

FEDERAL ENERGY REGULATORY COMMISSION  
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August 26, 2009

OFFICE OF ENERGY PROJECTS

Project No. 1256-029—Nebraska  
Loup River Hydroelectric Project  
Loup River Public Power District

Neal D. Suess, President/CEO  
Loup Power District  
2404 15<sup>th</sup> Street  
P.O. Box 988  
Columbus, NE 68602-0988

Reference: Study Plan Determination for the Loup River Hydroelectric Project

Dear Mr. Suess:

Pursuant to 18 CFR §5.13(c) of the Commission's regulations, this letter includes my study plan determination for the Loup River Public Power District's (Loup Power District or District) Loup River Hydroelectric Project (Project). This determination is based on the staff's review of the revised study plan, comments on the proposed and revised study plan, and other elements of the record.

While many issues associated with your proposed and revised study plans have been resolved, some unresolved issues remain. This letter includes modifications to your revised study plan necessary to resolve the outstanding issues, which are discussed in Appendix A.

Background

On March 27, 2009, the District filed its proposed study plan that included 12 study plans on fish, water quality, cultural, recreation, land use, terrestrial, and developmental resources.

On April 21, 2009, May 5, 2009, May 11, 2009, and May 27 & 28, 2009, the District held study plan meetings with the relicensing participants, some of which included Commission staff, to discuss its proposed study plans. The District filed a revised study plan on July 27, 2009, which included:

- Leaving three study plans unchanged: Fish Passage, Land Use Inventory, and Section 106 Compliance.
- Modifying six study plans: Sedimentation, Hydrocycling, Water Temperature for the Loup River Bypassed Reach, Flow Depletion and Flow Diversion, Recreation Use, and Ice Jam Flooding on the Loup River.
- Deleting two study plans: Water Temperature in the Platte River and Fish Inventory.

Comments on the revised study plan were filed by the Nebraska Department of Natural Resources (Nebraska DNR) on August 7, 2009, and the U.S. Fish and Wildlife Service (FWS) on August 11, 2009. The District filed responses to the Nebraska DNR and FWS letters on August 18, 2009.

#### Study Plan Determination

Commission staff reviewed the District's revised study plan, comments on the plan, and other elements of the record. Based on that review, I am: (1) approving the Fish Passage, Land Use Inventory, and Section 106 Compliance study plans as filed; (2) approving the Sedimentation, Hydrocycling, Water Temperature for the Loup River Bypassed Reach, Flow Depletion and Flow Diversion, Recreation Use, and Ice Jam Flooding on the Loup River study plans with further modifications; and (3) approving the removal of the Water Temperature in the Platte River and the Fish Inventory study plans. I am not requiring the District to conduct sediment sampling for polychlorinated biphenyls in the Loup Power Canal as requested by the FWS. My reasons for modifying the District's revised study plan are explained in detail in Appendix A.

If you have any questions, please contact Kim Nguyen at (202) 502-6105 or email at [kim.nguyen@ferc.gov](mailto:kim.nguyen@ferc.gov).

Sincerely,

Jeff C. Wright  
Director  
Office of Energy Projects

Enclosures: Appendix A – Study Request Issues

cc: Mailing List  
Public File

## **APPENDIX A STUDY REQUEST ISSUES**

The following discusses staff's findings on the revised study plan proposed by the District and comments on those plans based on criteria outlined in the Commission's regulations [18 CFR sections 5.9(b)(1)-(7)]. Except as explained below, we concur with the District's conclusions and bases for its proposed study plans and conclude that the revised study plan, as modified below, adequately addresses all study needs at this time. This includes the deletion of the Water Temperature in the Platte River (Study 3.0) and the Fish Inventory (Study 6) study plans; no comments opposing their removal were filed.

### **Approved Study Plans As Filed in the Revised Study Plan**

**Study No. 7 – Fish Passage**

**Study No. 10 – Land Use Inventory**

**Study No. 11 – Section 106 Compliance**

### **Approved Study Plans with Modifications**

#### **General Comments Applicable to Various Studies**

##### **Determination of effects on federally listed species**

In the Sedimentation Study (task 5), the District proposes that if it were to determine that the project does not affect stream morphology in the Loup River bypassed reach and the lower Platte River, or that the system is in dynamic equilibrium, it will be inferred that the project does not affect interior least tern and piping plover nesting habitat parameters related to sediment transport and stream morphology and that no further analysis is warranted. Similar determinations of effect are implied in the Flow Depletion and Flow Diversion Study (task 2, 4, and 6). The FWS asserts that such determinations may limit the Commission's sole discretion regarding a determination of project effects on listed species. FWS recommends that this and other study plan deliverables be limited to study methods, results, and raw data.

While the District is free to interpret the study results, nothing in the study plan should be construed to limit the Commission's ability to draw its own conclusions as to adverse effects on listed species or to request additional studies or modifications to studies as provided by our regulations.

##### **Future projections of the lower Platte River hydrology**

In its comments on both the proposed study plan and revised study plan, FWS recommended that the District create future, projected hydrographs for use in comparing the benefits and costs among various, unspecified project operational alternatives. The projected hydrographs would be based on future water depletions to the lower Platte River “as demonstrated by Nebraska DNR (2009) and U.S. Department of Interior [Interior] (2006).”

Nebraska DNR (2009) predicts that the cumulative effects on all present and predicted well development in the basin over the next 25 years will result in a depletion of flow on the lower Platte River at North Bend of about 255 cfs, which equates to a total annual volume reduction of about 184,000 acre-feet. The current mean annual flow at the site based on the U.S. Geological Survey’s [USGS] 2008 Water-Date Report is 4,506 cfs. The projected reduction in flow over the next 25 years would reduce this mean annual flow by 255 cfs or less than 6 percent.

Whether this reduction will actually occur is debatable. Nebraska DNR (2009) bases this projection, in part, on speculations of future well development and a current well appropriations “lag effect” defined as the “delayed effect that the consumptive use of water associated with well pumping will have on hydrologically connected streamflow and the associated impact on surface water appropriations.” The prediction also assumes that precipitation and irrigation patterns will remain constant. Therefore, the result is a very precise estimate (i.e., 255 cfs, not 250 cfs, or 300 cfs) but with a reasonably high degree of uncertainty associated with its underlying assumptions.

Using a hydrograph that may or may not exist 25 years into the future would not be adequate for assessing project effects in the early years of a license when the flows can be predicted with the most certainty.

With regard to Interior (2006), FWS does not provide a methodology or explain what specific information in the report would be used to predict future water depletions in the lower Platte River. We note that Interior (2006) analyzes various flow management alternatives well upstream of the project area in the Central Platte River subbasin for the purpose of benefitting federally listed species; however, Interior (2006) at 3-15 concludes that the various flow management alternatives that were analyzed “would result in only small changes to these flow parameters in the Lower Platte River and, therefore, provide marginal benefits to the pallid sturgeon.” It’s not clear to us how this information would be translated into a projected hydrograph for the lower Platte River.

Our practice, which is widely accepted and utilized, is to use the current hydrologic record as an approximation of future hydrology. This approach, like that used by Nebraska DNR (2009), has many of the very same limitations in that the predicted hydrology may be affected by changes in land use practices, water uses, precipitation patterns, and other similar factors that affect flows decades in the future. However, the

advantage of our approach is that we can more accurately predict project effects on river hydrology early on when the flows can be predicted with the most certainty.

For the above reasons we will not require the District to synthesize a future hydrograph based on Interior (2006) and Nebraska DNR (2009), and use that record to assess project operational alternatives as recommended by FWS.

### **Study No. 1 – Sedimentation**

In its revised study plan, the District proposes to conduct a sedimentation study with the following objectives: (1) characterize sediment transport in the Loup River bypassed reach and lower Platte River (i.e., Platte River extending from the Loup River confluence downstream to the Missouri River); (2) characterize stream morphology in the Loup River bypassed reach and in the lower Platte River through a data and literature review; (3) determine if a relationship can be detected between sediment transport and interior least term and piping plover nest counts and fledge success; and (4) determine if sediment transport limits pallid sturgeon habitat in the lower Platte River downstream of the Elkhorn River confluence.

