interior least terns and piping plovers in the vicinity of the Project. The Project is shown to have no effect on the morphology of the Platte River due to sediment removal, and effects of Project operations are not statistically related to interior least tern and piping plover nest site locations. Project hydrocycling, while increasing the daily peak, has, under normal circumstances, no greater potential to impact nest sites when compared to run-of-river operations. The Project does not contribute to flow depletions in the Platte River, PCB mobilization, or ice jam formation and flooding (that may benefit habitat creation). Additionally, the Project provides suitable, productive nesting habitat on the North SMA. Therefore, continued Project operations may affect, but are not likely to adversely affect, the interior least tern and piping plover.

Whooping Crane

Whooping crane use of the Project area would be primarily as a migratory corridor between breeding and wintering grounds. Whooping cranes are not directly dependent on resources associated with the Loup River or the Project. The possibility exists that the diversion of flows from the Loup River could degrade potentially suitable roosting habitat downstream of the Diversion Weir; however, the likelihood of whooping cranes landing in the vicinity of the Project is low because it is located on the eastern edge of the central flyway corridor, which would make the potential effects from operation of the Project "discountable." Because the likelihood of a whooping crane occurring in the vicinity of the Project is extremely remote and any use of the area would be migratory, of short duration, and transient in nature, the relicensing of the Project may affect, but is not likely to adversely affect, whooping cranes.

Pallid Sturgeon

The majority of pallid sturgeon captured within the Platte River has been below the confluence with the Elkhorn River, and no occurrences have ever been documented in the Loup River or the Loup Power Canal. UNL researchers have completed nearly 3 years of a 5-year Sturgeon Management Study in the lower Platte River, and only a small percentage of pallid sturgeon were captured above the Elkhorn River confluence (Hamel et al., January 2010; Hamel and Pegg, 2011; UNL, June 30, 2011). Prior to the UNL Sturgeon Management Study, there had been no documentation of pallid sturgeon above the Elkhorn River confluence (Peters and Parham, 2008). This suggests that flows contributed by the Elkhorn River play a major role in habitat availability and flow requirements for the pallid sturgeon. Flows from the Elkhorn River and Salt Creek contribute approximately 22 to 28 percent of the total flow in the lower Platte River downstream of the Salt Creek. Based on these data and analysis indicating that the discharge is a contributing factor relative to the amount and accessibility of habitat for the pallid sturgeon, pallid sturgeon habitat above the Elkhorn River is limited, even with no hydrocycling present (that is, run-of-river operations). Table E-56 indicates the pallid sturgeon capture results from the recent UNL Sturgeon Management Study.

Table E-56. UNL Sturgeon Management Survey Summary

Year	Segment 1[a] (% of Total Pallid Captures)	Segment 2[a] (% of Total Pallid Captures)	Total
2009	66 (96%)	3 (4%)	69
2010	34 (87%)	5 (12%)	39
2011	10 (83%)	2 (17%)	12
Total	110 (92%)	10 (8%)	120

Notes:

[a] Segment 1 is the lower Platte River reach between the Missouri River and Elkhorn River confluence (Platte River RM 32.3 to RM 0). Segment 2 is the lower Platte River reach between the Elkhorn River confluence and the Loup Power Canal Tailrace Return confluence (Platte River RM 99.0 to RM 32.3).

The results from the sedimentation, hydrocycling, and flow depletion and diversion studies indicate that pallid sturgeon habitat suitability and connectivity are not substantially affected by the Project. These studies established that Platte River water development activities upstream of the confluence of the Loup and Platte rivers likely contribute more to conditions in the lower Platte River than Project operations. In addition, the literature review revealed that pallid sturgeon prefer the Platte River over the Loup River and Loup Power Canal for its sand substrates and abundant microhabitats, such as convergent zones behind sandbars and islands. The sedimentation study established that dredging and sediment removal activities in the Loup Power Canal are not affecting the natural variability of the sandbars downstream of the Tailrace Return confluence on the lower Platte River.

No observations of pallid sturgeon spawning in the Platte River have been recorded, though some juvenile pallid sturgeon have been captured within the Platte River (Peters and Parham, 2008). It is unclear as to what type of habitat the pallid sturgeon prefer for spawning, but coarse substrates and convergent flows seem to be important. These convergent areas vary little with changes in discharge (Jacobson et al., 2009) suggesting that hydrocycling should have little effect on pallid sturgeon use of these areas.

Temperature changes are often noted as factors affecting fish habitat suitability below hydropower facilities. However, the Project does not impound water for a prolonged period of time and does not include hypolimnetic releases; therefore, District hydrocycling and associated water releases have no effect on water temperature in the lower Platte River.

Because the Project does not affect water temperature downstream of the Tailrace Return and no occurrences of fish being stranded by hydrocycling operations have been documented, the Project may affect, but is not likely to adversely affect, the pallid sturgeon.

Western Prairie Fringed Orchid

The Project is anticipated to have no effect on western prairie fringed orchid. The Project area does not contain the requisite habitat features for this species, nor have any western prairie fringed orchids been documented in the vicinity of the Project. The Project is also located outside of the current range of this species. Therefore, the continued operation of the Project is anticipated to have no effect on either individual plants or the continued existence of the western prairie fringed orchid.

Nebraska State-listed Threatened or Endangered Species

North American River Otter

There are no known Project effects on North American river otters at this time. It is not known whether the species is present or breeding in the vicinity of the Project, but it is suspected that this species could potentially use the area due to the species’ highly mobile nature. No adverse effects of the Project on river otters are anticipated because despite Project operations, adequate habitat and associated hydrology is present within the Project Boundary and the Loup River bypass reach. Furthermore, as discussed in the fisheries section (Section 6.3.1), this area is documented as containing an above adequate fishery, which is the main food source for river otters.

Lake Sturgeon and Sturgeon Chub

The results from the sedimentation, hydrocycling, and flow depletion and flow diversion studies indicate that pallid sturgeon habitat suitability and connectivity are not substantially affected by the Project. Both lake sturgeon and sturgeon chub use similar habitats as the pallid sturgeon; therefore, a similar determination is made for these species. These studies established that Platte River water development activities upstream of the confluence of the Loup and Platte rivers likely contribute more to conditions in the lower Platte River than Project operations. The sedimentation study established that dredging and sediment removal activities in the Loup Power Canal are not affecting the natural variability of the sandbars downstream of the Tailrace Return confluence on the lower Platte River.

Temperature changes are often noted as factors affecting fish habitat suitability below hydropower facilities. However, the Project does not impound water for a prolonged period of time and does not include hypolimnetic releases; therefore, District hydrocycling and associated water releases have no effect on water temperature within the lower Platte River.

Because the Project does not affect water temperature downstream of the Tailrace Return and no occurrences of fish being stranded by hydrocycling operations have been documented, no impacts are anticipated on the lake sturgeon or sturgeon chub.

Small White Lady's Slipper

The Project is anticipated to have no effect on small white lady's slipper. The Project area does not contain the requisite habitat features for this species, nor have any small white lady's slippers been documented in the vicinity of the Project. Therefore, the continued operation of the Project is anticipated to have no impact on individual plants, associated habitat, and the continued existence of the small white lady's slipper.

E.6.6.4 Proposed Environmental Measures

Federally Listed Threatened or Endangered Species

Interior Least Tern and Piping Plover

Since the 1980s, when the interior least tern and piping plover were listed as endangered and threatened, respectively, the District has cooperated with resource agencies to implement measures to protect these species. The primary existing environmental measure for interior least terns and piping plovers is the voluntary cooperation among the District, USFWS, NGPC, and TPCP. The isolation, broad expanse, and frequent wetting of the North SMA, described in Section E.4.22, have made it a popular nesting site for interior least terns and piping plovers, whose nesting period ranges from late April to late July. Since 1988, the District has voluntarily cooperated with USFWS, NGPC, and TPCP to protect nesting interior least terns and piping plovers within the Project Boundary. This has led to cessation of dredging activity during the nesting/fledging season each year, as described below. During the upcoming license period, it is the intention of the District to continue to work jointly with the cooperating agencies in the suspension of dredging activity during the nesting/fledging season.

In 2006, the District was approached by a materials processing company that wanted to purchase, remove, and process stored sand from the North SMA. The District subsequently entered into an agreement with Preferred Sands[29] to remove sand from the North SMA and process it at Preferred Sands' facility located north of and immediately adjacent to the Nebraska Central Railroad line north of, and outside of, the Project Boundary. Preferred Sands currently processes approximately 125,000 tons of sand each month and has removed over 2 million tons of sand since the agreement has been in place. This has increased the capacity of the North SMA to receive additional dredged material.

As a condition of sand removal, the District required that Preferred Sands coordinate with USFWS and NGPC to ensure that sand removal operations would not adversely affect interior least terns and piping plovers. As a result, a Memorandum of Understanding (MOU) was developed by Preferred, USFWS, and NGPC that includes an adaptive management plan (AMP) to protect the threatened and endangered birds. The District and TPCP are cooperating parties to the MOU. As a cooperating party, the District has no specific obligations under the MOU; however, the District works with Preferred Sands to monitor the arrival and departure of the birds and alter dredging operations as necessary for the protection of these species.

The MOU provides cooperative, proactive management strategies to avoid negative impacts on interior least terns and piping plovers from Preferred Sands' industrial operations. The MOU outlines obligations and expectations of all signatories and cooperators and has provided a formalized working relationship for all involved. The MOU remains in effect until Preferred Sands terminates sand removal from the North SMA or if any of the signatory parties formally withdraws from the MOU. Preferred Sands has the opportunity to assign its rights and obligations under the

[29] The District's original agreement in 2006 was with Harwest. Through transfers and acquisitions, Preferred Rocks of Genoa and then Preferred Sands took over this operation. Each of these companies has accepted and abided by the conditions of the original agreement.

MOU to any entity that may succeed it in owning and operating the sand processing facility located on the District's property.

Each spring, District personnel watch closely for the arrival of interior least terns and piping plovers at the North SMA. When birds are identified, the District contacts USFWS and TPCP. At that time, the District restricts personnel vehicle traffic on the North SMA to a narrow strip along the top of the dike at the south end of the site. This dike is regularly monitored by personnel for breaches, erosion, and any potential problems with the dredging pipes. Particular care is taken by District personnel to avoid areas where birds may be congregating and nesting. Additionally, the District begins making plans to stop dredging to the North and South SMAs. Typically, dredging is stopped in early June and commences in mid- to late August, allowing the birds to nest, forage, and raise young at the North SMA. Dredging and discharge resume when the last young have fledged and the birds have begun their winter migration. By continuing dredging operations outside of the nesting/fledging season, the District continues to provide suitable, productive habitat for the interior least terns and piping plovers.

When TPCP arrives to begin monitoring the birds, they check in with both District and Preferred Sands personnel. After a monitoring visit is complete, TPCP debriefs both District and Preferred Sands personnel about where the birds are nesting. Additionally, TPCP informs Preferred Sands about any measures that need to be taken to protect them. Communication throughout the nesting season continues among District personnel, Preferred Sands, and TPCP. If the District needs additional time to come to a reasonable location to stop dredging activities, District personnel work closely with TPCP to remain aware of nesting birds and protect the nests. All parties have indicated that a good working relationship has been established with respect to monitoring activities.

Under the MOU, USFWS and NGPC are required to provide technical support and counsel regarding compliance with ederal and state regulations pertaining to interior least terns and piping plovers. USFWS and NGPC are also required to advise Preferred Sands regarding site requirements and specifications found in the developed AMP. TPCP, on behalf of NGPC and USFWS, is in charge of monitoring the birds at the North SMA and providing annual reports to all MOU parties. In the event that TPCP is unable to conduct annual monitoring, USFWS and NGPC assume responsibility for monitoring these species. Preferred Sands is responsible for the implementation of the AMP and payment of all costs associated with the AMP and monitoring.

The AMP was first developed in 2008 and has undergone no major changes since its initial development. The AMP has four major goals: 1) Improve nesting habitat by creating an Active Habitat Zone (AHZ) that is conducive to nesting by piping plovers and interior least terns, 2) Monitor interior least tern and piping plover nesting,

3) Discourage nesting in industrially active areas, and 4) Protect nests and colonies outside of the AHZ.

During the first year of AMP implementation (2008), Preferred Sands performed the following activities: prior to the nesting season, vegetation was cleared from all areas that had appropriate nesting substrate; a protective berm was created around the designated AHZ of the North SMA where interior least terns and piping plovers nested. This area was kept clear of equipment. Although the majority of birds nested in the AHZ, a few birds also nested outside of this area. During final dredging operations in early June, the berm was eroded in one corner due to slurry water from the dredge pipes. Preferred worked to restore the eroded portion while the District added an extension hose to the associated pipe to divert slurry around the AHZ. No nests were lost or inundated as a result of these actions.

During 2009, it was determined that the protective berm was no longer needed and the AHZ changed to include all areas where the birds were nesting from dredge pipe #13 southwest to the Headworks office (see Appendix E-1, Figure E-8). Preferred Sands implemented nesting deterrent methods, such as windrowing. This method was effective in keeping birds from nesting in active sand removal areas. Additionally, Preferred Sands excavated several shallow ponds to provide water and food sources with appropriate slopes for young piping plovers. The ponds retain slurry water as it drains from the northeast to the southwest and remain wet throughout the summer.

In 2010 and 2011, Preferred Sands did not have a large amount of heavy equipment moving and was mostly stationary in their operations. The birds were able to use much of the southwest corner of the North SMA for nesting and foraging, therefore, intensive management actions were not necessary.

After 4 years of implementing the MOU and AMP, the plan and process appear to be addressing the goals of protecting the nesting birds while allowing for the continued operationof sand removal. Nest success and fledge ratios were considered high in 2008 and 2009 (Bomberger-Brown, 2010). In 2010, severe weather in June impacted the nesting colonies and decreased the ratios. The 2011 results were not yet available when this Draft License Application was submitted to FERC. There is currently no formal review process for the AMP. Communication is shared among all parties, and no issues or discrepancies have been documented to date. The MOU is considered successful because there have been no incidences of “take” of either interior least terns or piping plovers on the North SMA since the inception of the MOU and commencement of sand removal activities commenced. Both the MOU and the AMP are currently being revised ofr updates due to personnel changes and company name revisions.

Photo E-30. The North SMA in 2007, before construction of a protective berm.

Photo E-31. Protective berm in 2008; limbs and branches stabilize sand.

Photo E-32. Protective berm for piping plovers and interior least terns in 2008.

Photo E-33. Discharge pipe extension to divert water around berm in 2008.

Photo E-34. Windrowing used to direct birds to a safe nesting area in 2008.

Photos E-30 through E-34, above, were provided by the Tern and Plover Conservation Partnership.

E.6.6.5 Unavoidable Adverse Impacts

Suitable nesting habitat exists for interior least terns and piping plovers on ephemeral sandbars within the lower Platte River. Project hydrocycling, while increasing the daily peak, has, under normal circumstances, no greater potential to impact nest sites when compared to a run-of-river scenario. However, the potential exists for impacts to nests and chicks due to natural storm events. These potential effects are not anticipated to jeopardize the continued existence of these species.

Additionally, because interior least terns and piping plovers nest on large sandy areas adjacent to rivers and lakes, continued recreational activity in Headworks OHV Park during nesting season may result in an adverse impact on these species by influencing nest site selection and productivity. However, as there is no record of nesting occurring in this area, these potential effects are not anticipated to jeopardize the continued exisitence of the species.

It is not anticipated that relicensing of the Project would result in unavoidable adverse impacts on any of the other Federally or state-listed species.

