The Loup River Hydroelectric Project

Initial Study Results

September 9, 2010

Loup Power District
Hydro Project

Agenda

8:30 AM	Welcome and Introductions
8:45 AM	Integrated Licensing Process Overview
9:00 AM	2010 Weather
9:15 AM	Progress Update for On-going Studies

- Study 2.0 - Hydrocycling
- Study 4.0 - Water Temp in Loup River Bypass Reach
- Study 5.0 - Flow Depletion and Flow Diversion
- Study 8.0 - Recreation Use
- Study 12.0 - Ice Jam Flooding on the Loup River

10:15 AM — Presentation of Study Results

- Study 7.0 - Fish Passage
- Study 8.0 – Recreation Use (Telephone Survey)
- Study 10.0 - Land Use Inventory
- Study 11.0 - Section 106 Compliance
- PCB Fish Tissue Sampling

Noon — Lunch

1:00 PM — Presentation of Study Results (continued)

- Study 1.0 – Sedimentation

4:30 PM — Next Steps

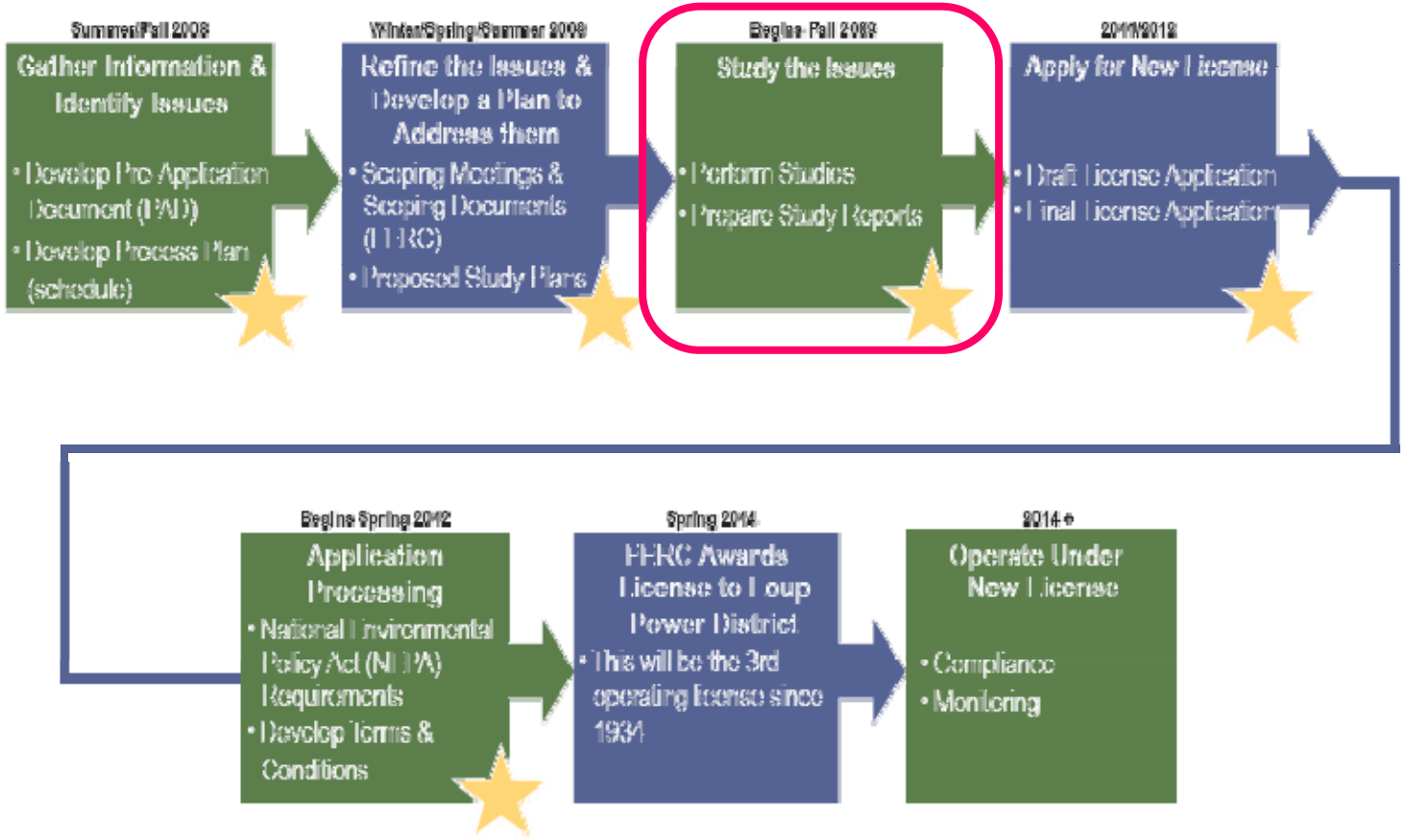
- Initial Study Results Meeting Summary
- Study Modifications
- Second Initial Study Results Meeting – January 21, 2011

5:00 PM — Adjourn

Goals of the ISR Meeting

- To present the results of completed studies identified in the Revised Study Plan and Study Plan Determination
- To discuss any proposals to modify the study plan (by the District or other participants) in light of study progress and data collected

Overview of Integrated Licensing Process



★ Includes Public Comment Opportunities

Study Plan Determination

- FERC issued on August 26, 2009
- Removed three studies:
  - Water Temperature in the Platte River, Fish Sampling, and Creel Survey [combined with Recreation Use]
- Approved three studies without modification:
  - Fish Passage, Land Use Inventory, and Section 106 Compliance
- Approved six studies with modification:
  - Sedimentation, Hydrocycling, Water Temperature in the Loup River Bypass Reach, Flow Depletion and Flow Diversion, Recreation Use, and Ice Jam Flooding on the Loup River

Next Steps

18CFR5.15

- September 24, 2010
  - District submits meeting summary
- October 24, 2010
  - Agencies file meeting summary disagreements and submit requests for modification to on-going studies
- November 24, 2010
  - District responds to summary comments and study modification requests
- December 27, 2010
  - FERC resolves comments and study modification requests

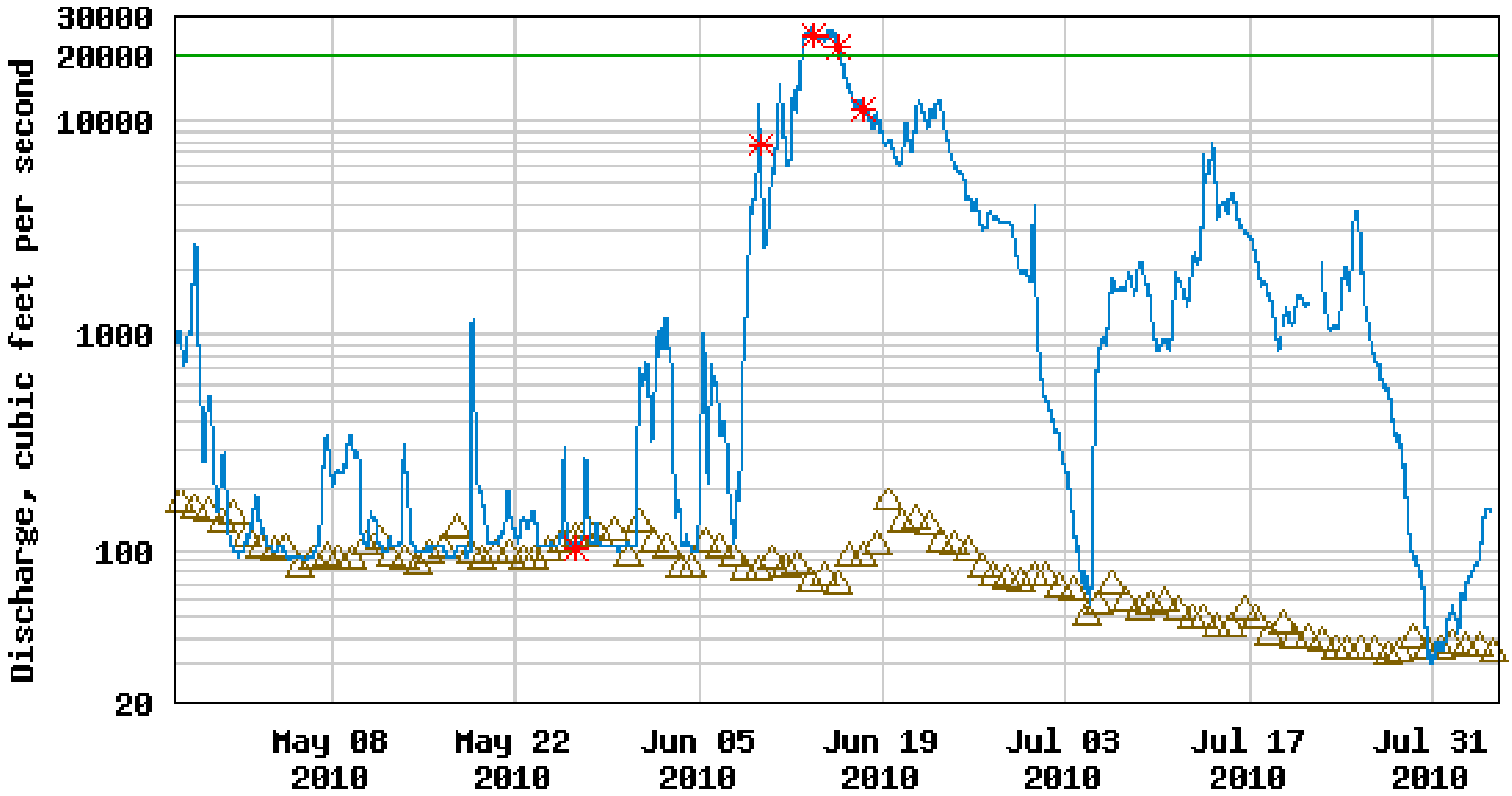
2010 Precipitation and Resulting River Flows

Spring 2010

- High winds
- Higher than normal precipitation
- Widespread flooding

USGS

USGS 06793000 Loup River near Genoa, Nebr.



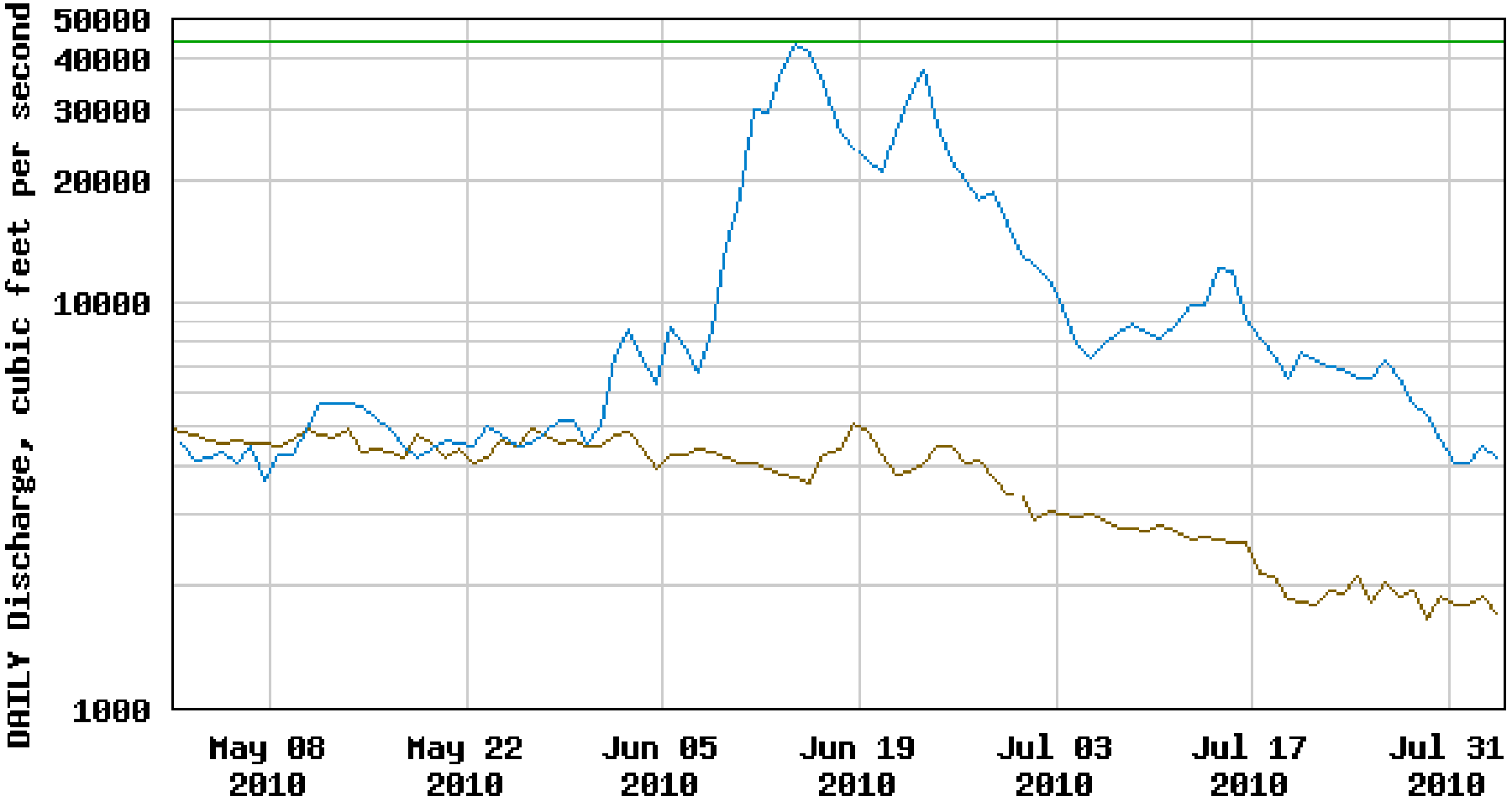
---- Provisional Data Subject to Revision ----

△ Median daily statistic (66 years) ✳ Measured discharge

— Discharge — Discharge at floodstage

USGS

USGS 06796000 Platte River at North Bend, Nebr.



---- Provisional Data Subject to Revision ----

Median daily statistic (61 years)

Discharge at floodstage

Daily mean discharge

On-Going Studies

- Study 2.0 Hydrocycling
- Study 4.0 Water Temp in Loup River Bypass Reach
- Study 5.0 Flow Depletion and Flow Diversion
- Study 8.0 Recreation Use
- Study 12.0 Ice Jam Flooding on the Loup River

2. Hydrocycling

2. Hydrocycling

Goal

- The goal of the hydrocycling study is to determine if Project hydrocycling operations benefit or adversely affect the habitat used by interior least terns, piping plovers, and pallid sturgeon in the lower Platte River.

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.

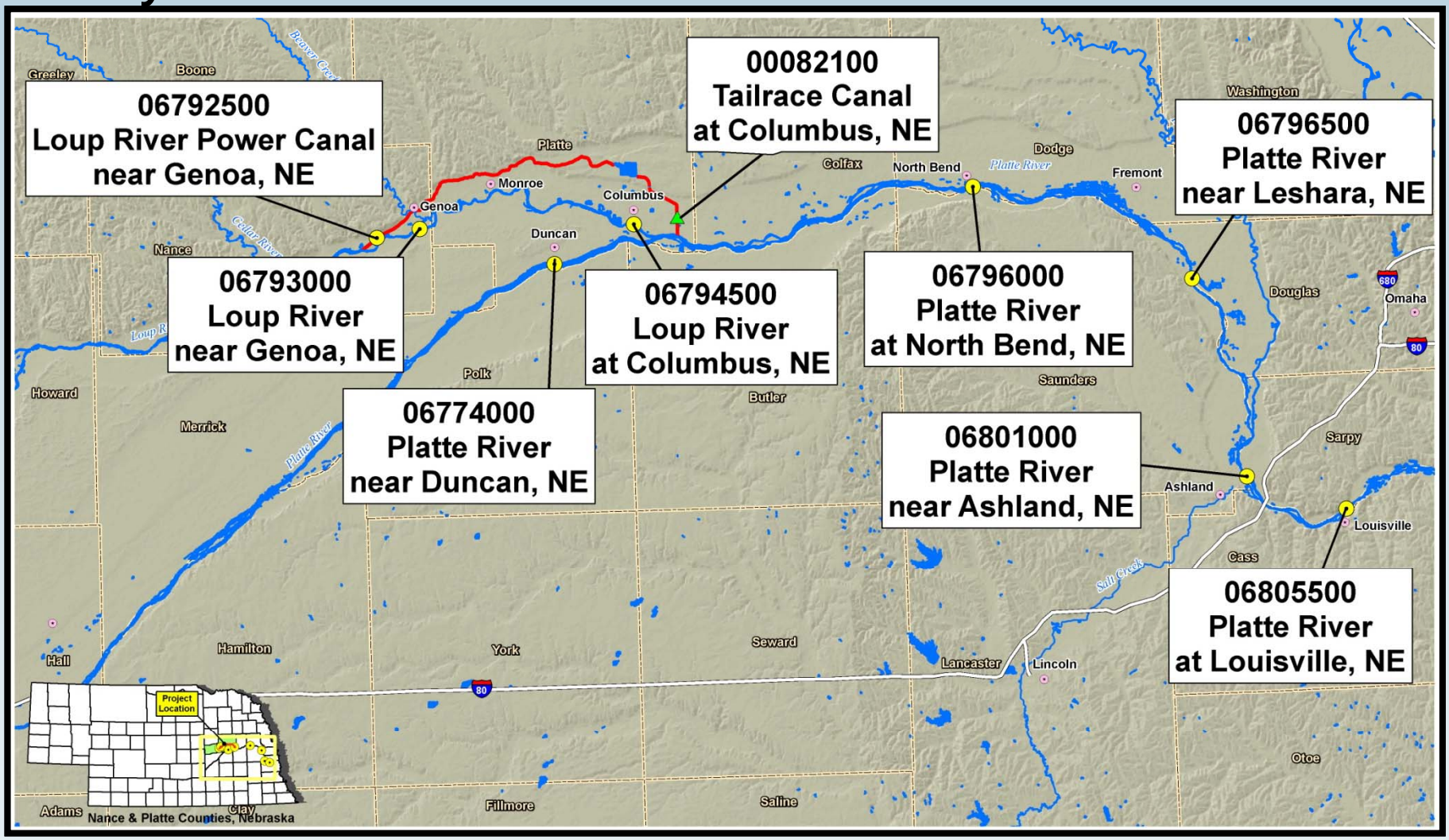
2. Hydrocycling

Objectives (continued)

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.

2. Hydrocycling

Study Area



2. Hydrocycling

Update

- Historic gage and flow data have been collected
- Hydrologic analysis has been completed for historic data
  - Flow duration, flood flow frequency, and wet-dry-normal years
- Developed synthetic hydrographs
  - Ungaged sites for current operations
  - All sites for run-of-river operations
- Cross section information has been obtained for the ungaged sites
  - Early May and late June due to high flows
  - Post nesting cross sections being collected in early September

2. Hydrocycling

Update

- Identified timeframes of interior least tern and piping plover arrival/nesting/departure for nest inundation study
- Comparing theoretical nest inundation under Project operations and run-or-river operation
- Evaluating sediment transport for current subdaily hydrocycling operations and run-of-river operations using methodology from Study 1.0 - Sedimentation
- Comparing threatened and endangered species habitat on other rivers with hydrocycling operations to conditions on the lower Platte River

2. Hydrocycling

Update

- Developing a 1D HEC-RAS model to study the effects of hydrocycling on interior least tern and piping plover nesting habitat

Results

- Updated Initial Study Report on January 6, 2011

4. Water Temperature in the Loup River Bypass Reach

4. Water Temperature in the Loup River Bypass Reach

Goal

- To determine if Project operations (flow diversion) materially affect water temperature in the Loup River bypass reach (with particular emphasis on the reach between the Diversion Weir and the confluence of Beaver Creek) or in the reach of the Platte River between the Loup River confluence and the Tailrace Canal.

