The Lower Platte River Cumulative Impact Study
Phase 2 Final Report - Overview of the Geographic Information System (GIS), Trend Analysis, and Hydrologic Analysis

September 2008

Platte River, Nebraska

Funded in part by a grant from:
EXECUTIVE SUMMARY

Over the course of the last few years, it was recommended that a cumulative impact study be conducted for the lower segment of the Platte River. As most of the state’s population is located along this reach, it was subject to the largest number of human impacts. A cumulative impact study is advisable when the number of activities within a certain area reaches a critical level. In this case, the number of bank stabilization permit requests and levee projects had caused the US Fish and Wildlife Service to question the overall, or cumulative, impact to the environment. Rather than have one community or one project be responsible (particularly financially) for such a study, a partnership of agencies banded together to begin this work. This partnership includes the following agencies: Nebraska Game and Parks Commission (NG&PC), Lower Platte River Corridor Alliance (LPRCA), Lower Platte South Natural Resources District (LPSNRD), Lower Platte North Natural Resources District (LPNNRD), Papio-Missouri River Natural Resources District (P-MRNRD), Nebraska Department of Natural Resources (NDNR), Nebraska Department of Roads (NDOR), US Fish and Wildlife Service (USF&WS), US Geological Survey (USGS), Metropolitan Utilities District (MUD), and Lincoln Water System (LWS).

Acting collaboratively, the Corps of Engineers, Omaha District, and the partnership wrote a Scope of Work to create the Geographic Information System (GIS) under Phase 1 of the project. Phase 2, completed in 2008, consisted of the compilation of the GIS, including all six of the computer-based mapping layers, or ‘time steps’. The group agreed that Anderson Level 1 land classification techniques would be applied to each of the time steps, 1857 (shoreline and islands only from early surveyors’ maps), and aerial photography from 1938, the 1950s, the 1970s, 1993, and 2003. This classification includes categories such as forest, rangeland, water, agriculture, urban, residential, and barren (sandbars and other non-vegetated areas). Classifying the lands using this system enables a comparison from the 1930s to the present. Trend comparison is also part of Phase 2. A study by the US Geological Survey (Temporal Differences in the Hydrologic Regime of the Lower Platte River, 1895-2006 Report 2007-5267) was also added to this study, partially funded by a Nebraska Environmental Trust grant.

The resulting cumulative impact study is already being utilized as an information library and management tool for environmental assessments, environmental impact statements, and other local, state, and Federal projects.
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A. Introduction

1. Background

Description of the Project, Purpose, and Need. Need for a Cumulative Impact Study.
The lower Platte River corridor, spanning from Columbus, NE nearly 110 miles to its confluence
with the Missouri River, is a unique area in eastern Nebraska with a wealth of resources.
Providing drinking water to 50% of Nebraska’s population, the corridor also supports exceptional
biodiversity and provides habitat for the federal and state listed pallid sturgeon, least tern, and
piping plover, as well as a variety of other fish and wildlife species. It serves as one of the few
remaining contiguous natural corridors in the eastern part of Nebraska covering all or parts of 8
counties and 24 communities. The natural resources of the area, inherent beauty, proximity to
large metropolitan centers, good transportation, numerous recreation and tourist destinations, and
desirability for residential and commercial development all provide the setting for unprecedented
growth and development both now and into the future.
The Cumulative Impact Study (CIS) project, a geographically-based mapping project, seeks to manage and protect the unique and valuable lower Platte River corridor ecosystem by collecting and organizing the necessary data and information to evaluate ecosystem and land use changes over time. To do this, geospatial analysis methods were employed to assess long-term ecosystem changes and determine the risk and impacts associated with large-scale infrastructure and development projects, as well as the combined effect of the many individual activities in the lower Platte River corridor. Future phases of this project could look at developing predictive models and tools for evaluating and predicting the impacts of future activities and projects.
The CIS project is multi-faceted in nature, focusing on the interaction of the land, water, and biological communities, and how changes have shaped the ecosystem of the lower Platte River corridor. This project was/is coordinated with federal, state, and local agencies as well as non-governmental organizations (NGOs) in an attempt to provide a regional framework to understand and evaluate the impact of growth, land use, and habitat changes in the river corridor while managing and protecting the ecological integrity of the area.

The need for a cumulative impact study is based on the recognition that the lower Platte River is located in the most heavily populated region of Nebraska and continues to see the largest growth rates in the entire state. Along with growth comes additional demand for water supplies, recreational opportunities, infrastructure, and land for residential, industrial, and commercial development. Coupled with the fact that the area has an abundance of natural resources including important and critical habitat, the need for a critical analysis and assessment tools to evaluate the impact of these demands on the resources became necessary and vital to protecting the sustainability of the area.

The CIS addresses these needs and provides the necessary resources to make informed decisions and assessments. The National Environmental Policy Act (NEPA-Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Part 1508.7) defines cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” The group also recognized that no single community or local jurisdiction should be responsible for the cumulative impact study since the issues transcend multiple jurisdictions and constitute a regional issue. Instead, the effort was better undertaken as the responsibility of the various agencies and resource management entities associated with the basin.
2. Partners

US Army Corps of Engineers, Nebraska Game and Parks Commission (NG&PC), Lower Platte River Corridor Alliance (LPRCA), Lower Platte South Natural Resources District (LPSNRD), Lower Platte North Natural Resources District (LPNNRD), Papio-Missouri River Natural Resources District (P-MRNRD), Nebraska Department of Natural Resources (NDNR), Nebraska Department of Roads (NDOR), US Fish and Wildlife Service (USF&WS), US Geological Survey (USGS), Metropolitan Utilities District (MUD), and Lincoln Water System (LWS)

To undertake this task, the CIS Study Working group was created through a cooperative agreement signed in September of 2003 between the U.S. Army Corps of Engineers and the Nebraska Game and Parks Commission (NGPC). An interlocal agreement was formed between the NGPC and other non-federal participants in the study including the Nebraska Department of Roads, 3 Natural Resource Districts – the Lower Platte South NRD, the Lower Platte North NRD, the Papio-Missouri River NRD, and the Nebraska Department of Natural Resources. Other partners who have joined since then include: the Lower Platte River Corridor Alliance, the Nebraska Land Trust, the US Geological Survey, the US Fish and Wildlife Service, and Metropolitan Utilities District.