E.6.6.6 Cumulative Impacts

Past, Present, and Future Actions

As detailed in Section E.1.7, water uses in the Loup River Basin are various and consist of domestic, industrial, livestock, irrigation, hydroelectric power generation, and others. In addition to the District's hydroelectric project, a hydroelectric project owned and operated by the Village of Spalding, Nebraska, exists on the Cedar River. Three non-Project storage dams and reservoirs and three non-Project diversion dams are also located in the Loup River Basin, as discussed in Section E.1.8. These activities and developments represent past and present actions that could be considered during cumulative impacts analysis. Aside from continued Project operations, no reasonably foreseeable future actions have been identified within the Loup River Basin. Additionally, any future Federal actions would be subject to ESA Section 7 consultation.

Impact Analysis

The removal of water from the Loup River for various purposes may continue to have a negative effect on river habitat used by interior least terns and piping plovers, causing point bars with direct connections to the bank for predators and vegetation of bars. Management and protection actions on the North SMA will continue to have beneficial cumulative impacts by providing and managing suitable nesting habitat for interior least terns and piping plovers on the Loup River system, which may offset the cumulative impacts of water withdrawls on on-river habitat.

Because the Loup River system is rarely used by migrating whooping cranes and still provides viable stop-over habitat for transient birds, the Project does not present cumulatively significant adverse impacts on whooping cranes or their habitat.

The Loup River is not known to be used by pallid sturgeon, lake sturgeon, and sturgeon chub; therefore, no cumulatively adverse impacts are anticipated from the Project. On the lower Platte River, habitat continues to be viable and productive for these species. Because the Project does not cause depletions to the lower Platte River and this segment of the Platte River is a highly managed system, it is determined that the Project would not present cumulatively significant adverse impacts on pallid sturgeon, lake sturgeon, or sturgeon chub.

The river otter population in the Loup River Basin and throughout the state of Nebraska has continued to increase since re-introduction. River otter continue to use the basin where habitat and food exist and have been documented throughout the basin. The Project is not anticipated to have a cumulatively significant adverse impact on river otters.

Project operations would have no cumulative effect on western prairie fringed orchid and small white lady's slipper.

E.6.7 Recreation and Land Use

E.6.7.1 Existing Environment

Existing Recreational Facilities

The Project Boundary encompasses approximately 5,000 acres of land. The majority of the Project Boundary lends itself to recreational opportunities, and with few exceptions,[30] these recreational opportunities are open to public use free of charge.

Central to the District's recreational facilities is the Loup Power Canal. The canal is approximately 35 miles long, has approximately 70 miles of shoreline (not including the 10 miles of shoreline surrounding Lake Babcock and Lake North), and is accessible to the public via access roads. The public access roads allow for primitive camping, hiking, biking, and bird watching/eagle viewing opportunities along the canal. In addition, fishing for channel and flathead catfish, walleye/sauger, freshwater drum, and crappie in the canal is very popular. The canal's most productive fishing opportunities occur downstream of the Skimming Weir, siphons, Monroe Powerhouse, Columbus Powerhouse, and Outlet Weir, all of which are described in Section E.4, Existing Project Facilities and Operations.

Within the Project Boundary, along the length of the Loup Power Canal, the District owns and operates five developed recreation areas containing approximately 1,700 acres of land and 800 acres of water (see Appendix E-4). These recreation areas are open to the public, some from May 1 to October 31 and others year-round (weather permitting). It is estimated that there are approximately 82,000 annual user visits to the District's various recreational amenities. District personnel maintain the facilities throughout the year, allowing visitors the following recreational opportunities, all of which are free of charge: water skiing, swimming, boating, camping, fishing, biking, hiking, picnicking, bird watching, photography, and OHV riding. The specific recreational opportunities available at the five developed recreation areas (listed west to east) are provided below. Locations of all recreation facilities are shown in Appendix E-4.

- Headworks Park – Headworks Park, which includes East Camp, Park Camp, Trailhead Camp, and Weir Park Camp, is located 6 miles west of Genoa on Nebraska State Highway 22 and is north of the Loup Power Canal (see Appendix E-4, Attachment A, Figure A-2). This 10-acre recreation area features 23 electrical hookups for campers, picnic areas (with shelters, picnic tables, picnic grills, potable water, and wheelchair-accessible toilets), swimming in a small lake, and fishing in small lakes and in the canal.

[30] Areas immediately adjacent to the Settling Basin and the Monroe and Columbus powerhouses are restricted from public access because of safety concerns.

Photo E-35. Entrance to Headworks Park.

Associated with Headworks Park is Headworks OHV Park (see Appendix E-4, Attachment A, Figure A-1). Headworks OHV Park is owned by the District and maintained by the Nebraska Off Highway Vehicle Association (NOHVA).[31] This 1,200-acre site is located south of the Loup Power Canal (separate from Headworks Park north of the canal) and includes open areas and approximately 50 miles of sandy trails that are accessible to all-terrain vehicles, dirt bikes, and snowmobiles. The park operates year-round, with the exception of closures during District dredging activities (generally March 15 to May 15 and August 15 to September 20), and is estimated to receive 20,000 annual user visits (NOHVA, April 23, 2007). In addition, Headworks OHV Park hosts NOHVA's annual spring and fall OHV jamborees. The most recent jamboree occurred on October 14-16, 2011. The event hosted 1,230 participants from several midwestern states. Proceeds from the jamborees were donated to the Genoa Rescue Squad for its support during the event (NOHVA, November 2, 2011).

31 NOHVA is a not-for-profit organization of over 2,900 members. NOHVA serves the interests of OHV enthusiasts in Nebraska by acting as liaison between OHV enthusiasts and Federal, state, and local government entities. NOHVA advocates environmentally sound, law-abiding, safety-minded, family-oriented, and responsible off-highway recreation.

Photo E-36. Headworks OHV Park, which hosts NOHVA's annual spring and fall OHV jamborees and receives approximately 20,000 annual user visits.

In 2003, NOHVA conducted a member survey to determine the economic impact of ATV and dirtbike use in Nebraska. The survey determined that ATV and dirtbike riders who rode at Headworks OHV Park spent $4,802,538 in Nebraska on day trips in 2002. The survey also estimated that participants of the two jamborees held in 2003 spent an estimated $53,000 in nearby Genoa (NOHVA, February 2004).

- Lake Babcock Park (aka Loup Park) – Lake Babcock Park is located on the north and west shores of Lake Babcock, just north of Columbus (see Appendix E-4, Attachment A, Figure A-3). This well-developed, 40-acre site includes camping areas (30 trailer spaces with electricity provided and 120 tent spaces), playground areas, pedestrian/bike trails, and a picnic shelter. Other specific amenities include picnic tables, benches, fire grates, potable water, and wheelchair-accessible toilets. In addition, Lake Babcock Park offers fishing access to the 600-acre Lake Babcock, which contains bullhead, carp, and channel and flathead catfish. At Lake Babcock, boats are restricted to 5 miles per hour with no wake, and no boating is allowed during bird migration periods.

- Lake North Park – Lake North Park is located 4 miles north of Columbus and, along with Headworks Park, is one of the District's most popular recreation areas (see Appendix E-4, Attachment A, Figure A-3). This site features 2 miles of beaches, two boat ramps, camping areas (25 trailer spaces with electricity provided and 100 tent spaces), and picnic shelters. Other specific amenities include fire grates, potable water, and wheelchair-accessible toilets. In addition, Lake North Park offers unrestricted boating and fishing access to the 200-acre Lake North, which contains carp, channel catfish, crappie, freshwater drum, and walleye.

Photo E-37. Lake North, which opened in the mid-1960s.

Photo E-38. Lake North, a popular District recreation area.

- Columbus Powerhouse Park – Columbus Powerhouse Park is located adjacent to the Columbus Powerhouse, which is nearly 2 miles north of U.S. Highway 30 on 3rd Avenue (see Appendix E-4, Attachment A, Figure A-4). This 4-acre park is open year-round and features a camping area, a playground, a picnic area, and fishing. Specific amenities include grills and wheelchair-accessible toilets.
- Tailrace Park – Tailrace Park is located at the confluence of the Tailrace Canal and the Platte River, 3 miles east and 1 mile south of Columbus (see Appendix E-4, Attachment A, Figure A-5). This 9-acre park is noted for its exceptional fishing. Tailrace Park also offers a playground area and picnic facilities.

In an effort to ensure the safety of swimmers at the District's aquatic recreational facilities, the District visually monitors for blue-green algae growth, and NDEQ performs weekly sampling for microcystin (a toxin generated by certain strains of blue-green algae). If NDEQ sampling detects microcystin, the District posts notices to warn swimmers.

In addition to the developed recreation areas and in cooperation with Columbus Area Recreational Trails, Inc. (CART), the District sponsors and maintains a public trail network within the Project Boundary. Essentially, the trail system abuts the north, west, and south perimeters of the Lake Babcock/Lake North area, with 18th Avenue acting as the eastern perimeter. The specific trails are described below and are shown in Appendix E-4:

- Two Lakes Trail – Two Lakes Trail was built in 2000 with a combination of government and privately donated funds (see Appendix E-4, Attachment A, Figure A-3). The trail winds 2.4 miles along the north shores of Lake Babcock and Lake North and consists of an 8-foot-wide concrete path, which is compliant with the Americans with Disabilities Act (ADA). Two Lakes Trail offers recreational opportunities for joggers, cyclists, runners, rollerbladers, walkers, bird watchers, and nature enthusiasts and was awarded the Millennium 2000 Community Trail Award.[32]

Photo E-39. Bicycle riders enjoying the District's trail network.

[32] Millennium Trails was a national initiative of the White House Millennium Council, in partnership with the Department of Transportation, that recognized, promoted, and stimulated the creation of trails to "honor the past and imagine the future" as part of America's legacy for the year 2000 (White House Millennium Council, 2008).

- Bob Lake Trail – Bob Lake Trail was built in 2004 in compliance with applicable ADA guidelines. It consists of a 1.3-mile-long, 9-foot-wide crushed limestone trail that skirts the southwest perimeter of Lake Babcock (see Appendix E-4, Attachment A, Figure A-3).

Photo E-40. Castner's Crossing footbridge, which crosses the Loup Power Canal and connects the Two Lakes Trail and the Bob Lake Trail.

- Robert White Trail – Robert White Trail was built in 2006 in compliance with applicable ADA guidelines. It consists of is a 1.5-mile crushed limestone trail that follows the southern perimeter of Lake Babcock from Bob Lake Trail to 18th Avenue (see Appendix E-4, Attachment A, Figure A-3).

As discussed in Section E.6.4, Wildlife and Botanical Resources, the Loup Lands WMA is a 485-acre parcel, located near the Headworks, that is leased to NGPC (see Appendix E-4, Attachment A, Figures A-1 and A-2). The Loup Lands WMA is open to the public for both wildlife viewing and hunting.

The Lake Babcock Waterfowl Refuge is partially located within the Project Boundary and consists of Lake Babcock, Lake North, and adjoining lands. The refuge was established in the 1940s and is regulated by NGPC (see Appendix E-4, Attachment A, Figure A-3). Approved and restricted recreation activities at the Lake Babcock Waterfowl Refuge are as follows (163 NAC 4-019):

- All hunting is prohibited in the posted area.
- The operation of all vessels is prohibited upon the waters of the refuge during the open waterfowl season (with the exception of District vessels necessary for Project operation and maintenance), except that portion of the refuge know as Lake North, where vessels may be operated at any time during the year for the purpose of pleasure or fishing.
- Fish may be taken by any otherwise legal means during the entire year in Lake North, but shall be prohibited in Lake Babcock during an open waterfowl season.

In addition to the previously noted cooperatives between the District and civic groups such as NOHVA and CART, the District has successfully worked with the Boy Scouts and Girl Scouts on multiple projects that provide the scouts opportunities to perform community service while adding to the District's recreational amenities. The District has provided building materials and manpower for these projects, and following project completion, the District adopts the maintenance activities associated with these projects. Some examples of successful projects are as follows:

- Creation of Contemplation Point, a small area where diverted local drainage is conveyed over rocks, resulting in calming sounds similar to a babbling brook. A wheelchair-accessible picnic table was also installed at this location.
- Construction of multiple kiosks that include trail maps and announcements.
- Installation of name plates on trees along trails (to aid in species identification).
- Construction and installation of bird nesting habitat and bat houses.

Recreational Use

The District's combined recreation facilities are estimated to receive more than 80,000 annual user visits, with Headworks Park and Lake North Park receiving the most user visits, as shown in Table E-57, and the OHV Jamborees at Headworks OHV Park drawing approximately 1,200 participants. Recreation use varies both seasonally and throughout the week, with heaviest use occurring in the summer, on weekends, and on holidays.

Table E-57 summarizes recreation use estimates derived from the District's 2010 Recreation Use Survey.

Table E-57. Recreation Site Average Daily and Average Annual Use

Type of Analyzed Day	Headworks Park	Lake Babcock Park (Loup Park)	Lake North Park	Columbus Powerhouse Park	Tailrace Park	Loup Power Canal	Total
Estimated Average Daily Use							
Weekday[a]	50	30	70	20	40	50	260
Weekend (All Weekends)[b]	320	60	150	30	70	90	720
Weekend (Non-Holiday Weekend Only)[c]	320	60	130	30	60	90	690
Weekend (Holiday Weekend Only)[d]	300	60	200	40	90	100	790
Memorial Day Weekend[e]	370	90	280	70	130	80	1,020
Independence Day Weekend[e,f]	240	10	150	40	120	50	610
Labor Day Weekend[e]	280	70	160	30	30	160	730
Estimated Annual Use							
2010	26,600	7,900	19,200	4,300	10,400	13,200	81,600

Notes:

[a] Includes all Tuesdays, Wednesdays, Thursdays, and Fridays for the recreation period of May 1 through October 31. Also includes all Mondays not associated with Memorial Day, Independence Day, or Labor Day weekend.

[b] Includes all Saturdays and Sundays, regardless of whether they are associated with a holiday weekend, for the recreation period of May 1 through October 31.

[c] Includes all Saturdays and Sundays that are not associated with a holiday weekend for the recreation period of May 1 through October 31.

[d] Includes the Saturdays, Sundays, and Mondays associated with the Memorial Day, Independence Day (observed on Monday, July 5, 2010), and Labor Day weekends.

[e] Includes the Saturday, Sunday, and Monday of the designated holiday weekend.

[f] Weather likely limited visitation, as rain was recorded in the area on both July 4 and July 5, 2010 (NeRAIN, December 3, 2010).

A very small minority of the 1,024 participants who responded to the recreation use survey along the Loup Power Canal cited concerns or frustrations related to overcrowding. Of the 1,012 respondents to District Recreation Use Survey Question No. 15: "Did anything interfere with your recreation activities today," only 3 persons

(0.3 percent—all surveyed on non-holiday weekends that did not correspond with the NOHVA jamboree) stated that overcrowding had interfered with their recreation.[33]

Additionally, in responding to District Recreation Use Survey Question No. 14: "Please give a general rating for the facilities you have used at this Loup Power District recreation area," the overwhelming majority (96 percent) of respondents rate the facilities as "Average" or better ("Above Average" or "Excellent").

Concurrent with the recreation use survey along the Loup Power Canal, conducted on 62 days between May 1 and October 31, 2010, survey proctors also recorded RV and tent counts at developed recreation sites and along undeveloped portions of the Loup Power Canal. When compared to the number of existing RV and tents sites at the various recreation areas, capacity exceedances were very limited and only occurred at Headworks Park. Noted exceedances at Headworks Park occurred on Memorial Day weekend and during the October 2010 NOHVA jamboree.