#### **Objective 1 – Characterizing sediment transport**

#### **Methodology**

Under this objective, the District would conduct two “tasks” called Task 2 and Task 3. Under Task 2, the District would update a sediment budget and sediment yield analysis completed by the Missouri River Basin Commission (MRBC) in September 1975 using information generated by the U.S. Bureau of Reclamation for the Platte River at Duncan (upstream of the Loup River confluence) and the District’s dredge records for the project’s settling basin. Under Task 3, the District would calculate effective discharge (i.e., the flow or range of flows that transport(s) the most sediment) and total sediment transported at a total of nine USGS gage sites on the Loup River, Platte River, and project’s power and tailrace canals and one additional non-USGS gage site on the Loup River upstream of the project’s diversion dam.<sup>1</sup>

In calculating effective discharge and total sediment transported at the USGS gage sites, the District would utilize historic USGS gage discharge and river cross-sectional rating curves along with existing sediment information sources. For the one site on the Loup River upstream of the project’s diversion dam, the District would synthesize a discharge record for the site presumably utilizing recorded hydrologic data from one or more of the other sites and correcting for the drainage area of the Loup River at the site

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<sup>1</sup> Effective discharge and total sediment transported are indicators of sediment transport.

upstream of the diversion. The District does not state how it would obtain the geomorphic indices (e.g., channel width, velocity, slope, gradation, etc.) for its calculation of total sediment transported at the upstream site but presumably would obtain them through a combination of field measurements and existing information sources. Effective discharge and total sediment transported would be determined for each study site for existing and alternative project operations using wet and drought year flows.

In its revised study plan, the District notes that there has been limited sedimentation and geomorphology study on the lower Platte and Loup Rivers, inferring that their proposed study is needed to better understand project effects on sedimentation and geomorphology in the project area.

### **Study Issues**

In its July 1, 2009, filing commenting on the proposed study plan, the FWS requested that, as part of the Task 2 sediment budget and sediment yield analysis, the District should directly measure the sediment supply contributions to the lower Platte River from the project's tailrace channel and calibrate sediment supply estimates for the Loup River based on actual sediment dredged from the canal and from the Loup River immediately downstream of certain tributary confluences. The District responded in the revised study plan that direct measurements of sediment supplies requires extensive sampling both spatially and temporally in order to draw meaningful conclusions and that the existing sediment estimates in the literature are sufficient to meet the study objective. In its comments on the revised study plan, the FWS responded that the District should instead adjust sediment yield estimates for tributaries to the Loup River downstream of the diversion based on reductions in sediment documented in the project's settling basin.<sup>2</sup> The FWS notes that the reductions in the Loup River subbasin sediment yield as reflected in the dredge records is likely system-wide.

### **Conclusions**

The FWS's supposition that a system-wide reduction in sediment yield as evidenced by the reduction in material dredged since 1975 is reasonable. Therefore, as part of Task 2, the District shall adjust the sediment yield calculated for the Loup River and its tributaries downstream of the project's diversion dam as well as the project's

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<sup>2</sup> In the PAD at 5-24, the District notes that its dredge records show that through 1975, average annual material dredged was 2.2 million tons. Since then, the average has decreased to 1.2 million tons per year.

tailrace<sup>3</sup> based on documented reductions in dredged material from the project's settling basin. This modification would require very little additional effort on the part of the District while improving the quality of the data.

## Objective 2 – Characterizing stream morphology

### **Methodology**

Under this objective, the District would complete Tasks 2 and 3 as described above for Objective 1. The District would also conduct an additional analysis (Task 4) in which they would review measured and reported USGS stream morphology data, presumably for the nine USGS gage sites identified above, and calculate the effective discharges associated with each site's stream morphology. The District would evaluate the effective discharges for various time periods, and analyze the information for substantive changes or trends over time. Based on this temporal review, the District would make a determination for each site as to whether the Loup and lower Platte River's morphology is in dynamic equilibrium or transitioning to other forms (i.e., states of aggradation or degradation). USGS morphology information would be reviewed to confirm the finding.

### **Study Issues**

In its July 1, 2009, filing commenting on the proposed study plan, the FWS stated that in its view, the USGS' cross-sectional data that would be used for Tasks 3 and 4 would not adequately represent the geomorphic indices of the Loup and Platte Rivers, because the USGS gages are located near bridge crossings which are relatively narrow and constricted as compared to the prevailing river morphology which is wide and unrestricted. The FWS also added that the nearest proposed study site on the lower Platte River (i.e., USGS gage site at North Bend) is too far downstream (about 30 miles) to capture project effects on stream morphology closer to the tailrace canal. The FWS, therefore, recommended that the District obtain additional cross-sectional information and calculate effective discharges and total sediment transported for the following sites:<sup>4</sup> (1) Loup River upstream of the project's diversion; (2) Loup River immediately downstream of the project diversion; (3) lower Platte River between the Loup River and the project tailrace canal confluences; (4) lower Platte River immediately downstream of the tailrace canal to river mile 96 (a distance of about 5 miles); and (5) lower Platte River

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<sup>3</sup> The Missouri River Basin Commission's 1975 sediment budget shows that the cumulative sediment yield from the Loup River and its tributaries downstream of the project's diversion to be 1,860,300 tons per year and from the project's tailrace to be 350,000 tons per year.

<sup>4</sup> The FWS did not specify the specific number of cross-sections to study at any of the sites.

near the USGS gage site at North Bend. The FWS added that comparisons in the geomorphic indices should be made between and among the sites.

In its revised study plan, the District responded that a characterization of stream morphology cannot be done with one or several cross-sections measured over a 1- to 2-year period but that multiple cross-sections at the same location taken over many years, like at the USGS gage sites, are needed in order to provide meaningful stream morphology information. The District added that the existing cross-sections for the USGS gage sites have been used multiple times by other unspecified entities for establishing aggradation/degradation trends in the lower Platte River upstream of the Elkhorn River confluence, and therefore, considers the USGS gage sites to be suitable for characterization stream morphology.

In its comments on the revised study plan, FWS reiterated its former concerns and added that field measurements of cross-sections of the aforementioned sites should be done in place of using cross-sectional rating curve data recorded at the USGS gage sites. The FWS also noted that the USGS cross-sectional data were only taken at points along the cross-sections that were inundated at the time of the measurements, and therefore, did not account for the geomorphic characteristics of above-water channel components (i.e., sand bars) important to federally listed interior least terns and plovers.

## **Conclusions**

As noted above, Objective 2 is simply to characterize stream morphology in the Loup River bypassed reach and in the lower Platte River through a determination on whether the rivers at multiple locations are in a braided condition at dynamic equilibrium or are in varying states of transition to aggrading or degrading, non-braided channel forms. As to the FWS' issue that the USGS cross-sectional data were only taken at points that were inundated, we don't see how this is relevant to the characterization of stream morphology in the manner proposed by the District, which relies on a review of hydraulic data and calculations.

As to the issue of the use of USGS gage sites at or near bridges, in an evaluation of the effects of bridges on water depths, velocities, and fish habitats for median- and low-flow conditions, Ginting and Zelt (2008) concluded that cross-sectional measurements made near bridges can be used as a "primary data set in hydraulic-habitat study, before embarking on a more spatially intensive but costly program of streamflow-depth and -velocity data collection." Our interpretation of the Ginting and Zelt (2008) report, including a review of the aerial photographs of the near-bridge and adjacent beyond-bridge sites provided in the report, is that near-bridge sites provide a reasonable representation of beyond-bridge sites for purposes of evaluating the potential effects of environmental stressors (like project operations or bridge piers) on flow and geomorphic conditions. We, therefore, see no reason to adopt FWS' recommendation for the District

to dispense with the proposed USGS gage sites in favor of beyond-bridge sites where the District would have to synthesize a flow record and obtain on-site field measurements of geomorphic indices.

In regard to FWS' recommendation that the District survey a point on the Loup River upstream of the project's diversion dam as part of the Objective 2 methodology, we note that the District already proposes to do this, and therefore, no action is required on our part (see revised study plan at 1-18).

In regard to the FWS' recommendation that the District survey a point on the Loup River downstream of the diversion dam and the lower Platte River downstream of the project at North Bend in lieu of using information from the USGS gages in these reaches, as noted above, we see no reason to dismiss historic data obtained at the USGS gages in favor of nearby sites where the District would have to synthesize flow information and survey geomorphic conditions.