Many disciplines are represented in this cooperative partnership including natural resources management, environmental regulation, cartography, GIS, roads and infrastructure, utilities, and fish and wildlife, ecotourism and recreation, hydrology, and floodplain management. This diverse membership has allowed the project to address a complex array of issues with the necessary expertise. The working group routinely held
meetings (approximately every 2 months over the past 4 years) designed to clarify the goals and parameters of the study, set direction, assign responsibilities and activities, monitor and evaluate progress, and review/test deliverables.

3. Funding

50% Federal, 50% Non-Federal. Phase 1 of this project included development of the project Scope of Work (SOW). Phase 2, was development of the Geographic Information System (GIS) and Internet Mapping System (IMS), a Hydrologic Analysis, and a Trend Analysis. As with Phase 1, the costs for this phase of the study were jointly born by the Federal government and the non-Federal partners in the group. In addition to seven contributions of $15,000 each for Phase 2, the non-Federal partners applied for and received a Nebraska Environmental Trust (NET) grant for $125,000. These NET funds were used by the COE to continue the GIS mapping and associated land use classification and by the USGS to tabulate and analyze the hydrologic records of a set of stream gauges along the Platte River within the study corridor.

Geographic Area/boundary. The partners in the working group determined that the most appropriate study boundary would be a 5 mile wide corridor (2.5 miles on either side of a centerline) along the lower Platte River from Columbus, Nebraska to the confluence of the Platte River and the Missouri River near Plattsmouth, Nebraska. The floodplain of the Elkhorn River, a major tributary, was not included in this study area and a definitive boundary line was drawn between the floodplain of these two rivers to focus the study solely on the lower Platte River. In addition, the 110 mile reach was divided into somewhat equal segments by using the 10 bridges as a logical set of divisions. A map depicting this boundary is shown below:
B. Methodology

1. Time Steps (Periods)

Government Land Office 1857, Aerial photography from 1938, the mid-1950s, the early 1970s, 1993, and 2003. Early working group discussions regarding the project scope indicated that a minimum of three, but preferably five, time steps or periods be used. Ultimately, five time steps that had available aerial photos were selected along with survey data from 1857 (converted to a map layer). While the 1857 maps are not aerial photos, it was decided that the information from the channel width and side channels, in combination with the surveyors notes, were valuable sources of early channel and environmental data.
Some group members were concerned about the loss of resolution when aerial photos or other data is digitized. However, digital data is only as good as its source and the consensus of the group is that the aerial photos and survey data as well as the resulting digitized data are the best information available. Time periods selected include: 1938, 1950s, 1970s, 1993, and 2003. The 1938 time period was selected because the corresponding aerial photos were the earliest available within the study area. The 1950’s and 1970’s time steps include multiple years because corresponding aerial photos were taken over multiple years. The 1993 time step was selected because it provides complete coverage of the project area. The 2003 aerial photos were the most recent available series for the study area at the time that the scope of work was written. As indicated above, the group discovered land surveys conducted in 1857 by the State of Nebraska’s State Surveyors Office (SSO). These surveys, which included transects along the lower Platte River at mile intervals, were converted to a map format and added as the sixth time step.

2. GIS Tasks
Obtaining aerial photographs, georeferencing, digitizing, land use classification.
The GIS work has consisted of dividing each aerial photograph into quarter-quarter sheets, rubber sheeting them, using 8-12 points per quarter-quarter sheet, and georeferencing them to the physical landscape.

The exception was the t71850 SSO transects (a Geographic Information System [GIS] label), which were downloaded from the State of Nebraska SSO website. The individual sheets were then converted to .jpg format. The .jpg images were then loaded into ArcMap for georeferencing to the NAD83 Nebraska State Plane (FIPS 26000), U.S. Feet. The individual sheets were georeferenced in ArcMap using a PLSS section corner shapefile (ESRI format) downloaded from the State of Nebraska website. After all the sheets were georeferenced, roads, shoreline, islands, were digitized in ArcMap.

The 1938 photographs are archived in the University of Nebraska at Kearney. Each of the contact prints was scanned at a 600x600 resolution with Adobe Acrobat 7.0, using a Fujitsu fi-5750C scanner set to grayscale. Images scanned were intended to provide the best coverage possible of the Platte River corridor within the study boundary. Later, the raw scans were loaded and the images displayed in ArcMap. The corresponding Decimal Degree NAD83 DRG was found to line up with the 1938 aerial photographs. Within each photo, twelve (12) intersections or points were located for an accurate display of the images. The average display error (.00012), transformation (1st order polynomial), cell size (.000009), and resample type (Nearest Neighbor) all contributed to the property of the rectified image.

The 1950s and 1970s series of aerial photographs had to be ordered from the US Department of Agriculture (USDA). The scans were then transferred to the University of Nebraska at Omaha for georeferencing and creation of a mosaic. The methodology which was used to georeference this set of aerial photography is as follows: Each of the aerial photographs is being referenced to the 1993 images within a projection of the Nebraska State Plane 2600 feet. The COQQ’s are accurate to 1:12,000 and are preferable to the 1:24,000 DRG’s, which are less horizontally accurate.

The 1993 series has been selected based on available complete coverage for the lower Platte River Valley in eastern Nebraska that year. The 2003 series was the most recent, complete aerial photography series available at the time the study began. Both the 1993 and the 2003 series were available in digital orthophotography on the web.
3. Quality assurance/Quality control (QA/QC)

The Omaha District contracted with the Kansas City District to conduct the quality assurance and quality control. The Kansas City District was provided with a scope of work, funding, and the mapping product. They completed the review and sent the Omaha District their comments. The QA/QC review was quite complimentary and offered constructive comments.

C. Results

1. Trend Analysis

From the categories and charts in Appendices A and B, it is relatively easy to see the changes over time. Using a variety of time steps (various years of aerial photography), it proved too difficult to delineate wetlands. A future study could do current wetland delineation with ground truthing of results. In the future, there may be a way to delineate wetlands of the past. This technology is not available at this time.

