The Loup River Hydroelectric Project

Study Plan Discussion

May 27 and 28, 2009

Loup Power District Hydro Project

Key Dates

- April 21: 1st Study Plan Meeting
- May 5: Cultural Resources; Study 11
- May 11: Recreational Resources; Studies 8, 9, 10
- May 27-28: 2nd Study Plan Meeting
- June 25 – Comments due on Proposed Study Plan
- July 1: Additional discussion as needed
- July 27 – District's Revised Study Plan due
- August 26 – FERC Study Plan Determination
- September 15 - Dispute Filing Deadline (18CFR §5.14)

2

FERC Study Request Criteria

1. Goals & Objectives of Study
2. Relevant Resource Management Goals, or
3. Relevant Public Interest
4. Background & Existing Information
5. Project Nexus
6. Proposed Methodology
7. Level of Effort and Cost

18CFR §5.9

3

Protection, Mitigation & Enhancement Measures

- Study results may identify need for PM&E measures
- District includes their proposed measures in the license application (as part of proposed action)
- Agencies comment on application and may suggest modifications or additional PM&E measures
- FERC reviews license application and agency comments and makes final determination on PM&E measures

4

Study Plan Collaboration

- Purpose of the Study Plan:
  - Identify studies needed to provide information for evaluation of a new project license relative to NEPA and ESA evaluations.
- Goal of This Meeting:
  - To seek consensus on the methods and activities associated with aquatic resources studies.

5

Study Plans

1. Sedimentation
2. Hydrocycling
3. ~~Water Temperature in the Platte River~~
4. Water Temperature in the Loup River Bypass Reach
5. Flow Depletion and Flow Diversion
6. Fish Sampling
7. Fish Passage
8. Recreation User Survey
9. Creel Survey

Combined into Recreation Use

10. Land Use Inventory
11. Section 106 Compliance
12. Ice Jam Flooding on the Loup River
13. PCB Sampling of Settling Basin - NEW

6

Loup Power District Operations Overview

- Project 1256 is District's only power generation facility.
- Project was conceived and designed for hydrocycling.
- All power from the hydroelectric facility is sold to NPPD at the point of generation.
- Project is operated by the District but is dispatched by NPPD per contract agreement.
- NPPD dispatches hydro when it is most cost effective for the system.

7

Loup Power District Operations Overview

- District purchases all its wholesale power from NPPD.
- District provides power to retail customers in four counties.
- Revenue from the hydroelectric facility provides capital for District's overall operation which reduces the rate charged to District's customers.
- Changes in Project flow or ability to generate will negatively impact the District's economics.
- Changes in Project operation affect all of NPPD's wholesale and retail customers.

8

Scoping Document 2

- Bypass Reach Temperature
  - Emphasis on diversion weir to Beaver Creek confluence
- Fish Passage
  - Expand to include all affected species
- PCBs
  - Effects of project operations on PCB mobilization within the settling basin
- Irrigation
  - Assessment of effect of any change to project diversions on irrigation from the canal

9

Scoping Document 2

- Nebraska Natural Legacy Project Tier 1 Species
  - Evaluate need for conservation and management actions
- Whooping Crane Foraging Habitat
  - Effects to foraging habitat in the bypass reach
- Off-road vehicle Recreation
  - Assessment of providing opportunities
- Trail Recreation
  - Assessment of providing opportunities

10

Studies 8-10 – Recreation, Landuse & Aesthetics

- Study 8 – Recreation Use
  - To be combined with Creel Survey
  - NOHVA survey deleted
  - May 11th participants providing comments on survey questions
- Study 9 – Creel Survey
  - To be combined with Recreation Use Survey
  - Methodology will be revised slightly
- Study 10 – Land Use Inventory
  - unchanged

11

Study 11 - Section 106 Compliance

- Study 11 – Section 106 Compliance
  - Study Plan unchanged

12

Studies 1-7 & 12 – Aquatic Resources

Recap of April 21st Meeting

- Overview of entire Proposed Study Plan (PSP)
- Overview of study requests/elements not included in PSP
- Sought consensus on goals & objectives for Studies 1-5 & 7
  - Study Plan Meeting outcomes memo
  - Meeting transcript

13

12. Ice Jam Flooding on the Loup River

Goal(s)

- The goal of the study of ice jam flooding on the Loup River is to qualitatively determine if the operation of the Loup Power Canal has a material effect on the formation of ice jams or a material effect on the severity of flooding caused by ice jams in the Loup River bypass reach.