In regard to the FWS' issue that the North Bend gage site located about 30 miles downstream of the project would not reliably represent the lower Platte River immediately downstream of the project's tailrace for purposes of assessing potential project effects, we agree. Annual sediment yield from the project's tailrace is about 10 percent of that which enters the canal from the Loup River;<sup>5</sup> therefore, flow in the tailrace is relatively depleted of sediment. The sediment-depleted tailrace flow (i.e., the relatively clear flow) has the capacity to mobilize sediment in the lower Platte River, with the most pronounced effect likely occurring immediately downstream of the tailrace canal confluence and a reduction in effect as the flow and its increasing sediment load progresses downstream toward North Bend. This effect could result in the river morphology in proximity to the tailrace being much different from that further downstream at North Bend. We, therefore, find that there is a need to survey at least one cross-section on the lower Platte River within the first 5 miles downstream of the project tailrace canal confluence so that we can adequately assess the effects of project operations, in terms of sediment removal, on the lower Platte River where any effects would likely be most pronounced.

Similarly, we agree with the FWS that a cross-section is needed for the lower Platte River between the Loup River and tailrace canal confluences (a distance of about 2 miles). This reach is part of the project's bypassed reach. Flow and sediment transport to this reach comes from both the Platte and Loup Rivers upstream; therefore, neither the

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<sup>5</sup> From figure 5-13 of the PAD, 1.9 million tons per year are removed from the settling basin and 0.70 million tons per year continues down the Loup Canal for a total sediment yield of 2.6 million tons per year from the Loup River. This compares to an annual sediment yield from the tailrace canal of 0.35 million tons per year.

Loup nor upstream Platte River USGS gage sites would reasonably represent channel morphology in the Platte River portion of the bypassed reach.

We are unmoved by the District's argument that meaningful information could not be obtained through an analysis of cross-sectional surveys taken on the lower Platte River upstream and downstream of the tailrace canal confluence. Although we agree with the District that channel morphologic characteristics based on comparisons of effective discharges between time periods (i.e., a temporal analysis) can not effectively be done for these additional sites, a spatial analysis at a single point in time can be performed for these and all of the other sites to determine if project operations, relative to sediment removal, affects channel morphology and to what extent based on proximity to the project's diversion and to the project's tailrace canal. We see no reason why such an analysis could not be done meaningfully given that a very similar spatial analysis of cross-sectional data taken at a single point in time at both USGS and non-USGS sites was successfully done by Ginting and Zelt (2008) for representative low flow and median flow conditions. The Ginting and Zelt (2008) study was conducted, in part, to document the effects of a potential stressor (i.e., presence of bridge piers) at successively greater distances away from its source.

Ginting and Zelt (2008) were able to survey bed elevations, water-surface elevations, and streamflow velocities at five cross-sections on the lower Platte River near North Bend over a 3-day period, or an average of about two cross-sections per day. Therefore, the District should be able to survey the additional cross-sections on the lower Platte River at about the same rate, which we find to be a small amount of additional effort relative to the proposed scope of the study.

For the above reasons, we conclude that in addition to synthesizing a flow record and surveying cross-sections on the Loup River upstream of the diversion dam, the District shall also synthesize a flow record for and survey at least one cross-section in the lower Platte River between the Loup River and tailrace canal confluences and at least one for the lower Platte River within 5 miles downstream of the tailrace canal. Because this analysis will be used to assess any project-induced sedimentation effects on interior least tern and piping plover nesting and pallid sturgeon habitat, the District shall, to the extent possible, survey the cross-sections in the late spring to early summer period (i.e., mid-May to mid-June) to coincide with the beginning of the interior least tern and piping plover nesting period. This time period would also coincide with the presumed pallid sturgeon spawning period (NGPC 2008a).

At all sites (USGS gage and non-USGS gage sites), the District shall compare the capacity of the flows for total bed material transport to the sediment budget updated under Task 2 and make a determination as to whether the rivers at the sites are currently in dynamic equilibrium (i.e., the capacity for total bed material transport is equal or about equal to the sediment yield estimate for the site), degrading state (i.e., the capacity for

total bed material transport exceeds the site's sediment yield estimate), or aggraded state (i.e., the sediment yield estimate exceeds capacity for total bed material transport).

Using the findings on the current state of river morphology at each site, the District shall make longitudinal (spatial) comparisons of all sites on the Loup and lower Platte Rivers starting at the most upstream site on each river, and progressing downstream. In performing this spatial analysis, the District shall ensure that it uses cross-sectional geomorphic data from the USGS gage sites that are reasonably comparable to the cross-sectional geomorphic data taken at the non-USGS sites (i.e., the data taken at both USGS gage and non-USGS gage sites shall be obtained as close in time as possible).

We note on page 1-22 of the revised study plan, the District proposes that the analyses in Tasks 3 and 4 will be performed for alternative conditions if it is determined that either the Loup or Platte Rivers are not in dynamic equilibrium, and the results will be compared to the results from the current condition analyses. The District shall perform the same alternatives analyses for the current condition spatial determination required above with the modification that the determination as to river state shall be done for each river reach (as represented by each study site) rather than for the rivers as a whole.

Objective 3 – Determining relationship between sediment transport and interior least Tern and piping plover nest counts and fledge success

**Methodology**

Under this objective, the District would conduct a Task 5 in which they would review the results of Tasks 3 and 4 to determine whether the project is affecting the morphology in the lower Platte River. If the analysis shows that the project is affecting the morphology of the lower Platte River, then the District would determine the magnitude of the effect using the information acquired under Task 4. In addition, the District would plot available interior least tern and piping plover annual nesting count and productivity data versus effective discharge and versus total sediment transported for both wet and dry cycles. The District would conduct a regression analysis of the plotted parameters and examine the plots for trends to detect if a relationship can be established between the sediment transport indicators (i.e., effective discharge and total sediment transported) and bird nesting or productivity.

**Study Issues**

No one commented on the Objective 3 methodology as presented in the revised study plan.

## **Conclusions**

We have modified Task 4 under Objective 2 to require that the District survey at least two additional cross-sections on the lower Platte River and include these additional sites as part of a spatial analysis of project effects on channel morphology. Accordingly, Task 5 is modified such that in the review of the results of Tasks 3 and 4 in determining whether the project is affecting morphology in the lower Platte River and whether additional analysis on interior least tern and piping plover should be performed, the District shall include the additional cross-sections and associated longitudinal analysis.

### Objective 4 – Determining if sediment transport limits pallid sturgeon habitat

## **Methodology**

Under this objective, the District would conduct a Task 6 in which they would review the results of Tasks 3 and 4 to determine whether the project is affecting the morphology in the lower Platte River downstream of the Elkhorn River confluence. If the analysis shows that the project is affecting the morphology of the lower Platte River downstream of the Elkhorn River confluence, then the District would determine the magnitude of the effect using the information acquired under Task 4. Additionally, the existing state of the Platte River below the Elkhorn River in terms of sediment transport and braided river morphology would be qualitatively compared to pallid sturgeon habitat characteristics of other rivers as cited in the literature to determine if changes in project operations relative to sediment transport could affect sturgeon use of the lower Platte River. If the differentiating factor is braided river morphology (i.e., if a qualitative review of the literature shows that sturgeon use requires a braided river morphology and the lower Platte River is shown to be transitioning away from that morphology), then the District would analyze alternative project operations to determine whether the project could restore a braided river morphology to the lower Platte River.

## **Study Issues**

In its comments on the proposed study plan, FWS suggested eliminating this objective, because in its view, the District would have difficulty segregating project sediment supply effects from other factors. In its response, the District declined to eliminate the objective from its sediment study plan, because in its view, the objective is a viable means of qualitatively assessing the potential for the project to affect pallid sturgeon habitat. The District adds that this qualitative comparison would only take place if it were shown the project is affecting stream channel morphology of the lower Platte River downstream of the Elkhorn River confluence. In its comments on the revised study plan, FWS did not specifically respond to the District.

## **Conclusions**

We agree with the District that the study has value in that it would help us to determine whether project operations related to sediment removal (and any associated effects on site morphology such as a degraded condition) would be adversely affecting pallid sturgeon use of the study reaches within the lower Platte River.

We note that pallid sturgeon habitat occurs on the lower Platte River upstream of the Elkhorn River confluence to as far as Columbus, NE, and historically, pallid sturgeon likely used this habitat (NGPC 2008a). Therefore, the District shall expand the geographic scope of Objective 4, including the study methodology, to include all required USGS gage and non-USGS gage study sites on the lower Platte River upstream of the Elkhorn River confluence with the exception of the USGS gage site at Duncan, NE (upstream of Columbus).