Current and Future Recreation Needs

Current and future recreation needs are identified in state, regional, and local plans, as described below.

The Nebraska State Comprehensive Outdoor Recreation Plan (SCORP) makes no specific reference to the existing Project-related recreation opportunities or any existing recreation needs associated with the Project or surrounding area. Instead, the SCORP speaks in broad generalities with regards to national, state, and local recreation trends and actions that can be taken to enhance recreation at the state and local level (NGPC, 2010).

In the *2004 Nebraska Tourism Industry Development Plan*, the state is divided into seven regions; the Project is located in the Lewis and Clark Region (Nebraska Travel and Tourism Division, 2004). The Tourism Industry Development Plan lists public and industry recommendations that were made by local residents who attended a series of public meetings. Suggestions specific to the Project are listed below:

- "Develop wildlife viewing opportunities at Lake Babcock, north of Columbus."
- "Encourage trail development at Lake Babcock, north of Columbus."
- "Maintain the Loup River Canal Trail (Genoa to Columbus) as a primitive hiking trail accessible to the public."

[33] It should be noted that Project surveys were performed on both weekdays and weekends, including Memorial Day, Independence Day, and Labor Day weekends.

Consistent with the second bullet above regarding trail development around Lake Babcock, the District constructed Bob Lake Trail in 2004 and Robert White Trail in 2006. The trails follow the west and south banks of Lake Babcock, respectively, and were constructed in accordance with applicable ADA guidelines.

CART is a §501(c)(3) non-profit organization that is composed of a group of volunteers who envision a series of human-powered transportation and recreation routes through the community of Columbus (CART, 2008a). Representatives from CART participated in Project relicensing meetings, and CART was provided the District's Draft Recreation Management Plan for review and comment. At the time when this Draft License Application was submitted to FERC, no input had been received from CART on the Draft Recreation Management Plan.

The CART Master Plan identifies multiple alignments for proposed trails within the Project Boundary. The Master Plan does not assign specific names to the proposed trails; however, their proposed alignments are generally described as follows (CART 2008b):

- Proposed trail that begins at the Lower Power Canal's mouth at Lake Babcock and follows the Lower Power Canal an unspecified distance west
- Proposed trail that begins at the outlet of Lake Babcock and follows the Intake Canal to the Columbus Powerhouse
- Proposed trail that begins at the Columbus Powerhouse and follows the Tailrace Canal to its confluence with the Platte River
- Proposed trail that provides a direct north/south connection between Two Lakes Trail and Lakeview School
- Proposed trail that would parallel 18th Avenue between the outlet of Lake Babcock and the grade divide between Lake Babcock and Lake North

The City of Columbus has both a Parks Department and a Community Development Department; however, the dealings of these entities are restricted to the City's jurisdictional limits and do not include the Project Boundary. The City of Columbus also has a Comprehensive Plan (City of Columbus, October 2005). The only discussion in the Comprehensive Plan related to recreation and the Project is found in Section 3.5, Growth Centers, and consists of the recommendation for a bikeway between the city center and Tailrace Park.

Nance County, Platte County, and Genoa do not have formal recreation departments or related plans.

Existing Shoreline Buffer Zones

The Loup Power Canal differs considerably from a natural waterway. It is an artificial channel constructed in a narrow corridor through rural agricultural lands and is flanked on both banks by access and maintenance roads. Naturally occurring riparian areas are largely absent from the canal corridor, and agricultural lands abut the Project Boundary along most of its length. The District has allowed the corridor area to become naturally vegetated with the exception of unpaved access roads that require maintenance as well as areas of bank stabilization.

Where the Loup Power Canal alignment intersected tributaries of the Loup River, siphons were constructed. Thus, the canal and the tributary streams remain hydraulically separated. The actual area contributing drainage to the Loup Power Canal is quite small. Therefore, the extent of sediment and nutrient loading into the canal is limited, and extensive shoreline buffer zones are not required for water quality purposes. Furthermore, the embankment sections adjacent to the Loup Power Canal protect it from runoff and associated sediment and nutrient loads.

The Project Boundary is wide in locations adjacent to the Headworks and regulating reservoirs. In these locations, substantial buffer zones exist between the canal and reservoir shoreline and surrounding urban development or agricultural areas. There is little need or opportunity to enhance these existing shoreline buffer zones.

Additional information is provided in Section E.6.1.1 under the "Conditions of Shorelines" subheading.

Current Shoreline Management Plan or Policy

It is District policy to allow public use of Project lands consistent with Project security and public safety considerations. No private homes, cottages, docks, landings, bulkheads, or other facilities are allowed on District lands. The lease for the privately-owned cabin (referenced in previous relicensing documents) has now been obtained by the District and the cabin has been removed.

Two exceptions to the above-noted policy are as follows:

1. The District has an existing agreement with Preferred Sands that allows Preferred Sands access to District property in order to gather and remove sand from the North SMA for processing and ultimate off-site shipment.
2. The District has multiple agreements with local landowners that allow them to draw irrigation water from the Loup Power Canal; all landowners must have a water right from the State prior to executing an agreement with the District.

National Wild and Scenic River or State-Protected River

The Project is not located within or adjacent to a river segment that is designated as part of, or under study for inclusion in, the National Wild and Scenic River System. In addition, the Project is not located within or adjacent to any state-protected river segments.

National Trails System or Wilderness Area

Although the Mormon Pioneer National Historic Trail follows the Platte River through Nebraska and is in close proximity to the Project Boundary, no Project lands are under study for inclusion in the National Trails System or for designation as a Wilderness Area.

Regionally or Nationally Important Recreation Areas

No National Recreation Areas exist either in or in close proximity to the Project Boundary.

In 1981, at the time of the previous relicensing effort, it was believed that "in general, the Loup Power system fishery could be described as excellent, and of regional importance to east-central Nebraska" (Rupp, 1981). In addition, "concerning the overall resources of both the canal and river and project effects on these resources, in my judgment, the power project has substantially improved the fishery resource and greatly enhanced recreational opportunities" (Rupp, 1981). The same claim of regional importance could likely be made in reference to the other recreational opportunities provided by District facilities and operations, including camping, boating, walking/biking, swimming, nature viewing, picnicking, and OHV riding.

Non-Recreational Land Use and Land Management

Non-recreational land use within the Project Boundary is managed for, and directly related to, the operation and maintenance of the Project. No other uses are contemplated or acceptable.

Land use adjacent to the Project Boundary is estimated as shown in Table E-58 and graphically depicted in Appendix E-1, Figure E-16, Sheets 1 through 14. Generally, land use within these areas is dominated by agriculture and open space.

Table E-58. Land Use

Land Use	Percent Cover
Agriculture	72.6
Open Space	11.8
Transportation ROW	4.8
Industrial	4.2
Single-Family Residential	3.6
Water	1.3
Wildlife Management Area	0.6
Commercial	0.5
Institutional	0.3
Mobile Home Residential	0.3

E.6.7.2 Environmental Analysis

In 2010, the District conducted a comprehensive recreation use study, which included both a recreation use survey and an angler use and harvest (creel) survey, to gather data regarding existing recreation use of Project facilities, including use by anglers. Data collection was conducted from May 1 to October 31 along the entire length of the Loup Power Canal, including the developed recreations areas, and the Loup River bypass reach.[34] Additionally, a telephone survey regarding recreation use was conducted and trail counters were used to collect trail use data.

The results of the recreation use survey are summarized as follows and detailed in the District's Updated Study Report, Study 8.0, Recreation Use. The data collected during the recreation use study, including both the recreation use survey and the creel survey, and Study 10.0, Land Use Inventory, was considered during the development of District's Draft Recreation Management Plan, provided in Appendix E-4.

[34] Recreation surveys along the Loup River bypass reach were requested by FERC. The bypass reach is not considered a recreation amenity of the Project.

During Project scoping, a Recreation Workgroup was developed that included the following agencies: National Park Service (NPS), USFWS, NGPC, and NOHVA. All members of the Recreation Workgroup, in addition to the City of Columbus and CART, were provided the Draft Recreation Management Plan for review and comment. Comments provided by these agencies were considered and incorporated into the plan to the greatest extent possible (see Appendix E-5, Consultation, for comments received and District responses). The Draft Recreation Management Plan is provided as Appendix E-4 and outlines District plans for enhancing existing recreation facilities.

Use Estimates of District Recreation Sites

Based on 2010 survey and observation data, the District's entire recreation system is estimated to receive approximately 82,000 annual user visits. Notable use estimate findings are provided in Table E-59 as well as the following:

- The estimated average weekend recreation use is roughly three times that of the estimated average weekday use.
- Overall, Headworks Park is the most frequently visited recreation site, followed by Lake North Park.
- Whereas visits to Lake North Park are highest on weekdays, visits to Headworks Park are highest during the weekend, including holiday weekends.
- Memorial Day weekend was the busiest time for District recreation facilities in 2010.

Table E-59. Recreation Site Average Daily and Average Annual Use

Type of Analyzed Day	Headworks Park	Lake Babcock Park (Loup Park)	Lake North Park	Columbus Powerhouse Park	Tailrace Park	Loup Power Canal	Total
Estimated Average Daily Use							
Weekday[a]	50	30	70	20	40	50	260
Weekend (All Weekends)[b]	320	60	150	30	70	90	720
Weekend (Non-Holiday Weekend Only)[c]	320	60	130	30	60	90	690
Weekend (Holiday Weekend Only)[d]	300	60	200	40	90	100	790
Memorial Day Weekend[e]	370	90	280	70	130	80	1,020
Independence Day Weekend[e,f]	240	10	150	40	120	50	610
Labor Day Weekend[e]	280	70	160	30	30	160	730
Estimated Annual Use							
2010	26,600	7,900	19,200	4,300	10,400	13,200	81,600

Notes:

[a] Includes all Tuesdays, Wednesdays, Thursdays, and Fridays for the recreation period of May 1 through October 31. Also includes all Mondays not associated with Memorial Day, Independence Day, or Labor Day weekend.

[b] Includes all Saturdays and Sundays, regardless of whether they are associated with a holiday weekend, for the recreation period of May 1 through October 31.

[c] Includes all Saturdays and Sundays that are not associated with a holiday weekend for the recreation period of May 1 through October 31.

[d] Includes the Saturdays, Sundays, and Mondays associated with the Memorial Day, Independence Day (observed on Monday, July 5, 2010), and Labor Day weekends.

[e] Includes the Saturday, Sunday, and Monday of the designated holiday weekend.

[f] Weather likely limited visitation, as rain was recorded in the area on both July 4 and July 5, 2010 (NeRAIN, December 3, 2010).

Demand for District Recreation Sites

Nebraska's SCORP for 2011 to 2015 states that "there is no consensus in the field of recreation planning on the best practice in measuring current and future demand for outdoor recreation resources and facilities" (NGPC, 2010). This suggests that the quantification of demand for District recreation facilities is difficult regardless of the amount of recreational survey data collected. The following discussion of demand shows that District facilities adequately provide for both existing and projected future recreation demand.

The National Recreation and Park Association (NRPA) developed guidelines in 1971, 1983, and 1995 that outlined how many acres of park and how many miles of trail there should be in a community based on its population. The 1995 guidelines indicated that there should be 10 acres of park per 1,000 people and 1 mile of trail per 8,000 people. These numbers help define a level of service or minimum park and recreation infrastructure capacity required to satisfy a community's park and recreation needs. NGPC recognizes this method as commonly used, and many planners and engineering firms focus on these numbers because no other standards exist for recreation facilities (NGPC, 2010).

Considering the NRPA guidelines and the U.S. Census Bureau's 2010 population data for Nance (3,735) and Platte (32,237) counties (U.S. Census Bureau, 2010), the population of the combined counties (35,972) would require 360 park acres and 4.5 miles of trail. Table E-60 displays local population counts from 2000 to 2010 as well as population projections for 2020 and 2030.

Table E-60. Population Counts and Projections

Location	2000 Census[a]	2010 Census[b]	2020 Projection[c]	2030 Projection[c]	Measured % Change 2000-2010	Projected % Change 2010-2020	Projected % Change 2010-2030
Nance County	4,038	3,735	2,920	2,450	-7.5	-21.8	-34.4
Platte County	31,662	32,237	30,535	29,528	+1.8	-5.3	-8.4
Total	35,700	35,972	33,455	31,978	+0.8	-7.0	-11.1

Notes:

[a] Source: U.S. Census Bureau, 2000, "Census 2000 Summary File 1 100-Percent Data," *American FactFinder*, retrieved on December 2, 2010, http://factfinder.census.gov.

[b] Source: U.S. Census Bureau, 2010, "2010 Demographic Profile Summary File," *American FactFinder*, retrieved on June 6, 2011, http://factfinder2.census.gov.

[c] Source: Nebraska Department of Economic Development, "Projected County Populations," retrieved on July 18, 2011, http://www.neded.org/files/research/stathand/bsect12.htm.

The sizes of the District's multiple recreation sites are shown in Table E-61. With 1,762 acres of land available for public recreation and an additional 800 aquatic acres, District facilities more than exceed the NRPA guideline. Not included in these figures (see Table E-61) is the consideration that nearly the entire 5,000-acre Project Boundary is publicly accessible for recreation. Also, the City of Columbus has an extensive series of developed public parks, and NGPC maintains several additional

WMAs in Nance and Platte counties. In summary, available recreation facilities exceed the NRPA guideline for Nance and Platte counties.

Table E-61. Size of District Recreation Sites

Recreation Site	Area (acres)	Recreation Site	Area (acres)
Developed Terrestrial Recreation Sites		Undeveloped Terrestrial Recreation Sites	
Headworks Park	10	Headworks OHV Park	1,200
Lake Babcock Park	40	Loup Lands WMA	485
Lake North Park	14	Total	1,685
Columbus Powerhouse Park	4		
Tailrace Park	9	Aquatic Recreation Sites	
		Lake Babcock	600
		Lake North	200
Total	77	Total	800
Total Recreation Area: 2,562 acres			

The District's developed trail system also exceeds the NRPA guideline for trails. The District's trail system provides 5.2 miles of developed and maintained pedestrian/bicycle trail: 2.4-mile Two Lakes Trail, 1.3-mile Bob Lake Trail, and 1.5-mile Robert White Trail. Additionally, an estimated 50 miles of OHV trails are publicly accessible at Headworks OHV Park.

Based on the following considerations, projected recreation demand is not anticipated to increase during the applied-for license period:

- U.S. Census Bureau data shows that the populations of Nance and Platte counties have been essentially static over the past decade. State of Nebraska population projections for Nance and Platte counties show notable population decreases through 2030 (see Table E-60).
- The findings of the NGPC 2009 statewide recreation survey indicate that outdoor recreation is generally decreasing in Nebraska (NGPC, 2010).

Loup Power Canal Survey Responses

Based on collected survey responses, those who recreate along the Loup Power Canal most commonly:

1. Live within 25 miles of District facilities.
2. Use District facilities because they are close to home.

3. Recreate either alone or with a single guest.
4. Do not stay overnight.
5. Visit District facilities on a weekly basis.
6. Visit during the summer months of May, June, July, and August.
7. Describe themselves as white (non-Hispanic, Latino, or Spanish).
8. Earn an annual household income between $26,000 and $50,000.

Notable exceptions to the above list include users of the Headworks OHV Park. This group often travels well over 25 miles to access the unique recreation opportunity afforded by Headworks OHV Park and often stay overnight. As they reside in areas farther removed from District facilities, their frequency of visitation is two to three times per year and corresponds with the spring and fall NOHVA jamborees.

