STUDY 7.0 FISH PASSAGE

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

The Project begins at the Headworks, which is located midway between Fullerton and Genoa, Nebraska, and consists of a Diversion Weir, Intake Gate Structure, and Sluice Gate Structure. The low-head Diversion Weir diverts a portion of the Loup River flow through the Intake Gate Structure into the Loup Power Canal and generation system. The Project is able to divert up to 3,500 cfs of water. This is the capacity of the Loup Power Canal as well as the limit of the District's water right.

The Loup River provides habitat for the channel catfish. The ability of channel catfish to move upstream past the Diversion Weir and Sluice Gate Structure may be restricted by the hydraulic characteristics (that is, flow, velocity, and stage) at the Diversion Weir. A study on fish presence and absence upstream of a low-head dam on the nearby Cedar River presents evidence that high velocities through the dam sluiceways may have been acting as a barrier to fish passage upstream (Admiraal and Schainost, 2004). The analysis proposed in this fish passage study will determine if the Diversion Weir and Sluice Gate Structure impede channel catfish passage in the Loup River.

1. GOALS AND OBJECTIVES OF STUDY

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

The goal of the fish passage study is to determine if a reasonable pathway exists for fish movement upstream and downstream of the Diversion Weir.

The objectives of the fish passage study are as follows:

1. To evaluate the hydraulic flow, velocity, and stage parameters at the Diversion Weir and Sluice Gate Structure.
2. To review stage and discharge data available at nearby U.S. Geological Survey (USGS) gage stations (USGS Gage 06793000, Loup River near Genoa, NE, and USGS Gage 06792500, Loup River Power Canal near Genoa, NE).
3. To collect hydraulic information, including surveying river cross sections at the upstream and downstream face of the Headworks and recording headwater and tailwater elevations at the Diversion Weir.

4. To review literature to determine velocity and depth criteria for upstream fish passage at the Diversion Weir.
5. To review flow duration curves at the Diversion Weir.
6. To develop a hydraulic model to determine the flow split between the Diversion Weir and sluice gates for a range of flows.
7. To determine whether fish pathways exist over the Diversion Weir, through the Sluice Gate Structure, or by other means.

2. RELEVANT RESOURCE MANAGEMENT GOALS

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

The Nebraska Game and Parks Commission (NGPC) manages fisheries statewide for productive sport fishing. NGPC has identified the channel catfish as a sport fish of special interest within the Project Boundary and the Loup River Basin. Furthermore, NGPC is concerned that the Diversion Weir and Sluice Gate Structure may obstruct channel catfish spawning migrations, which in turn may inhibit productive fishing opportunities in state waters (HDR, August 19, 2008).

3. BACKGROUND AND EXISTING INFORMATION

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

3.1 Project Structures

The Diversion Weir consists of a 1,320-foot-long, low concrete weir. The fixed crest of the weir is at an elevation of 1,574 feet, and wooden flashboards are maintained along the top of the weir to create an effective crest elevation of 1,576 feet. The right, or south, abutment of the Diversion Weir is flanked by a dike extending approximately 3,000 feet to high ground.

The Intake Gate Structure is located on the north bank of the river. It is constructed of reinforced concrete and supports 11 steel radial gates that admit Loup River water into the Loup Power Canal. The elevation of the concrete gate sills is 1,569.5 feet, and each gate is 24 feet long with a maximum opening of 5 feet.

The Sluice Gate Structure spans the portion of the river flowing between the downstream leg of the Diversion Weir and the Intake Gate Structure. It is in place to promote formation of a scour channel along the front of the Intake Gate Structure as well as to keep the Intake Gate Structure free of debris and ice. The elevation of the sluice gate sills is 1,568 feet, and each steel gate is 20 feet long with a maximum opening of 6 feet.

3.2 Channel Catfish

Channel catfish generally inhabit large rather turbid streams having low or moderate gradients. Adults are found in the larger pools, in deeper water, or around submerged objects. The young often occur in riffles or the shallower parts of pools. During spawning season, channel catfish prefer overhangs, holes in banks, and natural cavities with semi-darkness and seclusion as factors in choice of nest sites (Pflieger, 1997). A characteristic of a healthy fishery during spawning would allow channel catfish to freely move upstream and downstream of the Headworks.