A brief synopsis of each of the segments is given below.

In Segment A, urban areas have increased from 182 acres to 987 acres. This project segment contains major metropolitan areas and this is to be expected. The agricultural areas have increased slightly (70 acres greater), as has the forest classification area (421 acres greater).

Barren lands have decreased from 860 acres during 1938 to 120 acres in 2003. As the 1930s were a period of extreme drought, it is likely that other surrounding decades would not have had as dramatic acreages of barren land. Water acreages have decreased slightly, from 887 acres to 822 acres.


In Segment C, the agricultural land use increased from 14,644 acres in 1938 to 17,014 acres in 2003. Barren lands decreased by 39 acres, from 399 acres to 360 acres in 2003. Forested lands increased from 5,246 acres in 1938 to 6,598 in 2003. Range lands went from a low of 841 acres in 1938 to a high of 5,110 acres in the 1970s, and back to 1,662 acres in 2003. Urban lands increased from 134 acres in 1938 to a total of 1,423 acres in 2003. Water acreages remained somewhat constant, gradually increasing from 1582 acres in 1938 to 1,678 acres in 2003.

In Segment D, the agricultural and forested lands both increased, from 25,277 (1938) to 35,933 (2003) and 3,228 acres (1938) to 7,285 acres (2003) respectively. Barren lands increased from 768 acres in 1938 to 1,374 acres in 2003. Range land had an increase in the 1950s and the 1970s, then increased in 1993 and 2003. Urban lands increased dramatically from 35 acres in 1938 to 2,346 acres in 2003.
2. 2. Internet Mapping Service (IMS) - Where and how to access the GIS layers

The GIS layers, in a read only format, will be available online through a web-based internet map service to partners and the general public. The shape files (layers) will also be available for downloading. The Lower Platte North NRD is the host for this information and will provide O&M for the IMS. The internet web site address is: www.nrdmapmaker.org/LowerPlatteCIS.

This site, and the associated mapping layers, can be accessed for classroom use, reports, studies, trends, and a variety of other uses.

D. Conclusion

1. Major Highlights

Using very gross generalizations, it is surprising that there have been relatively subtle land use acreage changes along the Platte River in the last 80 years. Glancing through all completed segments, the agricultural acres and water acres have remained relatively steady. Urban areas, especially in the eastern segments of the project area, have increased in the last few decades, as was expected. Forested lands have increased slightly over time. Range lands were higher, in terms of acreages, during the earlier time steps or witnessed a slight increase during the middle time steps (1950s, 1970s).

Photo 5: Platte River near Fremont, Nebraska.
Examples of Landuse Acreage Changes and Mapping

Segment A Landuse Acreage Changes

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<td>450</td>
<td>736</td>
<td>681</td>
<td>820</td>
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2. Future Needs
Prior to any further compilation of data, it would be prudent to identify the research questions which the group or groups would like to have addressed. To date, only one agency has identified a research question.

3. Reference to USGS Hydrological Study
Appendix A – Work Plan for Lower Platte CIS
Lower Platte Cumulative Impact Study

Work Plan

For Phase 2

June 15, 2007
July 18, 2008 update

A Collaborative Effort by the Participants
Nebraska Game and Parks Commission, Cost-sharing with the US Army Corps of Engineers
In Cooperation with: Papio-Missouri Natural Resource District, Lower Platte North Natural Resources District, Lower Platte South Natural Resources District, US Geological Survey, Lower Platte River Corridor Alliance, Nebraska Department of Environmental Quality, Nebraska Department of Natural Resources, University of Nebraska at Lincoln, Nebraska Department of Roads, Nebraska Land Trust
Introduction
This document defines the tasks and parties of responsibilities to execute the Lower Platte River Scope of Work. Each task will be broken down by budget, responsible party, method of execution, estimates completion date.

Overview. The Lower Platte River Corridor is a unique area in eastern Nebraska with a wealth of resources. The corridor supports exceptional biodiversity and is important for a multitude of reasons such as providing habitat for the endangered pallid sturgeon, least tern, and threatened piping plover, as well as a variety of other fish and wildlife species. It stretches nearly 110 river miles from Columbus to the mouth of the Platte River near Plattsmouth and serves as one of the few remaining contiguous natural corridors in the eastern part of Nebraska. The area includes all or portions of 8 counties and 24 communities and provides drinking water to nearly 50% of the state’s population. The natural resources of the area, inherent beauty, proximity to large metropolitan centers, good transportation, numerous recreation and tourist destinations, and desirability for residential and commercial development ALL provide the setting for unprecedented growth and development both now and into the future.

The Cumulative Impacts Study (CIS) project, a geographically-based project, seeks to manage and protect the unique and valuable Lower Platte River Corridor ecosystem by collecting and organizing the necessary data and information to evaluate ecosystem and land use changes over time. Future phases of this project will look at developing predictive models and tools for evaluating/predicting the impacts of future activities and projects. To do this, geospatial analysis methods will be employed to assess long-term ecosystem changes and determine the risk and impacts associated with individual large-scale infrastructure and development projects, as well as the combined effect of the many activities in the Lower Platte River Corridor.

The CIS project is multi-faceted in nature, focusing on the interaction of the land, water, and biological communities, and how changes have shaped the ecosystem of the Lower Platte River Corridor. This proposal has the support of, and is coordinated with, federal, state, and local agencies as well as NGO’s in an attempt to provide a regional framework to understand and evaluate the impact of growth, land use, and habitat changes in the river corridor, while protecting the ecological integrity of the area.

To undertake this task, the Cumulative Impacts Study Working Group was created through a cooperative agreement signed in September of 2003 between the U.S. Army Corps of Engineers and the Nebraska Game and Parks Commission. An interlocal agreement was formed between the NGPC and participants in the study including NDOR,
3 NRDs - LPNNRD, LPSNRD, PMRN RD, DNR (although they are member of LPRCA). Other partners who have joined since then include LPRCA, Nebraska Land Trust, USGS, USF&WS, and UNL. The group has held a series of meetings designed to clarify the goals and parameters of the study.