14

12. Ice Jam Flooding on the Loup River

Objective

1. To characterize the available information (ice observation reports, associated atmospheric temperature data, and associated gage flow data) and its relevance to performing a quantitative or qualitative analysis.

Associated Activities

- Collect and review NDNR ice reports for the Loup River.
- Collect flow and temperature data (water and air).
- Review historic ice jam and related flood information.
- Review Project operations relative to ice jam flood events.
- Coordinate with the Corps of Engineers (or other) regarding the suitability of the available data for performing a quantitative or qualitative analysis.

15

12. Ice Jam Flooding on the Loup River

Objective

2. To perform a qualitative analysis to determine if a relationship can be found between Project operations and the occurrence or severity of ice jam flooding in the Loup River bypass reach.

Associated Activities

- Update July 1994 USACE report tables and graphs relative to the bypass reach.
- Plot flows in the Loup Power Canal and Loup River bypass reach from November to April of each year.

16

5. Flow Depletion and Flow Diversion

Goal(s)

- Determine if Project operations result in a 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 will be used to determine if the Project 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.

17

5. Flow Depletion and Flow Diversion

Objective

1. To determine the net consumptive losses associated with Project operations compared to alternative conditions.

Associated Activities

- Collect gage and atmospheric data.
- Calculate net consumptive use for the Loup Power Canal system and Loup River bypass reach.
  - Evaporation
  - Evapotranspiration (ET)

18

5. Flow Depletion and Flow Diversion

Objective

2. To use current and historic USGS gage rating curves to evaluate change in stage in the Loup River bypass reach during Project operations and compare against alternative hydrographs.

Associated Activities

- Create flow duration and flood frequency curves based on USGS gages.
- Quantify the stage in the Loup River bypass reach at Genoa and Columbus.

19

5. Flow Depletion and Flow Diversion

Objective

3. To evaluate historic flow trends on the Loup and Platte rivers since Project inception.*

Associated Activities

- Evaluate historic flows in Loup and Platte Rivers.

20

5. Flow Depletion and Flow Diversion

Objective

4. To determine the extent of interior least tern and piping plover nesting on the Loup River above and below the Diversion Weir.

Associated Activities

- Compare nest counts for Loup River upstream and downstream of the diversion and identify significant differences
- Examine aerial images to identify and compare habitat parameters following methodology utilized by Kirsch in 1996
- Plot recorded nesting sites (from given years) above and below the diversion
- Identify habitat requirements from habitat study reports
- Compare observed conditions to habitat requirements

21

5. Flow Depletion and Flow Diversion

Objective

5. Determine Project effects, if any, of consumptive use on fisheries and other habitat on the lower Platte River downstream of the tailrace canal.

Associated Activities

- Similar to tasks for Objectives 1 and 2 and including the premise that depletions would directly correlate with effects (adverse or beneficial) to fisheries and riverine habitat
  - Calculate net consumptive use for the Loup Power Canal system and Loup River bypass reach
  - Create flow duration and flood frequency curves based on USGS gages

22

5. Flow Depletion and Flow Diversion

Objective

6. Determine the relative significance of the Loup River bypass reach to the overall Loup River fishery.

Associated Activities

- Use existing NGPC fish sampling data to compare fishery dynamics in the Loup River both above and below the Diversion Weir.

23

1. Sedimentation

Goal(s)

- 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. In addition, compare the availability of sandbar nesting habitat for interior least terns and piping plovers to their respective populations and to compare the general habitat characteristics of the pallid sturgeon in multiple locations.

24

Proposed Methodology

- Assess Project affects on morphology
- Regime-based analytical methods previously used on the Platte River
  - Quantitative Analysis
  - Current vs. Alternate Conditions
- Flow and sediment regime affects morphology

25

1. Sedimentation

Objective

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

Associated Activities

- Update sediment budget utilizing existing data sources.
- Generate collective sediment discharge curves at gage stations.
- Determine Sediment Transport Indicators
  - Effective Discharge
  - Total Sediment Transport

26

Effective Discharge

- Transports the largest fraction of the total sediment load
- Results in the average morphologic characteristics of the channel (the most important – channel shaping flow)
- Used to assess channel characteristics - width and depth

27

Total Sediment Transport

- Total amount of sediment transported during the analyzed time period
- Annual sediment discharge compared to total sediment yield from associated watershed
- One factor in the flow-limited or supply-limited analysis

28

Procedure

- Flow frequency curve
- Sediment discharge rating curve
- Collective sediment discharge curve

