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

US Army Corps of Engineers ®
Omaha District

Funded in part by a grant from:

The Nebraska Environmental Trust
preserving NATURAL NEBRASKA™ for future generations

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.

Photo 1: Platte River near Platte River State Park, Nebraska, Lied Bridge in background.

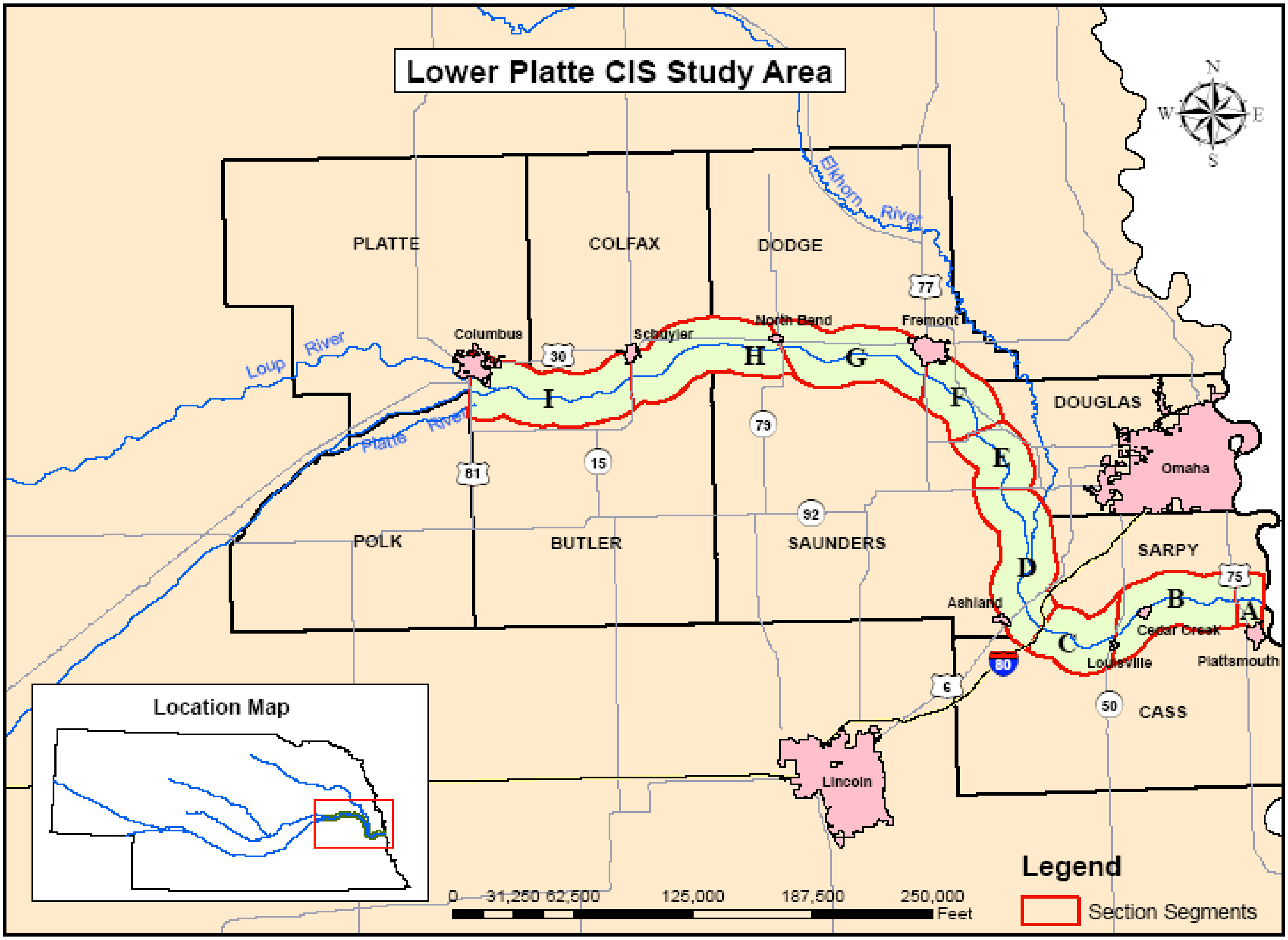


Figure 1: Lower Platte CIS Study Area

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.


Photo 2: Typical levee and bank stabilization along the Platte River.

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:

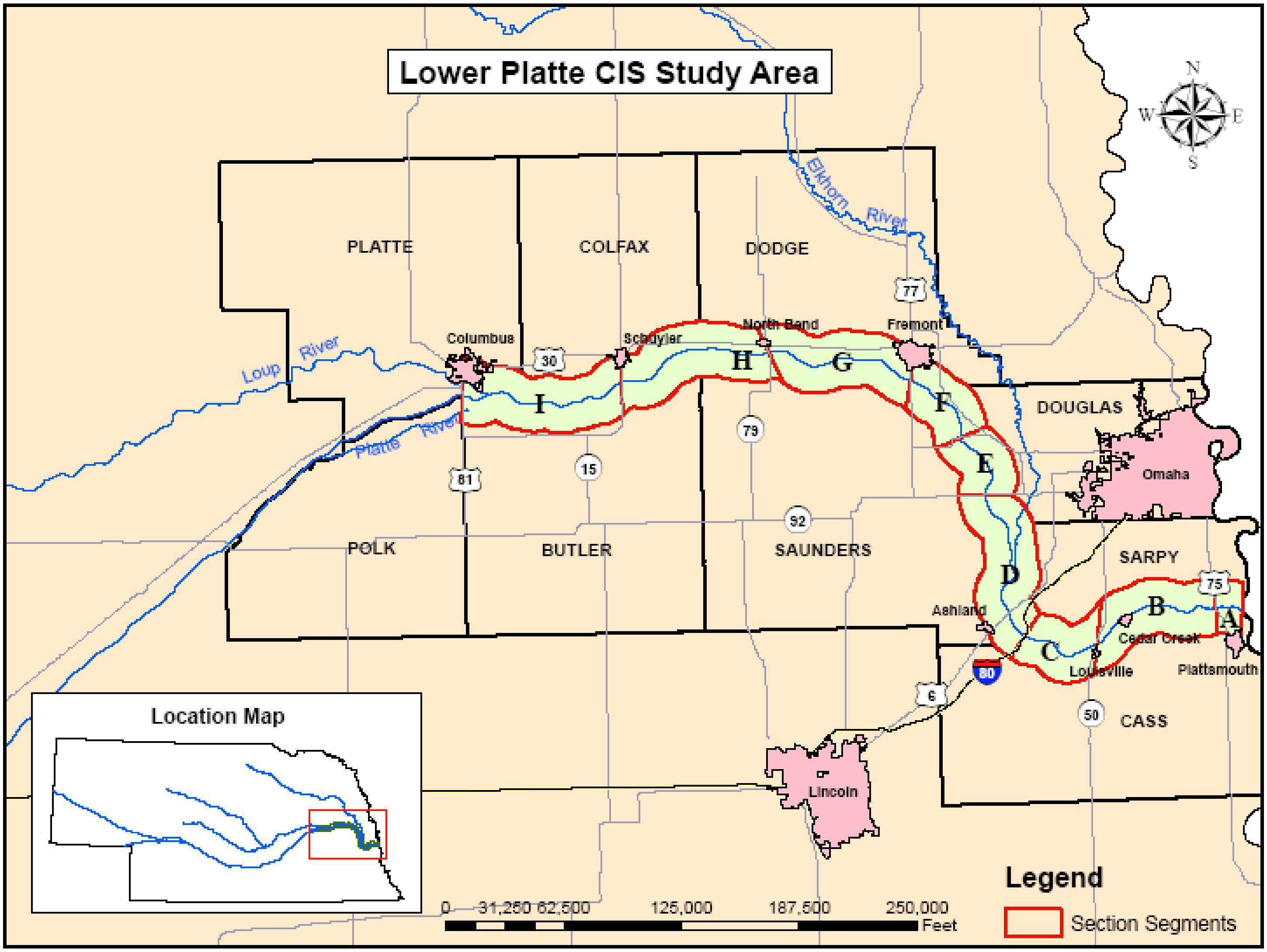


Figure 2: Lower Platte Cumulative Impact Study project area, Nebraska.

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.

Photo 3: Highway 64 Bridge, Platte River Landing near center, and treatment ponds.

2. GIS Tasks

Obtaining aerial photographs, georeferencing, digitizing, land use classification.

Photo 4: A typical view of the Platte River and sandbars.

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 B, the agricultural land use ranges from 30,911 acres in 1938 to 27,922 acres in 2003. Barren land ranges from 842 acres in 1938 to 1216 acres in 2003. Forest increases from 5527 acres in 1938 to 7948 acres in 2003. Range lands remained nearly constant, 3338 acres in 1938 and 3305 acres in 2003. Urban acres increased dramatically, from 179 acres in 1938 to 2311 acres in 2003. Water acres also remained somewhat constant, at 2828 acres in 1938 to 3098 acres in 2003.

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. Randge 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.

Segment D had a gradual increase in agricultural lands and a gradual increase in forested lands, increasing from 25,277 (1938) to 35,933 (2003) and 3,228 acres (1938) to 7,285 acres (2003) respectively. Barren land gradually 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

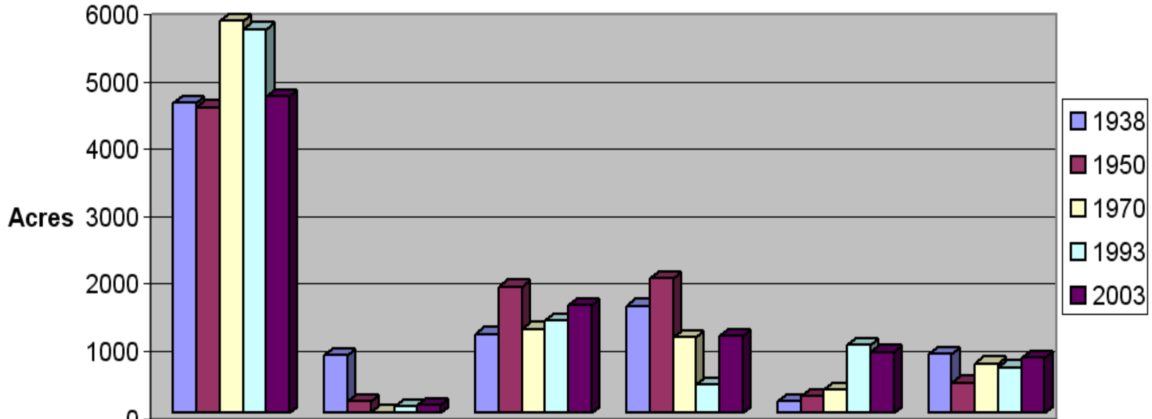
1. Major Highlights

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).