E. TASKS

1. Georeference and digitize 1850’s Dataset – Will require acquisition of transect data, organization of information, addition to database(s) and GIS, and coordination with UNO.  
   a. Budget – $30,000.00  
   b. Responsible Party/POC – USACE, Lloyd Schultz  
   c. Estimated Completion Date – Completed  
   d. Method of Completion - ArcMap’s georeferencing tool was used with 8-12 control points per raw scanned map. See Attached.

2. Scan, Georeference and Mosaic 1938 Dataset –  
   a. Budget – $50,000.00  
   b. Responsible Party/POC – USACE, Scott Zessin  
      i. Estimated Completion Date – Done but needs mosaicing.  
   c. Method of Completion – ArcMap’s georeferencing tool was used with 8-12 control points per raw scanned map. See Attached.

3. Scan, Georeference and Mosaic 1950s Dataset – Will need to digitize, rectify, and classify.  
   a. Budget – $50,000.00  
   b. Responsible Party/POC – USACE, Lloyd Schultz  
   c. Estimated Completion Date – Done  
   Method of Completion – Scans ordered and delivered by USDA. University of Nebraska at Omaha Blanket Purchase Agreement contract awarded to georeference and mosaic.

4. Scan, Georeference and Mosaic 1971 Dataset – Will need to digitize, rectify, and classify.  
   a. Budget – $50,000.00  
   b. Responsible Party/POC – USACE, Lloyd Schultz  
   c. Estimated Completion Date – Done  
   d. Method of Completion – Scans ordered and delivered by USDA. University of Nebraska at Omaha Blanket Purchase Agreement contract awarded to georeference and mosaic.

   a. Budget –  
   b. Responsible Party/POC – USACE, Lloyd Schultz  
   c. Estimated Completion Date – Completed  
   d. Method of Completion – Organize data. No buffer number for roads, as prescribed by group.

6. Miscellaneous Land Use and Infrastructure  
   a. Bridges  
      i. Budget - $700.00  
      ii. Responsible Party/POC – NDOR delivered all information to USACE.  
      iii. Estimated Completion Date – August 2008, USACE will do.  
      iv. Method of completion –  
   b. Bank Stabilization  
      i. Budget – $6000.00  
      ii. Responsible Party/POC – USFWS/USACE  
      iii. Estimated Completion Date –
iv. **Method of completion** – Shape file included, via USFWS. No construction dates available. Future research project, find dates.

c. **Levees**
   i. **Budget** - $15000.00
   ii. **Responsible Party/POC** – USACE
   iii. **Estimated Completion Date** –
   iv. **Method of completion** – Utilized 1996 Corps report on levees, either Federally constructed or Federally certified. Levee layer current as of 1996.

d. **Utilities** – DOR will reply later on this item.
   i. **Budget** - $60.00
   ii. **Responsible Party/POC** – NDOR/DNR/USACE
   iii. **Estimated Completion Date** –
   iv. **Method of completion** – Although data is available at USACE, group mutually agreed not to place this sensitive information on the website.

e. **Towers** – LPNNRD was planning to contact the FCC on this one
   i. **Budget** - $800.00
   ii. **Responsible Party/POC** –
   iii. **Estimated Completion Date** –
   iv. **Method of completion** - Check with Chris Poole and Frank Albrecht (state park towers, 2).

f. **Trails** – NEG&PC will follow up on this one. Meeting in Dec to discuss.
   i. **Budget** - $400.00
   ii. **Responsible Party/POC** – Nebraska Game and Parks Commission/USACE
   iii. **Estimated Completion Date** –
   iv. **Method of completion** - Check with Frank Albrecht, NE Game and Parks.

g. **Railroads** – in 5-23-06 e-mail from DOR
   i. **Budget** - $30.00
   ii. **Responsible Party/POC** – NDOR/DNR/USACE
   iii. **Estimated Completion Date** – Fall 06
   iv. **Method of completion** – heads up digitizing

h. **Airports**
   i. **Budget** - $200.00 Only one.
   ii. **Responsible Party/POC** – USACE/NRD
   iii. **Estimated Completion Date** –
   iv. **Method of completion** -

i. **Floodplain**
   i. **Budget** - $800.00
   ii. **Responsible Party/POC** – FEMA/USACE
   iii. **Estimated Completion Date** – Sarpy, Douglas, Dodge now available, Platte, Saunders, and Cass Counties in process.
   iv. **Method of completion** – DFIRM update

j. **Commercial/Industrial**
   i. **Budget** - $1000.00
   ii. **Responsible Party/POC** – NRD, Chris Poole/USACE
   iii. **Estimated Completion Date** – Done, under Urban category.
   iv. **Method of completion** -

k. **Residential, Homes and Wells**
   i. **Budget** - $200.00
   ii. **Responsible Party/POC** – NRD/USACE
   iii. **Estimated Completion Date** – USACE will add, irrigation and household.
   iv. **Method of completion** – Download off of website

l. **Recreation**
   i. **Budget** - $30.00
ii. Responsible Party/POC – Nebraska Game and Parks Commission/USACE
iii. Estimated Completion Date – Completed by Sudhir.
iv. Method of completion – Info given to Jon Kragt (?), Chris Poole spring 2006. Chris Poole said he would send this to Jon Kragt.

m. Zoning, Comprehensive Plans
i. Budget - $2000.00
ii. Responsible Party/POC – NRD/USACE
iii. Estimated Completion Date – mid-June 2006, just completed.
iv. Method of completion – Rodney Verhoeff and Shaula Ross will check on this.

n. Gravel Mining
i. Budget - $800.00
ii. Responsible Party/POC – NRD/USACE
iii. Estimated Completion Date – Done. Teresa Silence adding points.
iv. Method of completion -

o. Protected Lands
i. Budget - $2500.00
ii. Responsible Party/POC – Nebraska Land Trust/LPNNRD/USACE
iii. Estimated Completion Date –
iv. Method of completion - Shaded maps provided by Dave Sands to Chris Poole. LPSN RD will send eco-tourism map to Chris Poole and Teresa Silence.