Fishing from shore, relaxing/hanging out, camping, and OHV riding were the most commonly cited activities in which respondents participate. Similarly, these activities, along with wildlife/scenic viewing and picnicking, were noted as the most important activities by respondents.

Respondents generally gave District recreation facilities high ratings. District trails and Headworks OHV Park received the highest ratings, whereas restrooms and parking received the lowest.

Trail Counts

Collected trail count data suggest the following:

1. The most trail use occurs in May; trail traffic is very consistent from June through September and decreases in October.
2. Two Lakes Trail receives 59.5 percent of the total trail traffic; Bob Lake Trail receives 25.7 percent; and Robert White Trail receives 14.8 percent.
3. Trail traffic is generally consistent throughout the work week and increases slightly on the weekend.
4. Two Lakes Trail receives a daily average of 71.9 trips/day; Bob Lake Trail receives 31.0 trips/day; and Robert White Trail receives 17.9 trips/day.
5. Essentially no trail users are present between 9:00 p.m. and 6:00 a.m. Trail use begins at approximately 6:00 a.m. and is moderate and consistent through the morning hours. Trail use increases following the lunch hour and remains consistent through approximately 8:00 p.m., when usage drops off sharply.

Creel Survey Summary

Total fishing pressure along the Loup Power Canal[35] during the 2010 open water fishing season is estimated to be 32,766 angler hours, or 119 angler hours per hectare (ha). Angler effort estimates are highest for the months of September (7,739 hours) and May (6,531 hours), and shore fishing is estimated to account for over 94 percent of the angler hours expended (as opposed to fishing from a boat). The 2010 creel survey estimates that angler effort in 2010 was 265 percent and 118 percent of the estimated angler hours associated with the creel surveys conducted by NGPC in 1996 (NGPC, June 1997) and 1997 (NGPC, April 1998), respectively.

Anglers fishing the Loup Power Canal between May 1 and October 31, 2010, harvested an estimated 8,973 fish (all species and fishing methods combined), including an estimated channel catfish harvest of 4,185, which was nearly 47 percent of the overall harvest. The overall and channel-catfish-specific harvests were most abundant in October despite estimated catch values peaking in May. Other species commonly harvested in 2010 included freshwater drum (22.2 percent), crappie species (12.4 percent), and white bass (9.1 percent).

The estimated number of fish caught and released on the Loup Power Canal from May 1 to October 31, 2010, is 11,843. Release estimates exceeded the number of fish harvested for every species except white bass, bluegill, and sauger.

The average harvest rate for all anglers fishing the Loup Power Canal from May 1 to October 31, 2010, was 0.30 fish per angler hour. The highest estimated catch rates occurred in May (1.31 fish per angler hour) and October (0.86 fish per angler hour), respectively. The highest estimated harvest rate occurred in October (0.57 fish per angler hour).

The average channel catfish harvest rate (for anglers targeting channel catfish) was 0.22 fish per angler hour. The highest associated catch rates occurred in July (0.65 fish per angler hour) and October (0.52 fish per angler hour), while the highest estimated harvest rate occurred in May and October (0.35 fish per angler hour).

More than 99 percent of the anglers surveyed along the Loup Power Canal between May 1 and October 31, 2010, were Nebraska residents. More specifically, over 58 percent of surveyed anglers reside in Platte County, Nebraska (which includes the City of Columbus).

Angling parties averaged 1.75 members in size, indicated a mean completed trip length of 2.90 hours, and made an estimated 11,299 angler trips.

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[35] For purposes of creel survey analysis only, all references to the Loup Power Canal include the Loup River at the Headworks and the lower Platte River at the mouth of the Loup Power Canal. Anglers fishing in these waters at only these locations were surveyed in incorporation of the District's 2010 creel survey.

The majority of the surveyed anglers (64.5 percent) were targeting channel catfish, while 9.7 and 9.3 percent were targeting “anything” and walleye/sauger, respectively.

According to collected data, the vast majority (over 87 percent) of anglers described themselves as white (non-Hispanic, Latino, or Spanish). Additionally, more than 11 percent of anglers described themselves as Hispanic, Latino, or Spanish. The most common annual household income range reported by anglers was $26,000 to $50,000 (over 42 percent). Respondent frequency generally decreased as income increased.

Fifty-seven percent of respondents rated shore fishing opportunities along the Loup Power Canal as “Excellent” or “Above Average.” An additional 35 percent of respondents rated shore fishing opportunities as “Average.”

Water Quality

As a result of the relicensing-associated 2009 fish tissue analytical sample results, the PCB fish consumption advisory that was previously in effect for the Loup Power Canal has been rescinded (NDEQ, May 25, 2011). Further detail in provided in Section E.6.3.2. Currently, there are no active fish consumption advisories for Project fisheries.

In an effort to ensure the safety of swimmers at Lake North, the District visually monitors for blue-green algae growth, and NDEQ performs weekly sampling for microcystin (a toxin generated by certain strains of blue-green algae). If NDEQ sampling detects microcystin, the District posts notices to warn swimmers.

Loup River Bypass Reach

Although the Loup River bypass reach is not a District recreation site and the majority of land along the bypass reach is privately owned, a survey of recreation users was conducted along the Loup River bypass reach in accordance with FERC’s Study Plan Determination (August 26, 2009).

Collected survey responses indicate that recreational use of the Loup River bypass reach is very limited and that Project operations do not adversely affect those that use the area. The findings of limited use are explained due to the limited public access of the bypass reach.[36] Survey responses are summarized as follows:

- Of the 1,022 respondents to Loup Power Canal Survey Question No. 11, “Do you use recreation sites in the area that are not owned and operated by Loup Power District, and if yes, which one(s),” only 13 (1.3 percent) noted use of the Loup River bypass reach.

[36] Although water in the Loup River bypass reach is considered a public water of the state, Nebraska case law has determined that riparian land ownership extends to the center or thread of the stream (*Stubblefield v. Osborn*, 149 Neb. 566, 31 N.W.2d 547 (1948), as cited in Professional Surveyors Association of Nebraska, “Riparian Rights”).

- Of the 97 respondents to Loup River Bypass Reach Survey Question No. 7, "Did anything decrease your enjoyment during your visit to the Loup River today," 88 percent and answered "No." Of those who answered "Yes," none noted Project operations as the reason for decreased enjoyment.
- Of the 22 respondents to Loup River Bypass Reach Survey Question No. 12, "Did anything decrease your enjoyment during your visit to the Loup Lands WMA," 100 percent answered "No."

Based on collected survey responses, those who recreate along the Loup River bypass reach most commonly:

1. Live within 25 miles of the Loup River bypass reach.
2. Recreate either alone or with a single guest.
3. Do not stay overnight.
4. Visit the Loup River bypass reach on a weekly basis.
5. Visit the Loup River bypass reach during the summer months of May, June, July, and August.
6. Access the Loup River bypass reach from Headworks Park, Pawnee Park, or private property.
7. Have never visited Loup Lands WMA.
8. Describe themselves as white (non-Hispanic, Latino, or Spanish).
9. Earn an annual household income between $26,000 and $50,000.

A notable exception to the above list is the timing of visitation at the Loup Lands WMA. Respondents who visit the WMA indicate that the greatest number of visits occur in the fall and spring, concurrent with Nebraska hunting seasons and prime morel mushroom season.

Fishing from shore, relaxing/hanging out, swimming/wading, hiking, camping, mushroom hunting, walking/running, and OHV riding were the most commonly cited activities in which respondents participate.

Anecdotally, the following information, collected in 1981 at the time of the District's previous relicensing effort, is believed still accurate today: "Concerning the overall resources of both the [Loup Power] canal and [the Loup] river and project effects on these resources, in my judgment, the power project has substantially improved the fishery resource and greatly enhanced recreational opportunities" (Rupp, 1981).

E.6.7.3 Proposed Environmental Measures

The District has identified the following Project improvements in its Draft Recreation Management Plan. All listed improvements are intended to enhance the existing recreational opportunities associated with the Project.

Headworks Park

The District is planning to implement the following recreation improvements during the term of the operating license and in accordance with the implementation schedule noted for each specific improvement. In addition to the following improvements, the District intends to continue its cooperative effort with NOHVA by providing trail riding opportunities at Headworks OHV Park and hosting NOHVA jamborees:

- In late 2011, the District upgraded the 23 camper outlets at Headworks Park to 50 amps. Previously, all outlets were 20 or 30 amps. The outlet upgrade now accommodates larger recreational vehicles and their associated power demand.
- The District plans to construct a new permanent restroom facility at Headworks OHV Park. The restroom would house men's and women's double-vaulted waterless toilets that meet ADA guidelines. The restroom would not include running water or shower facilities. This improvement will be completed in 2016.[37]
- Playground equipment at developed recreation areas is evaluated yearly for replacement and improvements; consistent with current practice, it is anticipated that improvements would be made at Headworks Park for approximately the first 10 years of the new license period to replace outdated equipment.
- The District plans to install a sand volleyball court on the north side of Park (Raitt) Lake. This improvement will be completed in 2015.

Lake Babcock Park (Loup Park)

Playground equipment at developed recreation areas is evaluated yearly for replacement and improvements; consistent with current practice, it is anticipated that improvements would be made at Lake Babcock Park for approximately the first 10 years of the new license period to replace outdated equipment.

[37] Contemplated construction completion dates assume license issuance and Recreation Management Plan approval on or before April 15, 2014.

Lake North Park

The District is planning to implement the following recreation improvements during the term of the operating license and in accordance with the implementation schedule noted for each specific improvement:

- The District plans to construct a wheelchair-accessible fishing pier, which would meet ADA guidelines, along the north shore of Lake North. Preliminary design plans, which are subject to change, consist of a 12-foot by 24-foot covered structure with railing that would be accessible from Two Lakes Trail via ADA-compliant paths. This improvement will be completed in 2015.
- The District plans to designate a no-wake zone in the southeast corner of Lake North. This measure is planned to enhance the recognized fishing opportunities that exist in this portion of the lake. The no-wake zone would be designated by marker buoys and would occupy approximately 5 acres of Lake North. This improvement will be completed in 2015.
- In late 2011, the District upgraded the 12 camper outlets at Lake North Park to 50 amps. Previously, all camper outlets were 20 or 30 amps. The outlet upgrade now accommodates larger recreational vehicles and their associated power demand.
- Playground equipment at developed recreation areas is evaluated yearly for replacement and improvements; consistent with current practice, it is anticipated that improvements would be made at Lake North Park for approximately the first 10 years of the new license period to replace outdated equipment.
- In 2011, the District implemented zebra mussel awareness measures in an effort to minimize the chance of infestation at Lake North and to ensure that the existing recreational opportunities afforded by Lake North continue. Specifically, the District posted signs, developed in association with NGPC, which outline the threat posed by zebra mussels and measures that can be taken to minimize risk (see Photo E-41).

Photo E-41. New Invasive Species Signage: photographed August 17, 2011.

Columbus Powerhouse Park

Playground equipment at developed recreation areas is evaluated yearly for replacement and improvements; consistent with current practice, it is anticipated that improvements would be made at Columbus Powerhouse Park for approximately the first 10 years of the new license period to replace outdated equipment.

Tailrace Park

Tailrace Park has been subject to considerable vandalism and public safety concerns for a number of years (see Photo E-42). Its location is such that it is near enough to Columbus to be easily accessible, while also remote enough to provide some sense of isolation to persons engaging in undesirable or illegal activities. Currently, Tailrace Park has unrestricted vehicle access.

The District recognizes the area's unique landscape, Platte River access, and favorable fishing opportunities. However, as a result of years of removing graffiti, collecting substantial litter, and repairing damaged property, the District also believes that the area is not suitable for sustained public recreation. Considering notable concerns regarding undesirable or illegal activities, the District is planning no recreation improvements to Tailrace Park.

In hopes to deter undesirable or criminal activity at Tailrace Park, the District is considering ending vehicular access to the park while maintaining pedestrian access for those wishing to use the recognized fishing opportunities. However, a final decision has not been made. If the District decides to end vehicle access, gates, fencing, or other barriers that are not passable by vehicles would be installed well north of park facilities. Additionally, a parking area would be designated north of the barriers, and accommodations for foot traffic access would be maintained.

Photo E-42. Vandalism at Tailrace Park: photographed April 5, 2011.

Trails

The District has historically enjoyed a successful partnership with CART. During the term of the new license and with the continued cooperation with CART, the District intends to continue this partnership via its sponsorship and maintenance of its public trail network within the Project Boundary.

Beyond the continued maintenance of its existing public trail system, the District intends to construct a new 2,000-foot trail segment along the southeast side of Lake Babcock. The planned trail segment is consistent with CART's Master Plan (CART, 2008b) and would parallel 18th Avenue from the Intake Canal, north to the dike that separates Lake North from Lake Babcock. The planned trail would expand the existing public trail network by connecting to both the Robert White Trail and the Monastery Trail, both of which were formally dedicated during a CART ribbon-cutting on June 4, 2011. The District plans to complete the trail in 2016 or 2017.

E.6.7.4 Unavoidable Adverse Impacts

The Project does not adversely affect recreational opportunities for the residents of Nance and Platte counties. Conversely, the Project has increased the recreational opportunities available in close proximity to these residents by providing virtually uninhibited access to its 5,000 terrestrial and aquatic acres, developed parks, and sizable trail network. As determined through extensive relicensing-associated recreation use surveys, the recreational amenities associated with the Project receive substantial use and high ratings from the recreating public.

Additionally, the Project was generally found to be compatible with land uses of adjacent properties. Future analysis determined that published land use plans for local jurisdictions (Nance County and the City of Columbus) do not indicate future land use conflicts with Project operations. Those areas within the Project that may be incompatible with recreational public use are denoted as Restricted Operations Areas and safely separated from publicly accessible areas. These areas total approximately 556 acres, and due to their designated separation, do not conflict with, or pose a threat to, public recreation.

E.6.7.5 Cumulative Impacts

The Project affords substantial recreational benefit to the public. The continuation of Project recreation and the improvements included in the District's Draft Recreation Management Plan would cumulatively benefit the recreational opportunities of Nebraska when considered in association with past, present, and reasonably foreseeable future recreational development.

E.6.8 Aesthetic Resources

E.6.8.1 Existing Environment

The Project is located in a gently rolling rural landscape typical of Nance and Platte counties. It is a very linear development, extending approximately 36 miles across the countryside with a Project Boundary width that only occasionally exceeds 500 feet. With few exceptions, the land bordering the Project Boundary is dedicated to agricultural use. Exceptions include where the Upper Power Canal passes through Genoa; the 1,200-acre regulating reservoir, located 3 miles north of Columbus; a small section of the Tailrace Canal that borders the City of Columbus corporate limit, and the final 3-mile reach of the Tailrace Canal, which borders a large industrial park.

The Project elements most often visible to the public, which are primarily viewed from vehicles traveling on public roads and highways, are the tranquil, slow-flowing, unlined segments of the Loup Power Canal extending from the Headworks to the Platte River. These canal segments were formed by excavation and embankment of native soils. In general appearance, the canal is visually attractive and not much different than the natural streams that flow through the landscape every few miles. Three low weirs and five hydraulic siphons are located along the Loup Power Canal.

Similar to the bridges that span the canal, these are low-profile, passive structures with no moving parts; therefore, they do not materially detract from the overall quality of the viewshed.

All segments of the Loup Power Canal are bordered on both sides with unpaved, lay-of-the-land access and maintenance roads. Some segments have a degree of surface treatment on at least one side of the canal to permit emergency access to important Project structures during inclement weather conditions. Nearly all canal roads are open to vehicle, bicycle, and pedestrian access by the public. However some sections are closed to vehicle access because of safety and security issues, recurring vandalism, and other illegal activities.