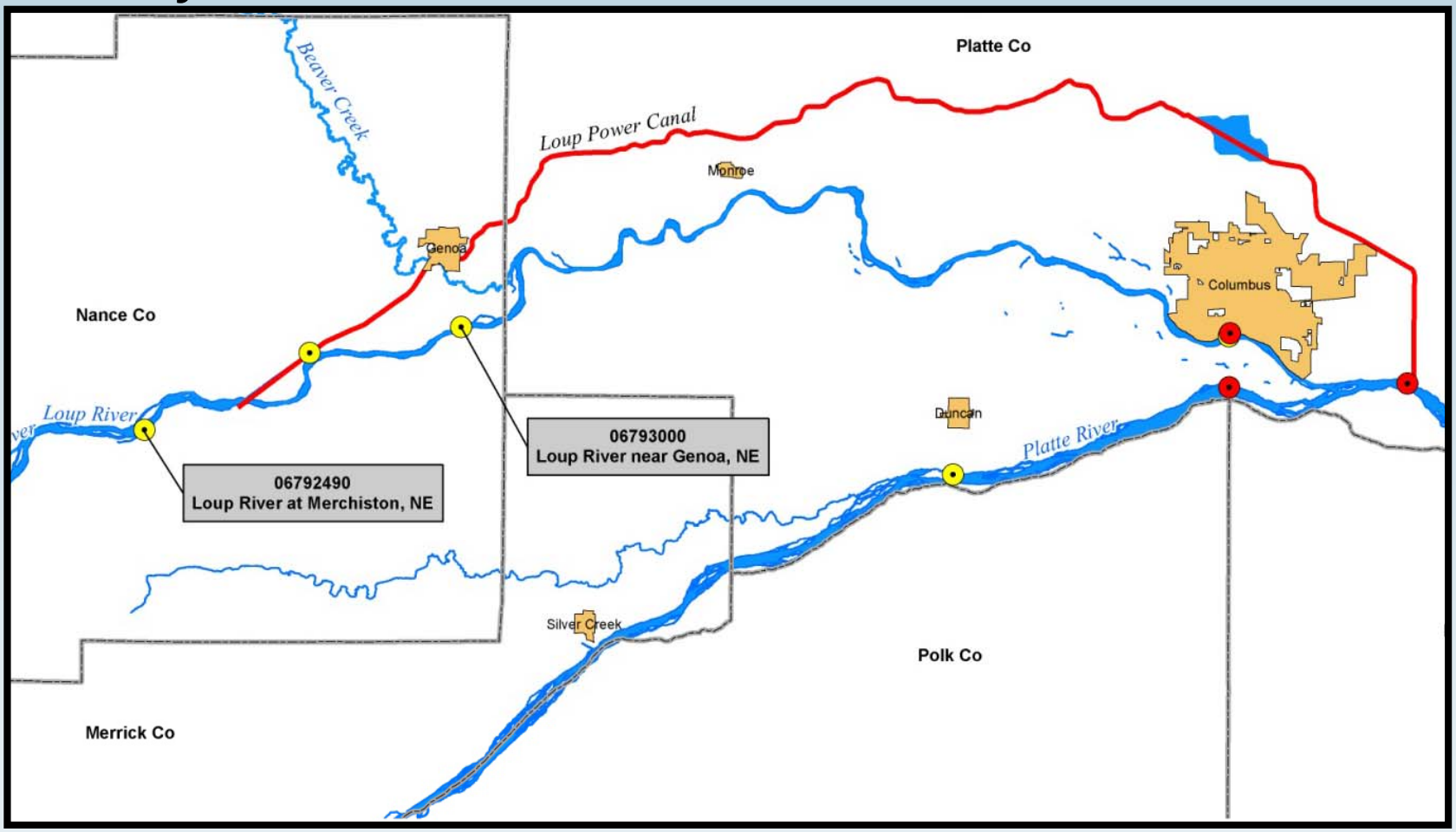
4. Water Temperature in the Loup River Bypass Reach

Objectives

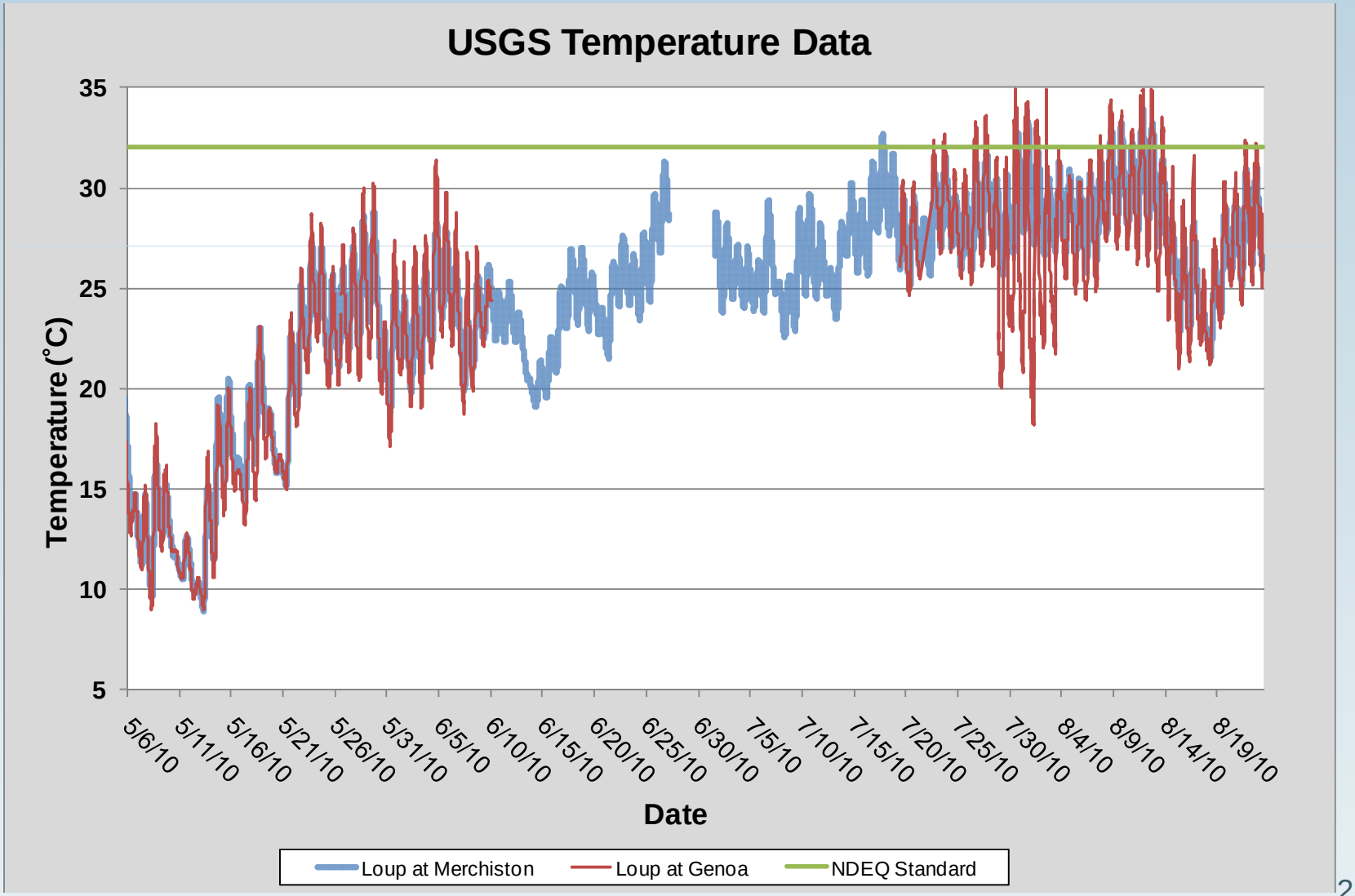
1. To estimate the relationship between flow in the Loup River bypass reach, ambient air temperature, water temperature, relative humidity, and solar radiation.
2. To describe and quantify the relationship, if any, between diversion of water into the Loup Power Canal and water temperature in the Study Reach of the Loup River bypass reach.
3. To determine if water temperature standard exceedances occur in the reach of the Platte River between the Loup River confluence and the Tailrace Canal.

4. Water Temperature in the Loup River Bypass Reach

Study Area



4. Water Temperature in the Loup River Bypass Reach



4. Water Temperature in the Loup River Bypass Reach

Update

- Data collection continues through September 30th
- Data analysis is on-going:
  - Critical reach confirmations
  - Regression analysis to identify patterns and trends
  - Develop a relationship to predict conditions when the water quality temperature standard may be exceeded

Results

- Updated Initial Study Report on January 6, 2011

5. Flow Depletion and Flow Diversion

5. Flow Depletion and Flow Diversion

Goals

- To 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.
- 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 compared to alternative conditions.

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.

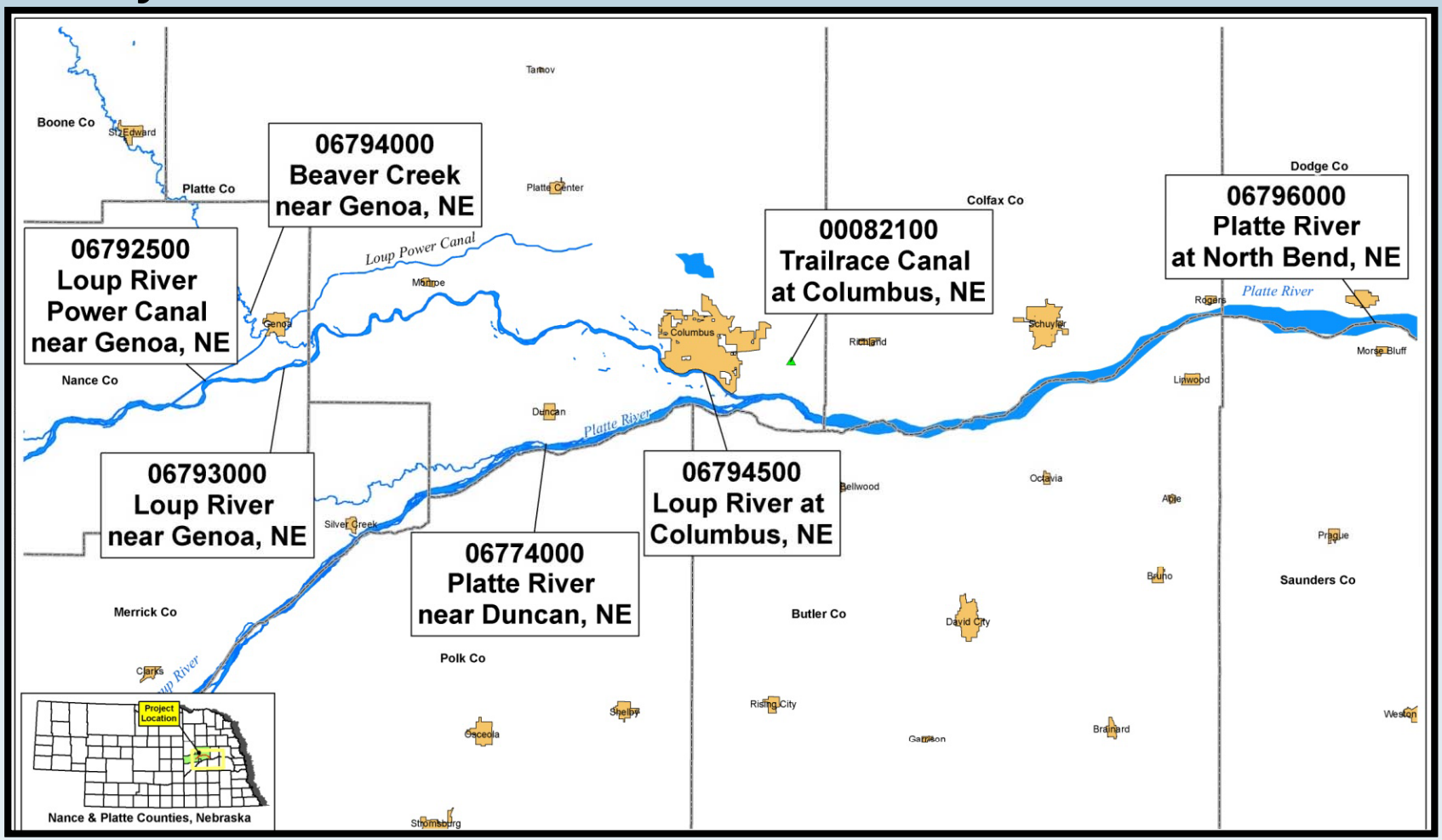
5. Flow Depletion and Flow Diversion

Objectives (continued)

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 Project effects, if any, of consumptive use on fisheries and 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.

5. Flow Depletion and Flow Diversion

Study Area



5. Flow Depletion and Flow Diversion

Update

- Cross section information has been obtained for the ungaged sites
  - Mid April, May and June due to high flows
  - Low flow cross sections being collected in early September
- Atmospheric data collected (pan evaporation, precipitation, and ambient temperature)

5. Flow Depletion and Flow Diversion

Update

- Hydrologic analysis has been completed for historic data
  - Flow duration, flood flow frequency, and wet-dry-normal years
- Determining consumptive use in Project reach and Bypass Reach
- Developing 1D HEC-RAS model at the ungaged sites to evaluate the effects of current project operations vs. a no diversion alternative on T&E species habitat

5. Flow Depletion and Flow Diversion

Update

- Reviewed available least tern and piping plover nest count data
  - Lack of data prohibits meaningful statistical relationship comparisons
- Established river miles and methodology for comparison of the Loup River characteristics both above and below the diversion and performed field visit to document aerial imagery signatures.

Results

- Updated Initial Study Report on January 6, 2011

8. Recreation Use

8. Recreation Use

Goals

- To determine the public awareness, usage, perception, and demand of both the Project's existing recreation facilities (including fisheries) and the Loup River bypass reach (including the Loup Lands WMA), to determine if potential improvements are needed, and to develop a Recreation Management Plan to address existing and future recreation needs.

8. Recreation Use

Objectives

1. To measure recreation usage of Project recreation facilities (including fisheries) and the Loup River bypass reach (including the Loup Lands WMA).
2. To document the types of recreation use occurring at Project recreation facilities and along the Loup River bypass reach.
3. To determine whether Project recreation facilities meet current demand.

8. Recreation Use

Objectives (continued)

4. To determine the public's perception and awareness of Project recreation facilities, including fisheries, and to identify the impact of Project operations on recreation experiences.
5. To determine what species anglers are targeting and catching, including catch rates.
6. To collect data for use in the preparation of a Recreation Management Plan for the District's facilities.

8. Recreation Use

Study Area

- Loup Power Canal (including developed recreation areas):
  - Headworks Park
  - Lake Babcock Park
  - Lake North Park
  - Columbus Powerhouse Park
  - Tailrace Park
- Loup River Bypass Reach:
  - 2 public parks
  - 4 wildlife management areas
  - 3 public road bridges

8. Recreation Use

Update

- Development of Bypass Reach Recreation Survey Plan
- Creel Survey Proctor Training (Feb 11, 2010)
- Pre-Survey Outreach
- In-Person Surveys On-Going
- Trail Counts
- Telephone Survey

8. Recreation Use

Results

- Updated Initial Study Report on January 6, 2011

Recreation Management Plan

- Pending completion of data collection and analysis

12. Ice Jam Flooding on the Loup River

2010 Ice Jam at Lake Oconee

2010 Ice Jam at N-39 Bridge

12. Ice Jam Flooding on the Loup River

Goal

- Evaluate the impact of project operations on ice jam flooding on the Loup and Platte rivers between Fullerton and North Bend.

12. Ice Jam Flooding on the Loup River

Objectives

1. To evaluate the effect of Project operations on hydrology, sediment transport, and channel hydraulics on the ice processes in the Loup and Platte rivers.
2. To develop and ice jam and/or predictive model to evaluate project effects.
3. To identify structural and nonstructural methods for the prevention and mitigation of ice jams, should it be demonstrated that operation of the Project materially impacts ice jam formation on the Loup and Platte Rivers.

12. Ice Jam Flooding on the Loup River

Study Area

- Loup River
  - Fullerton to the Platte River Confluence
- Platte River
  - Loup River confluence to North Bend

12. Ice Jam Flooding on the Loup River

Update

- District contracted study to Corps of Engineers (COE).
  - Using specific hydrologic, field survey, and sediment transport information being developed in ongoing Sedimentation, Hydrocycling, and Flow Depletion and Flow Diversion Studies as inputs to the defined tasks of the Ice Jam Flooding Study
  - Reviewed historical pre-Project ice jam information provided by the District
  - Assembled meteorological data for study area
  - Obtained supplemental river cross section surveys
  - Prepared ice formation analysis for study reach

12. Ice Jam Flooding on the Loup River

Update

- District contracted study to Corps of Engineers (COE)
  - Analyzing Ice transport using DynaRICE model
  - Developing HEC-RAS model for analysis of ice-affected hydraulics
  - Identifying structural and nonstructural means to mitigate impacts

Results

- Updated Initial Study Report on January 6, 2011

Completed Studies

- Study 1.0 Sedimentation
- Study 7.0 Fish Passage
- Study 8.0 Recreation Use (Telephone Survey)
- Study 10.0 Land Use Inventory
- Study 11.0 Section 106 Compliance
- PCB Fish Tissue Sampling

7. Fish Passage

7. Fish Passage

Goal

- Determine if a useable pathway exists for fish movement upstream and downstream of the Diversion Weir.

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.

7. Fish Passage

Study Area

7. Fish Passage

Methodology

- Hydraulic model developed and analyzed to determine if usable fish pathways exist
- Analysis focused on the spawning migration season of representative Loup River fish species (April, May, and June)
- Compared resulting Loup River flow velocities to both the critical and burst swimming speeds of these fish species

7. Fish Passage

Fish Swimming Performance

Species	Estimated Adult Fish U_{CRIT} (fps)	Estimated Adult Fish U_{BURST} (fps)
White Bass	3.9	Undetermined[1]
Channel Catfish	2.7	3.9
Walleye	2.7	5.2-8.5
Sauger	2.6	Undetermined[2]
White Sucker	2.1	5.0-10.0

7. Fish Passage

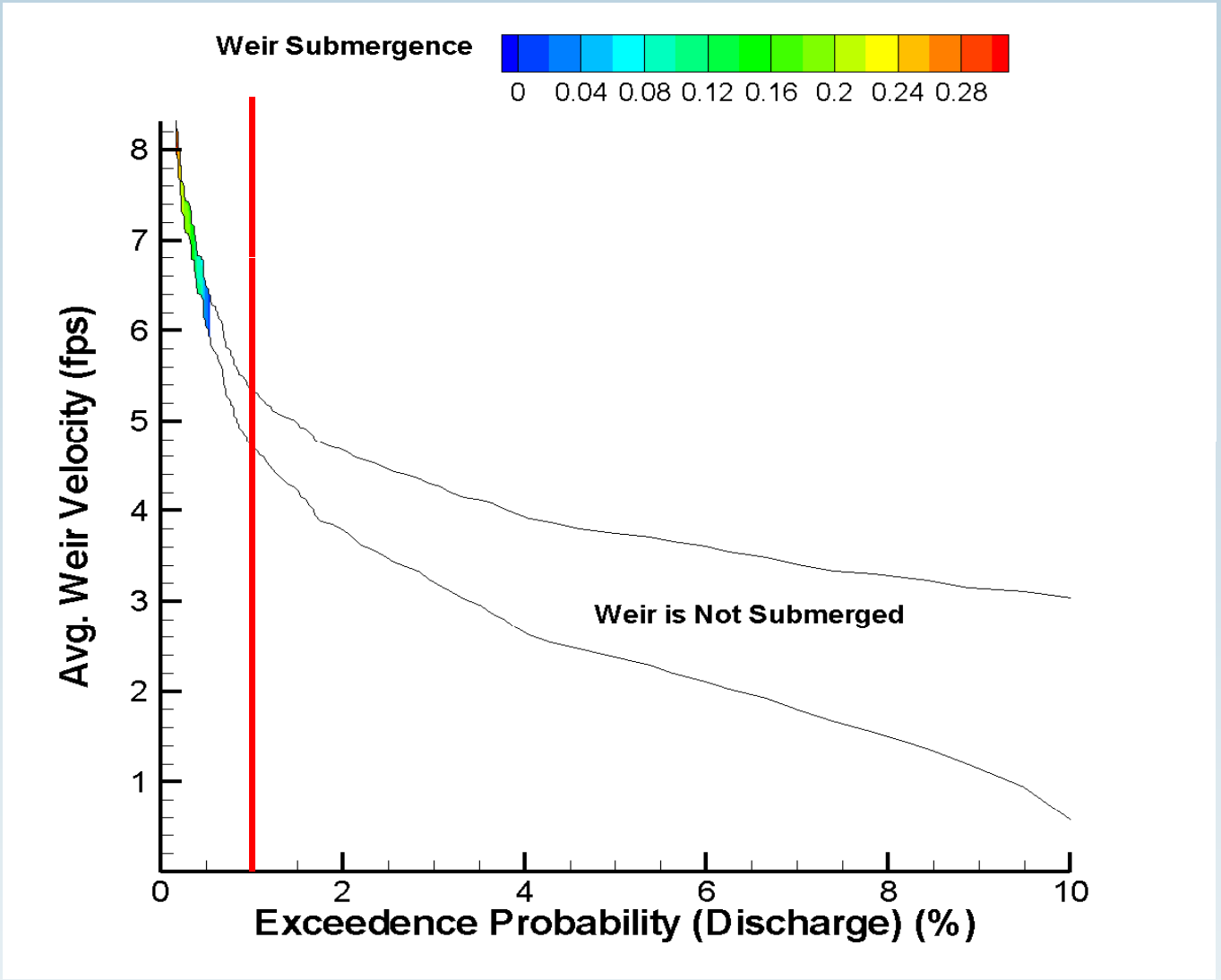
Diversion Weir

Serves as a barrier to fish passage 99% of the time during the spawning season

- Submerged less one day per spawning season
- Average velocities: 6 to 8 fps
- Critical fish swimming speeds: 2.1 to 3.9 fps
- Maximum burst speeds of white sucker (10.0) and walleye (8.5) allow passage during limited times