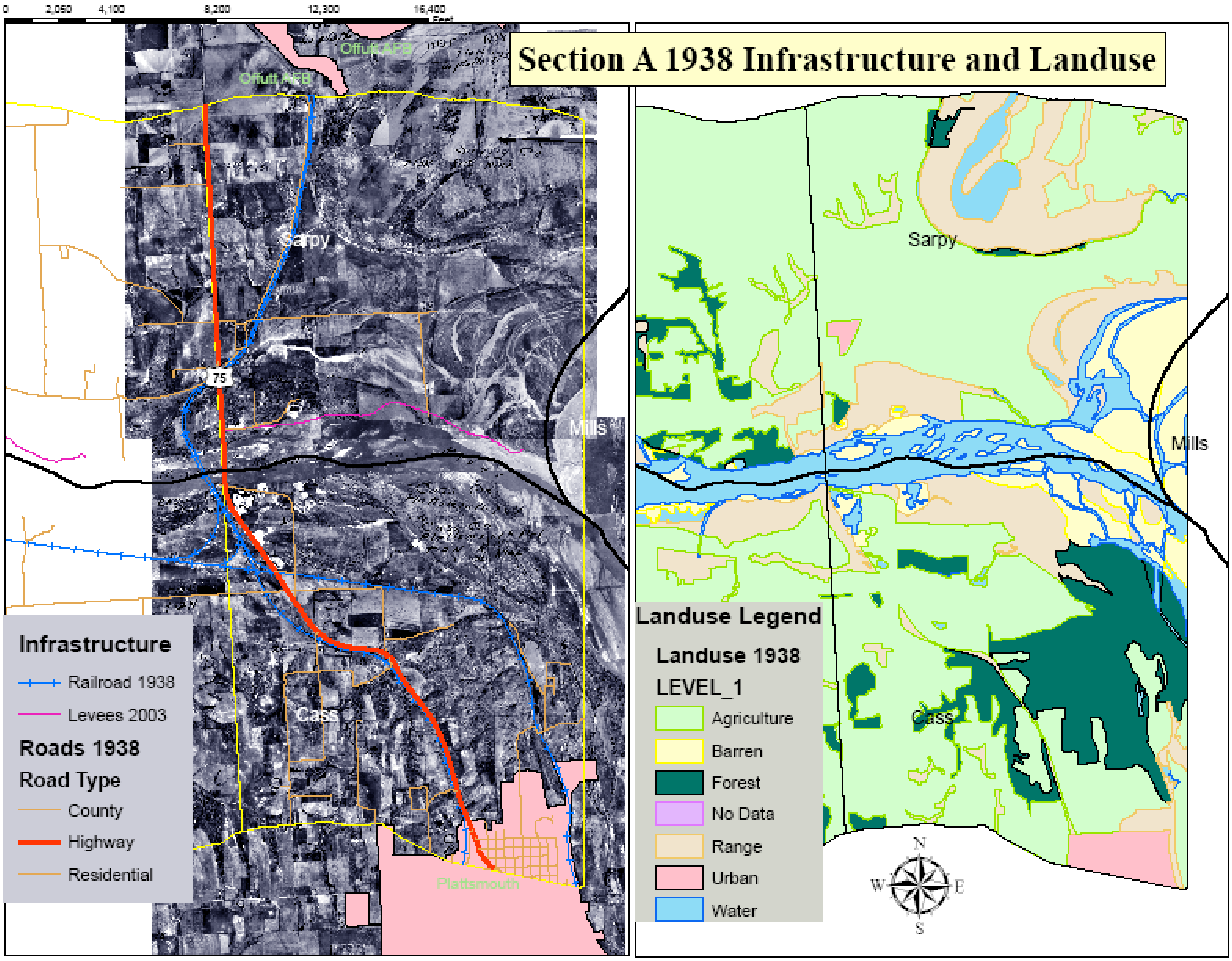
Photo 5: Platte River near Fremont, Nebraska.

Examples of Landuse Acreage Changes and Mapping

Segment A Landuse Acreage Changes



	Agriculture	Barren	Forest	Range	Urban	Water
1938	4606	860	1173	1590	182	885
1950	4539	177	1875	2003	252	450
1970	5823	18	1250	1127	342	736
1993	5697	105	1380	420	1013	681
2003	4697	120	1597	1152	910	820



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

"Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895–2006" By Daniel Ginting, Ronald B. Zelt, and Joshua I. Linard.

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

Lower Platte Cumulative Study
Phase 2 Work Plan
June 15, 2007
July 18, 2008 update

Introduction

This document defines the tasks and parties of responsibilities to execute the Lower Platter 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, PMRNRD, 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 digitize1850'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. <u>See Attached.</u>

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. <u>See Attached.</u>

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** – <u>Done.</u>

   Method of Completion – Scans ordered and delivered by USDA. <u>University of Nebraska at Omaha Blanket Purchase Agreement contract awarded to georeference and mosaic.</u>

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** – <u>Done.</u>
   d. **Method of Completion** – Scans ordered and delivered by USDA. <u>University of Nebraska at Omaha Blanket Purchase Agreement contract awarded to georeference and mosaic.</u>

5. **Digitize and attribute Anderson Level 1 Land Use classification –** <u>Develop Road Centerline Data and Buffers – Determine River Channels and Islands – 1938, 1993, 2003</u>
   Dataset –