As noted above under Objective 3 – Conclusions, we have modified Task 4 under Objective 2 to require that the District survey at least two additional cross-sections on the lower Platte River and include these additional sites as part of a spatial analysis of project effects on channel morphology. Accordingly, Task 6 is modified such that in the review of the results of Tasks 3 and 4 in determining whether the project is affecting morphology in the lower Platte River and whether additional analysis on sturgeon should be performed, the District shall include the additional cross-sections and associated longitudinal analysis.

## **Study No. 2 – Hydrocycling**

In the revised study plan, the District proposes to evaluate the effects of hydrocycling on interior least terns, piping plovers, and pallid sturgeon by : (1) comparing sub-daily hydrocycling operation values (maximum and minimum flow and stage) to daily values (mean flow and stage), over periods of weeks, months, and specific seasons of interest to protected species; (2) determining potential for nest inundation due to hydrocycling and from any alternative conditions; (3) assessing effects on sediment transport parameters (primarily through Study 1); and (4) identifying material differences in potential effects on habitat of the interior least tern, piping plover, and pallid sturgeon.

## **Methodology**

Under objective 4, the District would conduct a literature review of hydrocycling/pulsing effects on interior least tern, piping plover, and pallid sturgeon habitat, such as backwaters and side channels, on other river systems and compare the conditions on those systems with that on the lower Platte River as influenced by project operations to determine if project operations contribute to habitat conditions outside the spectrum of habitat used by these species on the other river systems. The comparative

analysis would identify whether there are differences or similarities between project operations and hydrocycling/pulsing operations on these other rivers to see if habitat characteristics or species usage that result from their respective operations are similar or different and if so, why. If differences are noted that would adversely affect interior least tern and piping plover habitat on the lower Platte river below the project tailrace and on the pallid sturgeon on the lower Platte River below Elkhorn, the District would determine whether these limitations are the result of project hydrocycling or other factors. If they are the result of hydrocycling the District would examine alternative conditions to determine if any of these limitations could be reduced.

### **Study Issues**

In its comments on the revised study plan, the FWS recommends that the literature review be supplemented by including the following study sites on the lower Platte River under Objective 4: (1) the 2-mile reach between the Loup River and tailrace canal confluences; (2) immediately downstream of the tailrace canal confluence; (3) near the North Bend USGS gage; (4) near the Leshara USGS gage; and (5) near the Louisville USGS gage. Collected data would include: (1) intra-day project hydrocycling effects on fish habitat (in terms of preferred depths and velocities); (2) longitudinal effects of hydrocycling to fish habitat from upstream to downstream; (3) intra-day project hydrocycling effects on interior least tern and piping plover suitability criteria; and (4) longitudinal effects of project hydrocycling on sandbar erosion as the hydrocycling attenuates downstream. The FWS notes that the specific methods are referenced in their comments on the proposed study plan. In the proposed study plan, the FWS states that the methodology should be “similar to that of the Platte River Recovery Implementation Program’s stage change study (HDR 2008).” Specific habitat parameters to be sampled would include: (1) flow quantity; (2) depth; (3) velocity; (4) sandbar elevation; and (5) bed forms.

### **Conclusions**

We have reviewed the HDR (2008) study and note that the methodology to be utilized involves one- and two-dimensional modeling of depths and velocities, and based on this information, predictions of resulting “bedforms.” The modeled depths, velocities, and bedforms would be used to identify and quantify habitat types, presumably at river flows of interest.

A similar, albeit less intensive, flow versus habitat study for shortnose and pallid sturgeon has already been conducted on the lower Platte River (Peters and Parham 2008). In addition, the District notes that the Platte River Recovery Implementation Program (Program) is currently studying the effects of Platte River stage changes on pallid sturgeon habitat downstream of the Elkhorn River confluence and that the Program should complete the study by December 2009. The District proposes to use the results of

the Program's study to assist in their hydrocycling effects analysis. For these reasons, we see no need to require the District to conduct additional field work in order to establish flow versus pallid sturgeon habitat relationships for the lower Platte River either upstream or downstream of the Elkhorn River confluence.

However, pallid sturgeon habitat occurs on the lower Platte River upstream of the Elkhorn River confluence to as far as Columbus, NE, and that historically, pallid sturgeon likely used this habitat (NGPC 2008a). Therefore, the District shall expand the geographic scope of the hydrocycling study for pallid sturgeon, including the associated study methodology, upstream to also include the reach bounded by the Elkhorn River and tailrace canal confluences.

Any effects of hydrocycling on pallid sturgeon habitat would likely be most pronounced immediately downstream of the tailrace canal confluence. As part of the hydrocycling study, the District proposes to develop synthetic hydrographs under existing and alternative operating conditions for the Platte River downstream of the tailrace canal. The District is vague as to the specific locations of the downstream sites. To ensure that hydrocycling effects on Platte River aquatic resources, including pallid sturgeon habitat, are adequately addressed, the District shall include a point on the lower Platte River within 5 miles downstream of the tailrace canal confluence in their preparation of synthetic hydrographs.

The District also proposes to plot synthetic hydrographs for each study site for periods of weeks, months, and specific seasons of interest to the federally listed species. The District proposes to review the results of this analysis "in the context of the life requisites of the pallid sturgeon and its use of the lower Platte River below the confluence of the Elkhorn River."

We have concerns with the scope of the analysis and with the District's vagueness in describing exactly what will be measured or compared in terms of project operational effects on pallid sturgeon habitat or "life requisites." Therefore, as noted above, we're expanding the scope to include as part of the analysis, the lower Platte River reach between the tailrace canal and Elkhorn River confluences. In addition, to ensure that we have the information that we need to assess project hydrocycling effects on pallid sturgeon habitat, the District shall, at a minimum, for one representative low, normal, and high flow year, tabulate and plot: (1) the minimum daily percent suitable pallid sturgeon habitat under existing operations; (2) the maximum daily percent suitable sturgeon habitat under existing operations; and (3) mean daily percent suitable sturgeon habitat that would be observed if the project would continuously pass inflows through the project's canal system with no storage in either of the project reservoirs (run-of-river operations). In quantifying the percent suitable sturgeon habitat, the District shall use the discharge versus percent suitable pallid sturgeon habitat relationship established and presented in Chapter 10 of Peters and Parham (2008). This analysis should be done at the

required site within 5 miles downstream of the tailrace confluence as well as the downstream Platte River USGS gage sites identified in section 3.2 of Study 2.0 – Hydrocycling.

With regard to the interior least tern and piping plover, the FWS recommends supplementing the proposed literature review in objective 4 with additional data to assess the longitudinal effects of hydrocycling on interior least tern and piping plover nesting habitat suitability and sandbar erosion. The FWS recommends that the District quantify habitat changes important to nesting interior least terns and piping plovers—area of bare sand per unit area; size distribution of sandbars; and position of sandbars<sup>6</sup> (i.e., point bars or mid-channel bars)—within the following river reaches with documented interior least tern and piping plover nesting history: (a) the Platte River below the Loup River confluence and above the project tailrace; (b) immediately downstream of the project tailrace; (c) near the USGS North Bend, (d) near the USGS Leshara stream gage; and (e) near the USGS Louisville stream gage. The FWS recommends that the District collect the above information by obtaining stream cross-section data and analyzing the data with methods similar to those described in HDR (2008). The District asserts that the methods would show erosion rates downstream, but they would not assess effects of project hydrocycling or alternative conditions on tern and piping plover sandbar habitat characteristics because the methods could not distinguish between project effects and natural erosive properties of this highly dynamic system.

We disagree with the District. In order to assess the effects of hydrocycling on interior least tern and piping plover nesting habitats, we need a means to compare differences in alternative operations. The District's proposed literature review would not provide an adequate means to achieve this objective. Modeling is the only means of effectively measuring the effects of existing operations and any operational changes on interior least tern and piping plover habitat, short of measuring differences in sandbar habitat characteristics under different actual operational scenarios.