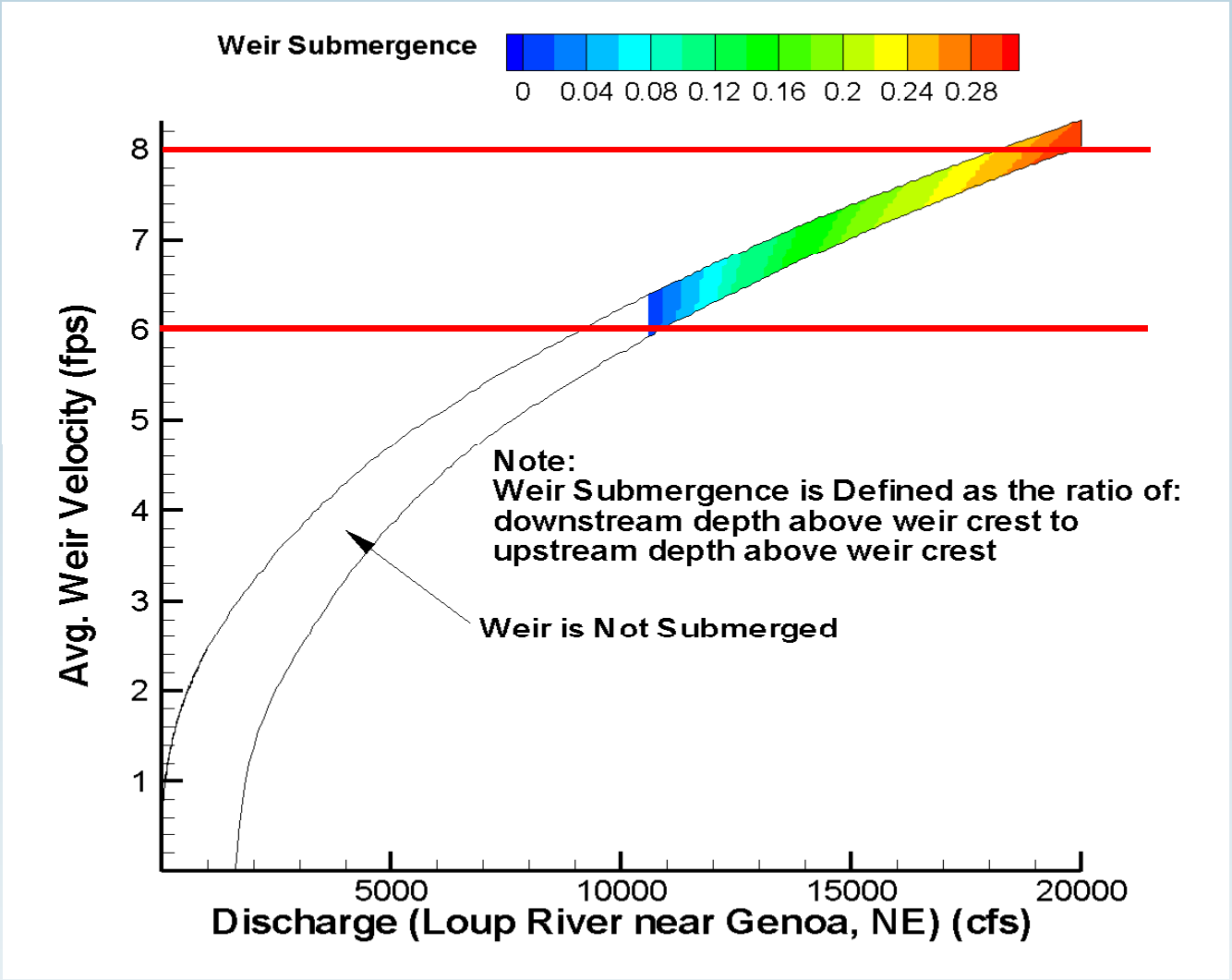
7. Fish Passage

Probability of Diversion Weir Submergence



7. Fish Passage

Flow Velocity During Weir Submergence



7. Fish Passage

Alternate Fish Pathway

Exists along the right bank less than one day per spawning season

- Requires submergence of the diversion weir
- Weir is submerged less one day per spawning season

7. Fish Passage

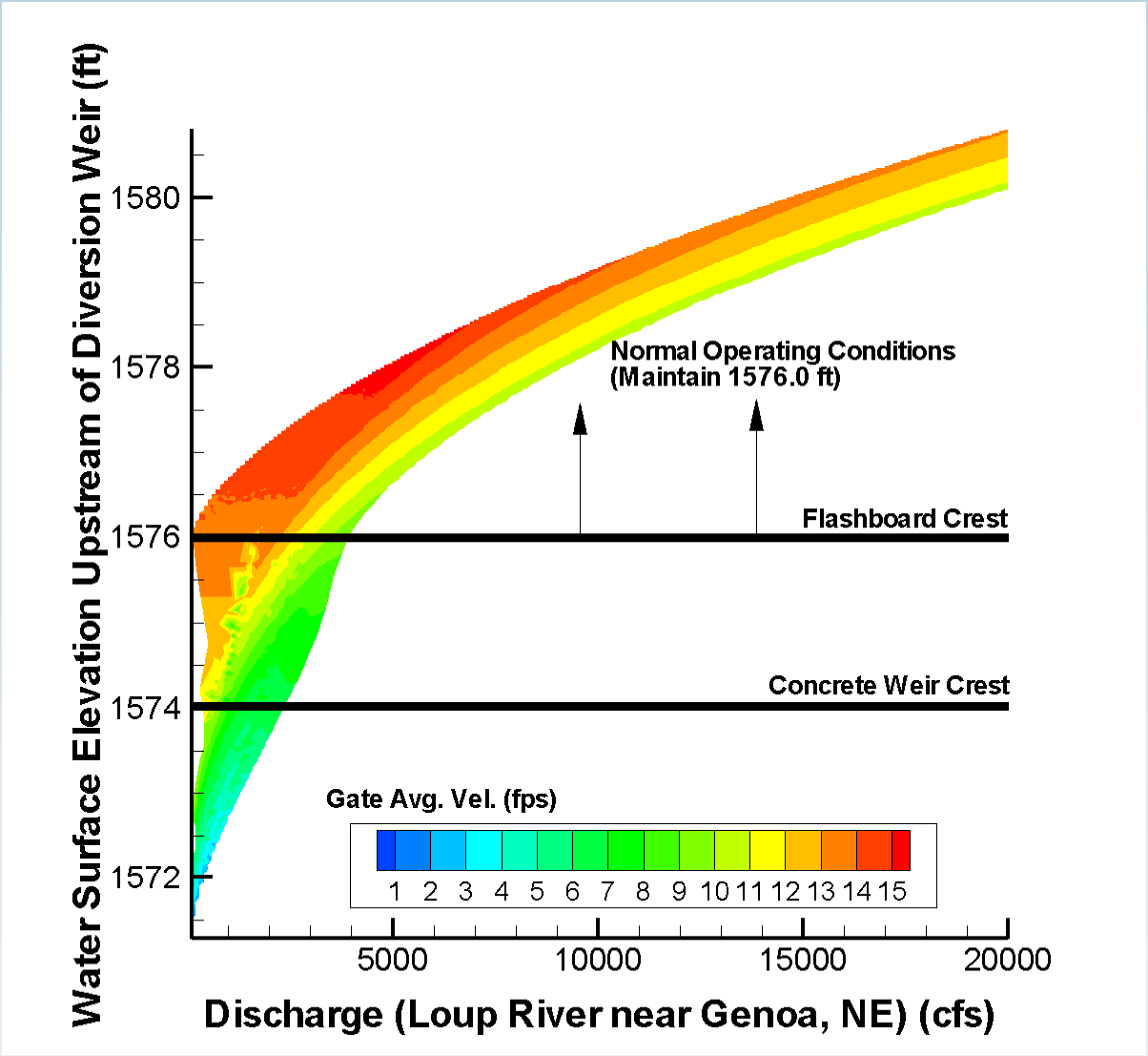
Sluice Gate Structure

Generally does not provide a useable fish pathway

- Gates opened infrequently
- Average velocities: 9 to 14 fps (1576 crest); 7 to 12 fps (1574 crest)
- Critical fish swimming speeds: 2.1 to 3.9 fps
- Maximum burst speed of white sucker (10.0) would allow passage during limited times when flashboards are out

7. Fish Passage

Sluice Gate Flow Velocities Related to WSE



7. Fish Passage

Results

- The Diversion Weir is submerged less than 1 percent of the spawning season and is generally a barrier to fish passage due to high flow velocities.
- The Sluice Gate Structure does not provide a fish pathway due to limited operation and high flow-through velocities.
- An alternative fish pathway around the Diversion Weir on the right bank of the Loup River exists (on average) less than 1 day out of every spawning season.

8. Recreation Use Telephone Survey

8. Recreation Use Telephone Survey

Goal

- Determine the public awareness, usage, perception, and demand of both the Project's existing recreation facilities (including fisheries) and the Loup River bypass reach (including the Loup Lands WMA), to determine if potential improvements are needed, and to develop a Recreation Management Plan to address existing and future recreation needs.

8. Recreation Use Telephone Survey

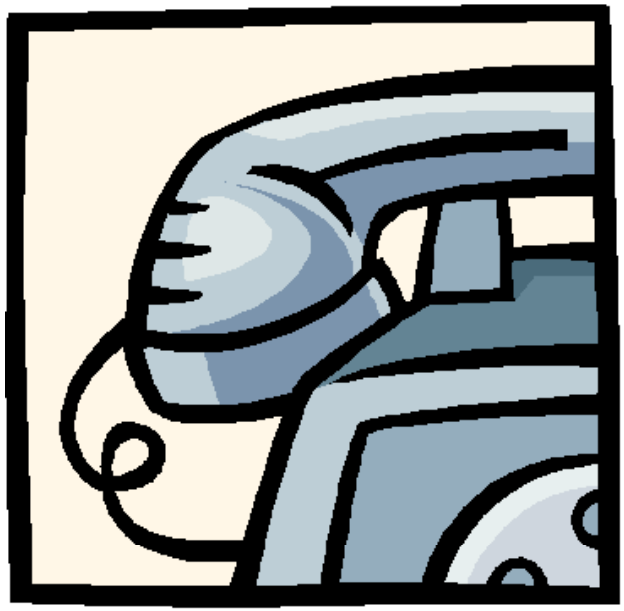
Objectives

1. To determine the public's perception and awareness of Project recreation facilities.
2. To collect data for use in the preparation of a Recreation Management Plan for the District's facilities.

8. Recreation Use Telephone Survey

Study Area & Data Collection

- A 12-minute telephone survey of 400 residents in Nance and Platte counties was conducted by The MSR Group between May 26 and June 9, 2010.



8. Recreation Use Telephone Survey

Survey Respondents by Age Group

Age	Percentage of Respondents
18 to 24	2.0
25 to 34	10.0
35 to 44	22.8
45 to 54	24.5
55 to 64	16.5
65 or older	24.3

8. Recreation Use Telephone Survey

Awareness of District Recreation Facilities

- Highest Awareness - Lake North Park and Lake Babcock Park
  - More than nine of ten respondents aware of each

- Lowest Awareness – Trails (3)
  - Less than five of ten respondents aware of each.

8. Recreation Use Telephone Survey

Usage of District Recreation Facilities

- Lake Babcock Park – 57%
- Lake North Park – 55%
- Headworks Park – 36%
- Bob Lake Trail – 32%
- Columbus Powerhouse Park – 29%
- Two Lake Trail – 27%
- Robert White Trail – 25%
- Tailrace Park – 22%
- Headworks OHV Park – 20%

8. Recreation Use Telephone Survey

Months of Highest and Lowest Recreation Use by Site

Site	Month of Highest Use	Month of Lowest Use
Headworks Park	July	December
Headworks OHV Park	July	February
Lake Babcock Park	July	January
Lake North Park	July	February
Columbus PH Park	July	December
Tailrace Park	July	November/December
Two Lakes Trail	July	February
Bob Lake Trail	July	January/December
Robert White Trail	July	February/December

8. Recreation Use Telephone Survey

Ratings of District Recreation Facilities

Facility	Excellent/Above	Average	Below/Poor
Trails	67.6	16.5	0.4
Campgrounds	33.1	40.5	3.2
Parking Lot	32.8	58.5	2.5
Picnic Area	33.5	51.8	3.2
OHV Park	29.6	40.5	1.1
Shoreline Fishing Area	26.5	36.3	5.6
Children's Playground	22.8	40.8	12.0
Restroom Facilities	17.6	50.7	14.5
Swimming Beach	14.8	33.2	19.8
Boat Ramps	14.8	26.8	3.5

8. Recreation Use Telephone Survey

Importance of Recreational Opportunities

- Aware of District Facilities
  - Most Important - relaxing/hanging out and trails
  - Least Important - jet skiing and water skiing
- Not Aware of District Facilities
  - Most Important - children's playground and relaxing/hanging out
  - Least Important - jet skiing and motorized boating

10. Land Use Inventory

10. Land Use Inventory

Goals

- Determine specific land uses of Project lands and adjacent properties to identify potential conflicts and/or opportunities relating to Project operations, public access, recreation, aesthetics, and environmental resource protection.

10. Land Use Inventory

Objectives

1. To identify and record current and proposed future land uses of Project lands.
2. To identify and record current and authorized future land uses of adjacent properties.
3. To identify and map all existing public access points to the Loup Power Canal, regulating reservoirs, and defined recreation areas on Project lands.
4. To identify and map any areas on Project lands or adjacent properties having potentially incompatible or conflicting land uses.

10. Land Use Inventory

Objectives (Continued)

5. To identify and map potential opportunities for improving public access to Project lands and recreation areas.
6. To identify potential opportunities to improve aesthetics on Project lands and recreation areas.
7. To identify potential opportunities to enhance public safety on Project lands.
8. To identify potential solutions for any land use conflicts that may be identified.
9. To provide information on land use, land use conflicts, and access to be used in conjunction with the results of Study 8.0, Recreation Use, to develop a recreation management plan.

10. Land Use Inventory

Study Area

- Project Boundary and immediately adjacent parcels, with focus on:
  - All Developed Recreation Areas
  - Loup Lands WMA
  - Lake Babcock Waterfowl Refuge
  - North and South Sand Management Areas
  - Siphons
  - Areas with evidence of heavy informal usage
  - Urban areas of Genoa and Columbus

10. Land Use Inventory

Results

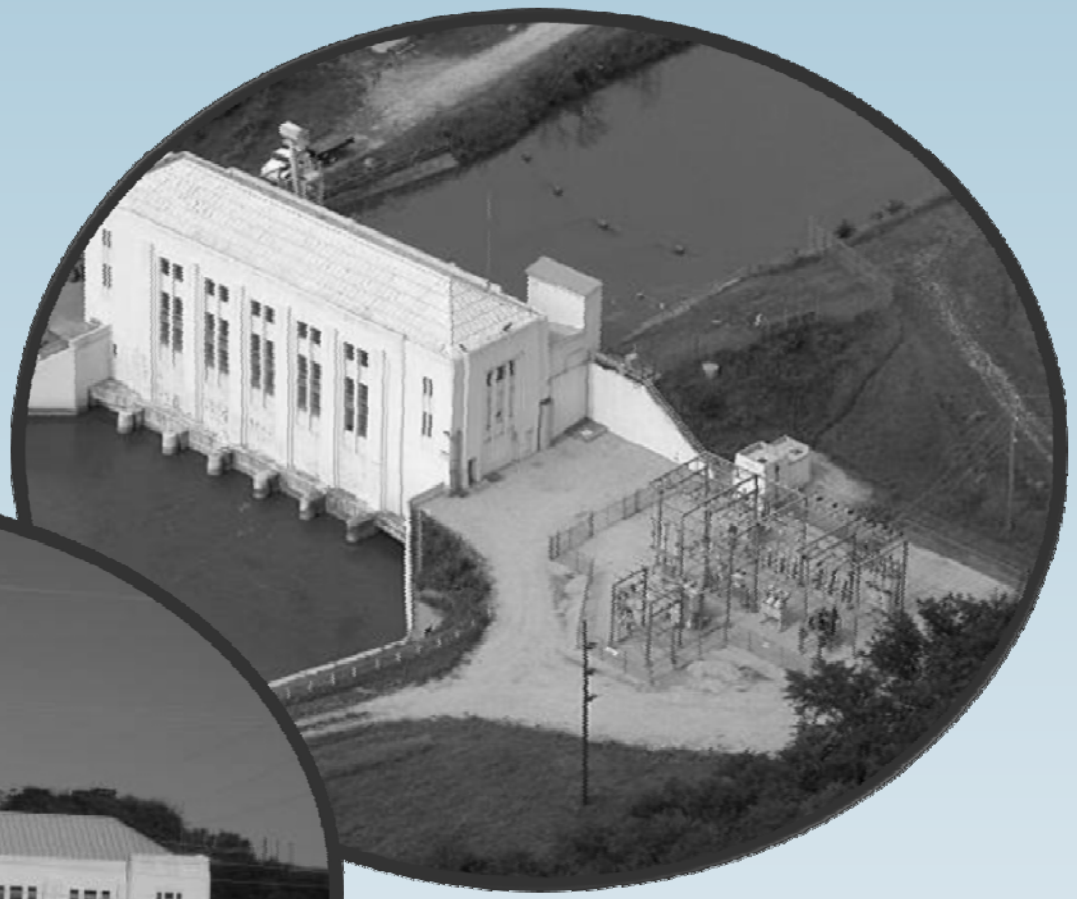
- Field verified land use maps developed
- Public access locations identified and mapped
- Potential land use conflicts identified and determined to be compatible

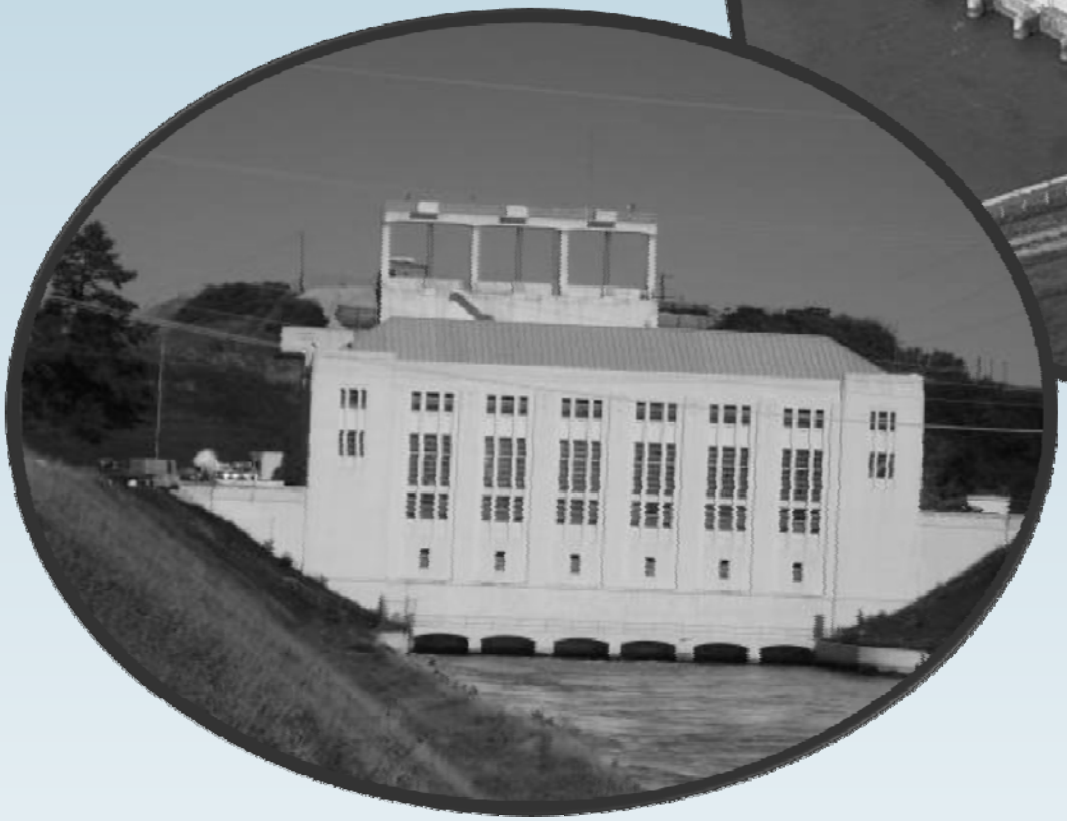
10. Land Use Inventory

Conclusions:

- Project land use and operations were found to be compatible with adjacent properties
- Future land use plans for Nance County and the City of Columbus do not indicate future land use conflicts
- Restricted Operations Areas are safely separated from publicly accessible areas and do not conflict with recreation opportunities
- Approximately 90% of the Project lands are accessible to the public from numerous locations

11. Section 106 Compliance





11. Section 106 Compliance

Goal

- Achieve NHPA Section 106 compliance through a programmatic, ongoing consultation relationship between the District and the Nebraska SHPO.