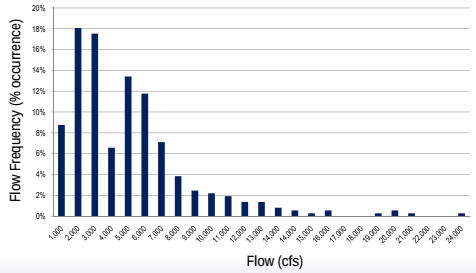
29

Flow Frequency

- Daily mean discharge from gage data
- Select a time period (i.e. annual, seasonal)
- Sort flows into uniform ranges
- Create a histogram of the number of occurrences in each range

30

Flow Frequency Curve



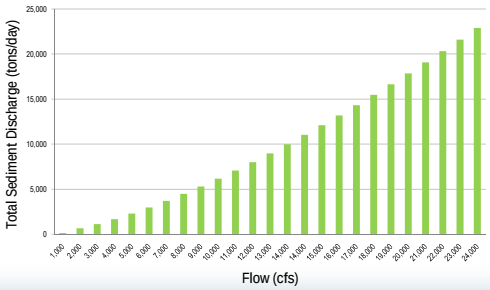
31

Sediment Discharge Rating Curve

- Relationship between flow and the sediment that is transported by that flow
  - Yang's Unit Stream Power Method
    - Function of Channel slope, depth and velocity characteristics, and grain size

32

Sediment Discharge Rating Curve



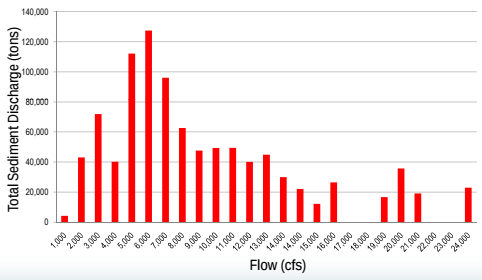
33

Collective Sediment Discharge Curve

- Created by multiplying flow frequency and sediment discharge
- Peak of Collective Sediment Discharge Curve is the Effective Discharge
- From Effective Discharge, determine channel characteristics
- Total Sediment Transported
  ∑ Mean daily discharge x sediment discharge

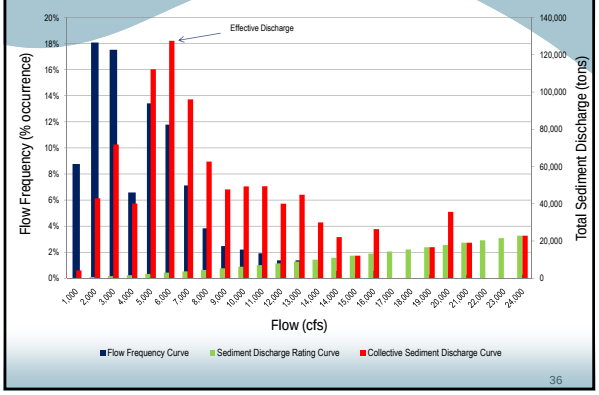
34

Collective Sediment Discharge Curve



35

Collective Sediment Discharge Curve



36

1. Sedimentation

Objective

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

Associated Activities

- Update sediment budget utilizing existing data sources.
- Generate collective sediment discharge curves at gage stations.
- Determine Sediment Transport Indicators
  - Effective Discharge
  - Total Sediment Transport

37

1. Sedimentation

Objective

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

Associated Activities

- Utilize existing literature to characterize stream morphology.
- Compare effective discharges, cross sectional changes, and associated stream characteristics.

38

1. Sedimentation

Objective

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

Associated Activities

- Plot and evaluate nest count data against sediment transport indicators
- Perform a regression analysis on plotted data
- Examine trends

39

1. Sedimentation

Objective

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

Associated Activities

- Accumulate nest counts on the Missouri River below Gavins Point Dam to Ponca, NE
- Review best available Missouri River sandbar formation data
- Qualitatively determine whether sandbar habitat is limiting interior least tern and piping plovers on the Missouri River
- Compare results between the Missouri River and the lower Platte River

40

1. Sedimentation

Objective

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

Associated Activities

- Determine if the project is affecting sediment transport
- If the project is affecting sediment transport:
  - Determine extent using effective discharge calculations and aggradation/degradation analysis
  - Compare to other rivers used by the pallid sturgeon

41

1. Sedimentation

Objective

6. To investigate the relationship between sedimentation and ice jam flooding.

Associated Activities

- Research a potential link between sediment and frazil ice transport.

42

2. Hydrocycling

Goal(s)

- 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 will be quantified and compared to alternative conditions.