Therefore, the District shall conduct a modeling study of the effects of hydrocycling on interior least tern and piping plover nesting habitat using the HEC-RAS 1D steady state back-water model and associated methodology for model calibration specified in HDR (2008). The District shall select a representative study site, in consultation with the FWS and Nebraska Game and Parks Commission (Nebraska GPC), in the following reaches: (a) in the Plate River below the Loup River confluence and above the project tailrace, (b) within five miles downstream of the project tailrace, and (c)

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<sup>6</sup> The FWS also identified depth and velocity as important parameters of interior least tern and piping plover nesting suitability. While depth and velocity influence sand bar erosion, these parameters do not represent habitat characteristics used by or selected by these species. We assume that the FWS was also considering habitat characteristics important to pallid sturgeon.

near the USGS North Bend gage station. The selected study site would preferably include areas where interior least terns and piping plovers have historically nested. Data collected shall include flow quantity, depth, velocity, sandbar elevation, and bed form (HDR 2008). Cross-sectional measurements to calibrate the model should be done immediately prior to the nesting season (first week in May) and again at the end of the nesting period (first week in August). The length of each cross-sectional measurement should be of sufficient length to capture the full range of flow (based on historical records for the area) expected at the each study site. The District shall photo document the cross-sections. After calibration, the model shall be run to model existing operations and run-of-river operations and any other operational alternative identified by the District. Each model run should be conducted for a normal, dry and wet year.

We are not requiring the additional sites recommended by the FWS at this time because any project effects would be most pronounced near the project tailrace. In addition, HDR (2008) is conducting similar efforts near Louisville which would help capture any attenuating flow effects. If modeling indicates that project hydrocycling is causing extreme effects further downstream than the North Bend gage site, then additional sampling may be required in year 2.

We estimate that the additional effort would add \$150,000 to the study's cost, but is necessary because the District's proposed methods would not provide sufficient information for the Commission's environmental analysis or section 7 Endangered Species Act consultation with the FWS.

#### **Study No. 4 – Water Temperature Study for the Loup River Bypassed Reach**

##### **Methodology**

The District proposes to coordinate with the USGS and install and operate water temperature sensors and recording devices from May 1 through September 30, 2010, on the Loup River bypassed reach at Genoa and the Loup River immediately upstream of the project diversion. The water temperature data will be analyzed to assess whether and to what extent diversion of water away from the bypassed reach causes any exceedance of Nebraska's 90-degree Fahrenheit water temperature standards.

In order to address some early stakeholder concerns about the effects of Beaver Creek tributary inflow to the bypassed reach downstream of the water temperature sensor, the District proposes to record water temperatures for about 7 to 10 days in the bypassed reach downstream at Columbus, NE, to confirm the underlying study assumption that the bypassed reach at Genoa would likely have the highest water temperatures in the bypassed reach due to limited flows.

## Study Issues

In its comments on the proposed study plan, the FWS noted that the lower Platte River downstream of the Loup River confluence to the tailrace canal is also part of the project's total bypassed reach, and therefore, flow diversions could potentially cause violations of the water temperature standard in the lower Platte River reach as well. The FWS, therefore, recommended that additional water temperature sensors be installed in the Loup River downstream of the Beaver Creek confluence and the Platte River between the Loup River confluence and the tailrace canal.

In the revised study plan, the District responded that they modified the study plan to include water temperature monitoring for a 7- to 10-day period in the Loup River downstream of the Beaver Creek confluence to test the underlying assumption of the study that the bypassed reach upstream of Beaver Creek is likely to have the highest water temperatures due to having the lowest flows (i.e., no increases in water temperature would likely be observed downstream of the Beaver Creek confluence). The District also noted that it was not adopting the recommendation to record water temperature in the lower Platte River because:

*“...if water temperature in the Loup River bypass reach is consistently below the state standard, then temperatures above the state standard occurring in the Platte River would likely be due to non-Project related effects from other inputs such as the Platte River upstream of the confluence with the Loup River or the Columbus wastewater treatment plant outfall.”*

In its comments on the revised study plan, FWS notes that “the Loup River at Columbus study site adequately serves to monitor water temperatures below the Beaver Creek confluence.” Therefore, we see this particular issue has having been resolved. However, the FWS also notes that they do not agree with the District's reasoning for not monitoring water temperature in the lower Platte River portion of the bypassed reach, because the lower Platte River bypassed reach is a separate, distinct portion of bypassed reach given that it is influenced by flows from the Platte River upstream of the Loup River confluence.

## Conclusions

Although we agree that other inputs could be the cause of any water temperature standard exceedances in the lower Platte River bypassed reach, we can not rule out the project's cumulative contribution to any exceedances. Therefore, we can not agree with the District's unsupported assumption that the project bypassed reach near the diversion dam is likely to have a higher water temperature than the lower Platte River bypassed reach, similar to the assumption described above regarding the Loup River bypassed reach downstream of the Beaver Creek confluence.

For this reason, the District shall also monitor water temperatures in the lower Platte River bypassed reach at Columbus over the same 7- to 10-day period proposed for the Loup River bypassed reach at Columbus. Similar to the District's proposal for the Loup River bypassed reach at Columbus (revised study plan at 4-8), if the monitoring shows that the lower Platte River water temperature at Columbus is substantially higher than in the Loup River bypassed reach at Genoa, then the District shall conduct additional water temperature monitoring in the lower Platte River bypassed reach for use in developing relationships between flow diversions, Platte River bypassed reach water temperatures, and ambient weather conditions at Columbus.

The results of water temperature monitoring in the Loup River bypassed reach and Platte River bypassed reach at Columbus along with all analyses shall be presented in the Initial Study Report.

### **Study No. 5 – Flow Depletion and Flow Diversion**

The District proposes to conduct a flow depletion and flow diversion study that has the following objectives: (1) determine the net consumptive losses associated with project operations compared to alternative conditions; (2) using current and historic USGS gage rating curves, evaluate stage changes in the Loup River bypassed reach during project operations and compare against alternative hydrographs; (3) evaluate historic flow trends on the Loup and Platte Rivers since project inception; (4) determine the extent of interior least tern and piping plover nesting on the Loup River above and below the diversion weir; (5) determine project effects, if any, of consumptive use on fisheries and habitat on the lower Platte River downstream of the tailrace canal; and (6) determine the relative significance of the Loup River bypassed reach to the overall fishery habitat for the Loup River. The FWS commented on tasks associated with Objectives 1 and 4.

#### **Objective 1 – Determining net consumptive losses associated with project operations**

#### **Methodology**

Under this objective, the District would calculate monthly and seasonal net consumptive use for the years 1980 through 2009 for the Loup power canal and the Loup River bypassed reach for current project operations and for alternative conditions. Consumptive use in the power canal and associated regulating reservoirs would be calculated on a monthly and seasonal basis by adding evapotranspiration (ET) losses from agricultural crop irrigation and evaporation losses from surface waters. Evaporative losses would be based on total surface area exposed to the atmosphere and the relationship of the lakes to pan evaporation data collected from the National Weather

Service. Likewise, consumptive uses in the Loup River bypassed reach would be calculated by adding ET losses and evaporation. ET losses would be based on the length of riparian vegetation bordering the Loup River bypass. Evaporation would be estimated by using the surface area and evaporation data from the National Weather Service. The surface area of the bypassed reach would be calculated from the channel cross section top width and distance between USGS gages. Net consumptive use would be estimated by taking the differences between the consumptive use losses in the power canal and regulating reservoirs and the consumptive use losses in the Loup River bypassed reach.

### **Study Issues**

The FWS states that if the Commission considers irrigation diversions from the power canal and diversions into the Lost Creek siphon as discretionary project actions subject to review in the relicensing process, then net consumptive losses of these diversions should be evaluated. The District asserts that irrigation diversions are water rights issued by the Nebraska DNR outside of the project; therefore, they must be maintained. The District also argues that consumptive use from irrigation diversions would be present and identical regardless of modifications to project operations. Therefore, consumptive use from irrigation diversions should not be required as part of the review process. Likewise, diversions into the Lost Creek siphon are required to keep the siphon open for local drainage and would be required under any project operating scenario, and thus would not be discretionary and subject to license review.

### **Conclusions**

We have determined that project retirement is not a reasonable alternative that would be considered in our environmental analysis (see Scoping Document 2 issued March 27, 2009), thus irrigation diversions from the project canal would continue as they have historically. Nonetheless, understanding the various inputs and depletions to the project system would improve our analysis of how changes in project operations may influence irrigation withdrawals and maintenance of the Lost Creek siphon. Therefore, the District shall provide an accounting of the 78 irrigation water withdrawal points along the length of the power canal, their associated water rights, and mean annual withdrawal (acre-feet) and monthly average withdrawal rate (cfs) based on the District's files of irrigator meter records and shall include these consumptive uses in calculating the net consumptive use at the project. As to flows discharged to maintain the Lost Creek siphon, the District shall provide an estimate of the timing and consumptive losses, if any, associated with these events.