7. Final Phase 2 Report - Acquire datasets for specified time steps. Create database(s) and GIS and make available online for use by partners. A basic trend analysis will be tabulated and included in the progress report. The Final Phase 2 (formerly progress) report will present the information gathered in Phase 2, in a manner accessible to the general public.
   a. Budget – $15,000.00 - $30,000
   b. Responsible Party/POC – Group
   c. Estimated Completion Date – February 2008;
   d. ArcIMS
      iii. September 2007 1950’s Roads
      iv. October 2007 1950’s Land Use
      vii. December 2007 Other miscellaneous data sets.
   c. ArcIMS Method of Completion – ArcIMS web service to be provided by the NRD. All completed data and metadata will be provided to Chris Poole.
   f. Web Page Data shall contain all products produced for this Phase 2 portion of the study.
      i. ArcIMS Web Page
      ii. Work Plan & Methodologies
      iii. PDF files of maps and atlas information
      iv. Downloadable data and metadata
      v. Trend analysis
         1. Land Use
         2. River Channels
         3. USGS Studies
         4. River Width Changes
         5. Linear Feet changes in Bank Stabilization
         6. Other Trends

8. USGS Summary of project timeline and tasks
   As part of this consortium, the USGS proposes to compile and analyze hydrological and channel cross-sectional information at its long-term gaging stations on the lower Platte River using archived and historical USGS data, to supplement the USGS data available through the National Water Information System (NWIS). Among the benefits of the study will be (1) to address the problem of the lack of integration of physical streamflow data with ecological habitat information in the lower Platte River ecosystem, and (2) documenting the flow regime at multiple stations and dates using comparable subsets of the available data. Such descriptions of the flow regime and streamflow-habitat relations are of interest to our Department of Interior sister agencies and others, and thus clearly relevant to the
USGS mission. The CIS committee has targeted compilation from six specific time periods, centered on years for which accurate mapping or aerial photography are available: ca. 1857, 1938, 1955, 1971, 1993, and 2003. The goals of the CIS are to analyze present and future changes in infrastructure, land use, river management, and hydrology, to understand how each of these general factors is interrelated to the river, its floodplain, and the bluff-to-bluff corridor (U.S. Army Corps of Engineers and Nebraska Game and Parks Comm., written commun., entitled “Lower Platte Cumulative Impact Study Scope of Work For Phase 2,” June 2005).
1. Individual map sheets downloaded from State of Nebraska website. Files were available for download as .pdf’s

2. Individual sheets were converted to .jpg format. This conversion allowed for images to be loaded into ArcMap for georeferencing. Sheets were georeferenced to NAD83 Nebraska State Plane (FIPS 26000), U. S. feet.

Township 16N Range 9E .jpg
3. Individual sheets were georeferenced in Arc Map using a PLSS section corner shapefile (ESRI format) downloaded from State of Nebraska website.
4. After all sheets were georeferenced, bankline, islands, and road network features were digitized in ArcMap.
TASK 2
Georeferencing and Mosaicing 1938 Imagery

1. Air Photo contact print scanned
   1938 Aerial Photos were scanned images of aerial photos taken by the USDA Soil Conservation Service (now the USDA-NRCS) in 1938. Original photos were on loan from the University of Nebraska-Kearney Geography Department. Photos were scanned at 600x600 resolution with Adobe Acrobat 7.0 using a Fujitsu fi-5750C scanner set to greyscale. Images scanned were intended to provide the best coverage possible of the Platte River corridor (~2.5 miles from the river on each side) from Columbus, NE to the Missouri River confluence near Plattsmouth, NE.

2. Load raw scans and display the images in ArcMap

3. Find corresponding Decimal Degree NAD83 DRG to line up 1938 aerial photographs

4. Find 12 intersections or points for accurate display of the images
   *Seen in the images below indicates the average display error (.00012), transformation (1st order polynomial), cell size (.000009), and resample type (Nearest Neighbor) which all goes into the property of the rectified image.

5. See task 4 and 5 for how Mosaicing of imagery into USGS quarter quad indexing was accomplished
**TASK 3 and 4**

**Georeferencing and Mosaicing the 1950’s and 1970’s Imagery**

**Area of Geo-referencing:**
The areas of these images being geo-referenced are along the Platte River starting by Columbus, NE running all the way to where the Platte goes into the Missouri River. All files and folders will be located under the folder named Lower Platte Reach. The 1950’s imagery and the 1970’s imagery is being geo-referenced to 1993 imagery located in the folder named COQQ 1993. The projection of the newly geo-referenced images will be Nebraska State Plane 2600 Feet which is located in the folder named Projection File. COQQ’s are accurate to 1:12,000 and are preferred to the less horizontally accurate 1:24,000 DRG’s

**Procedures:**

**Mxd Setup**
- After opening the mxd named 1950’s Setup, first add the shape file the LowerPlatteStudyLimits, then add the COQQ_1993 images.
- After opening the mxd named 1970’s Setup, first add the shape file the LowerPlatteStudyLimits, then add the COQQ_1993 images

**Georeferencing**
- (#1) Add a tiff image from the 1950’s or 1970’s folder and before georeferencing, make sure that under layer the image you are georeferencing is there.
- To take a look at the image you just added, go to georeferenced and scroll down to fit to display
- (#2) After locating the area on the images, you will need to find 9-12 reference points (intersections, section boundaries, buildings, bridges, etc) to be linked to the image. If you can do 12 reference points that would be best, but there will be areas where that will not be possible.
- Once all the reference points have been found, check your RMS value by clicking on the View Link Table. If possible have your RMS value around 15-25, though sometimes especially in rural areas it may be higher.
- Now save your RMS values, by clicking the save button and save it as r_(image number) in the georeferenced folder. Example, image is 1P_82, you would save it as r_1P_82
- (#3) Next click the georeferencing button and scroll down to rectify and a save as window should come up
- In the save as window, the resample type should be Nearest Neighbor (for discrete date), and the Output Raster path should be to the Georeference 1950s or Georeferenced 1970s folder and have the new tiff image be the same name as the text file, then click Save
**Finishing Up**

✓ Now you can delete the image from the mxd and then navigate to the Not Georeferenced folder and delete the image you just georeferenced.