43

2. Hydrocycling

Objective

1. To compare the sub-daily Project hydrocycling operation values (maximum and minimum flow and stage) to daily values (mean flow and stage). In addition to same-day comparisons, periods of weeks, months, and specific seasons of interest to protected species will be evaluated to characterize the relative degrees of variance between hydrocycling (actual) and alternative conditions in the study area.

Associated Activities

- Collect flow and stage data and determine the timing, frequency, rate of change, travel time, and magnitude of sub-daily flow and stage changes.
- Develop and plot hydrographs for the project and alternative conditions.

44

2. Hydrocycling

Objective

2. To determine the potential for nest inundation due to both hydrocycling and alternative conditions.

Associated Activities

- Determine highest flow (benchmark events) prior to June 1
- Identify flow events equal or greater than the benchmark event from June 2 to July 2
- Evaluate frequency of occurrence of flow events equaling or exceeding a benchmark flow for a given year
- Evaluate Project operations relative to benchmark flows

45

2. Hydrocycling

Objective

3. To assess effects, if any, of hydrocycling on sediment transport parameters.

Associated Activities

- Determine sediment transport indicators (effective discharge and total sediment transport) for project and alternative condition sub-daily hydrographs.

46

2. Hydrocycling

Objective

4. To identify material differences in potential effects on nesting habitat of the interior least tern, piping plover, and pallid sturgeon.

Associated Activities

- Examine effects of hydrocycling/pulsing operations to tern and plover nesting sites on other rivers and compare to conditions resulting from District operations
- Review river conditions on Missouri River below Gavins Point Dam and compare to lower Platte River below Elkhorn River confluence

47

4. Water Temperature in the Loup River Bypass Reach

Goal(s)

- The goal of the study of water temperature in the Loup River bypass reach is to determine if project operations (flow diversion) materially affect water temperature in the Loup River bypass reach with particular emphasis between the diversion weir and the confluence of Beaver Creek with the Loup River.

48

4. Water Temperature in the Loup River Bypass Reach

Objective

1. To estimate the relationships between flow in the Loup River bypass reach, ambient air temperature, water temperature, relative humidity, and cloud cover.

Associated Activities

- Coordinate with the USGS to install temperature sensors in the Loup River at the Diversion Weir and at the USGS gage at Genoa.
- Collect and review ambient air temperature data at the weather station at Genoa.
- Collect and review relative humidity and solar radiation at the weather station at Mead, Nebraska
- Collect and review flow data at USGS Gage at Loup River near Genoa and USGS Gage at Loup River Power Canal near Genoa.
- Develop plots and identify general patterns and distinguish trends.

49

4. Water Temperature in the Loup River Bypass Reach

Objective

2. To describe and quantify the relationship, if any, between diversion of water into the Loup Power Canal and water temperature in the Study Reach of the Loup River bypass reach.

Associated Activities

- Perform regression analyses on each described plot to determine relationships between water temperature, ambient air temperature, flow, relative humidity, and solar radiation.
- Establish a predictive relationship that can be used to predict during what conditions the water quality temperature standard may be exceeded.

50

6. Fish Sampling

District proposes that fish sampling in the canal is not necessary for Project relicensing:

- Canal fishery has previously been identified by NGPC as excellent
- No concerns have been raised related to quality of the canal fishery
- No issues identified in SD2 related to canal fisheries

District is willing to provide access for NGPC sampling in the future, independent of relicensing.

51

7. Fish Passage

Goal(s)

- The goal of the fish passage study is to determine if a useable pathway exists for fish movement upstream and downstream of the diversion weir.

52

7. Fish Passage

Objective

1. To evaluate the hydraulic flow, velocity, and stage parameters at the Diversion Weir and Sluice Gate Structure.

Associated Activities

- Review stage and discharge data at USGS gage stations.
- 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.
- Review flow duration curves at the Diversion Weir.

53

7. Fish Passage

Objective

2. To determine whether fish pathways exist over the Diversion Weir, through the Sluice Gate Structure, or by other means.

Associated Activities

- Literature review to determine velocity and depth criteria for upstream fish passage at the Diversion Weir.
- Develop a hydraulic model to determine the flow split between the Diversion Weir and sluice gates for a range of flows.
- Calculate the percent of time during the migration season that the Diversion Weir is a barrier to upstream fish movement.