The regulating reservoirs are clearly constructed impoundments, similar to a recreation lake or water supply reservoir. In the upper reaches, the reservoirs also display some aspects of a natural lake, such as bordering wetlands and forested areas. Lake Babcock and Lake North are a designated waterfowl refuge (see Appendix E-4, Attachment A, Figure A-3). Lake North, the smaller and deeper cell, is also a popular camping, fishing, and water recreation destination. The District has surrounded the regulating reservoir with public access and recreational opportunities while striving to preserve its appealing aesthetic qualities.

A wide Intake Canal extends for about 2 miles from Lake Babcock to the Columbus Powerhouse, and the Tailrace Canal extends about 5.5 miles from the powerhouse to the Platte River. Decades ago, an interesting, but visually intrusive, bank stabilization method was employed in the Tailrace Canal. Junked automobiles were placed side by side along sections of canal prone to erosion and sloughing. These cars are now partially buried and obscured by vegetation to the extent that make and model are difficult to identify. They have become visual artifacts of the Project, and the District has no plans to remove them.

The Tailrace Canal ends at the 700-foot-long Outlet Weir, where water overflows into the Platte River. The sight and sound of the continuously falling water is very pleasant. The District has established Tailrace Park, a frequently-used recreation site, on both sides of the canal at the outlet. Tailrace Park is a favorite community fishing spot but suffers from extensive littering and vandalism.

The Loup Power Canal corridor is visually pleasing and blends well into the rural fabric of the landscape. The corridor provides water, food, and shelter for wildlife. It also offers many scenic vistas and adds interest and diversity to the surrounding agricultural viewshed. The reservoirs and surrounding Project lands are visually attractive and highly valued by the community for the public use opportunities they provide. Some necessary, but less visually pleasing, Project elements include shore protection measures (woody brush and riprap), locally stored materials (soil and riprap) for emergency dike repair, and signage “congestion” at the public use and recreation areas.

Photos E-43 through E-49, below, present the aesthetic qualities of the Loup Power Canal and reservoir elements described above. Additional Project photos are provided in Section E.4 and Section E.6.7, Recreation and Land Use, above.

Photo E-43. View of the Upper Power Canal.

Photo E-44. The Beaver Creek siphon at Genoa.

Photo E-45. View of the Lower Power Canal.

Photo E-46. Camping at Lake North.

Photo E-47. View of the Tailrace Canal.

Photo E-48. The Outlet Weir at the Platte River.

Photo E-49. View of the Outlet Weir from the east bank.

The more developed and operational elements of the Project include the Headworks, the Monroe Powerhouse, and the Columbus Powerhouse.

The Headworks include the Diversion Weir, Intake Gate Structure, Sluice Gate Structure, maintenance buildings, gate operator residence, boiler house, storage buildings, floating Hydraulic Dredge, and North and South SMAs. These structures, with the exception of the Hydraulic Dredge, are located at the upstream end of the Settling Basin. Together, these features give the Headworks area a functional and industrial visual appearance consistent with the activities that take place there. However, the Headworks area is not open to the public nor is it visible from any public roads or residences.

The extensive North and South SMAs, located on either side of the 2-mile-long Settling Basin, are substantial visual features. The North SMA rises over 80 feet above natural grade and covers approximately 320 acres. Except for the steel pipelines leading to it, the North SMA has the appearance of a partially vegetated sandy bluff. Public access is restricted because of several safety issues and because this area is used for nesting by endangered interior least terns and threatened piping plovers. The South SMA is located between the Settling Basin and the Loup River bypass reach. This undulating, partially timbered landscape serves as both a sand deposition area and a popular OHV park.

Outside the immediate flow diversion and sand management operations area, the District has developed Headworks Park, a very popular recreation area, on both sides of the lower Settling Basin and Loup Power Canal. Headworks Park has several small lakes and wetlands associated with it. Although parts of the Headworks area are more functional than natural in appearance, it is well maintained and attracts substantial recreational activity.

Photos E-50 through E-52, below, present the aesthetic qualities of the flow diversion and sand management elements described above. Additional Project photos are provided in Section E.4.

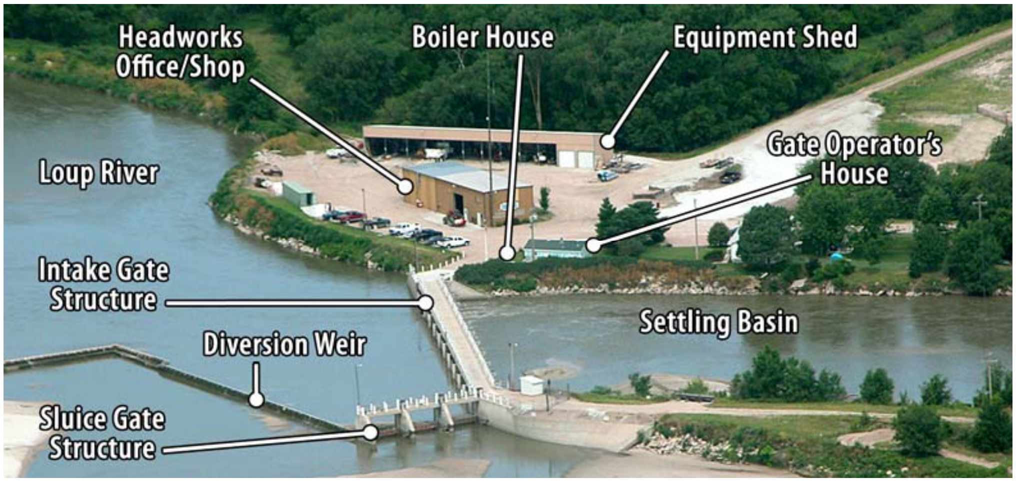

Photo E-50. Aerial view of the Headworks.

Photo E-51. View of the Settling Basin and an access road.

Photo E-52. Camping at Headworks Park.

The Monroe Powerhouse produces power from the 32-foot drop that separates the Upper Power Canal from the Lower Power Canal. It is a concrete structure with an adjacent outdoor substation and a nearby operator's residence. The art deco design and white paint of the powerhouse present an interesting contrast to the surrounding land forms and heavy vegetation. The Monroe Powerhouse is visible from a public road bridge that crosses the canal approximately 0.5 mile downstream.

The Columbus Powerhouse is the primary power generation feature of the Project. All of the features discussed above exist to deliver water to this important structure. The Powerhouse Inlet Structure at the terminus of the broad Intake Canal extending from Lake Babcock is surmounted by four concrete columns that support a gate hoisting apparatus. This distinctive structure is visible on the skyline from U.S. Highway 30 in Columbus.

Three large steel Penstocks emerge between and below the gate hoist columns and angle down to enter the Columbus Powerhouse building. The silver-painted penstock pipes are 20 feet in diameter and 320 feet long. Each one leads to a hydraulic turbine located in the lower level of the powerhouse. The concrete Columbus Powerhouse is also painted white and constructed in the art deco style with numerous windows. It is an attractive and well-maintained structure. Columbus Powerhouse is viewed by many hundreds of people each day from nearby roads and highways. The substation/switchyard to the east is visually overshadowed by the majestic appearance of the Columbus Powerhouse. The adjacent Powerhouse Park is a popular site to observe bald eagles during cold weather when they gather in large numbers to feed in the open water below the powerhouse.

Photos E-53 through E-55, below, present the aesthetic qualities of the powerhouse elements described above. Additional Project photos are provided in Section E.4 and Section E.6.7, Recreation and Land Use, above.

Photo E-53. Aerial view of the Monroe Powerhouse.

Photo E-54. The Columbus Powerhouse and substation.

Photo E-55. The art deco style of the Columbus Powerhouse.

E.6.8.2 Environmental Analysis

Anecdotally, the Project is generally attractive and visually compatible with all surrounding lands and waters. Prominent Project features, including the Loup Power Canal and Monroe and Columbus powerhouses, are aesthetically pleasing and have become embedded in the visual environment of the area.

FERC's Scoping Document 2 (Section 4.2.6, pages 21 and 22) identified potential Project effects on aesthetic resources resulting from encroaching vegetation and bank stabilization measures along shoreline areas (FERC March 27, 2009). To address this concern, the District conducted Study 10.0, Land Use Inventory, which included a stated objective of identifying potential opportunities to improve aesthetics on Project lands and recreation areas.

The only opportunity for improved aesthetics identified during Study 10.0, Land Use Inventory, was the documented graffiti at Tailrace Park.

Historical bank stabilization measures may also constitute opportunities for improved Project aesthetics. Specifically, hundreds of junked automobiles were lined side by side along the Tailrace Canal in the 1950s and 1960s. Although effective as bank stabilization, the measure lacks aesthetic appeal.

Aesthetic analysis did not find any instances of encroaching vegetation that could be interpreted as a potential aesthetic impact. Vegetation within the Project Boundary is generally manicured to maintain positive aesthetics.

E.6.8.3 Proposed Environmental Measures

In association with Project relicensing, the District developed a Draft Historic Properties Management Plan that includes preservation measures relevant to the continued aesthetic value provided by notable District structures, including the aesthetically pleasing Monroe and Columbus powerhouses. More specifically, the District will follow 36 CFR §68, The Secretary of the Interior's Standards for the Treatment of Historic Properties (Secretary's Standards).

In hopes to deter undesirable or criminal activity at Tailrace Park, the District is considering ending vehicular access to the park while maintaining pedestrian access for those wishing to use the recognized fishing opportunities. However, a final decision has not been made. If the District decides to end vehicle access, gates, fencing, or other barriers that are not passable by vehicles would be installed well north of park facilities. Additionally, a parking area would be designated north of the barriers, and accommodations for foot-traffic access would be maintained. See Section E.6.7.3 for further detail.

E.6.8.4 Unavoidable Adverse Impacts

The District has identified no mitigation measures to address potentially adverse aesthetic impacts associated with the junked automobiles along the Tailrace Canal. Due to the amount of time that has passed since their placement, and the amount of sediment and vegetative establishment around them, their removal would require considerable grading that would likely compromise bank stability and water quality.

The potential vehicular restriction at Tailrace Park is intended to curb vandalism in this location. The District will continue to monitor and clean these problems, as necessary.

E.6.8.5 Cumulative Impacts

In weighing the numerous Project components that display desirable aesthetic features against the limited and isolated occurrences of non-desirable aesthetics, the Project is considered to provide a net benefit to the aesthetics of the region. The preservation of aesthetically valued Project components via the District's Draft Historic Properties Management Plan would cumulatively benefit aesthetic resources of the region when considered in association with past, present, and reasonably foreseeable future actions.

E.6.9 Cultural Resources

E.6.9.1 Existing Environment

Since the 1930s, numerous archaeological surveys and excavations have occurred in the vicinity of the Project during unrelated infrastructure (such as road and civic) improvement projects and research projects. The Project facilities are located among cultural resources that have been identified during these surveys; however, prior to the District's Study 11.0, Section 106 Compliance, no formal cultural resources surveys had been conducted within the Project Boundary.

Area of Potential Effect

For purposes of the Project, the District and Nebraska SHPO concurred on January 23, 2009, that the Area of Potential Effects (APE) is the Project Boundary, which encompasses approximately 5,000 acres and includes the entirety of the District's holdings that are subject to the relicensing effort.

Summary of Archaeological Studies

The Phase IA Archaeological Overview of the Project area identified 20 previously recorded archaeological sites within or near the Project APE (Madson, October 15, 2009). Their locations, combined with an assessment of construction disturbance from the 1930s, resulted in the designation of eight areas (Areas A through H) within the APE considered to exhibit sufficient potential to merit field inventory for the presence of cultural resources. Other areas of the APE were considered non-sensitive due to the nature and extent of previous disturbances, mostly attributable to Project construction in the 1930s.

For the Phase I/II Archaeological Inventory and Evaluation, a pedestrian survey, including shovel testing, of the eight areas designated in the Phase IA Archaeological Overview was conducted to determine the presence of archaeological resources and to provide recommendations for their management (Carlson and Osborn, August 26, 2010). This effort included intensive archaeological testing of 418 acres of stable landforms (Areas A through H) where Project construction had not caused extensive disturbance and where previously recorded sites were described as situated entirely within or extending into the APE.

As part of this study, the entire 35-mile-long perimeter of the canal was also examined and shovel tests were excavated to expose sediments and check for buried cultural remains along seven canal segments. The Phase I/II Archaeological Inventory and Evaluation resulted in the identification of five areas of potential sensitivity for encountering buried archaeological sites within the APE. These results are presented in Table E-62.[38] All other examined areas were determined to have little likelihood of retaining intact cultural remains and were not recommended for further consideration. Other areas examined during the investigation did not exhibit archaeological materials but remain subject to discovery procedures.

[38] Table E-62 contains privileged information and has been withheld from the public volumes of the Draft License Application.

Table E-62 contains privileged information and is located in Volume 3, Privileged.

The boundary maps for five previously recorded archaeological sites indicated that they may extend into the APE. Four of these previously recorded archaeological sites (25NC06/25NC20, 25NC03-1, 25PT8, and 25PT1) are listed on or previously determined eligible for listing on the NRHP. The fifth previously recorded archaeological site (25NC04) remains unevaluated at this time. The shovel tests conducted in those portions of their previously reported boundaries within the APE during the Phase I/II Archaeological Inventory and Evaluation did not confirm the presence of intact subsurface cultural deposits. However, the presence of such deposits associated with these sites within the APE cannot be discounted at this time. One newly recorded site (25PT115) is recommended as eligible for listing on the NRHP based on the surface recovery of a temporally diagnostic artifact.

Summary of Architectural Assessment

A Historic Building Inventory and Evaluation was conducted as part of Project relicensing to identify and evaluate historic buildings and structures within the APE (Trnka, August 26, 2010). This study resulted in the identification of the Loup Power District (LPD) historic district, consisting of 16 buildings, structures, and objects that exhibit individual eligibility and 20 buildings and structures that lack individual eligibility but contribute to the eligibility of the historic district (see Table E-63). The properties that comprise the LPD historic district are presented in Table E-63 and are shown in Appendix E-1, Figure E-17, Sheets 1 through 14.

The LPD historic district is considered eligible under NRHP criteria A, B, and C on the national, regional, and local levels for its association with rural electrification under the Rural Electrification Administration in the late 1930s extending to about 1950, the impact of the Rural Electrification Act of 1936, its sponsorship by Nebraska Senator George William Norris, and the impact of the Project in transforming economic development of the Columbus region of Nebraska. The LPD historic district represents a massive engineering effort with simply designed concrete structures exemplifying architectural and engineering elements characteristic of the 1930s (Trnka, August 26, 2010).

The 16 properties that are part of the LPD historic district and that qualify as eligible on their own merits are considered to be key structures of critical importance to the integrity of the historic district and its ability to illustrate the significant qualities that make the historic district a distinctive entity. The 20 contributing properties to the LPD historic district that do not qualify on their own merits are considered to be of lesser historic importance and do not convey as much illustrative value as the key structures. Descriptive information on each contributing building, structure, and object is also provided in the District's Historic Building Inventory and Evaluation (Trnka, August 26, 2010).