*If you have any questions see contact information below*

Example Using the Steps for DRG’s (Note that you will be georeferencing to 1993 COQQ’s in place of DRG’s):

**MXD Setup**

![MXD Setup Image]
Geoferencing #1

Geoferencing #2
Geoferencing #3
Finishing Up:

Mosaic using ERDAS Imagine 9.0:

All the material needed except for the new georeferenced tiffs will be located in the Mosaic Images folder. You will be clipping out QQuads by a various number of images depending on how many fall within each QQuad. When clipping you will need to select and export for each QQuad from the original shapefile(QQuads). *Note: When clipping it may take several tries before all areas of white or borders are gone.*

Procedures to Mosaic:

**Mxd Setup**

- After opening the mxd named Mosaic QQuads, first add the shapefile named QQuads, then add all the 50s or 70s images depending on which set you are working on.
- Have only the images that cover your selected QQuad turned on to simplify step A below.
- Open the excel spreadsheet named Years for QQuads located in the Mosaic Images folder. Here you will need to input the original polygon name located in the imagename column in the attribute table in the excel spreadsheet under column Tile Name. Then check all the images within the selected polygon and record in excel all possible years located in the top right or left on the tiff file.

**Setting up the Mosaic Process**
(1) Open ERDAS Imagine 9.0, and then click on the DataPrep button, then the Mosaic Images button, and finally the Mosaic Wizard button. Shortly after clicking on the Mosaic Wizard Button, the Mosaic Wizard window opens.

Before doing anything click the load button and scroll to the mosaicsetup.bat file in the Mosaic Images folder and click ok.

(A) Add all tiff images by clicking on the open folder button. Make sure the file name is selected as tiff, I believe the default is img file.

*When adding, you need to add from the button up of the order of images in the mxd.*

(B) Select the Input Area tab and you will see the area is being cropped by 20%. You can use this and come back and change the percent or change it now to approximately what would be needed to crop out all white or borders.

Now click the output tiles tab and you will be adding the polygon that you exported from the QQuads shapefile. If you have not made the polygon shapefile, go into ArcMap and exported your polygon and save it in the Finished QQuads Shapefile folder. *Make file type shapefile instead of an aoi file.*

And Finally, click on the output tab and click the open folder button and navigate to either 1950s or 1970s folder with the file type being .img. *There may be some QQuads that have no images*
Example A:

Example B:
Example C:
Example D:

Contact Information:
Scott Zessin
Mapping and Surveys
U. S. Army Corps of Engineers
1616 Capitol Avenue, 6th floor
Omaha, Nebraska, 68102
402-995-2260
Email: scott.m.zessin@usace.army.mil
**TASK 5**

**Digitize/Photo Interpretation of Anderson Level 1 Land Use Categories - Develop Road Centerline Coverage with Buffers - Determine River Channels and Islands**

The Lower Platte CIS group came to an agreement to use level 1 of the Anderson Level 1 Land use classification system and define the limits to 2.5 miles from the center of the Platte River. The Level 1 Anderson Land Use classification system is listed below.

1. Urban or Built Up Land
2. Agriculture Land
3. Rangeland
4. Forest Land
5. Water
6. Wetland
7. Barren Land
8. Tundra
9. Perennial Snow or Ice

There are several challenges regarding the photo interpretation of the imagery into the land use classification schema. The first obstacle was determining wetlands from historical imagery. Meeting with CALMIT and later with the Lower Platte CIS group, it was determined that wetland classification was not a clearly definable category with just imagery alone. Soils were tried as a data layer that would help define wetlands but that also proved to be lacking in clearly defining areas. Wetlands was then taken off of the list and defined as open water when standing water was obviously present. Land use class 8 and 9 is not found in this part of the world and was not digitized.

Another problem was encountered when determining exactly where to put the digitized line when interpreting between woodland, grassland. When the woodland incorporated over 50 percent of the ground cover, then woodland was classified. Other issues were with size of the unit measured. Were a small clump of trees a woodland? Or was it simply too small to count. Do we eliminate any polygon under 1 acre? How do we handle a grove of trees on a farm yard a woodland or was it simply incorporated into the Agriculture land use class?

Image quality varied between the 1993 imagery and the more recent 2003 and 2004 imagery. The 1938 imagery was difficult to interpret based upon image contrast and washout. (see example)
Problems also exist with the georeferenced imagery compared to the orthorectified imagery. The georeferenced imagery had problems with the imagery being seamless from tile to tile and lining up properly. Line work was smoothed/averaged between images that were not lining up properly.

See the example of adjacent images not lining up below.
The ESRI products of ArcGIS 9.x and ArcView 3.x were used to digitize the land use data layer. ArcGIS was used by USACE in the office environment and ArcView 3.x was used when employees were working at home and did not have access to the ArcGIS licenses. Land Use digitization using ArcView 3.x was accomplished at a scale of 1:5000 or better. Care was taken to ensure topology was maintained to avoid slivers or overlap in the data.

Examples of challenging areas are shown below. Note that the water level is different since the imagery was taken between April and October.

Other problems with the 1938 imagery occurred because of gaps in the data. An additional land use category of no data was added to the Land Use classification to track this problem.
1938, 1993 and 2003 Landuse

This was digitized at approximately 1:2000 to 1:5000 scale. Since the imagery is so recent there were not that many issues with the imagery. There was one spot where the imagery looks like it had a glare; this was located just south of Interstate 80 and the platte river. When classifying, areas needed to cover substantial amount of land. For example if there was a group of trees(10), I would not classify as forest because it is not large enough.