54

13. PCB Sampling at the Settling Basin

SD2:

"The potential exists for dredging operations to mobilize PCB-laden sediments if present in the Settling Basin. In addition, small fish discharged onto the North Sand Management Area with sediments during dredging activities could potentially contain PCBs. Such fish could be ingested by federally listed least terns nesting and feeding on the North Sand Management Area." (pg. 12)

55

13. PCB Sampling at the Settling Basin

Goal(s)

- The goal of the study is to determine if PCBs are present in the Settling Basin or small fish dredged from the settling basin.
- If PCBs are detected in small fish, determine the potential effect on the interior least tern.

56

13. PCB Sampling at the Settling Basin

Objective

1. To determine if PCBs are present in the Settling Basin

Associated Activities

- Perform water sampling at the Settling Basin inlet and outlet both when the dredge is in operation (April to June) and not in operation (June to August).

57

13. PCB Sampling at the Settling Basin

Objective

2. To determine if small fish discharged to the North Sand Management Area contain PCBs.

Associated Activities

- Collect small fish from the dredge discharge and test this tissue for PCBs.

58

13. PCB Sampling at the Settling Basin

Objective

3. If PCBs are detected in small fish dredged onto the North Sand Management Area, determine the potential effect on least terns.

Associated Activities

- Review existing literature on PCB toxicity related to least terns.

59

Future Meetings & Next Steps

- June 25 – Comments due on Proposed Study Plan
- July 27 – District's Revised Study Plan due

- July 1: Is additional discussion needed?
- Others meetings needed?

60

1. Sedimentation

Objectives

1. To characterize existing sediment transport, and sediment transport associated with alternatives, in the Loup River bypass reach and in the lower Platte River through effective discharge calculations.
2. To characterize stream morphology in the Loup River bypass reach and the lower Platte River by reviewing existing literature on channel aggradation/degradation and cross sectional changes over time.
3. To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts and bird numbers (as provided by NGPC).
4. To evaluate whether sandbar availability is limiting interior least tern and piping plover populations on the lower Platte River.
5. To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn River. *
6. To investigate the relationship between sedimentation and ice jam flooding.

62

2. Hydrocycling

Objectives

1. To compare the sub-daily Project hydrocycling operation values (maximum and minimum flow and stage) to daily values (mean flow and stage). In addition to same-day comparisons, periods of weeks, months, and specific seasons of interest to protected species will be evaluated to characterize the relative degrees of variance between hydrocycling (actual) and alternative conditions in the study area.
2. To determine the potential for nest inundation due to both hydrocycling and alternative conditions.
3. To assess effects, if any, of hydrocycling on sediment transport parameters.
4. To identify material differences in potential effects on habitat of the interior least tern, piping plover, and pallid sturgeon.

63

4. Water Temperature in the Loup River Bypass Reach

Objectives

1. To investigate the relationships between flow in the Loup River bypass reach, ambient air temperature, water temperature, relative humidity, and cloud cover.
2. To describe and quantify the relationship, if any, between diversion of water into the Loup Power Canal and water temperature in the Study Reach of the Loup River bypass reach.

64

5. Flow Depletion and Flow Diversion

Objectives

1. To determine the net consumptive losses associated with Project operations compared to alternative conditions.
2. To use current and historic USGS gage rating curves to evaluate change in stage in the Loup River bypass reach during Project operations and compare against alternative hydrographs.
3. To evaluate historic flow trends on the Loup and Platte rivers since Project inception.*
4. To determine the extent of interior least tern and piping plover nesting on the Loup River above and below the Diversion Weir.
5. To determine effects, if any, of consumptive use on fisheries and other habitat on the lower Platte River downstream of the tailrace canal.
6. To determine the relative significance of the Loup River bypass reach to the overall fishery habitat for the Loup River.

65

7. Fish Passage

Objectives

1. To evaluate the hydraulic flow, velocity, and stage parameters at the Diversion Weir and Sluice Gate Structure.
2. To determine whether fish pathways exist over the Diversion Weir, through the Sluice Gate Structure, or by other means.

66

12. Ice Jam Flooding on the Loup River

Objectives

1. To characterize the available information (ice observation reports, associated atmospheric temperature data, and associated gage flow data) and its relevance to performing a quantitative or qualitative analysis.
2. To perform a qualitative analysis to determine if a relationship can be found between Project operations and the occurrence or severity of ice jam flooding in the Loup River bypass reach.

67

13. PCB Sampling in the Settling Basin

Objectives

1. To determine if PCBs are present in the Settling Basin
2. To determine if small fish discharged to the North Sand Management Area contain PCBs.
3. If PCBs are detected in small fish dredged onto the North Sand Management Area, determine the potential effect on least terns.

68