Table E-63. Eligible Buildings, Structures, and Objects of the LPD Historic District

Building/Structure/ Object	Date of Service	NRHP Status	Comments
Diversion Weir	1937	Individually eligible and contributing to LPD historic district	Is a low wall at the Headworks that diverts Loup River water into the Intake Gate Structure.
Intake Gate Structure	1937	Individually eligible and contributing to LPD historic district	Regulates diverted flow into the canal system.
Sluice Gate Structure	1937	Individually eligible and contributing to LPD historic district	Bypasses water past the inlet structure and canal down the Loup River bypass reach.
Settling Basin	1937	Individually eligible and contributing to LPD historic district	Is 2 miles long and allows sand and silt to settle for removal by dredge.
Pawnee Hydraulic Dredge	1935	Individually eligible object and contributing to LPD historic district	Removes sand and slit from Settling Basin.
Skimming Weir	1937	Individually eligible and contributing to LPD historic district	Deck was rebuilt in the 1960s.
Upper Power Canal	1937	Individually eligible and contributing to LPD historic district	Extends 11.5 miles and carries water from the Settling Basin to the Monroe Powerhouse.
Beaver Creek Siphon	1937	Contributing structure	Conveys the Upper Power Canal under Beaver Creek.
Bridge #3 – Genoa Concrete Bridge	1937	Contributing structure	Is maintained by the District.
Railroad Siphon	1937	Contributing structure	Conveys the Upper Power Canal under an existing railroad.
Bridge #4 – Nance County Road Bridge	1937	Contributing structure	Is maintained by the District.
303 Drainage Siphon	1937	Contributing structure	Conveys drainage water under the Upper Power Canal to the Loup River.
Looking Glass Creek Siphon	1937	Contributing structure	Conveys the Upper Power Canal under Looking Glass Creek.
Looking Glass Creek Bridge	1944	Contributing structure	Provides farm access.

Building/Structure/ Object	Date of Service	NRHP Status	Comments
Bridge #6 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #7 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #8 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #9 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Monroe Powerhouse	1937	Individually eligible and contributing to LPD historic district	Associated operator house and storage shed are non-contributing.
Lower Power Canal	1937	Individually eligible and contributing to LPD historic district	Extends 12 miles from the Monroe Powerhouse to the Columbus Powerhouse.
Dry/Cherry Creek Siphon	1937	Contributing structure	Conveys the Lower Power Canal under Dry and Cherry creeks.
Bridge #11 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #12 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #13 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
916 Siphon	1937	Contributing structure	Conveys the headwaters of Lost Creek under the Lower Power Canal.
Oconee Siphon	1937	Contributing structure	Conveys Lower Power Canal water under railroad tracks.
Bridge #16 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Bridge #19 – Platte County Road Bridge	1937	Contributing structure	Is maintained by the District.
Sawtooth Weir	1937	Individually eligible and contributing to LPD historic district	Regulates water in the Lower Power Canal where it discharges into Lake Babcock.
Lake Babcock	1937	Individually eligible and contributing to LPD historic district	Is a regulating reservoir for water storage and power generation.

Building/Structure/ Object	Date of Service	NRHP Status	Comments
Powerhouse Inlet Structure	1937	Individually eligible and contributing to LPD historic district	Regulates water into the Penstocks.
Penstocks	1937	Individually eligible and contributing to LPD historic district	Conveys water into the Columbus Powerhouse.
Columbus Powerhouse	1937	Individually eligible and contributing to LPD historic district	Associated east well house is non-contributing.
Tailrace Canal	1937	Individually eligible and contributing to LPD historic district	Extends 5.5 miles carrying water from the Columbus Powerhouse to the Outlet Weir. Associated "Detroit riprap" is non-contributing.
Lost Creek Siphon	1937	Contributing structure	Conveys Lost Creek under the Tailrace Canal.
Outlet Weir	1937	Individually eligible and contributing to LPD historic district	Conveys water from the Tailrace Canal to the Platte River.

Properties of Traditional Religious and Cultural Importance

A traditional cultural property (TCP) is a cultural resource that is eligible for listing on the NRHP because of the role the property plays in a community's historically rooted beliefs, customs, and practices. TCPs may be eligible for listing on the NRHP because of their association with cultural practices or beliefs of a living community that 1) are rooted in that community's history, and 2) are important in maintaining the continuing cultural identity of the community.

Tribes consulted about the Project did not indicate the presence of or respond to requests for information about properties of traditional religious and cultural importance within the Project's APE.

E.6.9.2 Environmental Analysis

Nebraska SHPO has concurred with the findings of the Phase I/II Archaeological Inventory and Evaluation. None of the five areas identified as archaeological sensitivity areas were noted as a concern for erosion and exposure of artifacts from normal Project operations; rather, these areas were identified for coordination of future ground-disturbing activities. Therefore, based on the development of an HPMP that outlines coordination requirements prior to ground-disturbing activities, it is not anticipated that continued Project operation would adversely affect archaeological resources.

Nebraska SHPO has also concurred with the findings of the Historic Building Inventory and Evaluation. The Historic Building Inventory and Evaluation indicated that the Project includes notable historic and archeological resources: 16 buildings, structures, and objects that exhibit individual eligibility and an additional 20 buildings and structures that lack individual eligibility but contribute to the LPD historic district. Considering the excellent condition of historic resources within the APE, the District's current stewardship and maintenance efforts, in conjunction with the HPMP, are deemed appropriate in their capacity to protect and preserve these resources.

E.6.9.3 Proposed Environmental Measures

To address FERC's obligations under Section 106, the District anticipates that FERC will enter into a Programmatic Agreement (PA) for managing historic properties that may be affected by issuing a new license to the District for the continued operation of the Project. The District expects that the PA will direct the Licensee to develop a HPMP for the Project. Accordingly, the District has developed a Draft HPMP that is being provided to Nebraska SHPO for review. All relicensing studies related to Section 106 resources have been developed in consultation with Nebraska SHPO. The Draft HPMP reflects the comments received during the consultation process and incorporates study recommendations.

The District's Draft HPMP establishes the following three goals for managing historic properties within the Project's APE:

- Ensure continued normal operation of the Project while maintaining and preserving the integrity of historic properties within the APE. The District is committed to managing historic properties in a manner that preserves their integrity while not impeding the Project's safe and efficient production of energy.
- To the extent possible, avoid, minimize, or mitigate adverse effects on historic properties within the APE. Preservation through avoidance of adverse effects on historic properties is the District's preferred management policy. However, if adverse effects on historic properties cannot be avoided, the District will consult with Nebraska SHPO and other interested parties, as appropriate, to identify measures for minimizing or otherwise compensating for the adverse effects.
- Ensure that historic properties are managed in a way that does not impede the District's ability to comply with the terms of its operating license and other applicable Federal, state, and local statutes. FERC and ACHP recognize that the effective management of historic properties is not intended to turn hydroelectric projects into museums or to jeopardize the

ability of the licensee to fulfill all of the terms and conditions of a license or other regulations. Accordingly, the District is committed to managing historic properties within the APE in a manner that is consistent with the license and with applicable Federal, state, and local codes and regulations.

E.6.9.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts on cultural resources from the District's proposals are anticipated.

E.6.9.5 Cumulative Impacts

The cumulative impacts of past inhabitance and development, including Project construction, are reflected in the cultural resources that currently exist within the APE. Project relicensing, and the associated HPMP, would result in a direct benefit to the Project's cultural resources. As no adverse cultural resource impacts would result from relicensing, and because no reasonably foreseeable future actions have been identified within the APE, the District has determined that Project relicensing would not have a cumulatively significant adverse impact on cultural resources.

E.6.10 Socio-economic Resources

E.6.10.1 Existing Environment

Although the Project is located in Nance and Platte counties near Genoa, Monroe, and Columbus, the District's service area includes Boone, Nance, Platte, and Colfax counties and part of Madison County. The 2010 U.S. Census lists a combined population of 86,868 residents within these counties (U.S. Census Bureau, June 3, 2011). Based on the location of Project infrastructure, however, the primary socioeconomic impact area of the Project is within Nance and Platte counties, with a combined population of 35,972 (U.S. Census Bureau, June 3, 2011).

All power generated by the Project is purchased by NPPD at the substations located at the Monroe and Columbus powerhouses. Then the District purchases wholesale electricity from NPPD and distributes it to the District's customers. The District purchases, sells, and delivers approximately 1.2 billion kilowatt hours of electric power annually to approximately 18,000 wholesale and retail customers throughout the service area.

Land Use

Most of the land area in Nance and Platte counties is used for agriculture (see Figure E-6). About 49 percent of the land area in Nance County is cropland, and about 82 percent of the land area in Platte County is cropland (USDA National Agricultural Statistics Service, February 3, 2009; U.S. Census Bureau, June 3, 2011). Total agricultural land (including cropland and rangeland) occupies 90 percent of Nance County and 93 percent of Platte County (University of Nebraska-Lincoln, 2005). Lands within cities and villages occupy less than 1 percent of Nance County and about 2 percent of Platte County (U.S. Census Bureau, August 15, 2006; University of Nebraska-Lincoln, 2005). The remainder of the area in each county is riparian forest and woodland, water, and wetland (University of Nebraska-Lincoln, 2005).

Cities and villages in the vicinity of the Project include Genoa, Monroe, and Columbus. With the exception of limited residential and commercial development in the vicinity of Genoa, land use along the Loup Power Canal west of Lake Babcock is agricultural.

The District owns and operates five developed recreation areas containing approximately 1,700 acres of land and 800 acres of water (see Section E.6.7, Recreation and Land Use, above). Land use along the Intake Canal is a mixture of residential and agricultural uses, and land use along the Tailrace Canal is agricultural, industrial, and residential. A residential area near the Columbus Powerhouse is anticipated to continue to develop. Residential, commercial, and industrial areas near the Tailrace Canal are also anticipated to grow (City of Columbus, October 2005).

Population

According to the 2010 U.S. Census, the population of Nance County is 3,735 (U.S. Census Bureau, June 3, 2011). The population of Nance County has declined since reaching a peak of 8,926 in 1910 (U.S. Census Bureau, March 27, 1995). The population in Nance County declined by 12.6 percent from 1990 to 2010, while the population of Nebraska increased by 15.7 percent (U.S. Census Bureau, March 27, 1995; U.S. Census Bureau, June 3, 2011).

The 2010 U.S. Census lists the population of Platte County as 32,237 (U.S. Census Bureau, June 3, 2011). The population of Platte County has increased since 1950, after declines in the 1930 and 1940 censuses (U.S. Census Bureau, March 27, 1995). Population growth in Platte County has occurred in Columbus, while the population in the remainder of the county has declined. From 1990 to 2010, the population of Platte County increased by 8.1 percent, about half of the rate of increase for Nebraska (U.S. Census Bureau, March 27, 1995; U.S. Census Bureau, June 3, 2011). Population trends in Nance County, Platte County, and the State of Nebraska are shown in Table E-64.

Table E-64. Population Trends in Nance and Platte Counties and Nebraska

	1970	1980	1990	2000	2010
Nance County	5,142	4,740	4,275	4,038	3,735
Platte County	26,508	28,852	29,820	31,662	32,237
Nebraska	1,483,493	1,569,825	1,578,385	1,711,263	1,826,341

Sources: U.S. Census Bureau, June 3, 2011, "U.S. Census Bureau: State and County QuickFacts", retrieved on September 6, 2011, http://quickfacts.census.gov/qfd/states/31000.html; U.S. Census Bureau, March 27, 1995, "Nebraska, Population of Counties by Decennial Census: 1900 to 1990," retrieved on August 11, 2008, http://www.census.gov/population/cencounts/ne190090.txt.

Communities in the vicinity of the Project include Genoa in Nance County and Monroe and Columbus in Platte County. The population of Genoa has declined from 1,082 in 1990 to 1,003 in 2010. The 2010 population of Monroe (284) has fluctuated slightly over the past 20 years. Columbus is the largest city in the vicinity of the Project as well as in Platte County. Columbus grew 7 percent between 1990 and 2000 and 5 percent between 2000 and 2010. Population trends in Genoa, Monroe, and Columbus are shown in Table E-65.

Table E-65. Population Change in Communities in the Vicinity of the Project

	1990	2000	2010
Genoa	1,082	981	1,003
Monroe	309	307	284
Columbus	19,480	20,971	22,111

Source: U.S. Census Bureau, June 27, 2007, "Subcounty Population Datasets (Nebraska)," *Population Estimates*, retrieved on August 11, 2008, http://www.census.gov/popest/cities/SUB-EST2006-states.html; U.S. Census Bureau, 1991, Census of Population and Housing, 1990. *American FactFinder*. Retrieved on August 11, 2008. http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC2&_submenuId=datasets_1&_lang=en&_ts=228243640647; U.S. Census Bureau, 2010. Summary File 1. Retrieved on November 2, 2011.

Employment

In Nance County, total employment based on place of work decreased by 0.7 percent from 2001 to 2009 (Bureau of Economic Analysis, April 21, 2011). Farm employment declined by 24.3 percent, while non-farm employment increased by 7.5 percent. The unemployment rate for Nance County was 3.8 percent in June 2011 (Nebraska Department of Labor, August 19, 2011).

The economy of Nance County is based primarily on government and agriculture. The leading sectors of employment are as follows, given as percentages of total employment (Bureau of Economic Analysis, April 21, 2011):

- Government (Federal, State, and Local) – 21 percent
- Agriculture – 20 percent
- Health care – 9 percent
- Retail trade – 8 percent
- Other services – 7 percent
- Wholesale trade – 3 percent
- Information – 1 percent

In Platte County, total employment based on place of work increased by 6.5 percent from 2001 to 2009 (Bureau of Ecomonic Analysis, April 21, 2011). Farm employment declined by 22.3 percent, while non-farm employment increased by 8.3 percent. The unemployment rate for Platte County was 4.0 percent in June 2011 (Nebraska Department of Labor, August 19, 2011).

The economy of Platte County is based primarily on manufacturing. The leading sectors of employment are as follows, given as percentages of total employment (Bureau of Ecomonic Analysis, April 21, 2011):

- Manufacturing – 24 percent
- Government (Federal, State, and Local) – 12 percent
- Retail trade – 11 percent
- Health care – 8 percent
- Construction – 6 percent
- Other services – 6 percent
- Administrative and Waste Management – 5 percent
- Accommodations and food – 5 percent
- Agriculture – 4 percent

The District employs 118 full-time employees and 6 regular part-time employees. Of the provided total, 34 employees are directly involved with the Project. Additionally, the Project employs 4 temporary workers during the summer months for park maintenance. Employment trends for Nance and Platte counties are shown in Table E-66.

Table E-66. Employment Trends in Nance and Platte Counties

Employment Sector	Nance County		Platte County	
	2001	2009	2001	2009
Farm	561	386	1,235	977
Non-farm	1,474	1,559	21,333	22,949
Total Employment[a]	**2,035**	**1,945**	**22,568**	**23,926**

Source: Bureau of Economic Analysis, April 21, 2011. "Total Full-Time and Part-Time Employment by NAICS Industry 1." [Table CA25N NAICS for Nebraska, Nance and Platte Counties, 2001-2009.], Retrieved on September 6, 2011.

http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5

Note:

[a] Total employment is by place of work. Employment includes full and part time.

Economic Development

One of the District's objectives is the promotion of economic and industrial growth within its five county service area. Over the years, the District has substantially contributed to economic development in the area through its provision of attractive electric power rates, strategic land development, and Headworks OHV Park.

The attractive electric power rates that the District offers to its five-county service area are a major factor in attracting a variety of industries, and their many associated jobs, to the area. Additional jobs result in an increased tax base, which ultimately translates to a higher quality of life for all residents of the area.

The District has purchased land for industrial development and worked with the City of Columbus and the Chamber of Commerce to attract approximately 70 manufacturing companies and 6,000 jobs to the Columbus area. The District has acquired over 1,000 acres (all of which are outside of the Project Boundary), developed them, and sold them to industries. Two major industries recently attracted to the Columbus area are Archer Daniel Midlands (ADM), which operates a corn processing plant and also includes a cogeneration facility, and KATANA-Summit, LLC, which manufactures towers for wind-powered electricity generation facilities.