   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 –** Done.
iv. **Method of completion -**

h. **Airports**

i. **Budget -** $200.00 Only one.
ii. **Responsible Party/POC –** USACE/NRD
iii. **Estimated Completion Date – Fall 06**
iv. **Method of completion – heads up digitizing**

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. LPSNRD 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**
i. May 31, 2007 provided on external drive - DRG's, 1938 imagery,1993 imagery, 2004 imagery with river channels, 2003 Land Use, 2003 Roads, 1993 Land Use, 1850 Data.
ii. July 2007 1993 Roads, 1938 Roads, 1938 Land Use.
iii. September 2007 1950's Roads
iv. October 2007 1950's Land Use
v. November 2007 1970's Roads
vi. December 2007, 1970's Land Use.
vii. December 2007 Oher miscellaneous data sets.
e. 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**

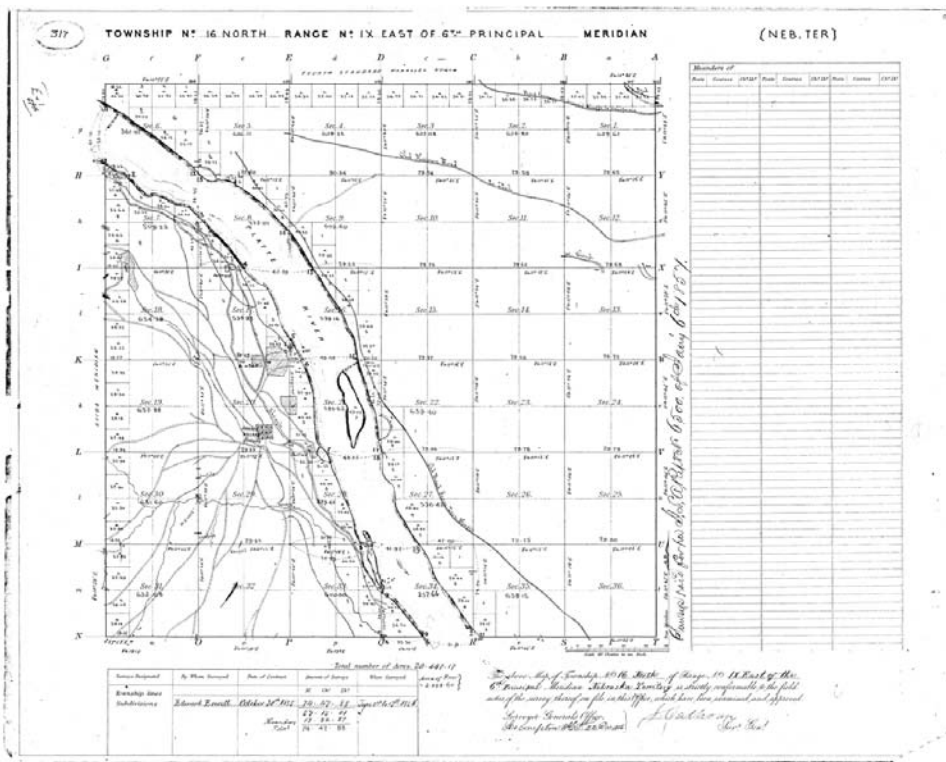
As part of this consortium, the USGS proposes to compile and analyze hydrological and channel cross-sectional information at its long-term gaging stations on the lower Platte River using archived and historical USGS data, to supplement the USGS data available through the National Water Information System (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).

TASK 1
Georeferencing and Digitizing 1850's Surveys

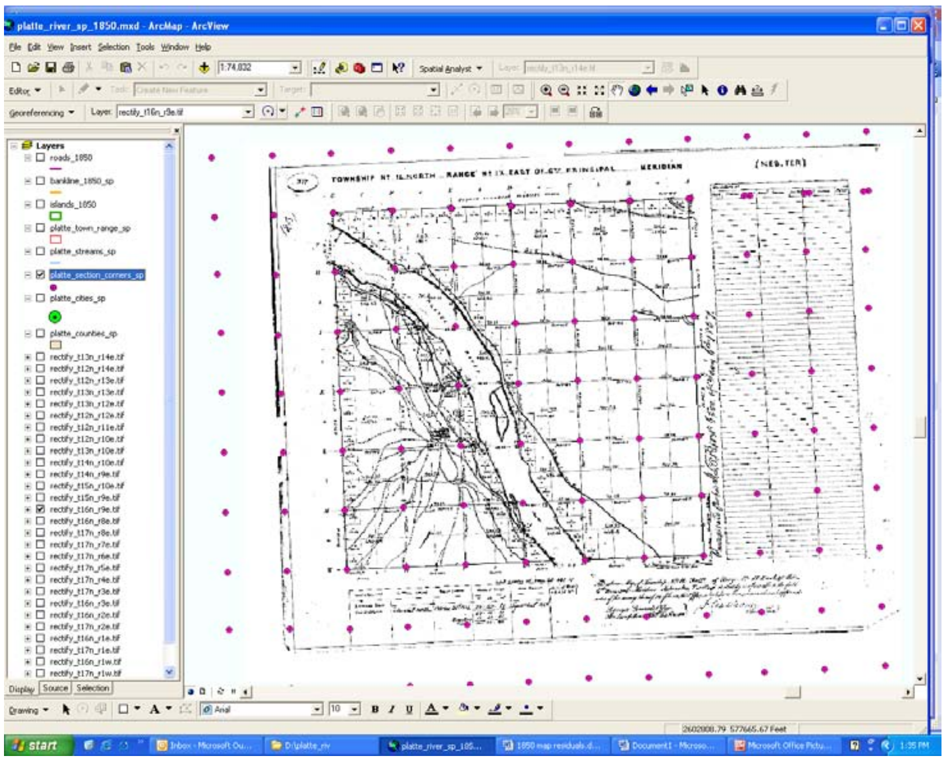
1. Individual map sheets downloaded from State of Nebraska website. Files were available for download as .pdf's

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.