11. Section 106 Compliance

Objectives

1. To review existing information with FERC and the Interested Parties (Nebraska SHPO, the Pawnee Tribe, the Iowa Tribe of Kansas and Nebraska, the Omaha Tribe, the Santee Sioux Tribe, and the Ponca Tribe of Nebraska) to identify consultation needs and additional archival and field data collection requirements
2. To gather sufficient information to identify any historic properties that may be affected by the Project
3. To conduct field studies to identify and evaluate historic properties, including archaeological properties and elements of the standing structure/built environment as well as properties of traditional religious and cultural value important to Native American tribes

11. Section 106 Compliance

Objectives (continued)

4. To document the historic properties in the Area of Potential Effects (APE) and, as applicable, present management recommendations in technical reports, an ethnographic memorandum, and a historic district documentation package
5. To develop, in consultation with Nebraska SHPO, Native American tribes, and ACHP, a Historic Properties Management Plan (HPMP) in accordance with FERC guidelines (FERC, May 20, 2002)
6. To develop a Programmatic Agreement (PA) to complete the Section 106 compliance process and to incorporate in the Project license (this is a standard procedure carried out by FERC)

11. Section 106 Compliance

Study Area

- Area of Potential Effect (Project Boundary)
  - Encompasses the entirety of the District's holdings subject to FERC relicensing
  - Nebraska SHPO concurred that the Project Boundary is the APE on January 23, 2009.

11. Section 106 Compliance

Methodology

- Phase IA Archaeological Overview
- Phase I/II Archaeological Inventory and Evaluation
- Ethnographic Documentation
- Historic District Inventory and Evaluation
- Historic Properties Management Plan
- Executed Programmatic Agreement

11. Section 106 Compliance

Results - *Phase IA Archaeological Overview*

- Determined that field exams were necessary for eight areas within the Project Boundary that appear to be undisturbed since the 1930s, or that are within or near documented archaeological sites
- Nebraska SHPO concurred with recommendations in Phase IA Archaeological Overview on November 11, 2009
- Filed with FERC as privileged information on December 4, 2009

11. Section 106 Compliance

Results - *Phase I/II Archaeological Inventory and Evaluation*

- Eighty-three shovel tests completed:
  - Prehistoric archaeological material was found in three tests
  - Historic artifacts were recovered from four tests
- One site is recommended eligible for listing on the NRHP
- Other sensitive areas of the canal corridor were identified for management through consultation with Nebraska SHPO
- Report submitted to SHPO for concurrence on August 27, 2010

11. Section 106 Compliance

Results - *Ethnographic Documentation*

- Initial Coordination with tribes
  - Ponca Tribe of Oklahoma, Ponca Tribe of Nebraska, Omaha Tribe, Pawnee Tribe, Winnebago Tribe, Santee Sioux Nation –
  - none responded with information related to places that are of traditional religious and cultural importance.
  - Winnebago Tribe will not participate in relicensing
- Tribes provided opportunity to review Phase IA
  - none responded
- Phase I/II Archaeological Inventory and Evaluation
  - Provided to tribes for comment

11. Section 106 Compliance

Results - *Historic Building Inventory and Evaluation*

- Project is a historic district eligible for the NRHP
- Eligible elements include 16 properties that exhibit individual eligibility and 21 properties that lack individual eligibility but contribute to the historic district
- The historic district also includes numerous non-contributing properties that are not eligible for listing on the NRHP.
- Historic Building Inventory and Evaluation
  - Submitted to SHPO on August 27, 2010

11. Section 106 Compliance

Results - *Historic Properties Management Plan & Executed Programmatic Agreement*

- Development of the HPMP is pending review and approval of the studies for archaeology, ethnography, and the historic district.
- Development and execution of the PA is pending review and approval of the studies archaeology, ethnography, and the historic district as well as approval of the HPMP.

PCB Fish Tissue Sampling

PCB Fish Tissue Sampling

Goal

- To determine if Project operations affect Polychlorinated Biphenyl (PCB) transport, and subsequently fishery resources, in the Project Area.

Objective

- Determine if the tissue of bottom-feeding fish, collected from two locations within the Project Area, contain PCB's.

PCB Fish Tissue Sampling

Study Area

- Loup Power Canal – two locations
  - Lake Babcock
  - Tailrace Canal at the U.S. Highway 30 Bridge

PCB Fish Tissue Sampling

Results

- NDEQ conducted sampling
  - Lake Babcock sampled on August 11, 2009
  - Tailrace Canal (U.S. Highway 30 bridge) sampled on August 12, 2009.
- Fillets were provided to the EPA Region VII laboratory in Kansas City, Kansas, for PCB analysis.

PCB Fish Tissue Sampling

Results

- PCB (Aroclor 1248, 1254, and 1260) concentrations at each site were below the applicable reporting limits.
- Results have not been officially reported by NDEQ
  - Data will be included in NDEQ's 2009 Fish Tissue Report once all statewide data has been assessed.
- NDEQ: “the current fish consumption advisory for the Loup Power Canal will likely be removed, following completion of the 2009 Fish Tissue Report in late 2010 or early 2011”

1. Sedimentation

1. Sedimentation

Goals

- 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.

1. Sedimentation

Objectives

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

1. Sedimentation

Objectives (continued)

3. To determine if a relationship can be detected between sediment transport parameters and interior least tern and piping plover nest counts (as provided by the Nebraska Game and Parks Commission [NGPC]) and productivity measures.
4. To determine if sediment transport is a limiting factor for pallid sturgeon habitat in the lower Platte River below the Elkhorn.

1. Sedimentation

Objective

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

Conclusions – Objective 1

- Both rivers at all locations studied are clearly not supply limited.
- Spatial analysis of effective and dominant discharge reveal that they increase in a downstream direction in a manner consistent with natural river processes.
- The effective discharge, and associated river morphology, has not changed since 1928.

Conclusions – Objective 1

- Sediment transport calculations show that the channel geometries are in “regime”. Nothing appears to be constraining either the Loup or Platte River from maintaining the hydraulic geometry associated with the effective discharges.
- The combinations of slopes, sediment sizes, and effective discharges result in all locations being well within the braided river morphologies, with none being near any thresholds of transitioning to another morphology.

1. Sedimentation

Objective

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

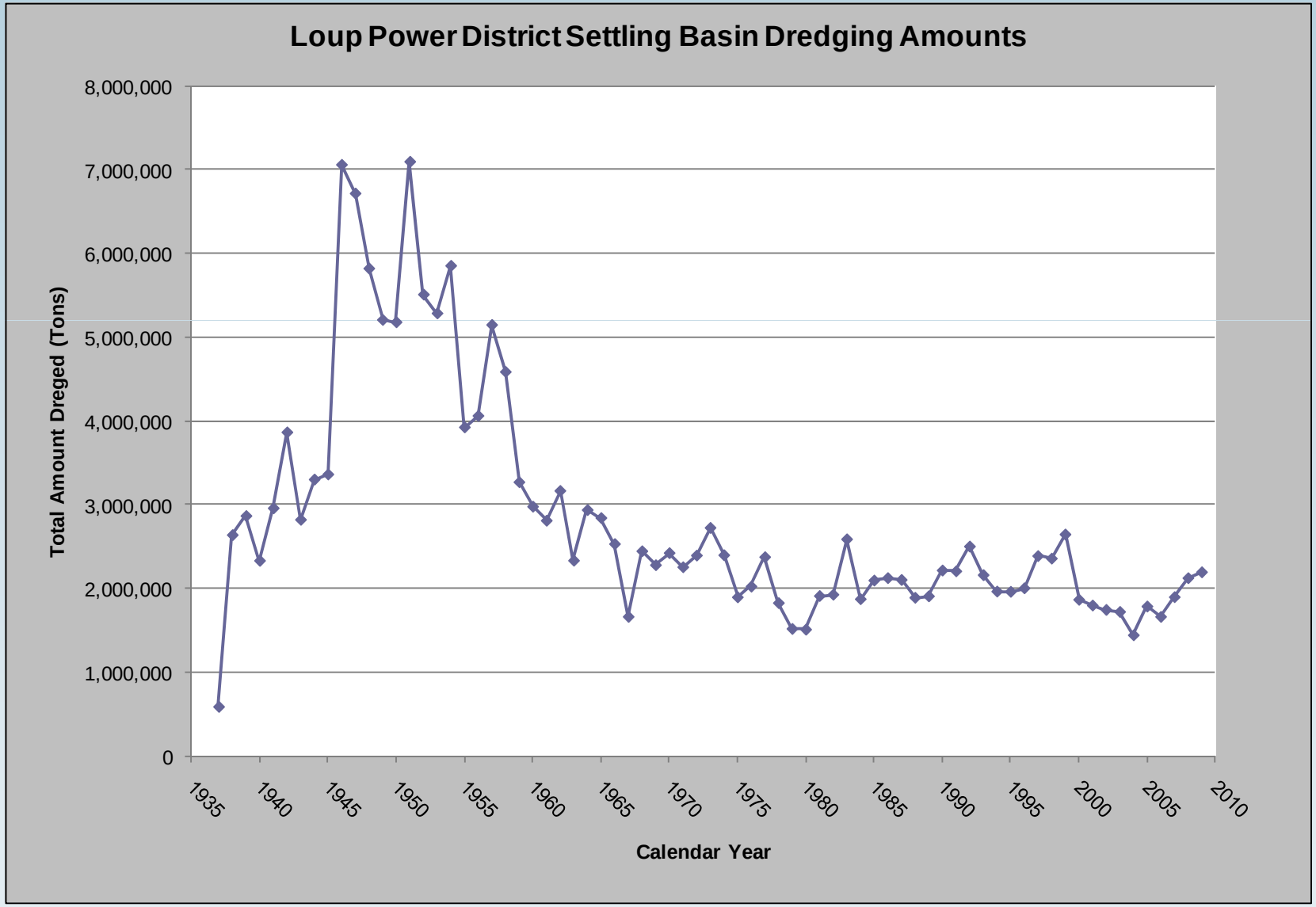
Associated Tasks

- Sediment budget
- Effective discharge and other sediment transport calculations
- Regime Analysis

Sediment Budget

- The calculated sediment yield for the Loup River and its tributaries downstream of the Diversion Weir as well as downstream of the Tailrace Weir was adjusted based on documented reductions from the Settling Basin.

Sediment Budget



Sediment Budget

- Reduction factor based on ratio of amount dredged from 1975 to 2009 and amount dredged from 1940 to 1974.
  - Average annual amount dredged between 1975 and 2009 was 2.0 million tons/year.
  - Average annual amount dredged between 1940 and 1974 was 3.75 million tons/year.
  - Resulting ratio of yield reduction is 0.534.
- Applied ratio to yield above the diversion and yield of Loup River basins below the diversion.

Sediment Budget

Watershed or Reach Name	Sediment Yield	
	MRBC Accumulative Total (tons/yr)	New Study Total (tons/yr)
Subbasin total above Diversion Weir	7,825,100	4,179,100
Sediment removed from Settling Basin	1,900,000	2,004,800
Sediment passing down Loup Power Canal	700,000	700,000
South Sand Management Area	NA	560,000
Subbasin total below Diversion Weir near Genoa	5,225,100	2,030,000
Loup Watershed below Genoa	1,860,300	993,500
Sediment yield at Columbus	6,970,000	2,960,000
Tailrace return + Loup bottom	2,210,300	1,343,500
Loup Subbasin yield to Platte River at Columbus	7,435,400	3,373,500
Upper Platte Subbasin total to Platte River at Columbus	1,865,400	1,870,000
Yield of Upper Platte and Loup Subbasins to lower Platte	9,300,800	5,243,500
Subbasins at Columbus		
Yield to Platte (North Bend)	9,885,900	5,770,000
Platte Tributaries (Leshara)	9,956,900	5,850,000
Platte Basin yield including Elkhorn (Ashland)	14,666,600	10,610,000
Yield from Platte Basin at Louisville	16,840,000	12,780,000

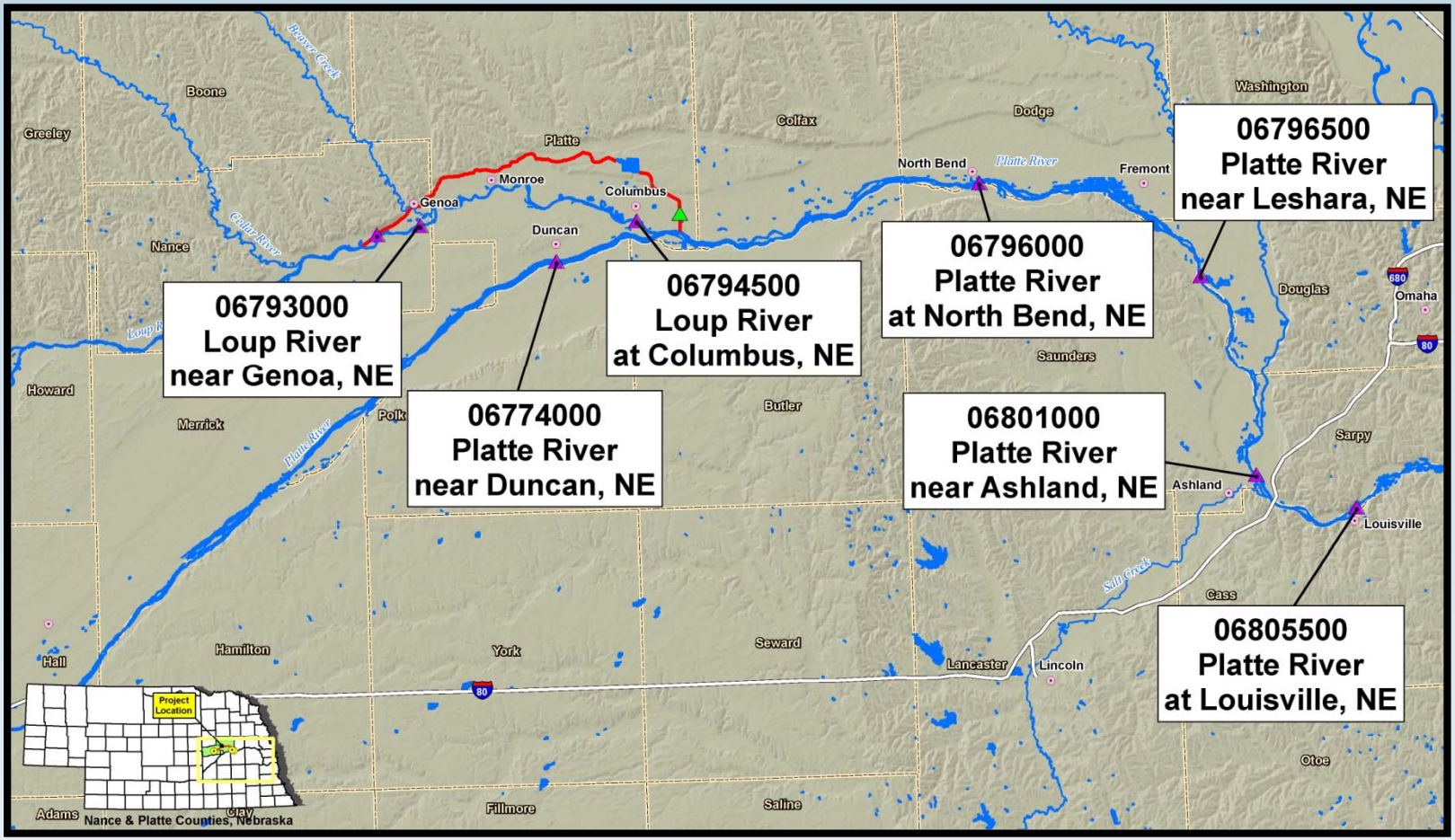
Effective Discharge and Other Sediment Transport Calculations

Associated Tasks

- Generate Sediment Discharge Rating Curves
- Generate Collective Sediment Discharge Curves
- Determine Sediment Transport Indicators
  - Effective Discharge
  - Total Sediment Transport
  - Dominant Discharge
- Regime Analysis

Effective Discharge and Other Sediment Transport Calculations

Study Area



Sediment Discharge Rating Curve

- Relationship between flow and the sediment that is transported by that flow
  - Yang's Unit Stream Power Method

$$\log C_t = 5.435 - 0.286 \log(\omega d/\nu) - 0.457 \log(U_*/\omega) + [1.799 - 0.409 \log(\omega d/\nu) - 0.314 \log(U_*/\omega)] \times \log(VS/\omega - V_{cr}S/\omega)$$

$$V_{cr}/\omega = \frac{2.5}{\log(U_* d/\nu) - 0.06} + 0.66 \quad , \quad 0 < (U_* d/\nu) < 70$$

and

$$V_{cr}/\omega = 2.05, \quad 70 \leq (U_* d/\nu)$$

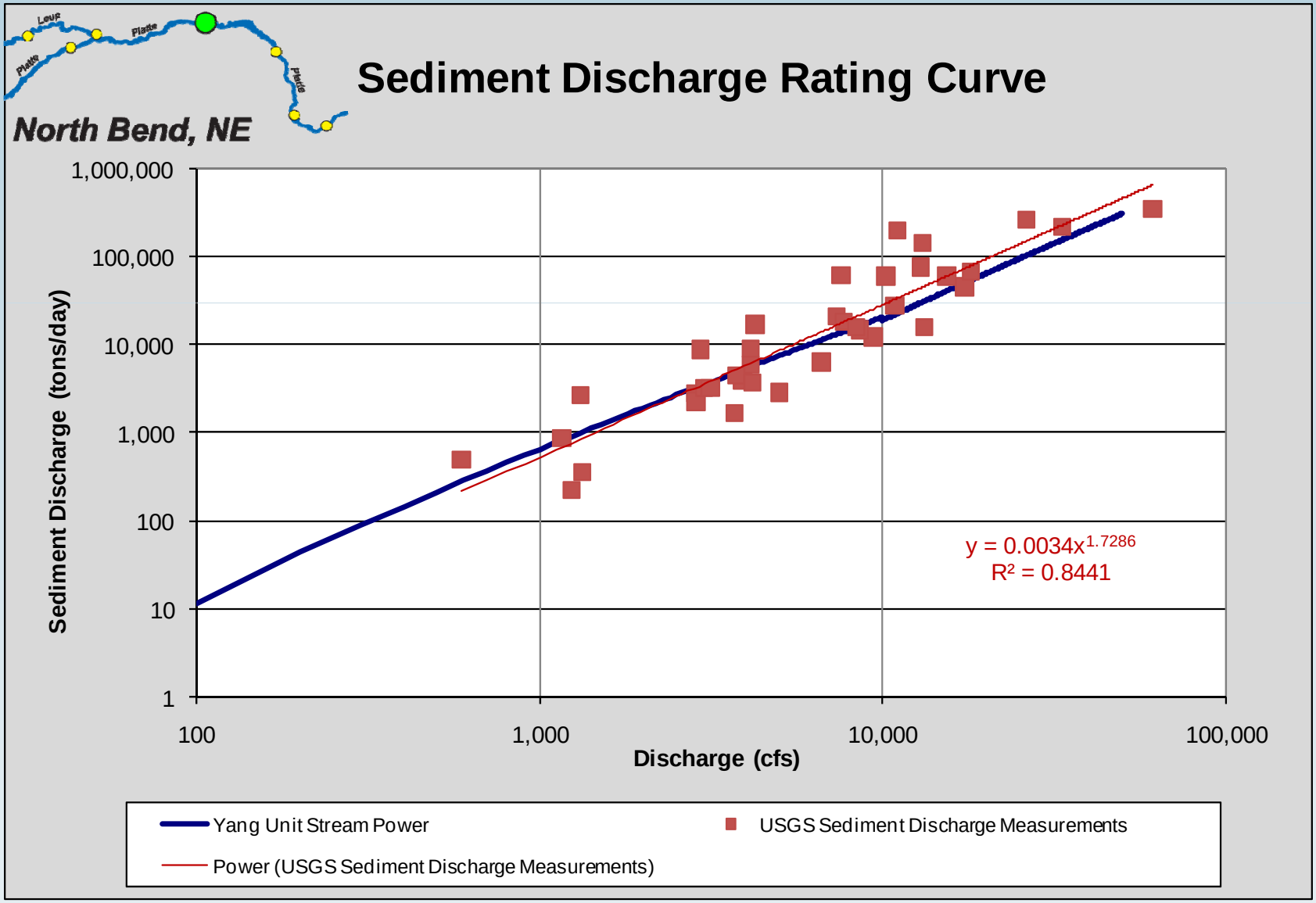
Sediment Discharge Rating Curve

- Yang's Unit Stream Power Equation (Yang and Stall, 1974)
- Proven use in braided systems including the Middle Loup
- Required variables
  - Velocity
  - Depth
  - Energy Slope
  - Particle Size
  - Kinematic Viscosity
  - Fall Velocity

Sediment Discharge Rating Curve

- Velocity and Depth
  - USGS measurements
- Energy Slope
  - USGS, Bentall (1991), and USACE FIS Models
- Particle Size
  - USGS measurements
- Kinematic Viscosity
  - Assumed 15° C (USACE 1990)
- Fall Velocity
  - Van Rijn equation