Objective 4 – Determining the extent of interior least tern and piping plover nesting on the Loup River above and below the diversion weir.

### **Methodology**

Under this objective, the District would compare historical nesting occurrences from above the diversion to nesting occurrences from below the diversion weir to the Loup River confluence. If no significant difference in nesting occurrences exists, the District would conclude that project operations are not affecting stage in the Loup River bypassed reach. The conclusion would assume natural nesting conditions above and below the diversion weir are similar. If significant differences in occurrence are found, then the District would examine aerial images of the riparian corridor five to ten miles upstream and downstream of the diversion weir to identify and compare interior least tern and piping plover nesting parameters (number, position, and average size of bare sand areas within the banks of the river; channel width; percent un-vegetated sandbars; percent vegetated sandbars (isolated and non-isolated); and presence and/or type of vegetation). The District would use the same methods used by Kirsch (1996) to characterize and quantify interior least tern nesting habitat on the lower Platte River. The observed conditions for each year for these nesting parameters would be compared to determine what extent flow diversion and the presence of the weir may result in different river and riparian vegetation conditions. Observed conditions would also be compared to nesting requirements to determine if any changes in the riparian corridor may have had an effect on the occurrence of the species. These habitat parameters would then be compared to the habitat associated with the alternative conditions to determine if any of the alternative conditions would result in improvements to the habitat parameters.

### **Study Issues**

The FWS recommends that the District supplement its study by comparing interior least tern and piping plover suitability nesting criteria and whooping crane roosting criteria (area of bare sand per unit area, size distribution of sandbars, position of sandbars [i.e., point bars or mid-channel bars], depth and velocity; wetted width; and unobstructed width) across different stream flows. To accomplish this, the FWS recommends that the District take cross-sectional measurements at study sites in the following reaches: a) the Loup River upstream of the diversion weir; b) the Loup River downstream of the diversion weir; and the c) the Platte River below the Loup River confluence and above the project tailrace. The FWS supports the use of aerial photo interpretation to document land cover changes over time to show long-term, large-scale changes in active channel area, but asserts that the proposed methods would not allow the development of a direct relationship between flow and nesting and roosting suitability criteria. The FWS recommends that cross-sectional data be gathered when flows exceed the minimum bypass flow of 50 to 75 cfs to test the effects of different project bypass alternatives on species' suitability criteria.

The District opposes including an assessment of flow-related roosting habitat suitability for the whooping crane in the study because the whooping crane is not likely to occur in the project area due to its migration corridor being well removed from the project. The District also asserts that its indirect assessment of project effects on interior least tern and piping plover habitat is sufficient for the Commission's environmental analysis and section ESA consultation.

### **Conclusions**

Although the primary whooping crane migration corridor is located about 35 miles west of the diversion works, the project is located within a much larger historical migration corridor and historical sightings have been made much closer to the project (3 miles west). Therefore, it is not unreasonable to consider whooping crane roosting habitat needs in the Commission's assessment of environmental effects. Therefore, the District's study plan is modified to include the whooping crane's roosting habitat criteria. The principal difference between the habitat requirements that the FWS is requesting is wetted width and unobstructed width. This should not add considerably to the District's study effort.

As discussed earlier for Hydrocycling (Study 2.0), we are not persuaded by the District's assertion that an indirect measurement of habitat will provide an adequate means to assess project effects on interior least tern, piping plover, and whooping crane habitat and alternatives to project operations. Therefore, the District shall supplement its analysis by conducting a modeling study of the effects of diverted flows on interior least tern and piping plover nesting habitat and whooping crane roosting habitat using the HEC-RAS 1D steady state backwater model and associated methodology for model calibration specified in HDR (2008). The District shall select a representative study site, in consultation with the FWS and Nebraska GPC, in the reaches identified above by the FWS. Data collected shall include flow quantity, depth, velocity, sandbar elevation, and bed form (HDR 2008). Cross-sectional measurements to calibrate the model shall be done during low flow conditions (50 to 75 cfs) and at a higher flow, selected in consultation with the FWS and Nebraska GPC. The length of each cross-sectional measurement should be of sufficient length to capture the full range of flow (based on historical records for the area) expected at the each study site. The District shall photo document the cross-sections. After calibration, the model shall be run to model existing operations and without the project diverting any flow and any other flow diversion alternative identified by the District. Each model run should be conducted for a normal, dry and wet year.

We estimate that the additional effort would increase the cost of the study by \$60,000, but the costs are necessary to ensure we have sufficient information for our environmental analysis and consult with the FWS under the ESA. Some economies of

scale would be attained because cross-sections for the Loup River bypass above the tailrace are also being done for the hydrocycling study.

Objective 6 – Determining the relative significance of the Loup River bypassed reach to the overall Loup River fishery

**Methodology**

Under Objective 6 of this study, the District would review NGPC fish sampling results for areas upstream and downstream of the project's diversion dam and evaluate whether significant differences exist between upstream and downstream with regard to species diversity and species richness. Using the flow duration and flood frequency curves developed under Objective 2, Task 3 of this study, the District would calculate the ability of fish to migrate upstream of the project's diversion during high flows when the diversion is submerged and the sluice gates are in the open position.

**Study Issues**

In its comments on the proposed study plan, FWS recommended generally and without much elaboration that the District should provide a direct comparison between stream flow in the bypassed reach and fish habitat suitability criteria for the current condition and action alternatives.<sup>7</sup> The District responds that a flow versus habitat study for the bypassed reach would have limited value because stream morphology on a braided river is dynamic, and therefore, a flow versus habitat relationship would only be valid for a short time, and possibly only for a few days or a week at most.

We agree with the District that due to the variability of the stream morphology inherent to the sandy, braided nature of the Loup and lower Platte Rivers, a flow versus habitat study with direct measurements of depths and velocities like the Physical Habitat Simulation System (PHABSIM) commonly used for the Instream Flow Incremental Methodology (IFIM) would be of little value. However, we agree with FWS that we need information to allow us to address project flow diversion effects on fish and their habitats in the Loup and lower Platte River bypassed reaches.

The Montana Method (Tennant 1976) has been used in Nebraska, including various reaches on the Platte and Loup Rivers, in order to establish minimum instream

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<sup>7</sup> FWS also recommended that the District make a number of hydraulic measurements across a series of cross-sections in the lower Platte River downstream of the project's bypassed reach. Considering that the study proposal applies to the bypassed reach, it's not clear what relevance the lower Platte River downstream of the project has to the project's bypassed reach. We, therefore, suspect that inclusion of this recommendation in the bypassed reach study was an oversight on the part of FWS.

flows. Under the method, various percentages of mean annual flow are classified as to their value to fish, wildlife, recreation, or related environmental resources. NGPC (2008b) used the following resource benefit characterizations for minimum flow releases at various percentages of mean annual flow:

<b>Flow Description</b>	<b>April to September</b>	<b>October to March</b>
Flushing/maximum flow	200 percent from 48 to 72 hours	
Optimum flow range	60-100 percent	60-100 percent
Outstanding habitat	60 percent	40 percent
Excellent habitat	50 percent	30 percent
Good habitat	40 percent	20 percent
Fair or degraded habitat	30 percent	10 percent
Poor or minimum habitat	10 percent	10 percent
Severe degradation	<10 percent	<10 percent

### **Conclusions**

In order to provide us with information necessary for us to assess the effects of project flow diversions on fisheries resources in the Loup and lower Platte River bypassed reaches, the District shall determine mean annual flows for the Loup River immediately upstream of the project diversion and lower Platte River immediately downstream of the Loup River confluence. Based on the computed mean annual flows, the District shall compute the various percentages of mean annual flow in the table above to describe fish habitat in the Loup and lower Platte River bypassed reaches. The District shall then compare actual mean monthly flows in the Loup and lower Platte River bypassed reaches under existing project operations to the table above to describe the existing state of the fishery resources. The results of this analysis should be provided in the Initial Study Report.