Attribute Definitions:
Level 1=Anderson Level 1 Classification
Type 1=Describes how the water areas were made or if an island had veg or non-veg
Use=What the body of was is used primarily for
Water Body=how large the water is
F_Area=square foot of the polygon area
Acres=Area divided by 43560
Descrip_1=if the area is an “island” on the river or “other island” like in a lake
River=Name of the river the polygon is located

<table>
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<th>LEVEL_1</th>
<th>TYPE_1</th>
<th>USE</th>
<th>WATER_BODY</th>
<th>F_AREA</th>
<th>ACRES</th>
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<tr>
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<td>Lake</td>
<td>43919.98179162950</td>
<td>1.01</td>
<td></td>
</tr>
</tbody>
</table>

1938, 1993 and 2003 Roads

This was digitized at approximately 1:2000 to 1:5000 scale. The center of the roads were digitized and then given an approximant width for those who would want to buffer later on. To keep this clean I would round the width by increments of 5’s. Below is an example of what the attribute table will look like.

<table>
<thead>
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<th>LENGTH</th>
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<th>CLASS</th>
<th>BUFFER</th>
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<td>Unknown</td>
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<tr>
<td>681.226</td>
<td>25</td>
<td>Unknown</td>
<td>12.5</td>
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<tr>
<td>6009.902</td>
<td>40</td>
<td>5th St</td>
<td>20</td>
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<tr>
<td>790.375</td>
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</tr>
<tr>
<td>3990.095</td>
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<td>72nd St</td>
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<tr>
<td>5807.873</td>
<td>25</td>
<td>Fairview Rd</td>
<td>12.5</td>
</tr>
<tr>
<td>4302.690</td>
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<td>Fairview Rd</td>
<td>17.5</td>
</tr>
<tr>
<td>13072.238</td>
<td>30</td>
<td>63rd St</td>
<td>15</td>
</tr>
<tr>
<td>5298.301</td>
<td>30</td>
<td>87th St</td>
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<tr>
<td>7388.215</td>
<td>40</td>
<td>99th St</td>
<td>20</td>
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</tbody>
</table>
TASK 6

Miscellaneous Infrastructure and Land use

Bridges - NDNR and/or NDOR will acquire this data set (includes existing, about to be built, remnants, etc.)

Bank Stabilization – USF&WS has provided this information.

Levees - USACE

Utilities – Nebraska Department of Roads and Nebraska Department of Natural Resources

Towers – Nebraska Game and Parks Commission/NDNR

Trails - Nebraska Game and Parks Commission

Railroads - Nebraska Department of Roads and Nebraska Department of Natural Resources USACE digitized photo visible railroad information when possible

Airports – Should be only one visible

Floodplain – FEMA USACE

Commercial/Industrial - Rodney or Julie will contact Steve Cacioppo with Douglas County to find available data from the different counties.

Residential, Homes and Wells – Wells were downloaded off of the http://dnrdata.dnr.state.ne.us/wellssql/ website for the entire state. Metadata was provided at http://www.dnr.state.ne.us/databank/metadata/well_doc.html

Recreation - NGPC

Zoning, Comprehensive Plans - Rodney or Steve Cacioppo will help with these data.

Gravel Mining - Could one of the NRD contact Conservation and Surveys to obtain these data?

Protected Lands – Provided by Nebraska Land Trust
TASK 7
Final Phase – Final Report and ArcIMS Site

Acquire datasets for specified time steps. Create database(s) and GIS and make available online for use by partners. A basic trend analysis will be tabulated and included in the progress report. The Final Phase 2 (formerly progress) report will present the information gathered in Phase 2, in a manner accessible to the general public.
TASK 8
USGS Hydrologic Studies

Contributed material for the Hydrologic Analysis component of the Work Plan (taken from the approved proposal, dated May 17, 2006):

As part of this consortium, the USGS proposes to compile and analyze hydrological and channel cross-sectional information at its long-term gaging stations on the lower Platte River using archived and historical USGS data, to supplement the USGS data available through the National Water Information System (NWIS). Among the benefits of the study will be (1) to address the problem of the lack of integration of physical streamflow data with ecological habitat information in the lower Platte River ecosystem, and (2) documenting the flow regime at multiple stations and dates using comparable subsets of the available data. Such descriptions of the flow regime and streamflow-habitat relations are of interest to our Department of Interior sister agencies and others, and thus clearly relevant to the USGS mission. The CIS committee has targeted compilation from six specific time periods, centered on years for which accurate mapping or aerial photography are available: ca. 1856, 1938, 1955, 1971, 1993, and 2004. The goals of the CIS are to analyze present and future changes in infrastructure, land use, river management, and hydrology, to understand how each of these general factors is interrelated to the river, its floodplain, and the bluff-to-bluff corridor (U.S. Army Corps of Engineers and Nebraska Game and Parks Comm., written commun., entitled “Lower Platte Cumulative Impact Study Scope of Work For Phase 2,” June 2005).

Karr and Chu (1999) identified five key components of stream systems that must be understood both for undisturbed or normative conditions as well as for present conditions as affected by human activities: (1) flow regime, (2) physical habitat structure, (3) water quality, (4) energy source, and (5) biological interactions. A variety of indicators for hydrologic alteration by humans have been proposed recently (Richter and others, 1996, 1997; Olden and Poff, 2003) to assist in comparing the flow regime of a stream before and after some period of disturbance. One key challenge is deciding how to link existing tools into a useful hydrologic/habitat model that can be applied to a specific system, taking into consideration local environmental conditions, local data sets, and existing networks that supply streamflow and other data. The CIS framework provides an opportunity to assemble the requisite information and explore system responses through time and variable climate conditions, in relation to large changes in water management and the extent of channel stabilization.

As part of this consortium, the USGS proposes to compile and analyze hydrologic and channel cross-sectional information at its long-term gaging stations on the lower Platte River to (1) determine whether any time trends or step changes between the targeted time periods are statistically significant, and (2) interpret any significant changes in relation to changes in climatic conditions, water management, or other factors. The first objective will be addressed by analysis of the available daily discharge data for long-term gaging stations on the lower Platte River, and by analysis of available historical data from discharge measurements at those gaging stations. The latter analysis will involve automation and storage of velocity, depth, and locational data from the individual vertical stations across the channel that have been collected routinely by hydrographers in the course of making stream discharge measurements. Heretofore, these data, recorded on original paper field forms, have not been stored electronically. The second objective will be addressed by analyses incorporating the temporal series of ancillary data sets that is being
compiled by other members of the CIS consortium. [Those data were not available to the consortium at the time needed for use; thus the analysis was limited to relating hydrologic temporal changes to coarse-resolution climatic time series data.] The analysis will focus on stations that have comparable measurement data from at least three of six time periods common among all sites selected--1895, 1938, 1955, 1971, 1993, and 2004. Comparisons will be made for each of three hydrologic conditions--low, average, and high (that is, near bankfull) flows. Measurements may be included from years adjacent to the target years as needed to compile a set of at least four comparable measurements (preferably five or more) per time period for each hydrologic condition at each station.