Headworks OHV Park near Genoa, discussed in Section E.6.7, Recreation and Land Use, attracts approximately 20,000 visitors per year. OHV and dirt bike riders spend an estimated $4.8 million per year in Nebraska on day trips to Headworks OHV Park, including an estimated $53,000 in Genoa during a semi-annual jamboree event (NOHVA, February 2004). NOHVA receives all proceeds from the jamborees, which are used to pay operating expenses of the park and to support local emergency community services in Genoa and Fullerton (NOHVA, June 29, 2008).

Income

In Nance County, per capita personal income was $38,493 in 2009, an increase of $14,442 over the per capita income in 2001. The median income for a family of four was $38,682 in 1999, increasing to an estimated $53,300 in 2011 (Nebraska Department of Economic Development, June 7, 2011).

In Platte County, per capita personal income was $35,494 in 2009, an increase of $9,452 over the per capita income in 2001. The median income for a family of four was $47,783 in 1999, increasing to an estimated $61,900 in 2011 (Nebraska Department of Economic Development, June 7, 2011).

In Nance County, taxable sales increased by 38 percent between 2000 and 2010. In Platte County, taxable sales increased by 31 percent in the same time period. In the State of Nebraska, taxable sales increased by 33 percent between 2000 and 2010.

E.6.10.2 Environmental Analysis

Because resource agencies and stakeholders did not request studies to address Project effects on social or socioeconomic resources, specific studies to assess these effects were neither included in FERC's August 26, 2009, Study Plan Determination, nor conducted by the District. It is generally stated that the Project provides multiple benefits to the socio-economic environment of Nance and Platte counties by employing local residents, providing affordable power to local consumers and industrial users, and providing recreation opportunities not otherwise available in the region.

In association with the District's Study 10.0, Land Use Inventory, the District conducted a general land use inventory of all Project lands and adjacent properties. Land use information was plotted on maps and analyzed to identify potential conflicts and opportunities relating to Project operations, public access, recreation, aesthetics, and environmental resource protection (see Appendix E-1, Figure E-16, Sheets 1 through 14).

The following conclusions have been reached regarding Project land use:

- Project land use and operations were found to be compatible with adjacent properties.
- Future land use plans for Nance County and the City of Columbus do not indicate future land use conflicts.
- Restricted Project Operations Areas are safely separated from publicly accessible areas and do not conflict with recreation opportunities. Restricted Operations Areas total approximately 556 acres.
- Approximately 90 percent of Project lands are accessible to the public from numerous locations—improved recreation areas, WMAs, the Loup Power Canal, and siphons.

E.6.10.3 Proposed Environmental Measures

As no adverse Project effects on socio-economic resources associated with the Project have been identified, the District is proposing no new environmental measures relative to socio-economic resources. In its continued efforts to provide low electric rates to its customers, the District proposes to continue the cost-effective operations that have historically benefited rate payers, and would continue to do so during the proposed license period. Additionally, the District is proposing multiple enhancements to Project-related recreation amenities. The District's proposed recreation enhancements are detailed in Section E.6.7 and in the Draft Recreation Management Plan, provided as Appendix E-4.

E.6.10.4 Unavoidable Adverse Impacts

No unavoidable impacts on socio-economic resources were identified during Project scoping and/or study.

E.6.10.5 Cumulative Impacts

The Project affords substantial socio-economic benefit to the region. Project relicensing would facilitate continued economic development within the District's five-county service area resulting from the District's attractive electric rates and would cumulatively benefit the socio-economics of Nebraska when considered in association with past, present, and reasonably foreseeable future actions.

E.6.11 Tribal Resources

E.6.11.1 Existing Environment

The following six Native American tribes are known to retain affinity to the general region; however, no part of the Project is located on Federally recognized tribal lands:

- Omaha Tribe of Nebraska
- Pawnee Nation of Oklahoma
- Ponca Tribe of Nebraska
- Ponca Tribe of Oklahoma
- Santee Sioux Tribe of Nebraska
- Winnebago Tribe of Nebraska

E.6.11.2 Environmental Analysis

To comply with Section 106 of the NHPA, the District provided its study reports, which included the results of the analyses conducted for its Study 11.0, Section 106 Compliance, to, and attempted to consult with, the above-listed tribes. District attempts toward tribal coordination, and more specifically their input for identification of properties within the APE that may retain traditional religious and cultural importance to them, did not result in the identification of any such properties.

E.6.11.3 Proposed Environmental Measures

If in the future, a tribe notifies the District of the presence of a property of traditional religious or cultural importance within the APE, the District will consult with Nebraska SHPO and the tribe to develop management measures appropriate to the property and will amend the HPMP as appropriate in accordance with the amendment protocols contained therein.

If archaeological remains are encountered by District personnel, contractors, or consultants during any land-altering activities within the APE or if a contributing element to the LPD historic district is affected in an unanticipated manner, the District shall take the following actions as applicable:

- Stop all project activities in the vicinity of the discovery and provide for the security, protection, and integrity of the cultural property.
- Immediately notify Nebraska SHPO and tribes, if Native American archaeological remains are involved, of the discovery situation. Provide a written description of the nature and location of the discovery and any actions that the District proposes to take to resolve any adverse effects on the discovery. Request concurrence from Nebraska SHPO and tribes, as appropriate, with the District's proposed actions to resolve adverse effects.
- Provide Nebraska SHPO and tribes, as appropriate, 48 hours to respond to the District's proposed actions to resolve any adverse effects, whereupon the District will take into account any comments and recommendations received and carry out such actions as necessary to address the adverse effects.
- Ensure that a report of actions taken to address the adverse effects is prepared and submitted to Nebraska SHPO and tribes, as appropriate, for their records.

E.6.11.4 Unavoidable Adverse Impacts

Because no Project-related concerns were provided by tribes known to retain affinity to the general region and because the District is proposing no changes to the Project that would adversely impact tribal resources, no Project-induced adverse impacts on tribal resources have been identified.

E.6.11.5 Cumulative Impacts

No Project-specific impacts on tribal resources have been identified; therefore, the Project does not contribute to the cumulative resource impact resulting from past, present, and reasonably foreseeable future actions.

E.7 ECONOMIC ANALYSIS

E.7.1 Current Average Annual Project Cost

Average annual costs of the Project for the period 2007 through 2010 were approximately $6.4 million, including operations and maintenance (O&M), administrative, legal, accounting, insurance, and payments made for amortization of bonds.

E.7.2 Cost of Proposed Environmental Measures

Proposed environmental enhancements are cumulatively estimated to increase annual O&M costs by approximately $43,300. These measures do not require any new Project lands or water rights. Table E-67 lists the proposed measures and their preliminary cost estimates.

Table E-67. Cost Estimate of Proposed PM&E Measures

Budgeted Year	Measure	Implementation Cost (2011 dollars)	Annual O&M Cost (2011 dollars)
Annual	Historic Properties Management Plan	N/A	$25,000
2011-2024	Improve playground equipment at developed recreation areas[a]	$20,000/year	$750/year
2011	Upgrade camper outlets at Lake North Park and Headworks Park	$12,000	$1,800
2014	Restrict vehicle access at Tailrace Park	$5,000	$1,000
2015	Install sand volleyball court at Headworks Park	$1,000	$1,000
2015	Construct wheelchair-accessible fishing pier at Lake North	$30,000	$4,500
2015	Create no-wake zone in the southeast corner of Lake North to facilitate improved fishing opportunities	$1,000	$500
2016	Install new permanent restroom facility at Headworks Park	$40,000	$6,000
2017	Complete construction of a new 2,000-foot-long trail along southeast shore of Lake Babcock	$40,000	$2,750

Note:

[a] Playground equipment at developed recreation areas is evaluated yearly for replacement and improvements; consistent with current practice, it is anticipated that improvements would be made at one or more playground areas for approximately the first 10 years of the new license period to replace outdated equipment.

E.7.3 Estimated Average Annual Project Cost Under Proposed License

The estimated capital expenditures for major repair and replacement of equipment and structures over the expected term of a new license are $10.42 million. The average annual cost of these capital expenditures assuming an amortization term of 20 years at 6.0 percent is estimated to be $432,000.

In total, the estimated annual average cost of the Project, as proposed by the District, is approximately $6.88 million. This estimate includes current O&M costs, anticipated increase in O&M costs, and the annual cost of anticipated future capital expenditures for major repair and replacement items.

E.7.4 Estimated Annual Value of Developmental Resources

The District sells all power produced by the Project to NPPD in accordance with a negotiated power purchase agreement (PPA). The 2010 price under the PPA was $44.12/MWh. The Project's average annual power production since 1938 is 136,405 MWh. Therefore, based on the current contract price, the annual value of Project power is approximately $6.0 million. Because the District's relicensing proposal includes no improvements that would result in increased generation, the value of Project power would not change except to the extent of changes in the cost of power during the applied-for license term.

The Project purpose does not include the provision of water for irrigation; however, the District allows irrigators with valid water appropriations to draw water from the Loup Power Canal. Irrigators pay interference to the District's senior water right in an amount equal to lost generation resulting from the withdrawls.

E.8 CONSISTENCY WITH COMPREHENSIVE PLANS

The District has reviewed the Federal and State of Nebraska list of comprehensive plans adopted by FERC under Section 10(a)(2)(A) of the Federal Power Act (16 USC § 803 (a)(2)(A)). The following nine plans are listed for the State of Nebraska (FERC, June 2011):

- The Nationwide Rivers Inventory (National Park Service, January 1982)
- Statewide Comprehensive Outdoor Recreation Plan (SCORP): A Guide to an Active Nebraska 2011-2015 (NGPC, 2010)
- Platte River Management Joint Study, Biology Workgroup Final Report (Platte River Management Joint Study, July 20, 1990)
- Endangered Resources in the Platte River Ecosystem: Description, Human Influences and Management Options (USFWS, July 20, 1990)
- Fish and Wildlife Resources of Interest to the U.S. Fish and Wildlife Service on the Platte River, Nebraska (USFWS, May 15, 1987)

- Whooping Crane Recovery Plan (USFWS, December 23, 1986)
- Great Lake and Northern Great Plains Piping Plover Recovery Plan (USFWS, May 12, 1988)
- North American Waterfowl Management Plan (USFWS, May 1986)
- Fisheries USA: The Recreational Fisheries Policy of the U.S. Fish and Wildlife Service (USFWS, December 5, 1989)

Based on a review of these comprehensive plans, the District has determined that the Project and associated operations are consistent with these plans. The following discussion provides additional information regarding each plan.

E.8.1 The Nationwide Rivers Inventory

The Nationwide Rivers Inventory (NRI) is a list of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more “outstandingly remarkable” natural or cultural values judged to be of local or regional significance. The NRI was reviewed for relevancy to the Project. No reaches of the Loup River or lower Platte River are listed on the NRI; therefore, continued operation of the Project would have no adverse effect on listed rivers and is consistent with the uses for which listed rivers are designated.

E.8.2 Nebraska Statewide Comprehensive Outdoor Recreation Plan

The 2011-2015 SCORP maintains Nebraska’s eligibility to participate in the Land and Water Conservation Fund (LWCF) program in addition to helping communities plan for recreation in the future. It assesses both the supply and demand of outdoor recreation facilities and provides direction and priorities toward strong outdoor recreation programs.

The Project provides considerable opportunities to the recreating public of northeast Nebraska by providing near unrestricted access to District amenities at no cost to the user. The District’s cooperative efforts with CART (trail network) and NOHVA (Headworks OHV Park), in addition to the recognized fishing, camping, and boating opportunities, provide notable and unique recreational opportunities that are consistent with Nebraska’s SCORP. During the applied-for license period, the District is committed to maintaining and enhancing the recognized recreation opportunities through the implementation of a Recreation Management Plan that was formulated through careful consideration of public input, collected through the District’s extensive 2010 recreation use survey.

E.8.3 Platte River Management Joint Study

In reviewing the Platte River Management Joint Study, the District has determined the study to not be applicable to the Project as the study is specific to the Big Bend Reach of the Platte River in central Nebraska. The Big Bend study reach of the central Platte

River and the Project-associated lower Platte River have dramatically different hydrologic regimes and associated habitat conditions

E.8.4 Endangered Resources in the Platte River Ecosystem

District review of Endangered Resources in the Platte River Ecosystem: Description, Human Influences and Management Options found this document to consist largely of a literature review of previous study and species information. The management strategy portion of the document was considerably smaller and was almost exclusively focused on the hydraulics of the central Platte River (not applicable to the Project reach). The only management strategy applicable to the lower Platte River was the preservation of existing riparian forest communities and the fee-title acquisition of wet meadows along the river. Because the Project does not currently impact riparian forest or wet meadow communities, and because the District's relicensing proposal does not include measures that would negatively impact these resources, Project operations are consistent with this document.

E.8.5 Fish and Wildlife Resources of Interest to USFWS on the Platte River

Although the document titled Fish and Wildlife Resources of Interest to the U.S. Fish and Wildlife Service on the Platte River, Nebraska was not available via FERC's e-library, the District obtained a copy of this May 15, 1987, document from the USFWS Grand Island, Nebraska, office. In reviewing document contents, the District found the document to contain very few management strategies or planning elements. Instead, the document generally states resources (fish, wildlife, and threatened and endangered species) of value along varying reaches of the Platte River. Based on document contents, there is little against which Project operations could be evaluated.

Despite the lack of planning content, the District notes the following excerpts related to existing conditions in the lower Platte River—conditions that were occurring during Project operations identical to those of today and those proposed for the relicensing term (USFWS, May 15, 1987):

- "The Platte River below the confluence of the Loup River has been identified by the NGPC as a Class I (highest-valued fishery resource) stream."
- "This river reach is considered to be one of the best warm-water river fisheries in the State."
- "Because of sizeable contributions of flow by the Loup River and other downstream tributaries, flow regime changes in the Platte River above the mouth of the Loup River are somewhat masked below the mouth of the Loup River. However, significant flow reductions in the North Platte River could adversely impact waterfowl use, waterfowl hunting, and the sport fishery. The degree of impact, however, probably would be less than in the upstream Platte River."

E.8.6 Whooping Crane Recovery Plan

The Whooping Crane Recovery Plan, now in its third revision (CWS and USFWS, 2007), states the following recovery goal:

> Establish multiple self-sustaining populations of whooping cranes in the wild in North America, allowing initially for reclassification to threatened status and, ultimately, removal from the List of Threatened and Endangered Species (delisting).

The plan lists the following actions needed to reach the stated goal:

- Continue to build the Aransas-Wood Buffalo National Park population and protect and manage its habitat to minimize the probability that a catastrophic event will eradicate this population.
- Attain breeder pair and productivity goals at four captive facilities in the United States and one in Canada to produce the birds required for reintroductions. Continue research to improve production of captive flocks.
- Establish two additional self-sustaining wild populations. Continue research to identify appropriate reintroduction sites and improve reintroduction techniques. Protect and manage habitat of reintroduced populations.
- Continue to use genetic information and advances in conservation biology to conserve flock genetics, and determine N_e and revise criteria as warranted.
- Maintain an outreach program.

Because 1) whooping cranes are not directly dependent on resources associated with the Loup River or the Project; 2) the vicinity of the Project is located on the eastern edge of the central flyway corridor; and 3) the District's relicensing-specific study results that show the unobstructed channel widths and shallow water channel percentages of the Loup River, both above and below the Diversion Weir, are below the range typically noted at whooping crane roost sites, Project operations are not contrary to the goal and actions of the plan.