3.3 USGS Flow and Gage Data

Flow velocity is an important factor exerting influence on channel catfish. The data will be used to create a flow duration curve at the Diversion Weir as well as for calibration of the hydraulic model. Each gage station is accompanied by the associated rating curves and velocity and cross-sectional data used to create the rating curves. USGS data at the following two locations, shown in Figure 7-1, will provide flow data that will be used for this study:

- USGS Gage 06793000, Loup River near Genoa, NE – Available discharge data from April 1, 1929, to current for this station includes 15-minute interval data and available 15-minute interval gage height data from June 12, 1997 to current.
- USGS Gage 06792500, Loup River Power Canal near Genoa, NE – Available discharge data from January 1, 1937, to current for this station includes 15-minute interval data and available 15-minute interval gage height data from August 30, 2000, to current.

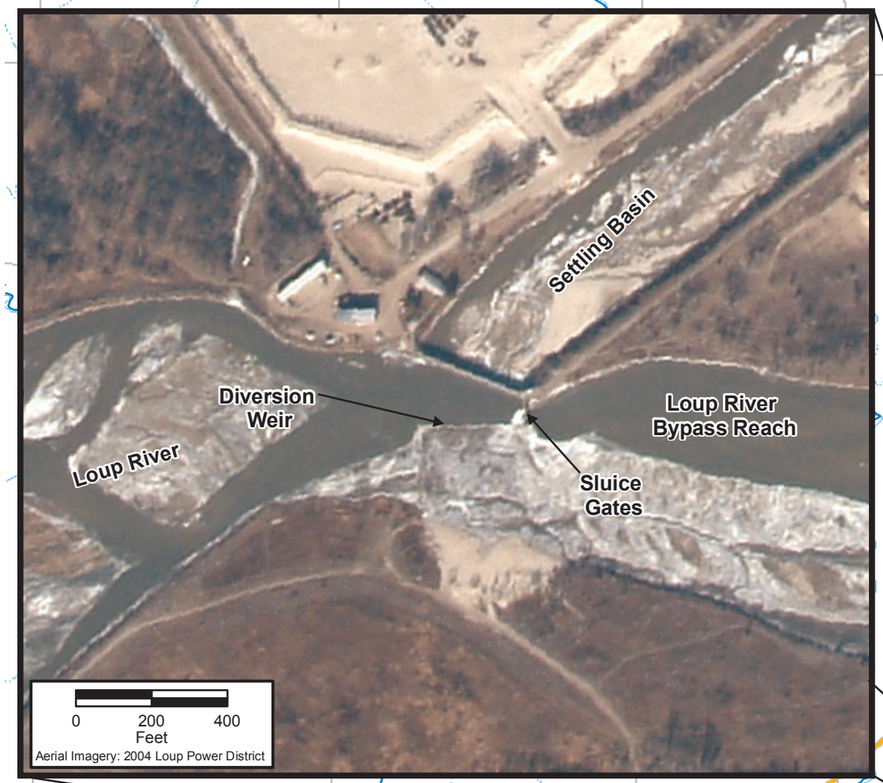
4. PROJECT NEXUS

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

The Diversion Weir associated with the Project establishes a water level sufficient to divert Loup River water through the Intake Gate Structure to the Loup Power Canal. The nexus between the Diversion Weir and fish passage is that the Diversion Weir may serve as a physical barrier to upstream and downstream fish movement during the spawning period of April, May, June, and July.

5. STUDY AREA AND STUDY SITES

The study area includes the area around the Headworks. The study area and the locations of the USGS gages from which data will be obtained are shown in Figure 7-1.



Beaver Creek

39

22

Genoa

Nance County

Platte County

06792500
Loup River Power Canal
near Genoa, NE

Upper Power Canal

06793000
Loup River
near Genoa, NE

Loup River Bypass Reach

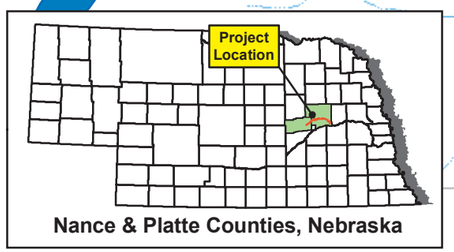
39

22

Diversion Weir
and Headworks

Loup River

Merrick County



Nance & Platte Counties, Nebraska

4,000 2,000 0 4,000
Feet

Legend

- USGS Gaging Station
- Rivers/Streams
- Loup Power Canal
- Major Road
- Local Road
- Railroad
- Corporate Limits
- County Line

Loup Power District Hydro Project

Fish Passage Study Area

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

DATE
March 2009

FIGURE
7-1

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6. PROPOSED METHODOLOGY

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

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

The methodology for the fish passage study includes three tasks, described below.