### **Study No. 8 – Recreation Use**

#### **Methodology**

The District proposes to merge the Recreation Use Survey and the Creel Survey into a Recreation Use Study and to reduce the study period from 12 months to 6 months (May 1 through October 31). The District plans to conduct surveys on four weekend days and six weekdays per month over the course of the study period (from May 1 to October 31, 2010), but only plans to include one summer holiday. The District also proposes to expand the survey period, at the discretion of the Commission, if the Telephone Survey or the Recreation Use Study shows that significant recreational use occurs between November 1 and April 31.

## **Study Issues**

The District proposes to exclude the Loup Lands Wildlife Management Area (Loup Lands WMA) from the Recreation Use Study because the area is leased to the NGPC and the District states that the agency is responsible for the management of Loup Lands. The District also proposes to exclude the 35-mile-long bypassed reach (Loup Power Canal) of the Loup River from the Recreation Use Study due to limited public access to the river across adjacent private lands and its ability to implement the study due to the limited access. At the May 11, 2009, recreation resources study plan meeting, the National Park Service (NPS) stated that it supports the inclusion of the Loup River bypassed reach in the Recreation Use Study in order to gain a better understanding of regional recreation use and of potential project impacts on recreation within the bypassed reach.

## **Conclusions**

### Combining the recreation use and creel survey

We agree that merging the two surveys would yield some economies of scale and still allow the District to collect the data needed for our analysis.

### Recreation use survey effort, study area, and sampling design

We tentatively agree that the District can reduce the length of the study period to May 1 through October 31 because this coincides with the time period when the majority of recreation use is expected at project facilities. However, modifications to the survey effort will depend on the amount of recreation use that is identified as occurring outside of the suggested survey period through the telephone survey and recreation use survey. Thus, in order for the Commission to be able to determine if the survey period should be extended, the District shall provide an Interim General Recreation Use Report on or before September 15, 2010, and an Interim Telephone Survey Report on or before October 15, 2010.

The Loup Lands WMA are located within the project boundary and the current lease agreement includes a provision to provide public access to the land as well as to the Loup River from Tract G (330 acres south of the Loup River bypassed reach) and Tract H (145 acres north of the Loup River bypassed reach). For the third parcel on the Loup Land WMA (Tract D, 10 acres), public access to the river is not specified in the lease. Wildlife viewing and hunting occur on the Loup Lands WMA. Although NGPC is tasked with developing a general management plan for all three tracts as part of the lease agreement, we could not find such a plan. Because no recreation user data is available for the Loup Lands WMA, these lands should be included in the Recreation Use Study so that user data would be available to inform future planning for and management of the

area. Therefore, the District shall include the Loup Lands WMA in the Recreation Use Study.

With regard to studying the Loup River bypassed reach, the District stated at the January 13, 2009, scoping meeting that boating (by canoe and kayak) and fishing occur within the Loup River bypassed reach, but did not provide any recreational use data. The public has access to the Loup River bypassed reach at several locations (Loup Lands WMA, Prairie Wolf WMA, George Syas WMA, Looking Glass Creek WMA, Highway 81 bridge, Highway 39 bridge, Monroe Road bridge, and Pawnee Park in Columbus, Nebraska), most of which have been used previously for creel studies by NGPC.

We need to understand existing use of the Loup River bypass and how project diversions may be affecting recreational use for our environmental analysis. The record does not contain sufficient data to complete our analysis. Further, because there is no Commission-approved recreation plan for the project, the information collected for the Recreation Use Study would be useful in developing such a plan. Therefore, the District shall include the Loup River bypass in the recreation use survey. A survey method shall be developed after consultation with the Nebraska GPC and NPS for the bypassed reach of the Loup River which includes those access points which receive the highest recreational use. A sampling schedule which includes the opportunity to sample selected access points at various times during the day (between dawn and dusk) as well as on weekdays and weekends is needed and shall be included.

In regard to sampling recreation during the holidays, we find the District's effort to be inadequate because the summer holidays are known to be the highest recreational use days. Therefore, the District shall include three summer holiday weekends (Memorial Day, Independence Day, and Labor Day) in the sampling effort. The weekend days associated with these holidays would count toward the four weekend days proposed.

The sampling schedule referenced in the study plan was developed for a creel survey only; thus 2-hour sampling blocks were used to develop the schedule. Because the creel study and the recreation user studies have been combined, survey proctors will need to spend more time in the field. It may take eight hours or longer to traverse the length of the Loup Canal and document recreational use at the five project parks (Headworks, Lake Babcock (or Loup Park), Lake North, Columbus Powerhouse, and Tailrace) as well as at Loup Lands WMA. Thus, multiple crews may be needed to conduct the surveys.

The District states in the revised study plan that "during peak use periods, when it is not practical to interview all recreation users, one proctor will count all users while the other proctor interviews as many users as possible within a reasonable time period." The District shall develop an interview selection protocol (such as every seventh person encountered) to enhance variability in the study population. Additionally, the District

shall define a reasonable interview time period for each developed area, relative to the amount of use each area receives, so that the proctors know how long to spend interviewing at each location. Finally, an estimation protocol shall be created for each developed area to ensure consistency among proctors when it is not possible to count all users in a given location.

Some of the recreation forms in the revised study plan are in need of correction or clarification. Clarify the questions on the In-Person Recreation Use Survey by incorporating the following modifications:

- Alter question 1 to read: “How many *people* are in your party today?”
- Modify question 2 to ask how long it took the respondent to travel from their home to the interview location.
- Include a list of District facilities in question 5 so the survey proctor can check all that apply and indicate the number of visits per facility.
- Add hunting to the list of activities in questions 9 and 10.
- Change the “good” option to “above average” to enhance consistency with the other response options in question 11.
- Reword question 12 to read “Did you or a member of your party experience conflict with any other visitors today? If yes, please describe the nature of the conflict.”

The Field Observation Form is confusing in its current format. Some of the choices given the survey proctors do not make sense. For example the activity “fishing” could occur in the following places: parking area; campground; picnic area; or playground. This form shall be redesigned so that it is easy for survey proctors to complete.

Clarify the questions on the Telephone Recreation Use Survey by incorporating the following modifications:

- Use the term sites in questions 1 through 3 to reduce respondent confusion between parks and trails and other types of facilities in question 4.
- Give respondents the opportunity to explain any “poor” ratings given in question 4A similar to question 11 on the In-Person Recreation Use Survey.
- Include hunting in the list of recreational opportunities for question 5A, 4B, 2C, and 5C.
- Expand Question 6A to ask about facilities that the public would be interested in using.
- For question 3B, add to the list the lack of barrier-free accessible facilities.

- It appears that respondents who answer “no” to question 2C will not have their demographic information recorded; therefore, please collect the following: (1) gender, (2) age, and (3) zip code from all respondents.

### **Study No. 12 – Ice Jam Flooding on the Loup River**

In March 1993, severe flooding in the lower Platte River basin inundated over 74,000 acres of land causing damages exceeding \$25 million. The probable cause of this flooding was a combination of ice jams and rapid snowmelt. Ice jams are caused by frazil ice formed in turbulent supercooled water, such as flows at the diversion weir and intake gates of the project. The U.S. Army Corps of Engineers (Corps) conducted two studies, resulting in two reports (July 1994 and January 1996), on ice jam flooding on the lower Platte River basin.

#### **Methodology**

The District proposes a 2-phase approach to determining if project operations have a material effect on the formation of ice jams or on the severity of flooding caused by ice jams in the Loup River bypassed reach. The first phase would consist of gathering and characterizing all available information, including Nebraska DNR Ice Reports, performing a qualitative analysis of ice and hydro-meteorological data for relationships between project operations and ice jam formation and flooding in the Loup River bypass, and determining if the available information would support a more detailed quantitative analysis of incremental project operation effects to the study reach. If the available data are insufficient, the study would identify additional information needs. In the phase 1 analysis, daily discharge in the power canal and bypassed reach would be plotted from November to April of each year (1994-2009) along with air temperature, precipitation, and accumulated freezing degree day. Instances of observed flooding and historic ice jams would be flagged on the plots. If no definitive correlation between project operations and ice jam formation based on the accumulated ice observation records and ice event data are found, then the District would conclude that project operations do not contribute to ice jam formation and flooding (see Attachment C to Study 12—CRREL [Cold Regions Research and Engineering Laboratory] Ice Jam Flooding Study Proposal (July 2009)).