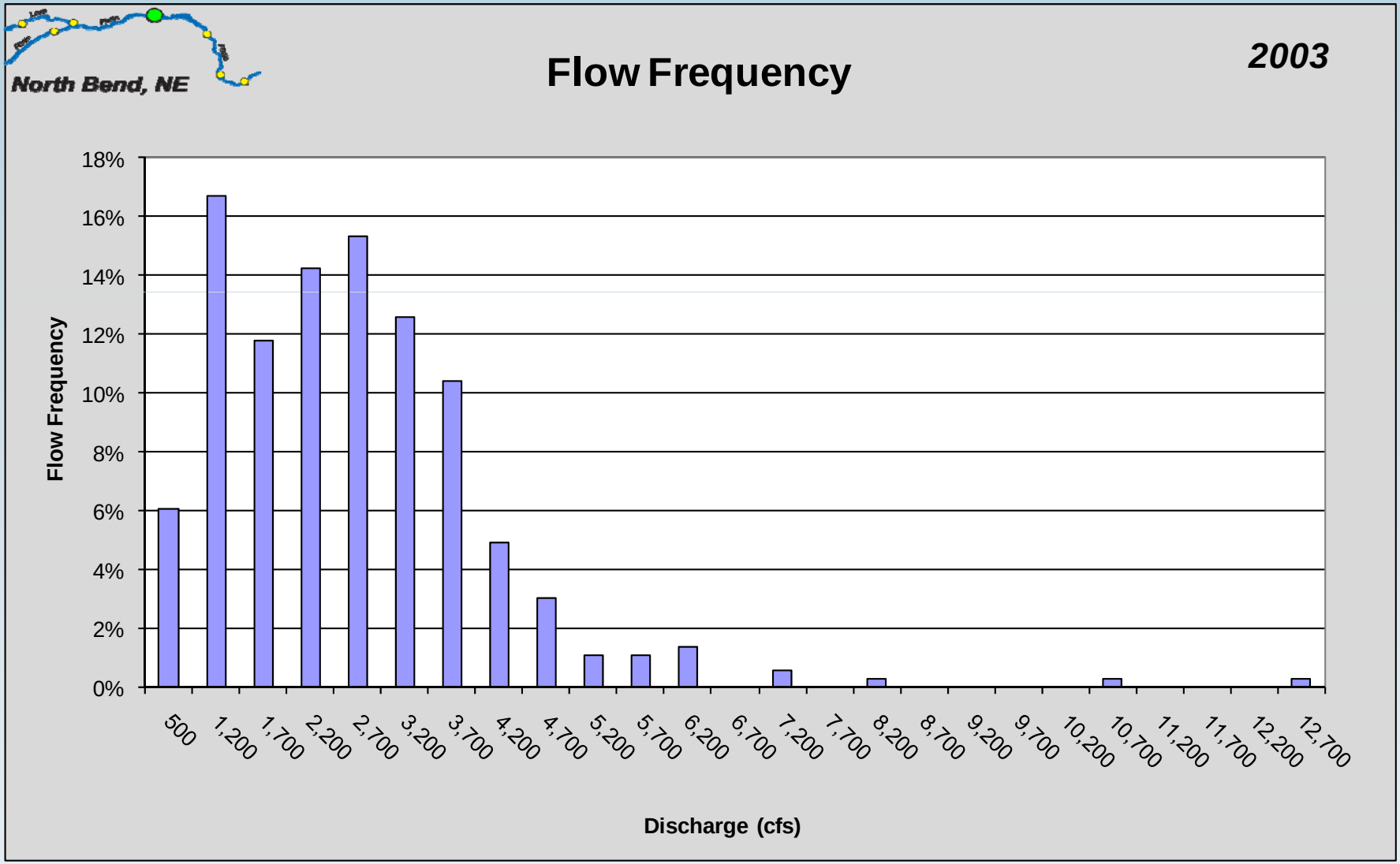
Sediment Discharge Rating Curve Example



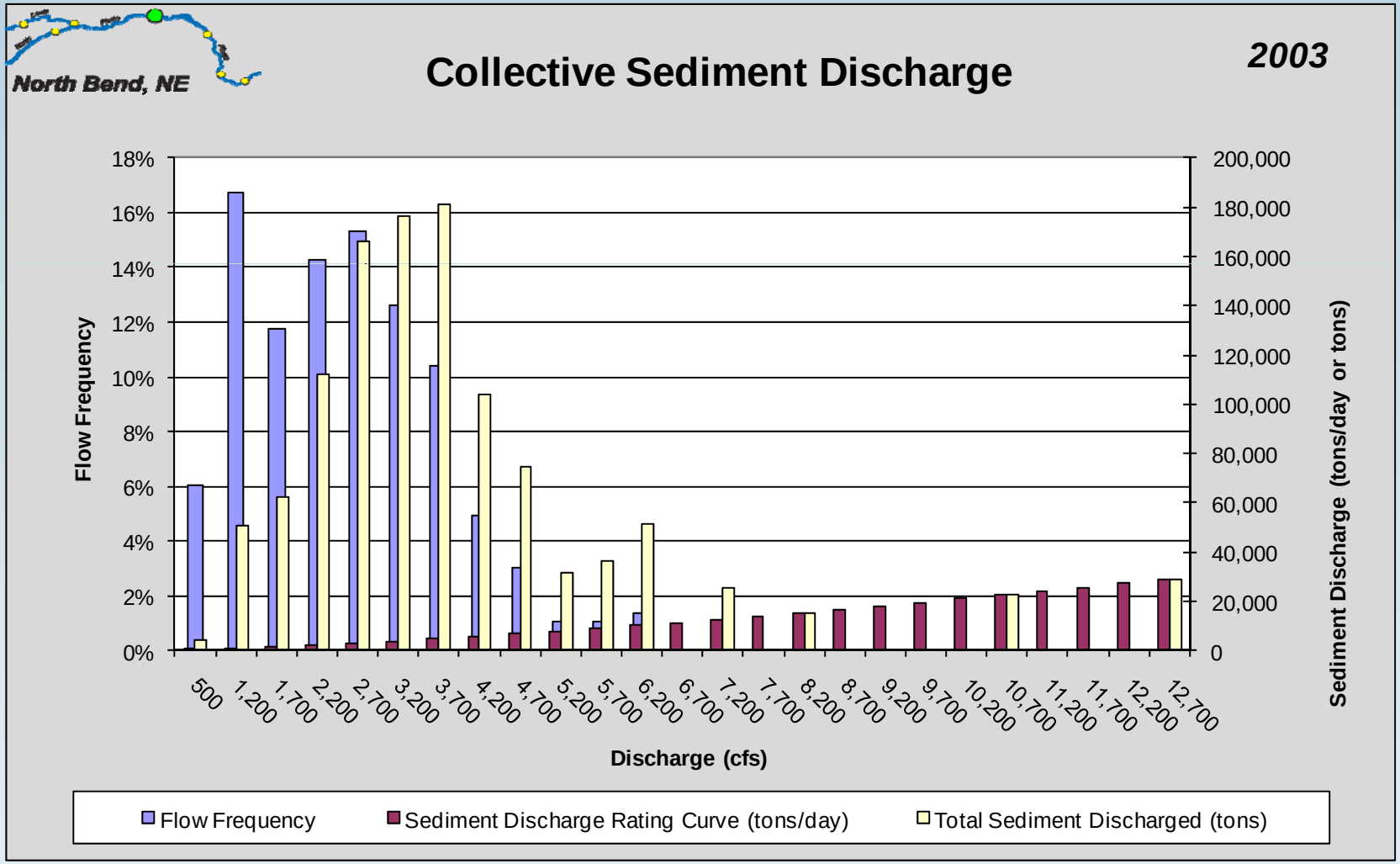
Effective Discharge and Other Sediment Transport Calculations

- Collective Sediment Discharge Curve
  - Combination of Flow Frequency Curve and Sediment Discharge Rating curve
- Flow Frequency Curve
  - 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

Flow Frequency Example



Collective Sediment Discharge Example



Effective Discharge and Other Sediment Transport Calculations

- Sediment Transport Indicators
  - Total Sediment Transport Capacity
  - Effective Discharge
  - Dominant Discharge

Total Sediment Transport Capacity

- Total sediment carried for a period of interest based on the sediment discharge rating curve and the corresponding flow hydrograph.

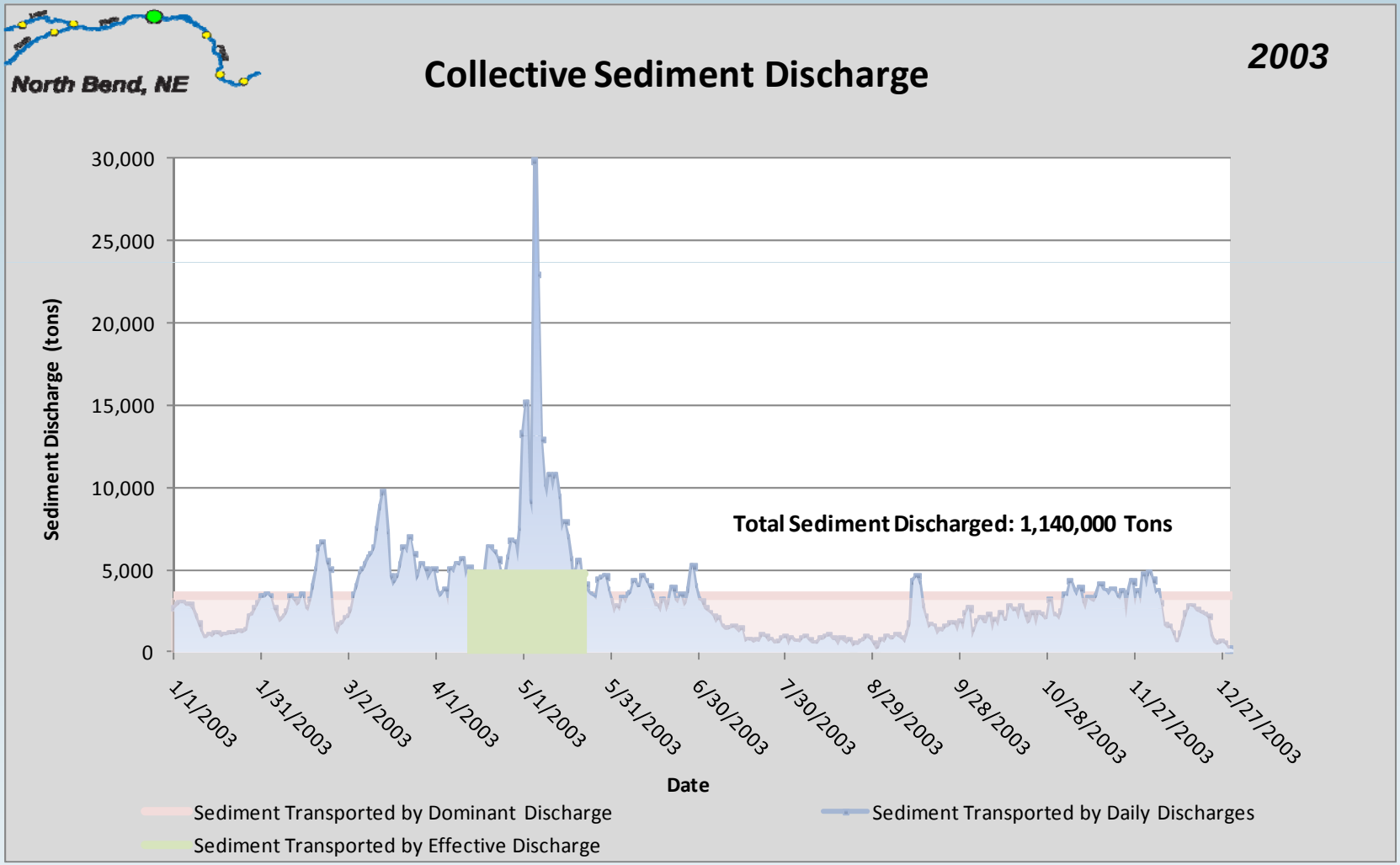
Effective Discharge

- 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
- Due to subjectivity, suggested for use in long term analysis (>year)

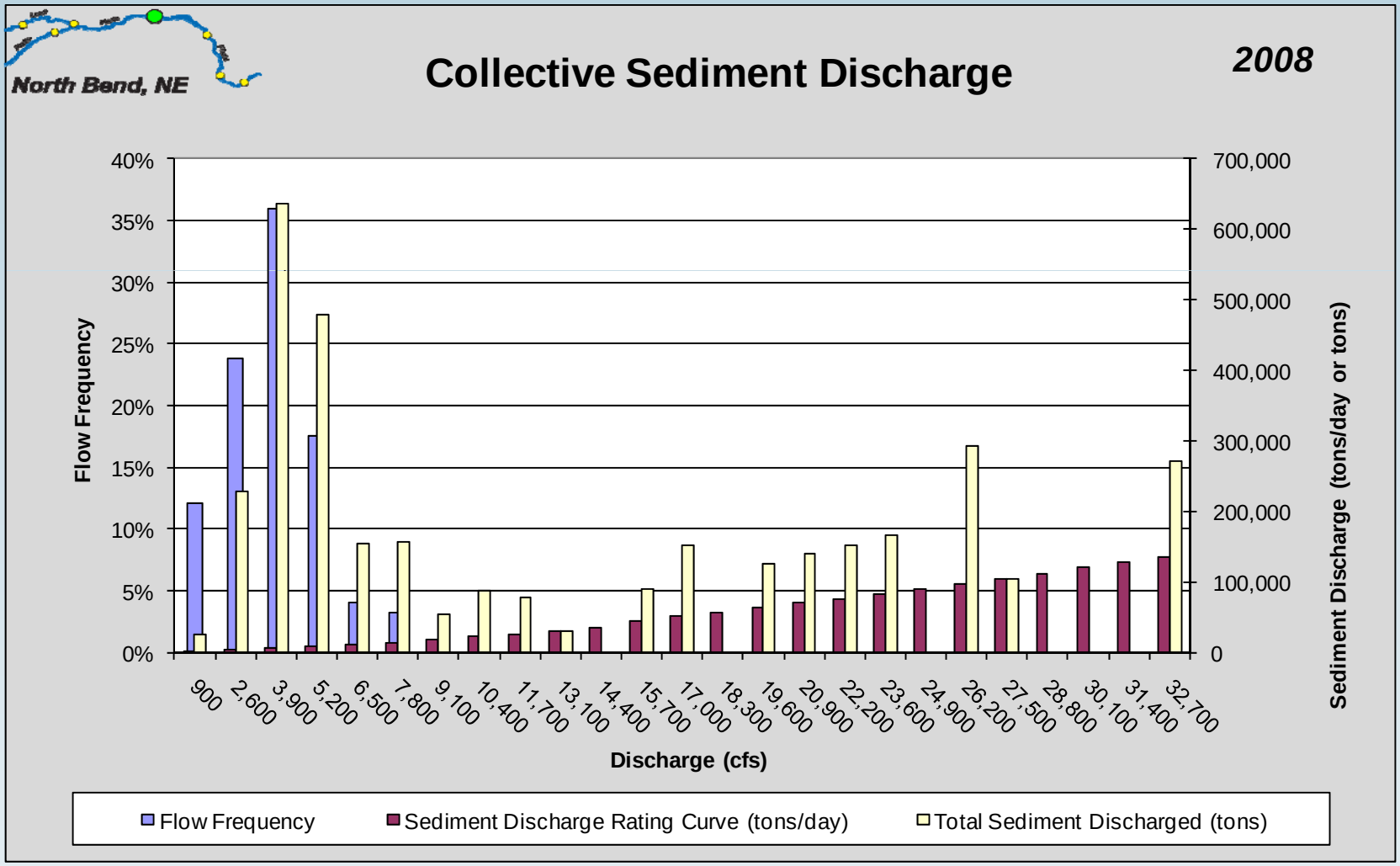
Dominant Discharge

- Average flow that transports the same amount of sediment as the actual hydrograph
- Also used to assess channel characteristics - width and depth
- Can be used for shorter analysis periods (<year)

Collective Sediment Discharge Example



Collective Sediment Discharge Example



North Bend in 2008 Example

Event Description	Flow Rate (cfs)	Duration	Total Sediment Transport Capacity (tons)
1.5 Year Return Interval	17,100	1 day	48,000
Event around 1.5 Year Flow	Ave. Event Flow: 8,140	9 days	152,000
Effective Discharge in 2008	3,900 (3,200 – 4,500)	125 days	640,000

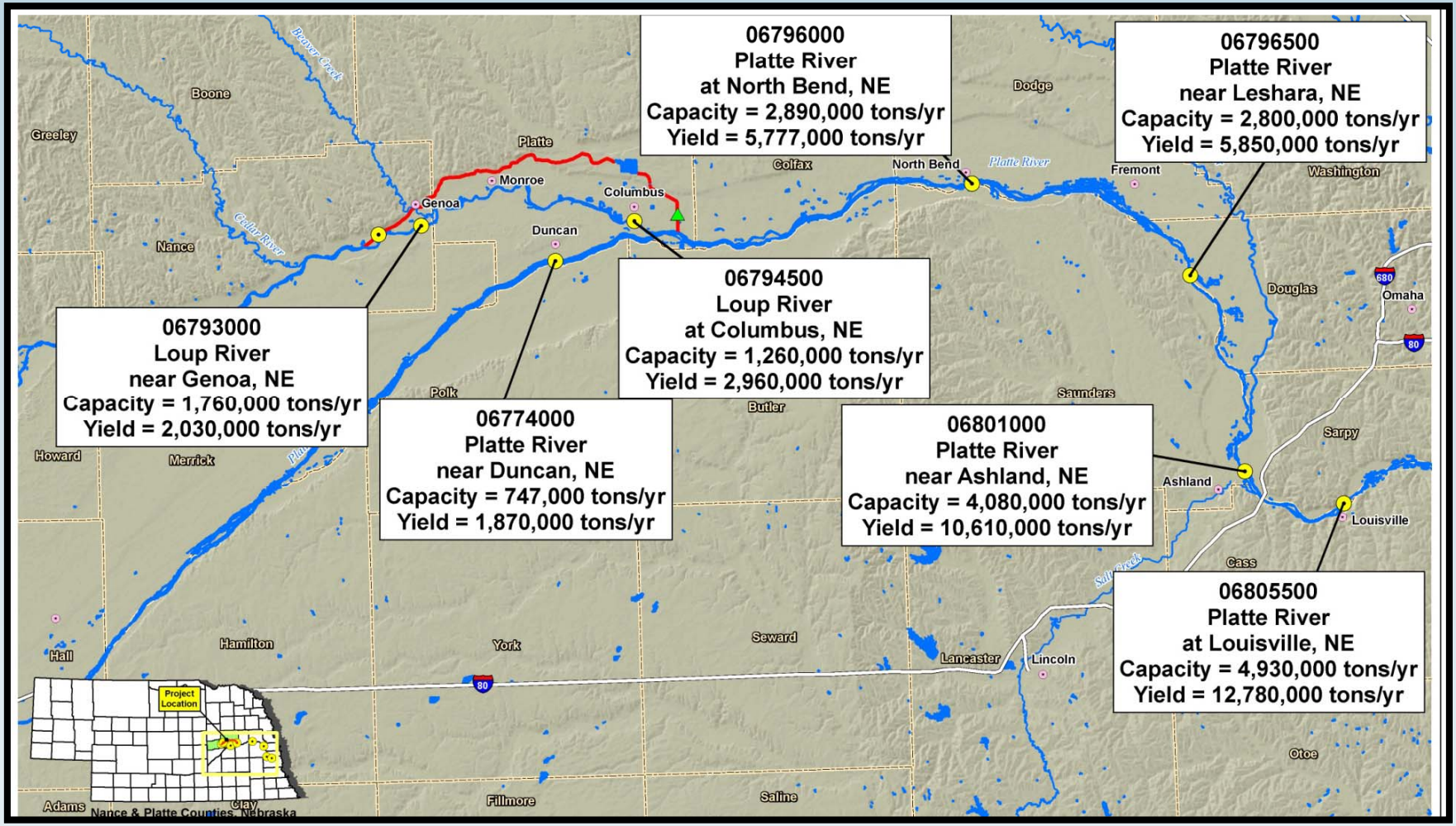
Effective Discharge and Other Sediment Transport Calculations

USGS Gage Number	Gage Name and Location	Mean Daily Discharge (cfs)	Effective Discharge (cfs)	Effective Discharge Range Low (cfs)	Effective Discharge Range High (cfs)	Dominant Discharge (cfs)	Approx. Return Interval (years)	1.5 Return Interval Flow Rate (cfs)	Flow Duration% Exceeded - Qe	Flow Duration% Exceeded - Dom
06793000	Loup River near Genoa, NE	950	2,400	1,800	3,000	1,350	<1.01	10,740	7	17
06794500	Loup River at Columbus, NE	1,150	2,400	2,110	2,770	1,500	<1.01	9,330	NA	NA
06774000	Platte River near Duncan, NE	1,850	3,000	2,880	3,200	2,240	1.05	5,140	16	27
06796000	Platte River at North Bend, NE	4,670	5,630	3,440	6,730	5,280	<1.01	17,100	28	26
06796500	Platte River at Leshara, NE	4,830	5,750	4,360	6,450	5,260	<1.01	17,100	29	35
06801000	Platte River near Ashland, NE	6,540	7,000	4,770	9,150	7,360	<1.01	27,000	25	21
06805500	Platte River at Louisville, NE	7,930	7,500	5,830	11,340	9,020	<1.01	30,400	30	20