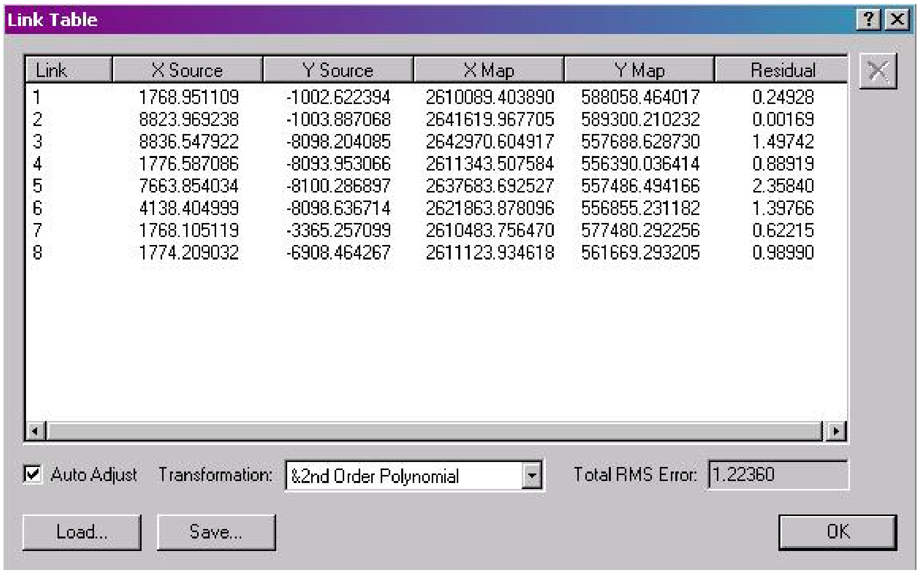


Township 16N Range 9E .jpg

3. Individual sheets were georeferenced in Arc Map using a PLSS section corner shapefile (ESRI format) downloaded from State of Nebraska website.



Screenshot of T16N R9E with PLSS section corner shapefile



Link Table

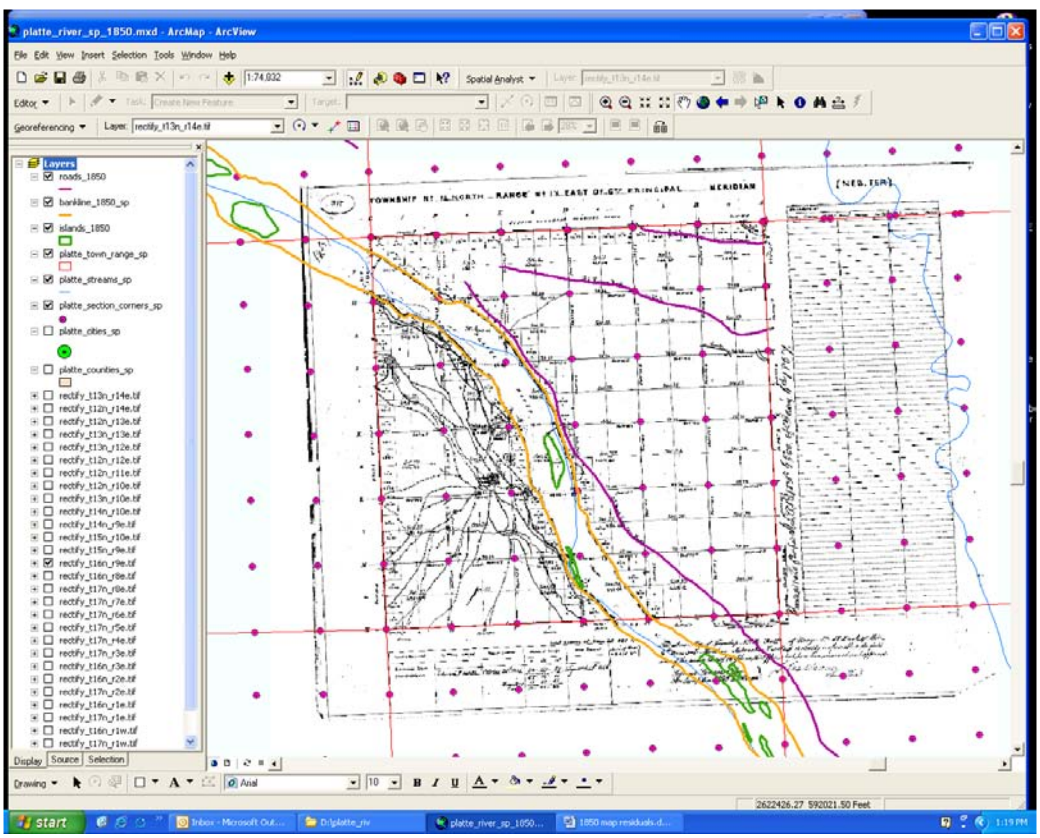
Link	X Source	Y Source	X Map	Y Map	Residual
1	1768.951109	-1002.622394	2610089.403890	588058.464017	0.24928
2	8823.969238	-1003.887068	2641619.967705	589300.210232	0.00169
3	8836.547922	-8098.204085	2642970.604917	557688.628730	1.49742
4	1776.587086	-8093.953066	2611343.507584	556390.036414	0.88919
5	7663.854034	-8100.286897	2637683.692527	557486.494166	2.35840
6	4138.404999	-8098.636714	2621863.878096	556855.231182	1.39766
7	1768.105119	-3365.257099	2610483.756470	577480.292256	0.62215
8	1774.209032	-6908.464267	2611123.934618	561669.293205	0.98990

Auto Adjust Transformation: &2nd Order Polynomial Total RMS Error: 1.22360

Load... Save... OK

Residual table for T16N R9E

4. After all sheets were georeferenced, bankline, islands, and road network features were digitized in ArcMap.



T16N R9E with digitized features

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.