Methods used to compile and analyze the data, which will provide several benefits to both the USGS and the cooperator alike, include (1) developing methodologies that can be applied during the cross-section analysis portion of the project that can be applied to the future development of the USGS automated database system for archived discharge-measurement details; (2) documenting the statistical uncertainty and hydrological relevance of the time steps chosen to the overall cumulative impact study in terms of stream flow regime, and (3) providing data and analytical results to the CIS Consortium for use in their on-line Geographical Information System.

Products
1. Data tables of measured velocity and depth at individual verticals across channel, for each selected station and time period. These tables would be provided electronically to the CIS consortium collaborators to allow them to be linked into GIS attribute tables.
2. Data tables of calculated hydrologic indicators for each selected station and time period. These tables would be provided electronically to the CIS consortium collaborators to allow them to be linked into GIS attribute tables.
3. Interpretive Report (likely a USGS Scientific Investigations Report), for example, "Changes in channel morphology, hydraulic geometry, and hydrologic indicators of the lower Platte River, 1895-2006."

References Cited


Table.—Summary of project timeline and tasks.

<table>
<thead>
<tr>
<th>Date</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/06</td>
<td>Grant notification. Complete workplan.</td>
</tr>
<tr>
<td>5/06</td>
<td>Complete topical outline and list of figures.</td>
</tr>
<tr>
<td>6/06</td>
<td>Complete compilation of daily discharge data sets (thru WY05).</td>
</tr>
<tr>
<td>7/06</td>
<td>Complete compilation/review of available measurements data.</td>
</tr>
<tr>
<td>8/06</td>
<td>Finalize data entry procedure and train student technician.</td>
</tr>
</tbody>
</table>

------- change of Federal FY -------

| 10/06 | Complete data entry of V and D from measured verticals.                                                                           |
| 11/06 | Complete compilation of daily discharge data sets for WY06.                                                                        |
| 1/07  | Complete first draft of data tables section of report.                                                                            |
| 2/07  | Data tables sent to cooperators for review.                                                                                       |
| 3/07  | Complete analysis of time series changes at each station.                                                                          |
| 4/07  | Complete first draft (all sections).                                                                                               |
| 6/07  | Colleague reviews completed.                                                                                                       |
| 7/07  | Submit for regional approval.                                                                                                      |
| 9/07  | Report approved; sent to printer.                                                                                                |

Appendix B – Acreage Counts by Land Classification

### SEGMENT A - Downstream Project Limit to U.S. Highway 75

<table>
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<td>4539</td>
<td>5823</td>
<td>5697</td>
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<tr>
<td>Barren</td>
<td>860</td>
<td>177</td>
<td>18</td>
<td>105</td>
<td>120</td>
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<tr>
<td>Forest</td>
<td>1173</td>
<td>1875</td>
<td>1250</td>
<td>1380</td>
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<td>2003</td>
<td>1127</td>
<td>420</td>
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<td>Urban</td>
<td>182</td>
<td>252</td>
<td>342</td>
<td>1013</td>
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<tr>
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<td>885</td>
<td>450</td>
<td>736</td>
<td>681</td>
<td>820</td>
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<tr>
<td><strong>TOTAL SEG A Acres</strong></td>
<td><strong>9296</strong></td>
<td><strong>9296</strong></td>
<td><strong>9296</strong></td>
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*No Data = areas where no imagery was available*

### SEGMENT B - U.S. Highway 75 to NE Highway 50

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*No Data = areas where no imagery was available*

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Appendix C – Land Classification Trends

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Appendix D – USGS Data and Report

Abstract

In cooperation with the Lower Platte South Natural Resources District for a collaborative study of the cumulative effects of water and channel management practices on stream and riparian ecology, the U.S. Geological Survey (USGS) compiled, analyzed, and summarized hydrologic information from long-term gaging stations on the lower Platte River to determine any significant temporal differences among six discrete periods during 1895-2006 and to interpret any significant changes in relation to changes in climatic conditions or other factors. A subset of 171 examined hydrologic indices (HIs) were selected for use as indices that (1) included most of the variance in the larger set of indices, (2) retained utility as indicators of the streamflow regime, and (3) provided information at spatial and temporal scale(s) that were most indicative of streamflow regime(s). The study included the most downstream station within the central Platte River segment that flowed to the confluence with the Loup River and all four active streamflow-gaging stations (2006) on the lower Platte River main stem extending from the confluence of the Loup River and Platte River to the confluence of the Platte River and Missouri River south of Omaha. The drainage areas of the five streamflow-gaging stations covered four (of eight) climate divisions in Nebraska—division 2 (north central), 3 (northeast), 5 (central), and 6 (east central).

Historical climate data and daily streamflow records from 1895 through 2006 at the five streamflow-gaging stations were divided into six 11-water-year periods: 1895–1905, 1934–44, 1951–61, 1966–76, 1985–95, and 1996–2006. Analysis of monthly climate variables—precipitation and Palmer Hydrological Drought Index—was used to determine the degree of hydroclimatic association between streamflow and climate. Except for the 1895–1905 period, data gaps in the streamflow record were filled by data estimation techniques, and 171 hydrologic indices were calculated using the Hydroecological Integrity Assessment Process software developed by the U.S. Geological Survey. A subset of 27 nonredundant indices (of the 171 indices) was selected using principal component analysis. Indices that described monthly streamflow—mean, maximum, minimum, skewness, and coefficients of variation—also were used. Comparison of these selected indices allowed determination of temporal differences among the six 11-water-year periods for each gaging station.