Effective Discharge and Other Sediment Transport Calculations

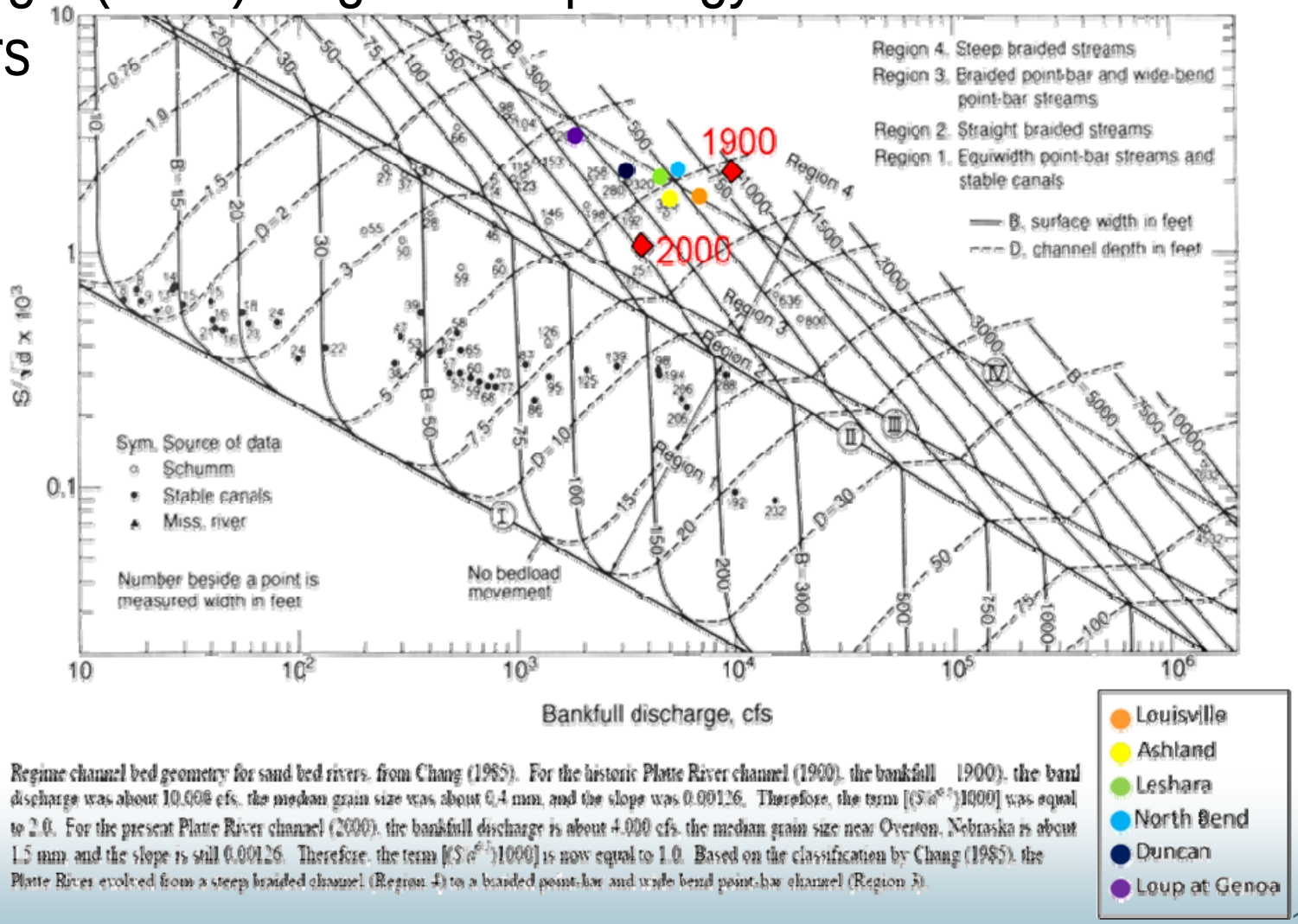
USGS Gage Number	Gage Name and Location	Drainage Area (square miles)	Annual Sediment Data (tons/year)	
			Capacity	Yield
06793000	Loup River near Genoa, NE	14,320	1,760,000	2,030,000
06794500	Loup River at Columbus, NE	15,200	1,260,000	2,960,000
06774000	Platte River near Duncan, NE	59,300	747,000	1,870,000
06796000	Platte River at North Bend, NE	70,400	2,890,000	5,770,000
06796500	Platte River at Leshara, NE	NA	2,800,000	5,850,000
06801000	Platte River near Ashland, NE	84,200	4,080,000	10,610,000
06805500	Platte River at Louisville, NE	85,370	4,930,000	12,780,000

Effective Discharge and Other Sediment Transport Calculations



Regime Analysis

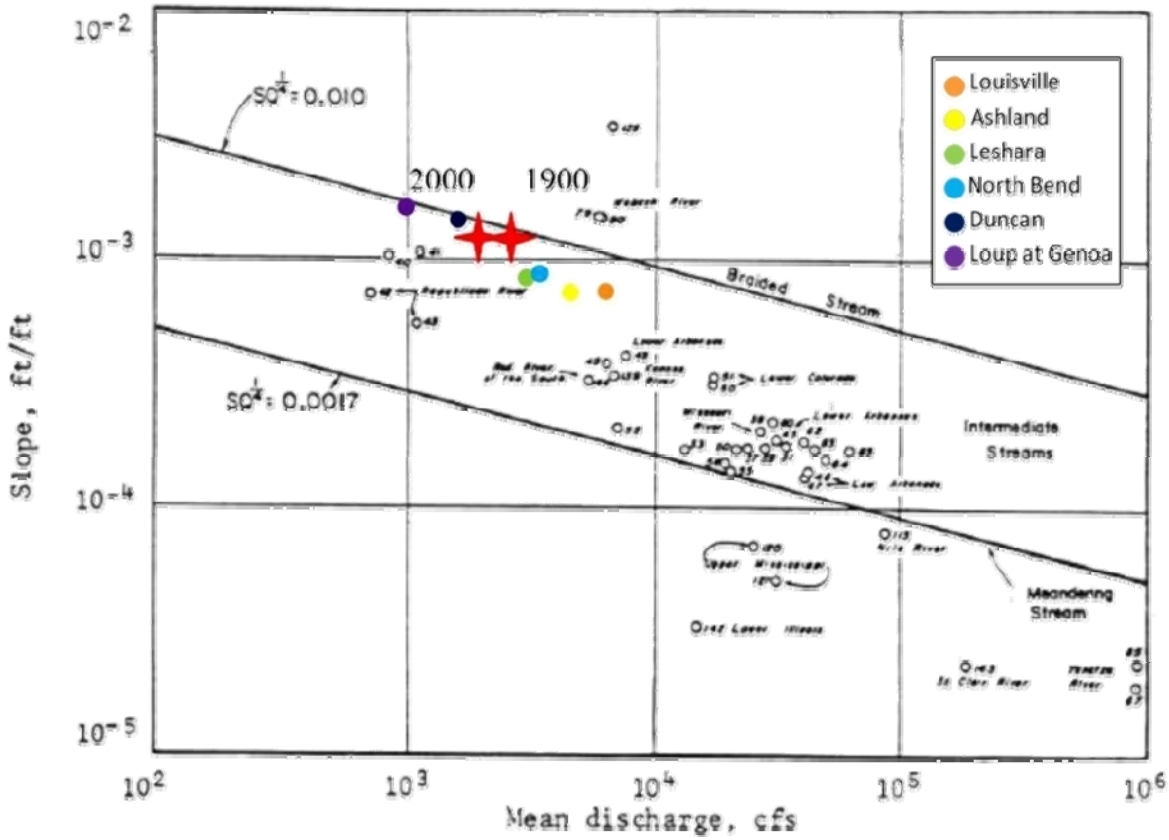
Chang's (1985) Regime Morphology Chart for Sand Bed Rivers



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

Regime Analysis

Lane's (1957) Regime Morphology Chart for Sand Bed Rivers



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

Conclusions – Objective 1

- Both rivers at all locations studied are clearly not supply limited.
- Spatial analysis of effective and dominant discharge reveal that they increase in a downstream direction in a manner consistent with natural river processes.
- The effective discharge, and associated river morphology, has not changed since 1928.

Conclusions – Objective 1

- Sediment transport calculations show that the channel geometries are in “regime”. Nothing appears to be constraining either the Loup or Platte River from maintaining the hydraulic geometry associated with the effective discharges.
- The combinations of slopes, sediment sizes, and effective discharges result in all locations being well within the braided river morphologies, with none being near any thresholds of transitioning to another morphology.

1. Sedimentation

Objective

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

Conclusions – Objective 2

- Literature and analysis clearly indicate that both rivers are in dynamic equilibrium with no indications of aggradation or degradation or channel geometry changes over time.
- Literature and calculations demonstrate that the Loup River bypass reach and the lower Platte River are in regime and well seated within regime zones classified as braided streams.

1. Sedimentation

Objective

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

Associated Tasks

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

Existing Literature

- USACE (1990)
  - Platte River Impacts Cumulative Impacts Analysis
- Peters and Parham (2007)
  - Ecology and Management of Sturgeon in the Lower Platte River, NE
- USBR (2004)
  - The Platte River Channel: History and Restoration
- USGS (1999)
  - Trends in Channel Gradation in Nebraska Streams
- USACE (2009)
  - Platte River at Fremont, NE, Existing Condition Stability Evaluation

Existing Literature

- USACE (1990)
  - “the river within the study reaches is in a state of quasi-equilibrium”
- Peters and Parham (2007)
  - the lower Platte River “retains most geomorphic characteristics of the [centuries old] historic Platte River”
- USBR (2004)
  - Regime analysis showed that the morphology of the Platte River is within the regime zones for braided rivers.

Existing Literature

- USGS (1999)
  - There was no evidence of any trend in aggradation or degradation in the Loup River at Genoa, Platte River at Duncan, Platte River at North Bend, and Platte River at Ashland.
  - A slight degrading trend was noted at Louisville, which was attributed to site-specific circumstances and not considered to be generic.

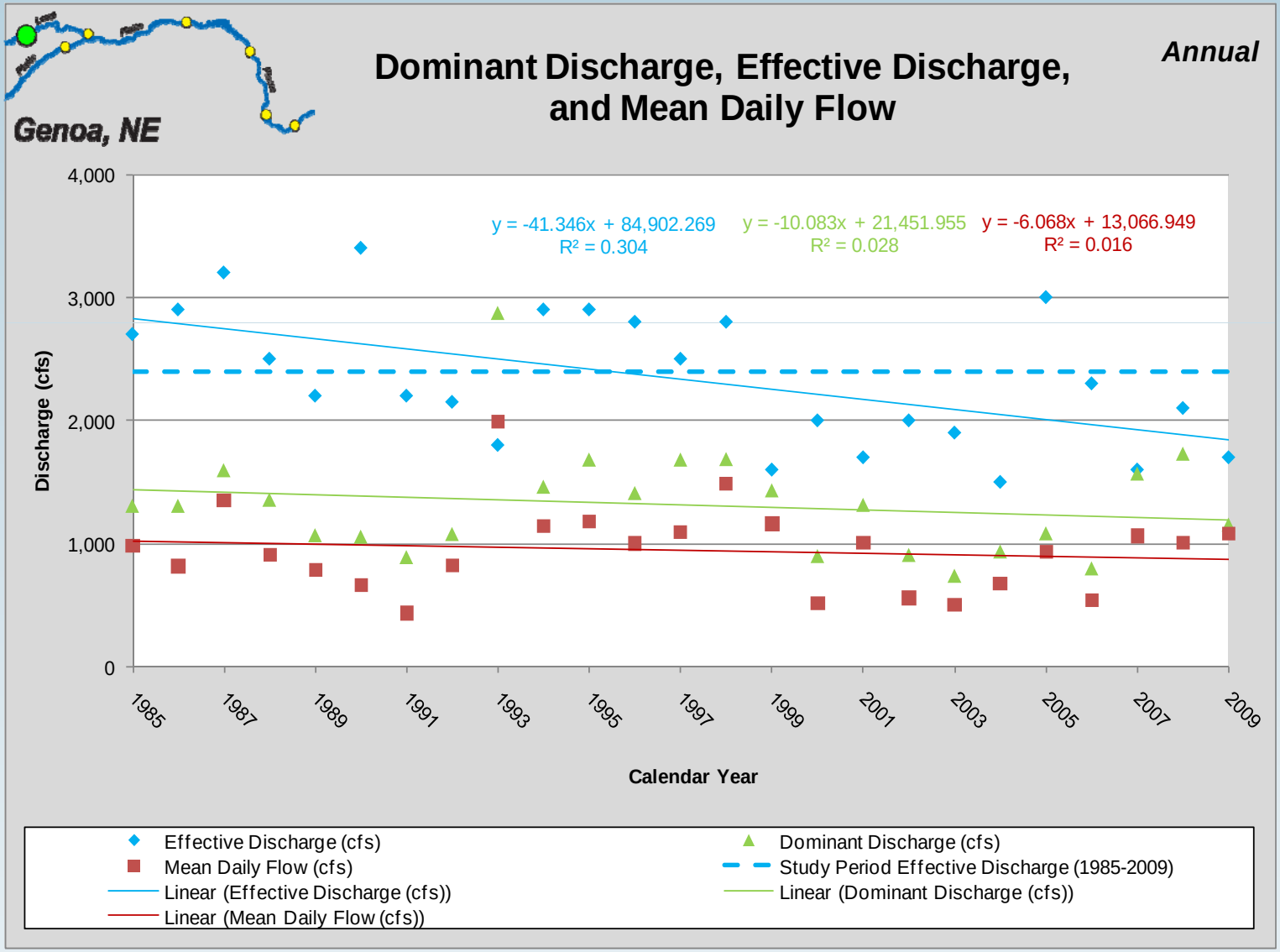
Existing Literature

- USACE (2009)
  - No information was discovered to indicate an ongoing change in the Platte River dynamic equilibrium within the study reach.
  - Specific gage plots illustrated stages vary from year to year reflecting natural channel dynamics.

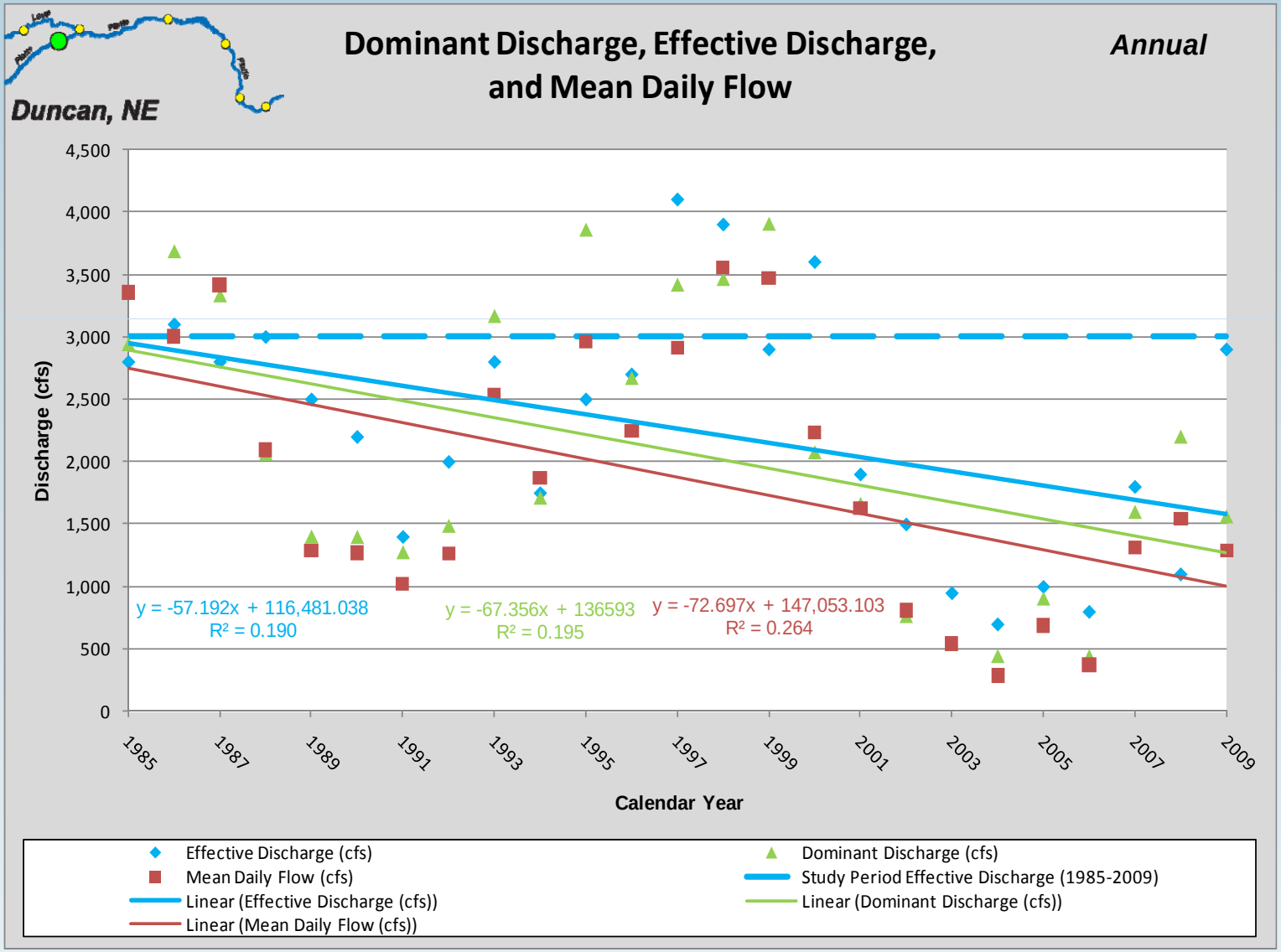
Sediment Transport Analysis

- Annual Trends in Flows and Effective and Dominant Discharges (Genoa and North Bend)
- Annual and Seasonal Trends in Channel Hydraulic Geometry (Genoa and North Bend)
- Regime Implications of Trends