Task 1 Data Review

Stage and discharge data available at nearby USGS Gage 06793000, Loup River near Genoa, NE, and USGS Gage 06792500, Loup River Power Canal near Genoa, NE, will be reviewed. This information was used to develop the flow duration curve at the Diversion Weir as described in Section 5 of the PAD. A flow duration curve is a plot of discharge vs. percent of time that a particular discharge was equaled or exceeded. The flow duration links the discharges, the flow depth and velocities (through the hydraulic model in Task 3, below) with a percentage of time equaled or exceeded at the Diversion Weir during the months of April, May, and June (the period of analysis).

In addition to the data described above, literature will be reviewed to determine the hydraulic conditions (flow velocity and vertical distance between upstream and downstream pools) that limit movement of channel catfish.

Task 2 Data Collection

River cross sections will be surveyed at the upstream and downstream face of the Headworks and at two additional locations: one 200 feet upstream and one 200 feet downstream of the Headworks. The cross sections will provide a basis from which to create a hydraulic model. They need to be located far enough away from the Diversion Weir that they are representative of the channel, and it is thought that 200 feet upstream and downstream is an appropriate distance.

In addition, a series of Diversion Weir headwater and tailwater elevations will be collected to develop the hydraulic relationship between the flow in the Loup River bypass reach and the tailwater elevation at the Diversion Weir. This would require that Project personnel record daily elevations at existing staff gages upstream and downstream of the Diversion Weir for the period of analysis. This would ensure that a full range of flow conditions would be recorded.

Task 3 Data Analysis

Hydraulic Modeling

A hydraulic model relating flow in the bypass reach, headwater and tailwater elevations, flow velocity over the Diversion Weir, and flow velocity through the Sluice Gate Structure will be created by developing and analyzing a baseline model, as described as follows.

The geometry for the Diversion Weir and Sluice Gate Structure will be incorporated into a mathematical model that relates flow, headwater and tailwater elevations, and velocity through and over the structures. A set of calibration flows and water surface elevations will be developed based on information at the USGS gage in the Loup River bypass reach and the Diversion Weir tailwater measurements obtained.

A set of flows will be developed, based on the spawning season flow duration curve, to route through the mathematical model. The mathematical model will predict the flow velocity over the Diversion Weir and through the Sluice Gate Structure. The flows should bracket the range of expected flows during the migration and spawning season. Because the flows are part of the flow duration curve, each flow will have a percent of time equaled or exceeded.

Hydraulic Conditions at the Diversion Structure

The difference in upstream and downstream water surface elevations at the Diversion Weir and the average velocity across the Diversion Weir and through the Sluice Gate Structure will be tabulated for all flows in the evaluation flow set (see Hydraulic Modeling under Task 3, above). The tabulated results will be compared to the fish passage criteria. This will allow creation of a table that documents the hydraulic conditions in the Loup River and the percent of time during the spawning period when the conditions in the river (that is, over the Diversion Weir and through the Sluice Gate Structure) are a barrier to catfish movement. The end result of this task is calculation of the time duration that the Diversion Weir serves as a barrier to channel catfish movement upstream in the Loup River.

Alternative Fish Pathways

The hydraulic data will be analyzed to determine whether fish pathways exist over the Diversion Weir, through the Sluice Gate Structure, or by other means.

7. CONSULTATION WITH AGENCIES, TRIBES, AND OTHER STAKEHOLDERS

This study plan was developed based on discussions with agencies prior to submittal of the PAD. The District will work with agencies to resolve any issues or concerns during the course of the study plan meetings prior to preparation of the revised study plan.

8. WORK PRODUCTS

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

The intended work product for the fish passage study is a study report. The study report will document the hydraulic conditions at the Diversion Weir and the duration (if any) that the Diversion Weir serves as a barrier to channel catfish passage during the spawning period. Along with the study report, a database of the data gathered and used in the analysis will be available.

Updates regarding the fish passage study will be included in the study progress reports to be submitted to FERC in March 2010 and June 2010.

9. LEVEL OF EFFORT AND COST

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

It is estimated that the fish passage study will cost approximately $70,000. This work will be completed by qualified water resources engineers and biologists.

10. SCHEDULE

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

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

The fish passage study is scheduled to begin in the first quarter of 2010, and the final study report is to be submitted in the third quarter of 2010.

11. REFERENCES

Admiraal, David, and Steve Schainost. 2004. "Fish Passage for Warm Water Fish Species." ASCE Conf. Proc. 138, 175.

HDR. August 19, 2008. Meeting notes from agency meeting. Available online at http://www.loup.com/relicense/html/documents/Meeting_Resources/AgencyResources/08aug08/08aug19meetingnotes.pdf.

Pflieger, W.L. 1997. *The fishes of Missouri*. Jefferson City, Missouri: Missouri Department of Conservation.