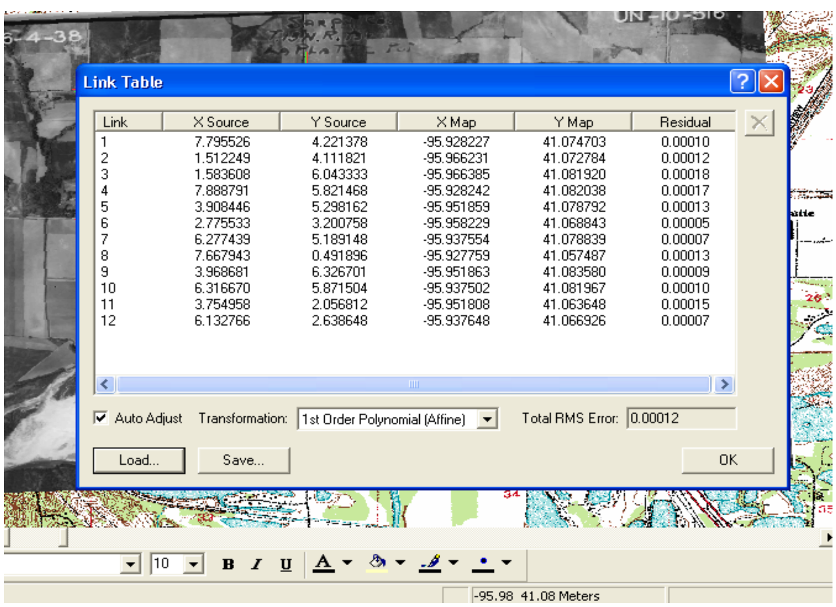
2. Load raw scans and display the images in ArcMap

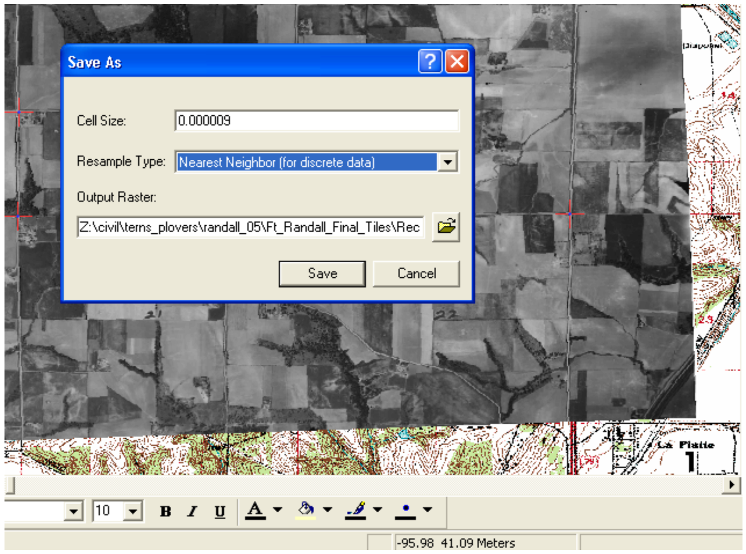
3. Find corresponding Decimal Degree NAD83 DRG to line up 1938 aerial photographs

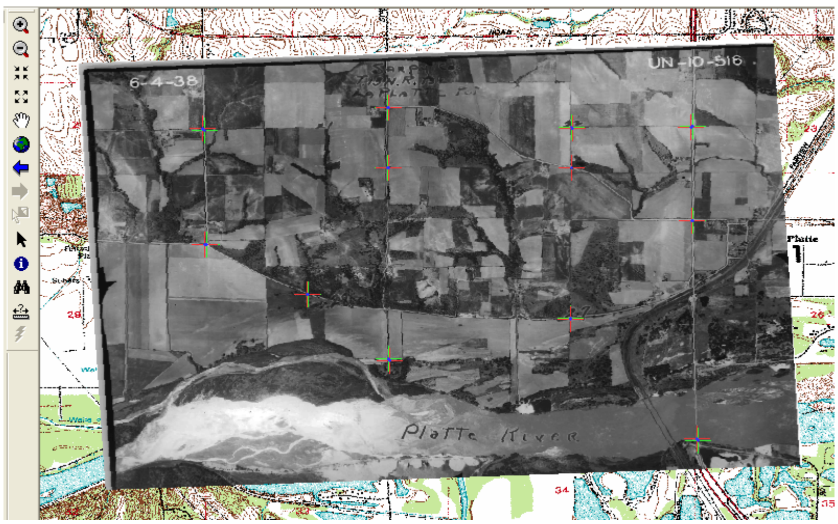
4. Find 12 intersections or points for accurate display of the images