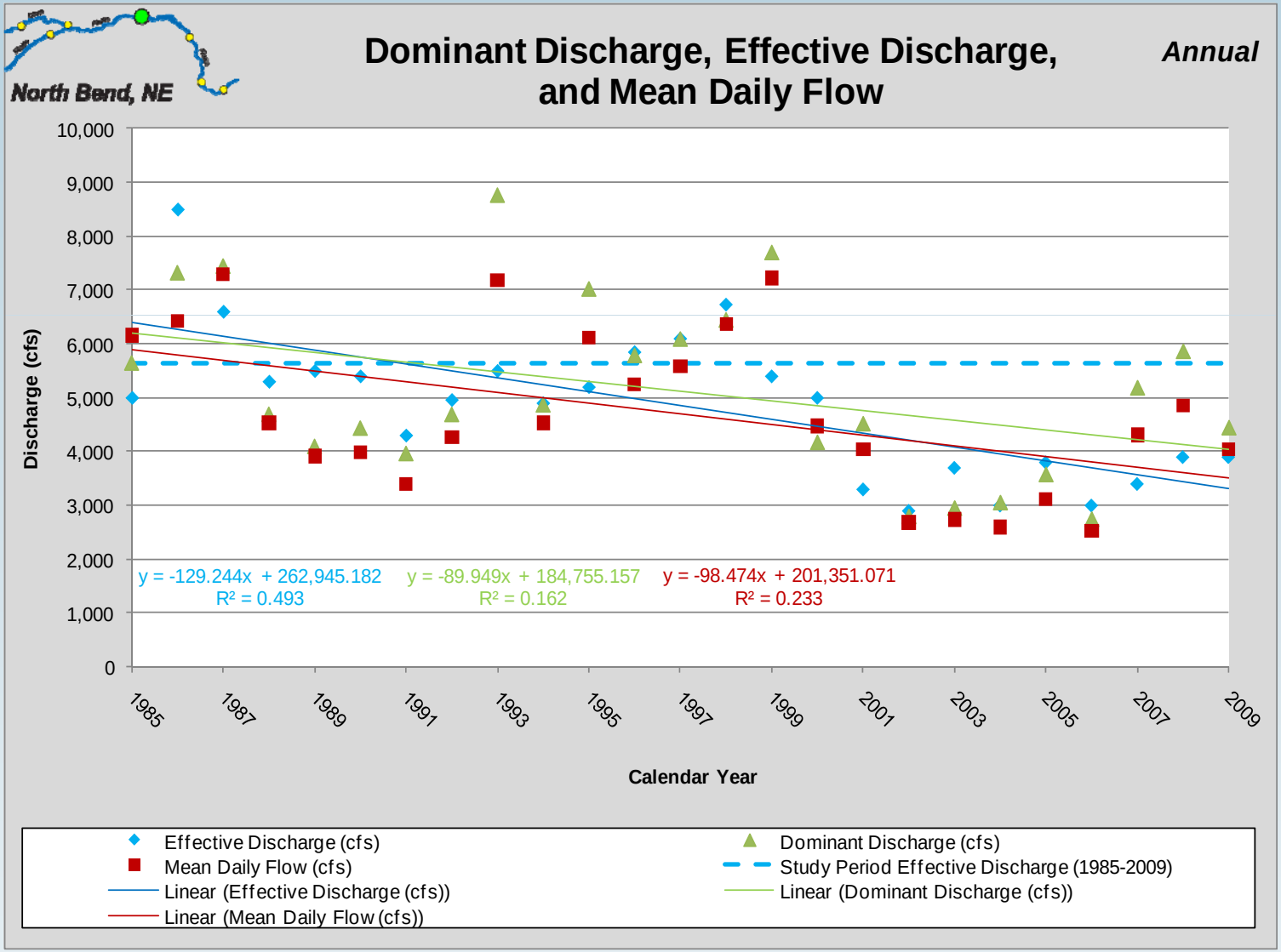
Stream Channel Morphology



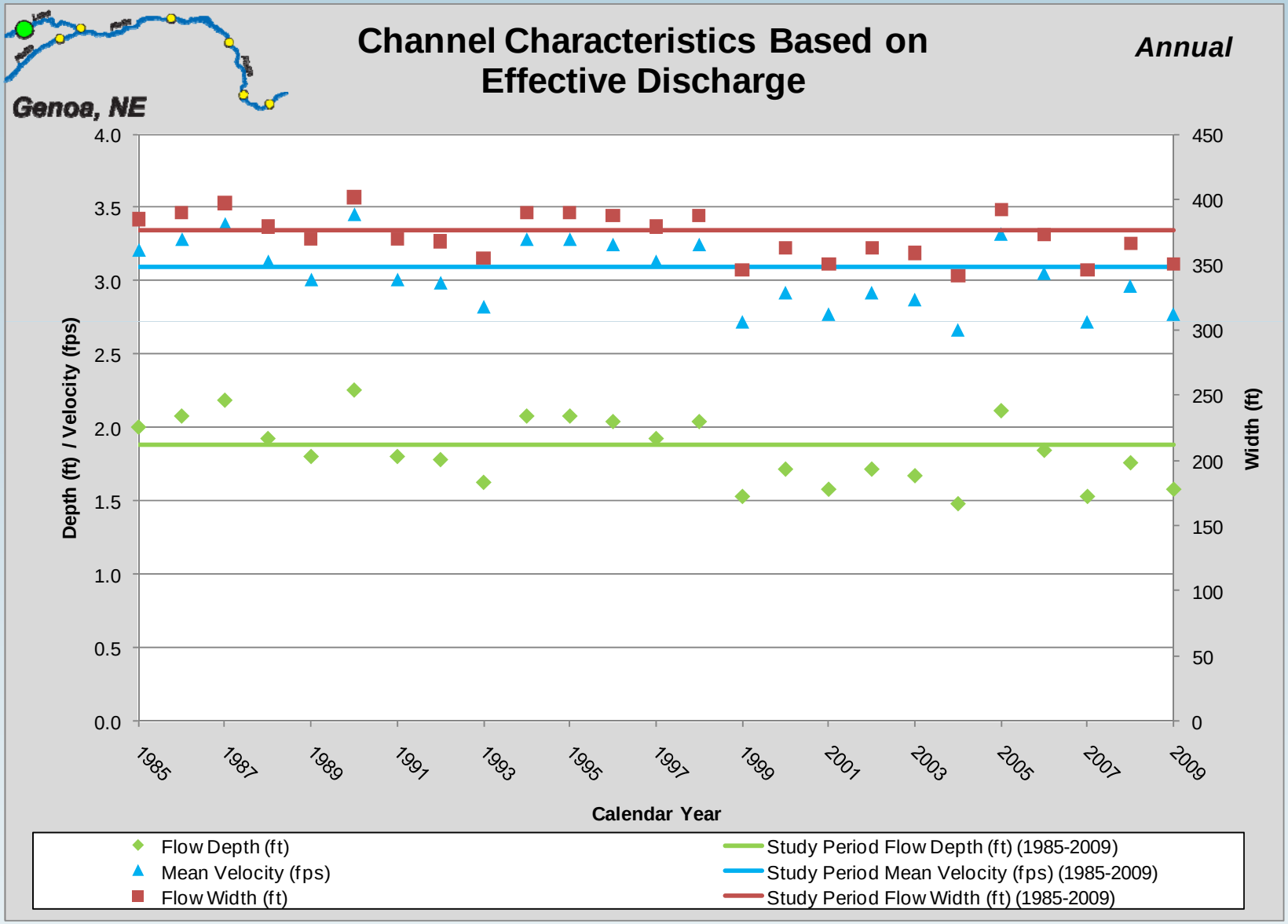
Stream Channel Morphology



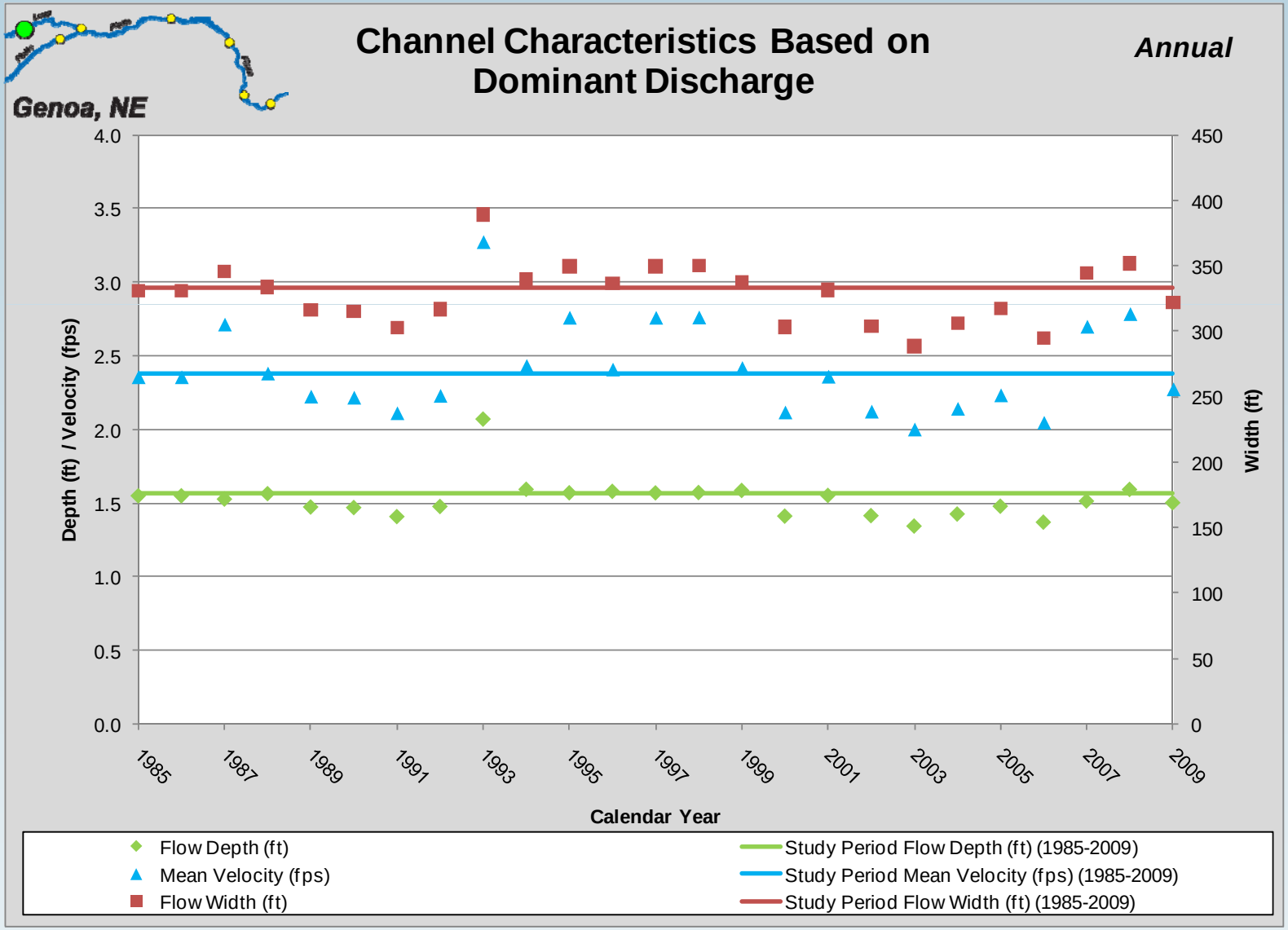
Stream Channel Morphology



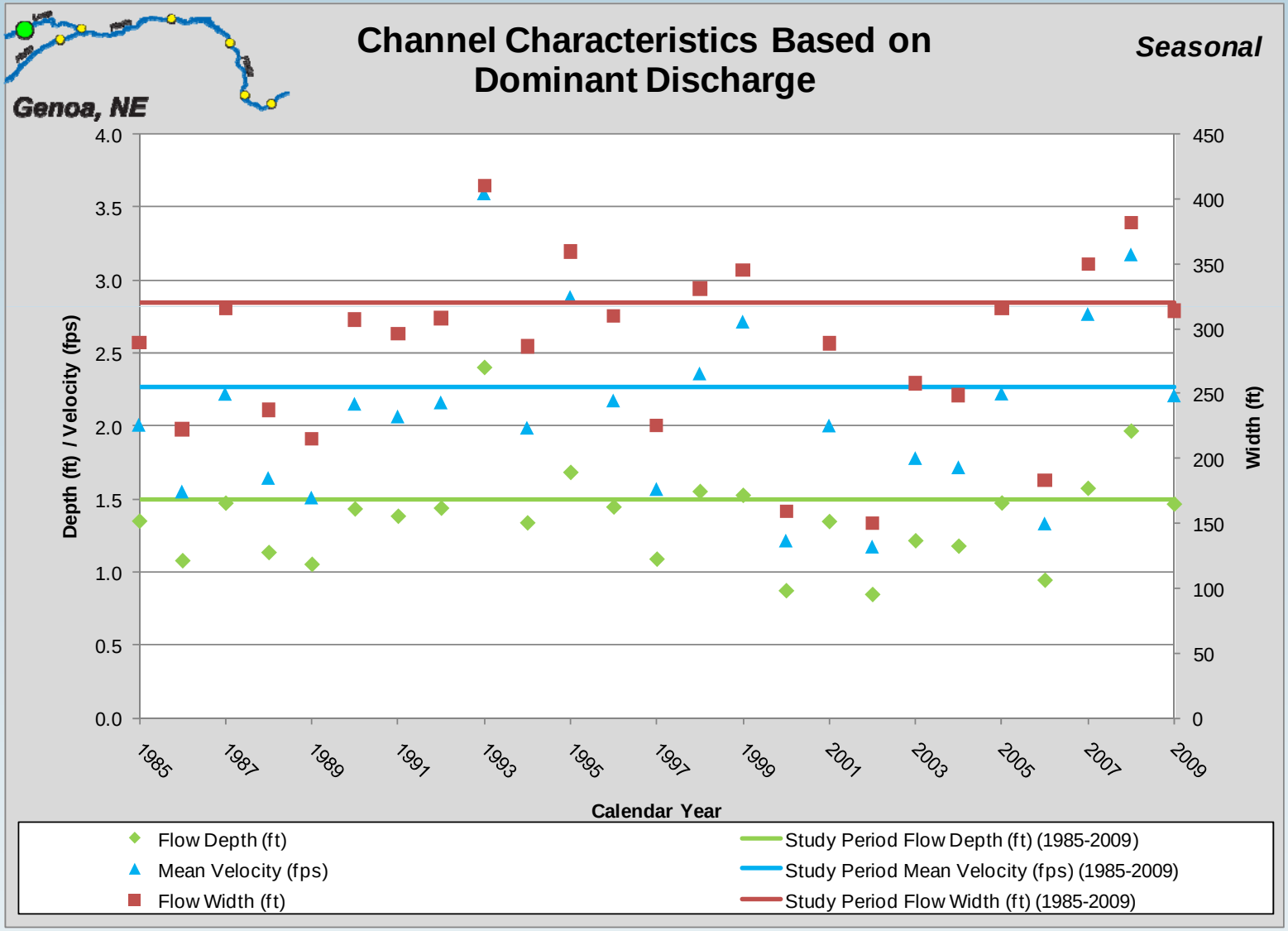
Stream Channel Characteristics



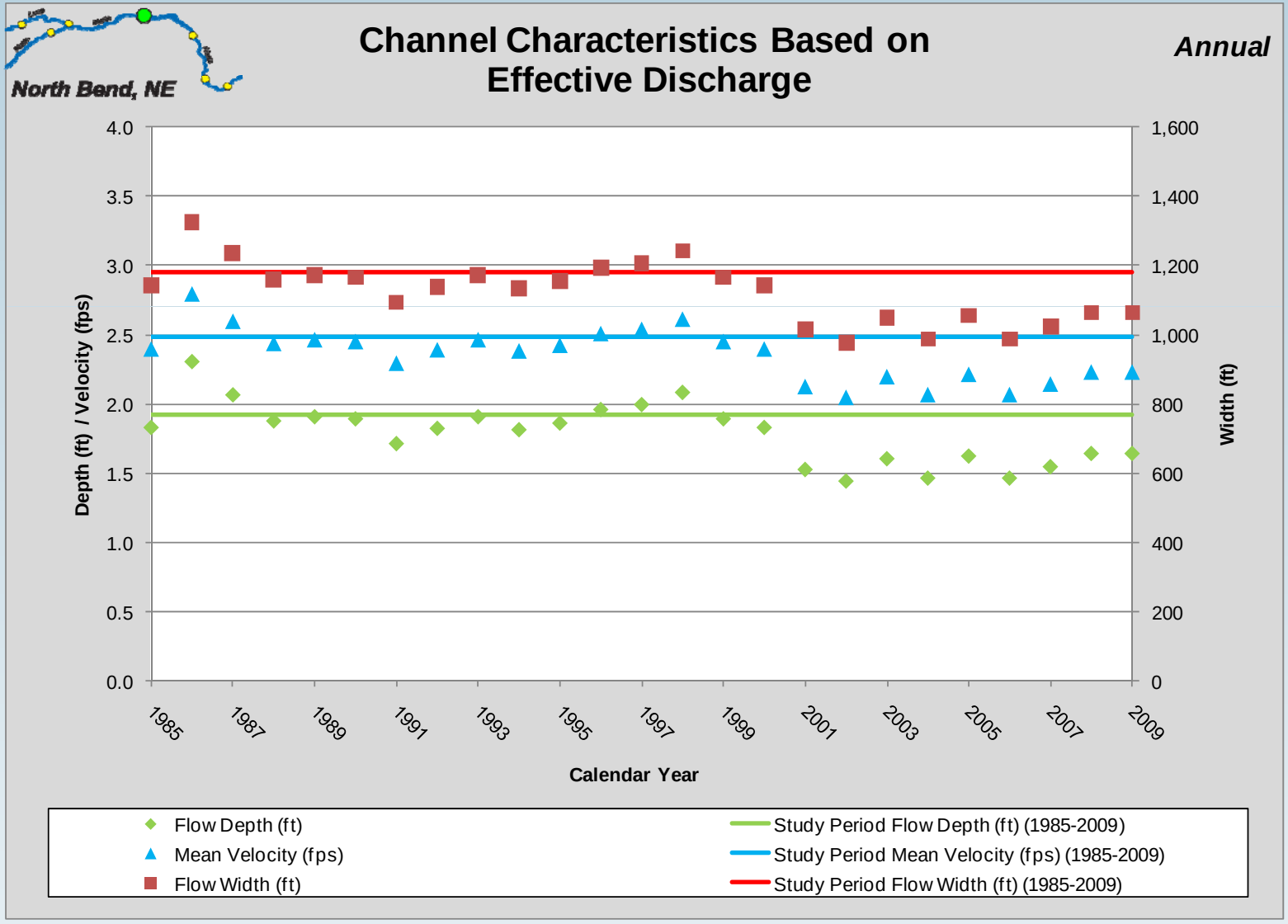
Stream Channel Characteristics



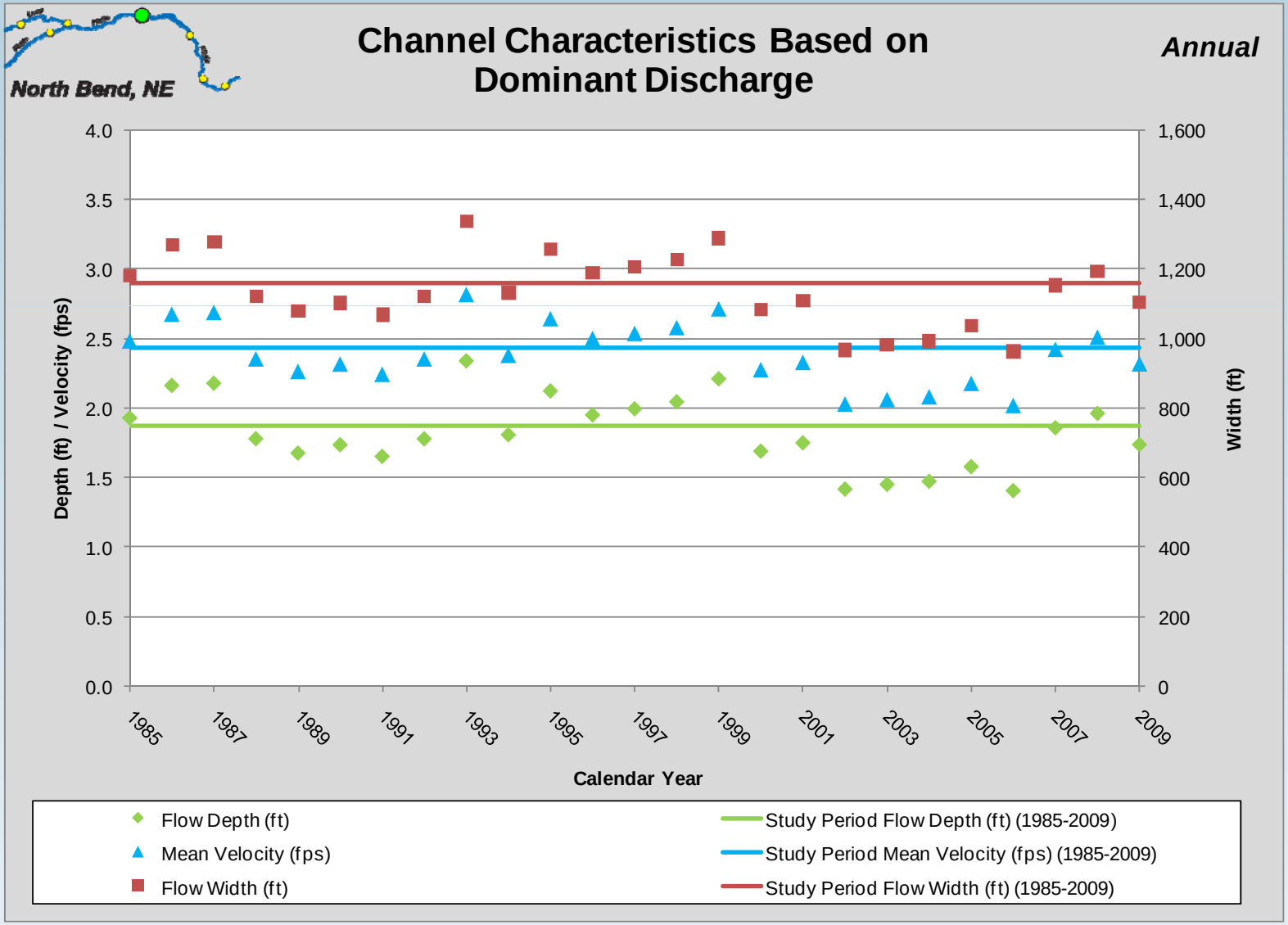
Stream Channel Characteristics



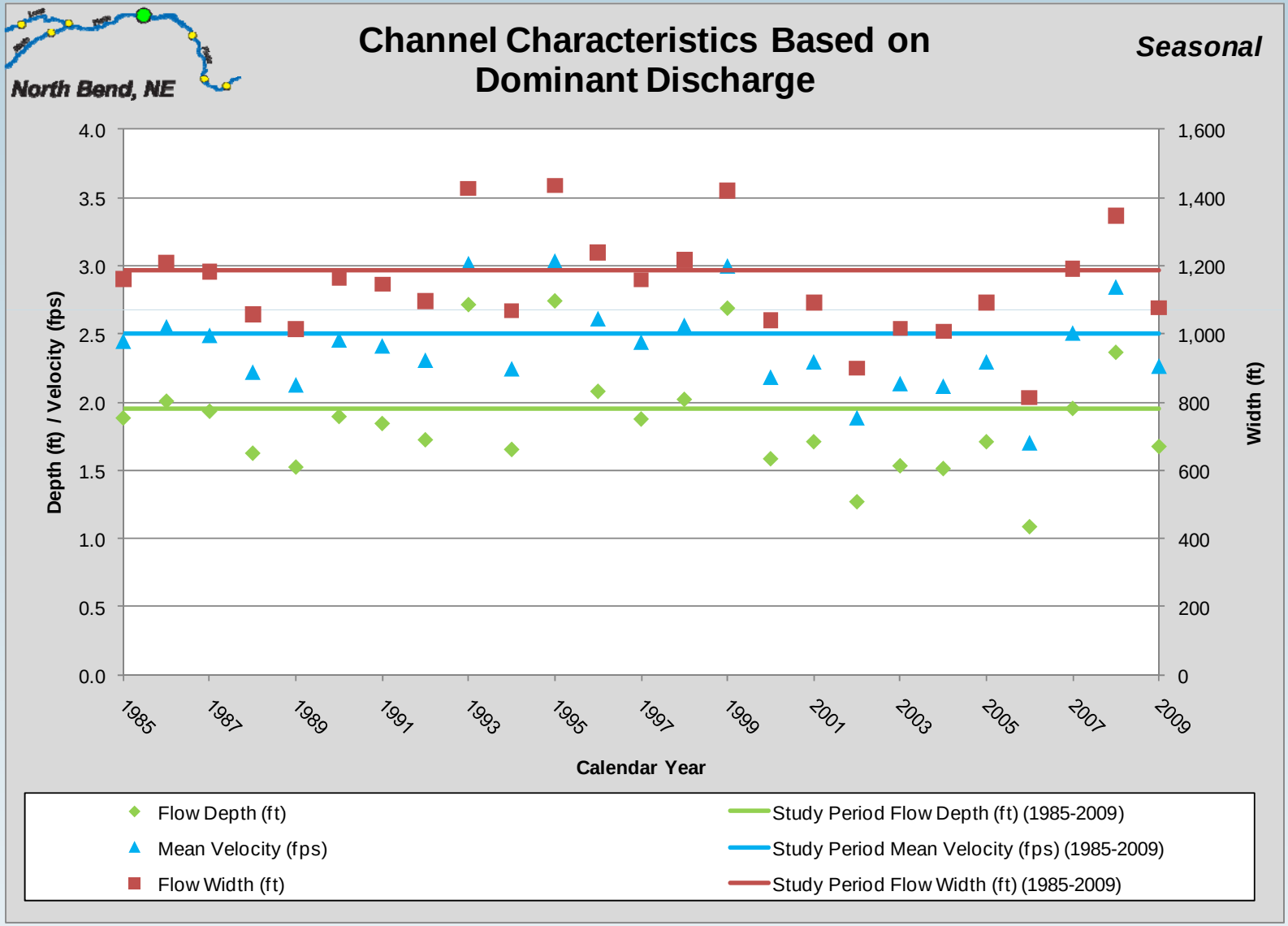
Stream Channel Characteristics



Stream Channel Characteristics



Stream Channel Characteristics



Conclusions – Objective 2

- Literature and analysis clearly indicate that both rivers are in dynamic equilibrium with no indications of aggradation or degradation or channel geometry changes over time.
- Literature and calculations demonstrate that the Loup River bypass reach and the lower Platte River are in regime and well seated within regime zones classified as braided streams.