E.8.7 Great Lake and Northern Great Plains Piping Plover Recovery Plan

The following excerpt from the Recovery Plan for the Great Lakes Piping Plover (USFWS, September 2003) and the discussion to follow suggest that the 1988 plan listed on FERC's *List of Comprehensive Plans* (FERC, June 2011) is no longer applicable to Nebraska and other states associated with the northern great plains population of piping plover:

> In 1986, recovery teams were appointed to develop recovery plans for the Atlantic Coast and the Great Lakes/Northern Great Plains breeding populations. These teams worked together with the two Canadian recovery teams to produce draft recovery plans for the Atlantic Coast and Great Lakes/Great Plains populations. In 1994, the Great Lakes/Northern Great Plains team released a draft revised recovery plan for public comment. Subsequently, the Service decided the two inland populations would benefit from separate recovery plans.

Although the District was able to easily obtain the subsequent and above-referenced Recovery Plan for the Great Lakes Piping Plover (USFWS, September 2003), the District has found no evidence that a similar/current recovery plan has been developed for the Northern Great Plains piping plover population.

Regardless, since 1988, the District has voluntarily cooperated with agencies to protect nesting piping plovers by ceasing dredging activity during the nesting/fledging season. Additionally, Preferred Sands, USFWS, and NGPC have developed an MOU to ensure cooperative, proactive management strategies to avoid negative impacts on piping plovers and interior least terns from Preferred Sands' sand mining and processing operations at the North SMA. Along with the MOU, Preferred Sands has developed an Adaptive Management Plan (AMP) (see Appendix E-2) for the North SMA. Details on these protective measures are provided in Section 6.6.3.

E.8.8 North American Waterfowl Management Plan

The North American Waterfowl Management Plan establishes goals and strategic initiatives for management of waterfowl in North America and was a joint venture between the United States, Canada, and Mexico. The plan sets the following management goals (USFWS, May 1986):

- Sustain waterfowl population levels to provide ecological and socioeconomic benefits.
- Provide for long-term protection, restoration, and management of waterfowl habitats.
- Manage waterfowl harvests as a renewable matter.
- Continually improve biological foundations of waterfowl conservation.

Specific to the Project and relative to the North American Waterfowl Management Plan, the Lake Babcock Waterfowl Refuge is partially located within the Project Boundary and is operated consistent with the intent of the plan. The refuge, consisting of Lake Babcock, Lake North, and adjoining lands, was established in the 1940s and is regulated by NGPC. Approved and restricted recreation activities at the Lake Babcock Waterfowl Refuge are as follows (163 NAC 4-019):

- All hunting is prohibited in the posted area.
- The operation of all vessels is prohibited upon the waters of the refuge during the open waterfowl season (with the exception of District vessels necessary for Project operation and maintenance), except that portion of the refuge know as Lake North, where vessels may be operated at any time during the year for the purpose of pleasure or fishing.
- Fish may be taken by any otherwise legal means during the entire year in Lake North, but shall be prohibited in Lake Babcock during an open waterfowl season.

E.8.9 Fisheries USA: The Recreational Fisheries Policy of USFWS

Fisheries USA: The Recreational Fisheries Policy of the U.S. Fish and Wildlife Service established the recreational fisheries policy of USFWS and sets the following goals (USFWS, December 5, 1989):

- Ensure and enhance the quality, quantity, and diversity of recreational fishing opportunities.
- Develop and enhance partnerships between governments and the private sector for conserving and managing recreational fisheries.
- Cooperate to maintain a healthy recreational fisheries industry.

Through cooperation with NGPC, the state agency tasked with fisheries management, the District has maintained—and will continue to maintain—consistency with this plan. Previous cooperative efforts include the Angler Use and Harvest (Creel) Survey conducted on Project fisheries in 2010 and the ongoing NGPC fish stocking of Project fisheries. Project fishing opportunities and access will be improved during the new license period as the District's Recreation Management Plan includes the installation of an ADA-compliant fishing pier in Lake North and the designation of a no-wake zone in a portion of Lake North that is recognized for productive crappie fishing.

E.9 CONSULTATION DOCUMENTATION

Throughout the ILP for the Project, a variety of stakeholders were identified. They included Federal, state, and local agencies, Native American tribes, local governments, non-governmental organizations, property owners adjacent to the Project and along the Loup River bypass reach, irrigators, electric customers, and members of the general public. Stakeholders were considered to belong to one of two groups:

- Interested Parties – Individuals and organizations with a general interest in the relicensing process who may occasionally attend Project meetings or receive Project information but do not actively participate in the relicensing proceeding.
- Relicensing Participants – Resource agencies, organizations, and individuals who actively participate in the relicensing proceeding, who may have statutory authority regarding certain aspects of the Project, or who may be participating in workgroups. Intervening parties on FERC's service list were also considered Relicensing Participants, and any Interested Party may choose to be a Relicensing Participant.

  In addition, Federally recognized Native American tribes who have an interest in the Project or the area in which the Project exists were Relicensing Participants. Consultation with tribes was initiated by FERC as a government-to-government relationship. Subsequently, the District provided applicable tribes relevant cultural resource documentation for their review and comment.

Throughout the ILP, two workgroups were established to discuss and resolve specific issues: Water Rights and Recreation/Land Use/Aesthetics. Workgroup members included Interested Parties and/or Relicensing Participants. Workgroup tasks included outlining workgroup goals in relation to the relicensing proceeding, identifying issues, and determining information needed to resolve issues. The District coordinated and facilitated workgroup meetings, summarized meeting discussion, and noted decisions made by the workgroup.

Consultation with Interested Parties, Relicensing Participants, and workgroups is summarized below.

E.9.1 First Stage of Consultation

During preparation of the PAD, the District held a series of meetings with stakeholders—including resource agencies, non-governmental organizations, Project workgroups, and the general public—to identify initial issues, concerns, and questions potentially related to operation of the Project (the contact information for relicensing participants is filed with FERC as privileged information in Volume 3 of the District's Draft License Application). The District carefully considered each of the issues identified as well as input from agencies and other stakeholders. Based on available existing information, the District determined which issues required further study or information gathering, which issues could be addressed with existing information, and which issues were not related to Project relicensing.

The District initiated Project relicensing when the Notice of Intent (NOI) and Pre-Application Document (PAD) were filed with FERC on October 16, 2008. Collectively, the NOI and PAD stated the District's intentions to renew its existing operating license and provided known information relative to Project history, operations, maintenance, and facilities, as well as existing natural and human environments within the Project Boundary. Lastly, the PAD introduced initial issues, concerns, and questions potentially related to operation of the Project that were identified during agency and workgroup meetings and identified potential studies to address these issues.

The PAD was concurrently distributed (in hard copy or electronic format) to Federal and state resource agencies, local governments, and Native American tribes in conformance with 18 CFR §5.2(a) and §5.6(a)(1) and (2). A distribution list of those parties is provided in Appendix E-5. Other parties known to be potentially interested in the relicensing proceeding were notified by mail that the documents were available for viewing on the District's website or at the District's office in Columbus.

On January 12, 2009, the District hosted a public scoping meeting and an agency site visit of Project facilities. The following day, January 13, 2009, the District hosted an agency scoping meeting intended to solicit comments from Federal, state, and local agencies.

E.9.2 Second Stage of Consultation

Following the scoping meetings, the District worked with Project stakeholders to define the studies to be conducted during the relicensing process. FERC provided guidance in its Scoping Documents 1 and 2 and its Study Plan Determination, while the District detailed its studies in its Proposed Study Plan and Revised Study Plan, as discussed below:

- Scoping Document 1 – FERC issued Scoping Document 1 on December 12, 2008. The purpose of Scoping Document 1 was to provide information on the Project and to solicit comments and suggestions on the preliminary list of issues and alternatives to be addressed in FERC's Environmental Assessment (EA).
- Proposed Study Plan – The District's Proposed Study Plan (PSP) was prepared in accordance with 18 CFR §5.11 and was filed on March 27, 2009. The PSP detailed 12 studies proposed by the District and agencies. Additionally, the document discussed the District's position on why additional studies were not warranted.

- Scoping Document 2 – Also on March 27, 2009, FERC issued Scoping Document 2 based on the verbal comments received at the scoping meetings and written comments received throughout the scoping process. The purpose of Scoping Document 2 was to clarify issues identified in Scoping Document 1 based on information received during the scoping process, to advise all participants about additional issues identified for inclusion in the proposed scope of the EA, and to seek additional information pertinent to these analyses.
- Revised Study Plan – The District's Revised Study Plan (RSP) was prepared in accordance with 18 CFR §5.13 and was filed on July 27, 2009. The RSP addressed all comments received on the PSP and included updated plans for the 12 studies included in the PSP.
- Study Plan Determination – FERC issued its Study Plan Determination on August 26, 2009, in accordance with 18 CFR §5.13(c). In its Study Plan Determination, FERC approved three studies as defined in the RSP without modification, approved six studies with modification, and removed three studies. The following is the complete list of studies identified in FERC's Study Plan Determination:
    - 1.0, Sedimentation (approved with modification)
    - 2.0, Hydrocycling (approved with modification)
    - 3.0, Water Temperature in the Platte River (deleted)
    - 4.0, Water Temperature in the Loup River Bypass Reach (approved with modification)
    - 5.0, Flow Depletion and Flow Diversion (approved with modification)
    - 6.0, Fish Passage (approved without modification)
    - 7.0, Fish Sampling (deleted)
    - 8.0, Recreation Use (approved with modification)
    - 9.0, Creel Survey (deleted – combined with 8.0, Recreation Use)
    - 10.0, Land Use Inventory (approved without modification)
    - 11.0, Section 106 Compliance (approved without modification)
    - 12.0, Ice Jam Flooding on the Loup River (approved with modification)

The District conducted these studies during 2010, and the study results were reported in the District's Initial Study Report (August 26, 2010), Second Initial Study Report (February 11, 2011), and Updated Study Report (August 26, 2011). All studies are complete.

- Initial Study Report (ISR) – In accordance with 18 CFR §5.15, the District filed its ISR on August 26, 2010, and held its Initial Study Results Meeting on September 9, 2010. The ISR and associated Initial Study Results Meeting provided results for the following studies:
  - 1.0, Sedimentation
  - 7.0, Fish Passage
  - 10.0, Land Use Inventory
  - 11.0, Section 106 Compliance

  All studies were completed in accordance with the RSP and FERC's Study Plan Determination. Additionally, the ISR provided progress updates for the studies that were ongoing at that time.
- Determination on Study Modifications – Pursuant to 18 CFR §5.15(c), FERC issued its Determination on Requests for Modifications to the Loup River Hydroelectric Project Study Plan for the studies presented in the ISR on December 20, 2010. In this document, FERC addressed requested study plan modifications for the sedimentation and hydrocycling studies, as received from commenting agencies. Based on these requests and other related elements on record, FERC modified only the sedimentation and hydrocycling studies. These modifications were addressed in the District's August 26, 2011, Updated Study Report.
- Second Initial Study Report (Second ISR) – At the time of ISR filing, approximately half of the District's studies were unfinished due to late-season data collection requirements. Therefore, the District filed its Second ISR on February 11, 2011, and held its Second Initial Study Results Meeting on February 23 and 24, 2011. The Second ISR and associated Second Initial Study Results Meeting provided results for the following studies:
  - 1.0, Sedimentation
  - 2.0, Hydrocycling
  - 4.0, Water Temperature in the Project Bypass Reach
  - 5.0, Flow Depletion and Flow Diversion
  - 8.0, Recreation Use
  - 12.0, Ice Jam Flooding on the Loup River

All studies were completed in accordance with the RSP and FERC's Study Plan Determination.

- Determination on Study Modifications – Pursuant to 18 CFR §5.15(c), FERC issued its Determination on Requests for Modifications to the Loup River Hydroelectric Project Study Plan for the studies presented in the Second ISR on June 10, 2011. In this document, FERC addressed requested study plan modifications for the sedimentation, hydrocycling, water temperature in the Project bypass reach, and flow depletion and flow diversion studies, as received from commenting agencies. Based on these requests and other related elements on record, FERC modified only the sedimentation study. These modifications were addressed in the District's August 26, 2011, Updated Study Report.
- Updated Study Report – In accordance with 18 CFR §5.15(f) the District presented the results documented in the Updated Study Report to FERC and other relicensing participants during the Updated Study Results Meeting held on September 8, 2011. The presented studies included analyses required as a result of FERC's December 20, 2010, and June 10, 2011, Determinations on Study Modifications. The following studies were presented:
    - Study 1.0, Sedimentation
    - Study 2.0 Hydrocycling
- Determination on Additional Study Modifications – Comments from resource agencies have been received on the District's study results, presented in the Updated Study Report. FERC's Determination on additional study modifications is expected in December 2012.
- Endangered Species Act Section 7 Consultation – Based on the potential occurrence of Federally listed species in the vicinity of the Project, the District has entered into informal, ongoing Section 7 consultation with USFWS. The District has prepared a Preliminary Draft Biological Assessment (BA) (see Appendix E-2). USFWS, NGPC, and the District are currently consulting on potential species conservation measures. The District anticipates including mutually agreed upon species conservation measures in the Draft BA, to be submitted with the District's License Application.

Throughout the study phase of Project relicensing, stakeholders were provided multiple opportunities to review and provide comment on study results. Comments received were subsequently responded to, and addressed as appropriate. Comment letters and responses and meeting notes are provided in Appendix E-5, Consultation.

E.10 REFERENCES

18 CFR §5.6(d)(3)(viii)(B). Recreational Use of Lands and Waters Compared to Facility or Resource Capacity.

18 CFR §5.18. Integrated License Application Process, Application Content.

18 CFR §16.14. Procedures Relating to Takeover and Relicensing of Licensed Project, Departmental Recommendation for Takeover.

33 CFR §328. Definition of Waters of the United States.

36 CFR §68. The Secretary of the Interior's Standards for the Treatment of Historic Properties.

36 CFR §800.16. Protection of Historic Properties, Definitions.

40 CFR §230.3(t). Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Definitions.

40 CFR §1508.7. CEQ Regulations for Implementing NEPA, Terminology and Index.

50 CFR §17. Endangered and Threatened Wildlife and Plants.

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

50 FR 21784-21792. May 28, 1985. Endangered and Threatened Wildlife and Plants; Interior Population of the Least Tern Determined to be Endangered; Final Rule.

50 FR 50726-50733. December 11, 1985. Endangered and Threatened Wildlife and Plants; Determination of Endangered and Threatened Status for the Piping Plover; Final Rule.

54 FR 39857-39863. September 28, 1989. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Eastern and Western Prairie Fringed Orchids; Final Rule.

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60 FR 36000-36010. August 11, 1995. Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify the Bald Eagle From Endangered to Threatened in All of the Lower 48 States; Final Rule.

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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.

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73 FR 21643-21645. April 22, 2008. Endangered and Threatened Wildlife and Plants; 5-Year Reviews; Notice of Initiation of Review; Request for Information on Seven Listed Midwestern Species.

73 FR 56860-56862. September 30, 2008. Endangered and Threatened Wildlife and Plants; 5-Year Review; Notice of Initiation of Review; Request for Information on the Piping Plover (*Charadrius melodus*).

163 NAC 4-019. October 9, 1998. Lake Babcock Waterfowl Refuge.

16 USC 661 et seq. Fish and Wildlife Coordination Act.

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

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

16 USC 791(a)-825(r). Federal Power Act.

16 USC 803(a)(2)(A). Federal Power Act, Section 10(a)(2)(A).

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

33 USC 1251 et seq. Water Pollution Prevention and Control (Clean Water Act).

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