If a definitive correlation exists and available data are sufficient, the District would contract with the CRREL to perform the quantitative analysis. The quantitative analysis would include estimating the severity and frequency of historic ice events using hind-casting methods; developing a simple ice-hydraulic model of the bypassed reach using available HEC-RAS, HEC-2 geometry or similar method and running a representative range of flows in the model under open water conditions to calculate ice cover profiles for selected design winters for both freeze-up and break-up cases; comparing model-predicted ice covers with ice observation reports and satellite imagery;

and calculating ice cover profiles for the 1993-94 worst case winter based on the historic bypassed reach flows and diversions (current conditions) case and several selected (yet unidentified) diversion cases and comparing any differences.

### **Study Issues**

The Nebraska DNR asserts that the District's proposed methods are too narrowly described and are limited in such a way as to prevent a quantitative analysis, without which the question as to whether project operations are contributing to ice jam flooding cannot be answered. In response to the revised study plan, the Nebraska DNR re-filed an alternative study plan that includes detailed methods that would be implemented immediately to achieve the following objectives: (1) evaluate the effect of project operations on hydrology, sediment transport, and channel hydraulics in the lower Platte River basin; (2) evaluate the combined effects of project operations on hydrology, sediment transport, and channel hydraulics on ice processes in the lower Platte River basin; (3) develop an ice jam and/or break-up predictive model; and (4) identify structural and nonstructural methods for the prevention and mitigation of ice jams, if the project materially contributes to ice jam formation on the Loup and Platte Rivers.

### Study area

The Nebraska DNR relied on the Corps to define the scope of the methods and study area. The Nebraska DNR study area would extend from the Loup River at Fullerton, Nebraska (about 4 miles upstream of the project diversion weir on the Loup River) to the confluence of the of the Platte and Missouri Rivers. The District limits its proposed study area to the bypass and power canal because (1) the area can be more readily analyzed because it experiences the maximum incremental effects of project operations; (2) this reach is subject to limited non-project influences on ice formation (i.e., tributaries, bridges, confluences, levees, etc.); (3) there is increasing uncertainty about the incremental effects of the project on icing events with increasing distance downstream. The District asserts that if no incremental effects are found near the project, it would not be justified to extend the study further downstream.

### Methods

The Nebraska DNR included detailed study methods that included collection of generally the same existing data as the District, but expanded on the methods by including (1) a hydrology study that includes the development of an unsteady hydraulic routing model (e.g., HEC-RAS) and modeling flows "with" and "without" project canal flow diversions; (2) a sediment transport assessment using a sediment transport model in HEC-RAS that includes modeling existing operations and operations without the removal of sediment by the project; (3) an ice formation study that estimates the total volume of ice produced within the study reach "with" and "without" power canal diversion of flow

and channel regimes for use in computations of ice-affected hydraulics; (4) an ice transport during freeze-up and break-up study that includes the use of a two-dimensional model, such as DynaRICE ice-hydraulic numerical model, to model ice transport through selected channels and hydraulic structures as well as ice initiation to demonstrate differences in the formation of ice “with” and “without” power canal diversions; (5) an ice-affected hydraulics analysis using HEC-RAS modeling to predict where ice jams form under 2-, 5- and 10-year flows “with” and “without” power canal diversions; (6) the development of ice jam/break-up predictive model, and (7) identification of structural and non-structural means that may prevent and mitigate the impacts of ice jams if the project is shown to increase flood risk in any part of the study reach.

The District does not propose to include the hydrologic and sediment transport analysis proposed by the Nebraska DNR because it exceeds the information needs of the Commission’s environmental analysis for assessing project effects. Much of the data proposed to be collected by Nebraska DNR is being collected in other studies (i.e., Sedimentation Study, Hydrocycling Study, and Flow Depletion and Flow Diversion Study). The District also opposes the use of the more refined predictive modeling of ice events than is currently available and the development of a new predictive model for ice events in the Platte River basin because the development of such a model is not the responsibility of the District, but that of the Nebraska DNR. The District asserts that Nebraska DNR’s proposed ice formation, ice transport during freeze-up and break-up, and ice affected hydraulics is technically similar to its methods, but far broader in scope than is required for assessing project effects.

## **Conclusions**

### Study area

Severe flooding due to the combination of ice jams and rapid snowmelt occurred within the Lower Platte River basin in Nebraska during March 1993. The two areas most affected were along the south side of the Loup River at Columbus and just downstream from the confluence of the Elkhorn and Platte Rivers near Ashland (White and Kay 1996). This event prompted the US Army Corp of Engineers ice jam flooding analyses in 2004 and 2006.

Ice formation and flooding are affected by stream morphology and hydrology. As discussed in several studies above, we are approving studies with modifications that would examine the project effects on stream morphology and hydrology. We expect that those effects, if any, would be the greatest in the Loup River bypass and immediately below the tailrace. Therefore, we are modifying the Districts icing study to include the Loup River from Fremont, Nebraska to the Platte River at the USGS North Bend gaging station. This area would cover one of the areas most affected by the March 1993 flood, without confounding the results with inputs of the Elk Horn River, which also

experienced severe flooding in the March 1993 flood. If the results of the study indicate that the project may be influencing flooding further downstream, additional analyses would be required in year 2 of the study period.

### Methodology

The premise of the District's phased approach is based on the need to evaluate whether there is sufficient information to proceed with a detailed quantitative analysis. The Nebraska DNR developed a program and began collecting additional icing information based on the Corps' recommendation in 1994. The Corps was able to develop an ice jam predictive model on the existing information and recommend future studies to examine the effects of project operations, if any, on ice formation based on less data than are now available for the project area (White and Kay 1996). As keepers of the icing data, the Nebraska DNR and Corps have a good understanding of what information is available and what still needs to be collected to evaluate the effects of the project on ice jam formation and flooding.

Given the Corp's expertise and experience on this system and generally similar approaches to the quantitative analyses and similar costs, we find that the approach recommended by the Nebraska DNR, based on the Corps' recommendation, will provide the means by which the Commission can evaluate project influences on ice formation and flooding and best achieve the objectives and goals of the icing study. In addition, combining all data sources from the District and Nebraska DNR's revised study plans would ensure a complete record for the quantitative analysis. Therefore, we are requiring that the District implement the Nebraska DNR icing study filed as Attachment B to its August 7, 2009, comments on the revised study plan with the following modifications: (1) the geographic scope of the study will be limited as explained above; (2) the development of the predictive icing model shall be limited to the examination of project effects; (3) the identification of mitigation measures shall also be limited to operational or structural changes to minimize or mitigate project effects on ice jam formation and subsequent flooding; and (4) the data to be gathered shall consist of a combination of both studies to include: (a) all hydraulic data from USGS stream gage sites in Attachment B of the Nebraska DNR's plan; (b) sediment data including bed load and suspended sediment load from the same gages or other sources; (c) hydrometeorologic data such as air temperature and precipitation from the National Climatic Data Center and the National Weather Service station at Genoa; (d) all data from the Nebraska NDR Ice Report database; (e) all needed data from the CRREL Ice Jam Database; and (f) high water mark, such as tree scars, data from the Corps' and other agencies' records.

As to the District's concern that it is being held responsible to develop a regional model, we agree with the District that the development of a regional model to predict ice events is not the responsibility of the project. Therefore, we are not requiring the District to develop a regional model.

## **Study Requests Not Approved**

### **Sediment Sampling for PCB's in the Loup Power Canal and Lake Babcock**

In its comments on the revised study plan, the FWS recommended that the District sample for polychlorinated biphenyls (PCB's) from fish tissue and sediments from Lake Babcock and the Loup Power Canal between Monroe and Columbus powerhouses. The District proposes to conduct fish tissue sampling in 2009 cooperatively with the Nebraska Department of Environmental Quality. One of the sample sites includes Lake Babcock, which is located in the affected reach mentioned by FWS. This information, along with the fish tissue sampling results presented in the PAD for the project area, will be sufficient for our analysis. The District shall report the results of this analysis in their Initial Study Report.

The relevant issue for any licensing decision is whether any PCB mobilization caused by project operations affects fishery resources. To answer that question, it is most appropriate to first sample fish tissue for PCB's in the potentially affected reach (i.e., Lake Babcock) to determine if PCB's are presently affecting fish, regardless of the source (e.g, project-induced mobilization of canal sediments versus upstream Loup River flows carrying PCB's from other sources). Should elevated fish PCB levels be found in the fish tissues, we may consider additional PCB monitoring in year 2.

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