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 the Nebraska Game and Parks Commission [NGPC]) and productivity measures.

Conclusions – Objective 3

- It was determined that the system is in dynamic equilibrium and the Project does not affect morphology in this reach of the Platte; therefore, it is inferred that the Project does not affect pallid sturgeon or least tern and piping plover habitat parameters related to sediment transport.
- No further analysis is needed based on the RSP methodology, but analysis of plots of interior least tern and piping plover nest counts against sediment transport parameters was completed due to timing of other study activities.

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 the Nebraska Game and Parks Commission [NGPC]) and productivity measures.

Associated Tasks

- Plot interior least tern and piping plover nest count and productivity data against sediment transport parameters.

Conclusions – Objective 3

- There is not a significant relationship between interior least tern and piping plover nest counts and sediment transport parameters
- No evidence from this analysis was discovered that would suggest a potential relationship between nest counts and sediment transport parameters

Relationship between Nest Counts and Sediment Transport Parameters

- Nest Counts
  - Best available data (1983 - 2009)
  - Scarcity of fledge ratio data
  - Accuracy of adult counts for riverine habitat nesting and breeding
- Some years were excluded due to no data or late season surveys
  - Tailrace to North Bend – 1999
  - North Bend to Leshara – 1996, 1999, 2000, 2004, 2005
  - Ashland to Louisville – 1986
  - All segments – 1995

Relationship between Nest Counts and Sediment Transport Parameters

Parameters for Comparison

- Annual effective discharge
- Annual dominant discharge
- Seasonal dominant discharge
- Annual cumulative sediment discharge
- Seasonal cumulative sediment discharge
- Annual cumulative flow
- Seasonal cumulative flow
- Annual peak mean daily flow
- Seasonal peak mean daily flow
- Annual flow width from effective discharge
- Annual flow width from dominant discharge
- Seasonal flow width from dominant discharge
- Annual percent diverted flow
- Seasonal percent diverted flow

Comparison Combinations

- Spatial variations
  - Upstream
  - Downstream
  - Upstream and downstream
- Time variations
  - No-lag – sediment transport parameter in year X compared to nest counts in year X
  - 1-year lag – sediment transport parameter in year X compared to nest counts in year X+1
  - 2-year lag – sediment transport parameter in year X compared to nest counts in year X+2

Comparison Combinations

- Species evaluated – 2
- Sediment transport & hydrologic parameters compared – 14
- River segments analyzed – 4
- Spatial comparisons - 3
- Time series comparisons – 3
- Total graphs generated – 1008

Relationship between Nest Counts and Sediment Transport Parameters

- Statistics – R^2
  - Strength of the linear association between nest counts and a particular sediment transport or hydrologic parameter
  - Describes the proportion of total variation in nest counts that is explained by that parameter
  - R^2 values range from 0 to 1
- Example
  - R^2 of 0.1 indicates 10 percent of variation in nest counts can be explained by the given parameter.

Relationship between Nest Counts and Sediment Transport Parameters

- "Significant" R^2 value varies
  - 0.500 often considered the low end of correlation
  - None of the R^2 for interior least terns was greater than 0.500
  - Only 1 R^2 for piping plovers was greater than 0.500

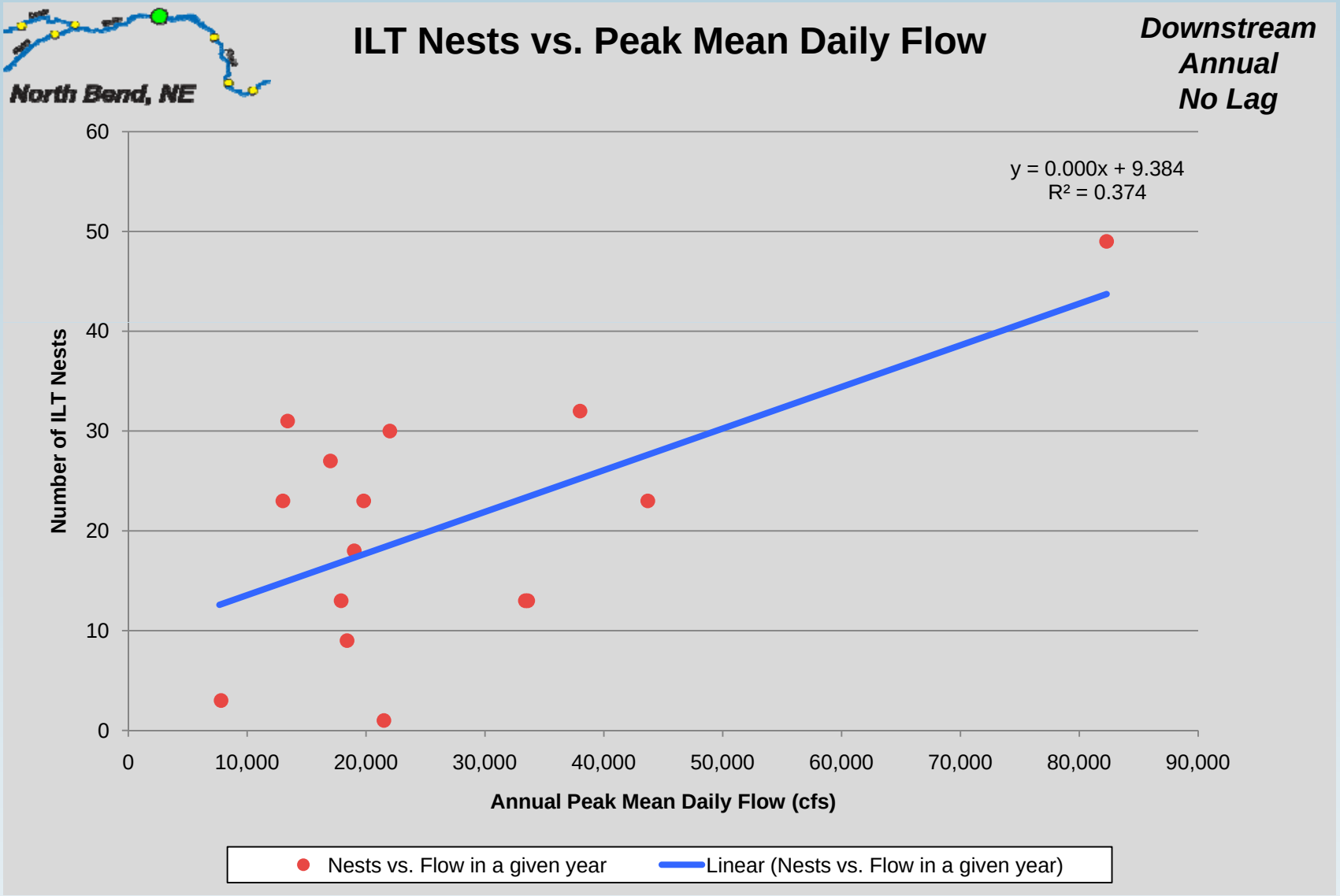
Summary of R^2 Values

Species	R^2 Range	Number of Plots exceeding R^2 of 0.300
Interior Least Terns	0.000 – 0.389	6
Piping Plover	0.000 – 0.588	26

Relationship between Nest Counts and Sediment Transport Parameters

- Interior least terns
  - 6 R^2 values greater than 0.300
  - 4 of the 6 are associated with Peak Mean Daily Flow
    - Downstream and upstream of North Bend – no-lag
    - Upstream of North Bend - 1-year lag
    - Upstream of Leshara – 2-year lag
  - 2 of the 6 associated with sediment transport parameters
    - Seasonal dominant discharge; upstream of Leshara; 1-year lag
    - Seasonal cumulative sediment; upstream of Leshara; 1-year lag

Example Graph – Terns



Example Graph – Terns

ILT Nests vs. Cumulative Sediment

Upstream Seasonal 1 Year Lag

y = 0.000x + 0.462
R² = 0.364

Number of ILT Nests

45
40
35
30
25
20
15
10
5
0

0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000

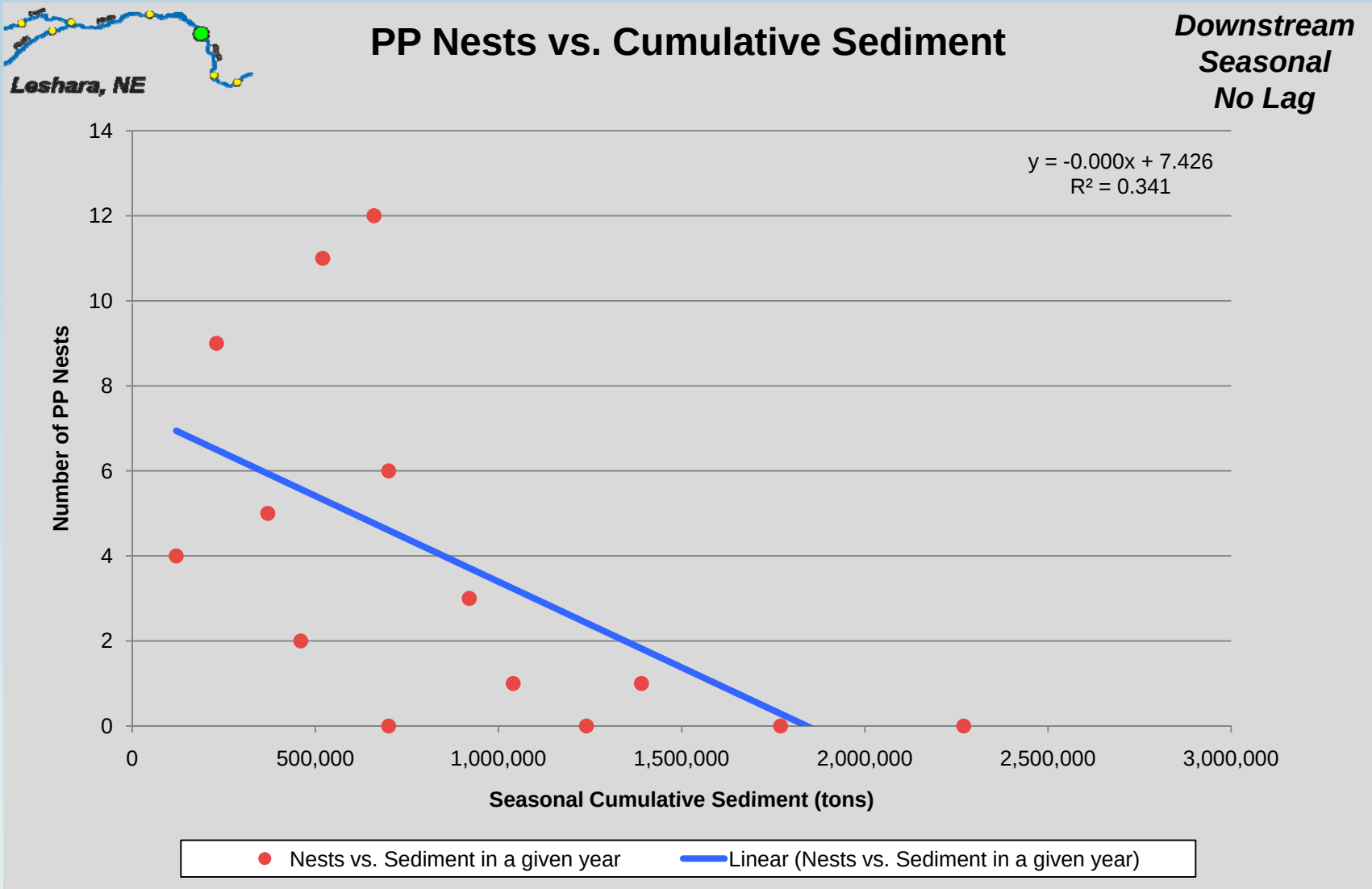
Seasonal Cummulative Sediment (tons)

Nests vs. Sediment in given year
Linear (Nests vs. Sediment in given year)

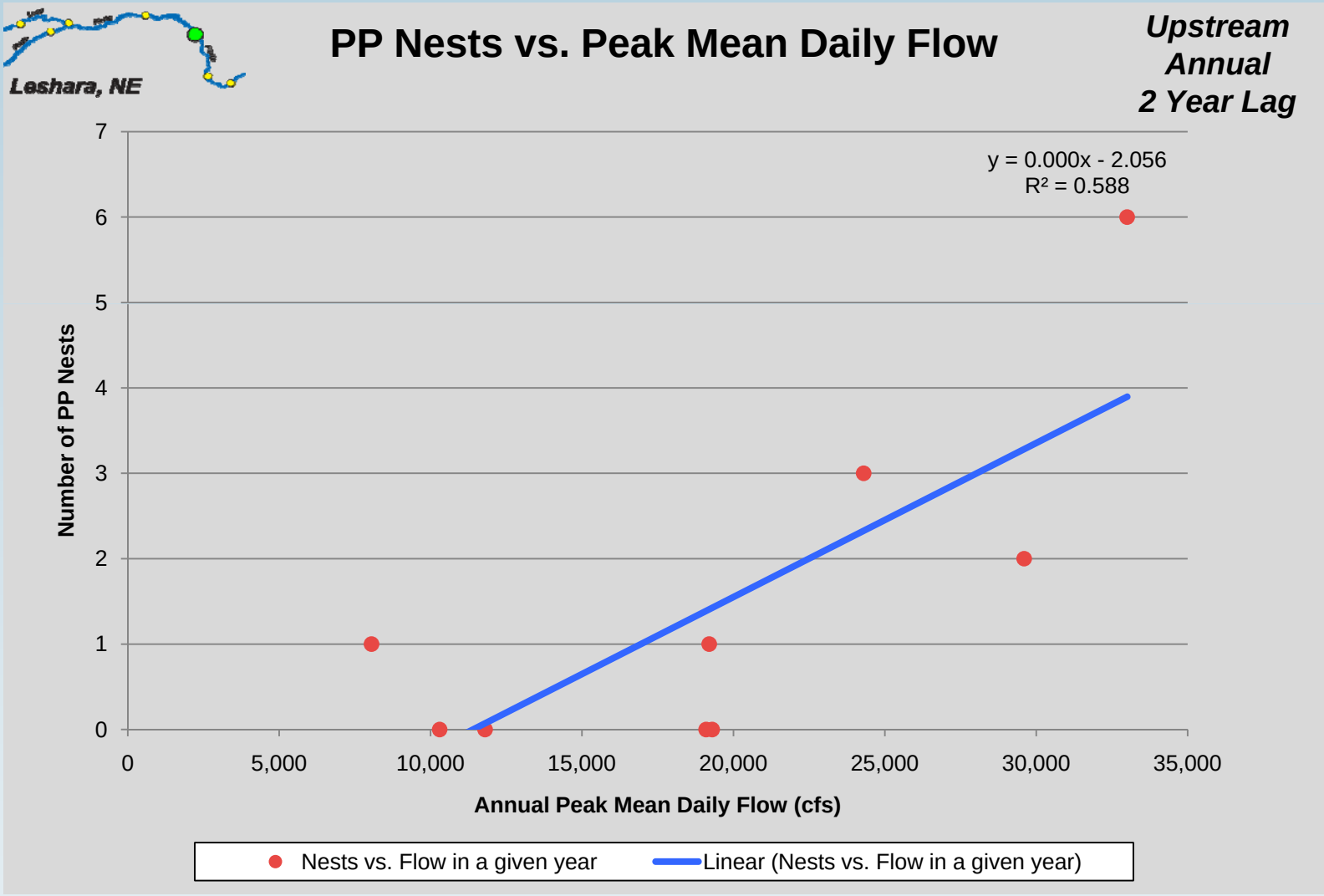
Relationship between Nest Counts and Sediment Transport Parameters

- Piping plovers
  - 26 R^2 values greater than 0.300
  - 9 of the 26 are associated with downstream of Leshara; no-lag
    - Leshara to Ashland averaged 6.3 nests per year over the 22-year period
  - 5 of the 26 are associated with upstream of Leshara; 1-year lag
    - Small dataset – 1995, 1996, 1999, 2000, 2004, and 2005 excluded due to lack of data

Example Graph – Plovers



Example Graphs - Plovers



Conclusions – Objective 3

- There is not a significant relationship between interior least tern and piping plover nest counts and sediment transport parameters
- No evidence from this analysis was discovered that would suggest a potential relationship between nest counts and sediment transport parameters

Other Studies

- Classifying Bird Habitat on the Lower Platte River (USGS, 2009) – Valley width

1. Sedimentation

Objective

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

Conclusions – Objective 3

- It was determined that the system is in dynamic equilibrium and the Project does not affect morphology in this reach of the Platte; therefore, it is inferred that the Project does not affect pallid sturgeon habitat parameters related to sediment transport.
  - Lower Platte River geomorphology is in dynamic equilibrium.
  - Literature review states lower Platte River is appropriate pallid sturgeon habitat.
  - Recent sturgeon captures show species occupation.
- No further analysis is needed based on the RSP methodology.

Literature Review - Lower Platte River as Pallid Sturgeon Habitat

Peters and Parham (2008)

- "…the fact that we caught pallid sturgeon during spring, summer and fall months of the year indicates to us that the lower Platte River is an important part of RPMA 4..."
- "…the capture of six pallid sturgeon (in the lower Platte River) that were stocked into the Missouri River suggests that conditions in the Platte River are attractive to stocked pallid sturgeon."

Literature Review - Lower Platte River as Pallid Sturgeon Habitat

Platte River Recovery Implementation Program (October 24, 2006)

- "Consistent with the April 28, 2004 finding of the National Academy of Sciences, it is now agreed that current habitat conditions on the lower Platte River do not adversely affect the likelihood of survival and recovery of the pallid sturgeon because that reach of the river appears to retain several habitat characteristics apparently preferred by the species."

UNL 5-Year Shovelnose Sturgeon Population Dynamics Study

- Study Reach
  - Platte River 30 miles west of Columbus to confluence with the Missouri River.
- Gear
  - Trotlines and drifting trammel nets.
- Results
  - 2009 - 69 pallid sturgeon were captured.
  - 2010 - 20 to 25 pallid sturgeon were captured through mid-summer.
  - No sturgeon collected upstream of Columbus.
  - Several shovelnose sturgeon and one pallid sturgeon were collected 0.5 mile below the Tailrace Canal.
  - No gravid females of spawning age collected.

Conclusions – Objective 3

- It was determined that the system is in dynamic equilibrium and the Project does not affect morphology in this reach of the Platte; therefore, it is inferred that the Project does not affect pallid sturgeon habitat parameters related to sediment transport.
  - Lower Platte River geomorphology is in dynamic equilibrium.
  - Literature review states lower Platte River is appropriate pallid sturgeon habitat.
  - Recent sturgeon captures show species occupation.
- No further analysis is needed based on the RSP methodology.

Next Steps – Completed Studies

18CFR5.15

- September 24, 2010
  - District submits meeting summary
- October 24, 2010
  - Agencies file meeting summary disagreements and submit requests for modification to on-going studies
- November 24, 2010
  - District responds to summary comments and study modification requests
- December 27, 2010
  - FERC resolves comments and study modification requests

Next Steps – Remaining Studies

- January 6, 2011
  - Submittal of Updated Initial Study Report to FERC
- January 20, 2011
  - Updated Initial Study Report Agency Meeting (Location TBD)

Thank You for Your Attendance

Loup Power District
Hydro Project