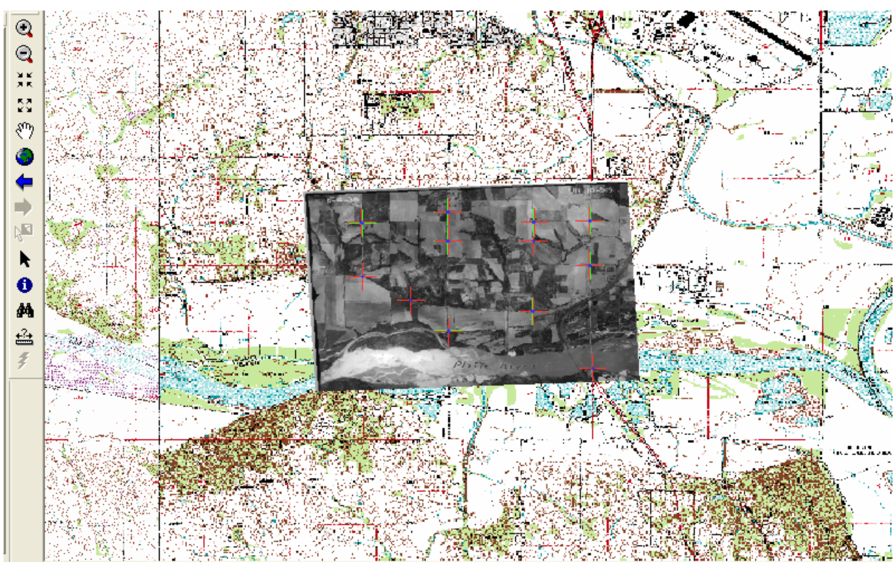
*Seen in the images below indicates the average display error (.00012), transformation (1st order polynomial), cell size (.000009), and resample type (Nearest Neighbor) which all goes into the property of the rectified image.

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




Save As
Cell Size:
0.000009
Resample Type:
Nearest Neighbor (for discrete data)
Output Raster:
Z:\civil\terns_plovers\randall_05\Ft_Randall_Final_Tiles\Rec
Save
Cancel
-95.98 41.09 Meters


6-4-38
UN-10-516
Platte River



TASK 3 and 4
Georeferencing and Mosaicing the 1950's and 1970's Imagery

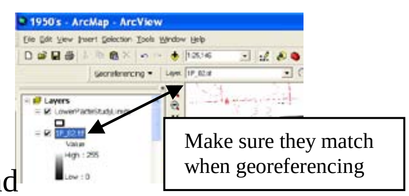
Area of Geo-referencing:
The areas of these images being geo-referenced are along the Platte River starting by Columbus, NE running all the way to where the Platte goes into the Missouri River. All files and folders will be located under the folder named Lower Platte Reach. The 1950's imagery and the 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:

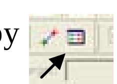
Mxd Setup

- ✓ 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

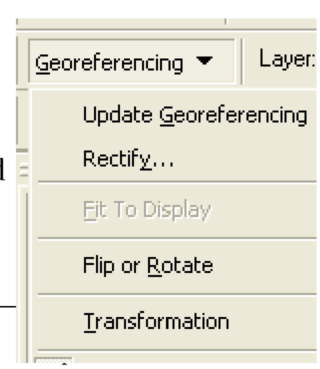
Georeferencing



- ✓ **(#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



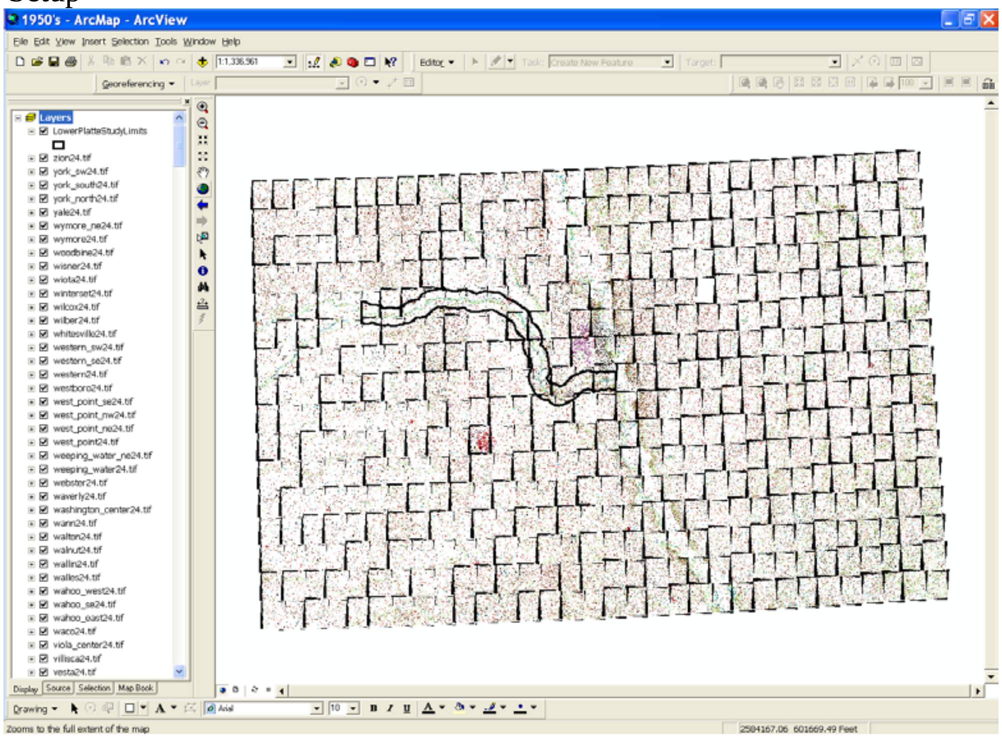
Finishing Up

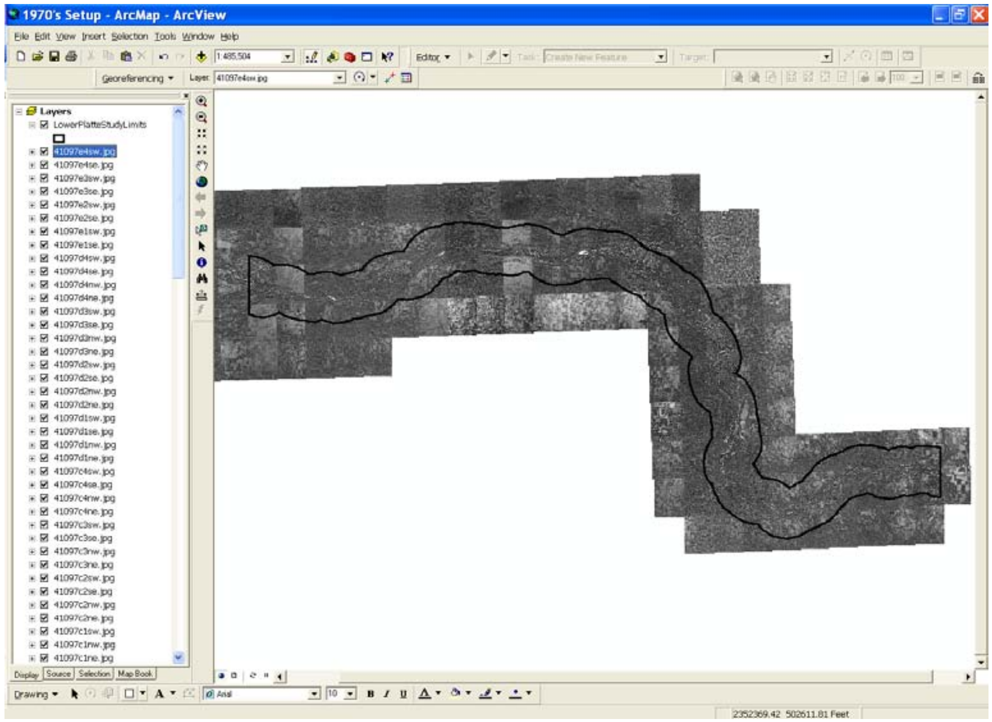
✓ Now you can delete the image from the mxd and then navigate to the Not Georeferenced folder and delete the image you just georeferenced

If you have any questions see contact information below

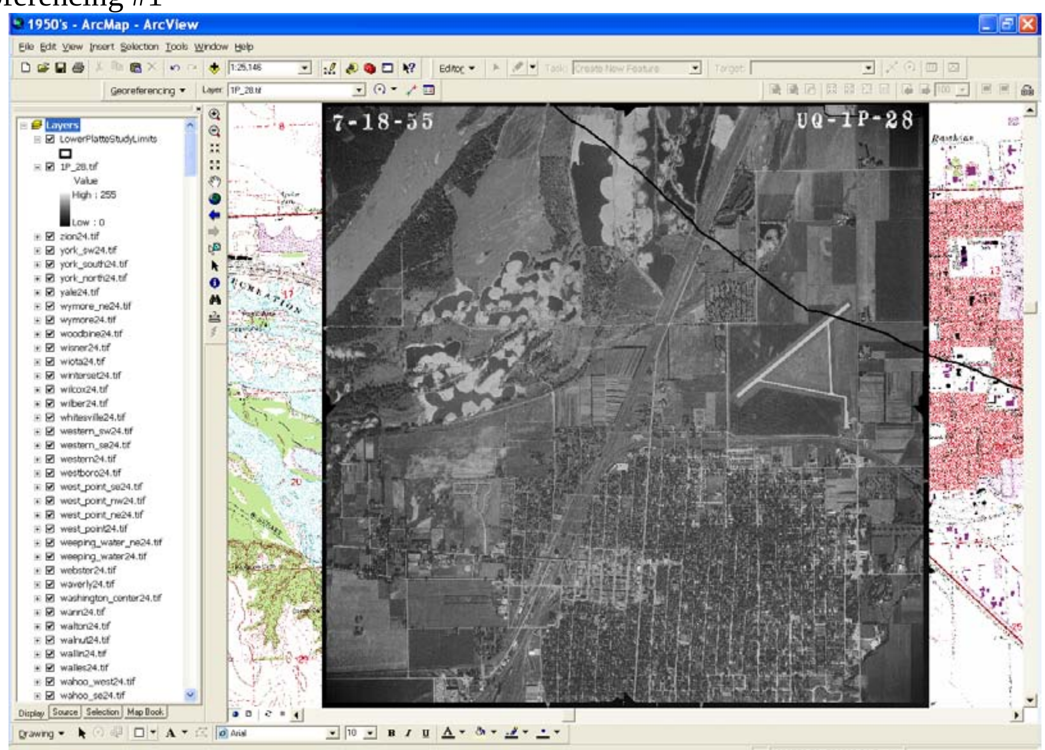
Example Using the Steps for DRG's (Note that you will be georeferencing to 1993 COQQ's in place of DRG's:

MXD Setup

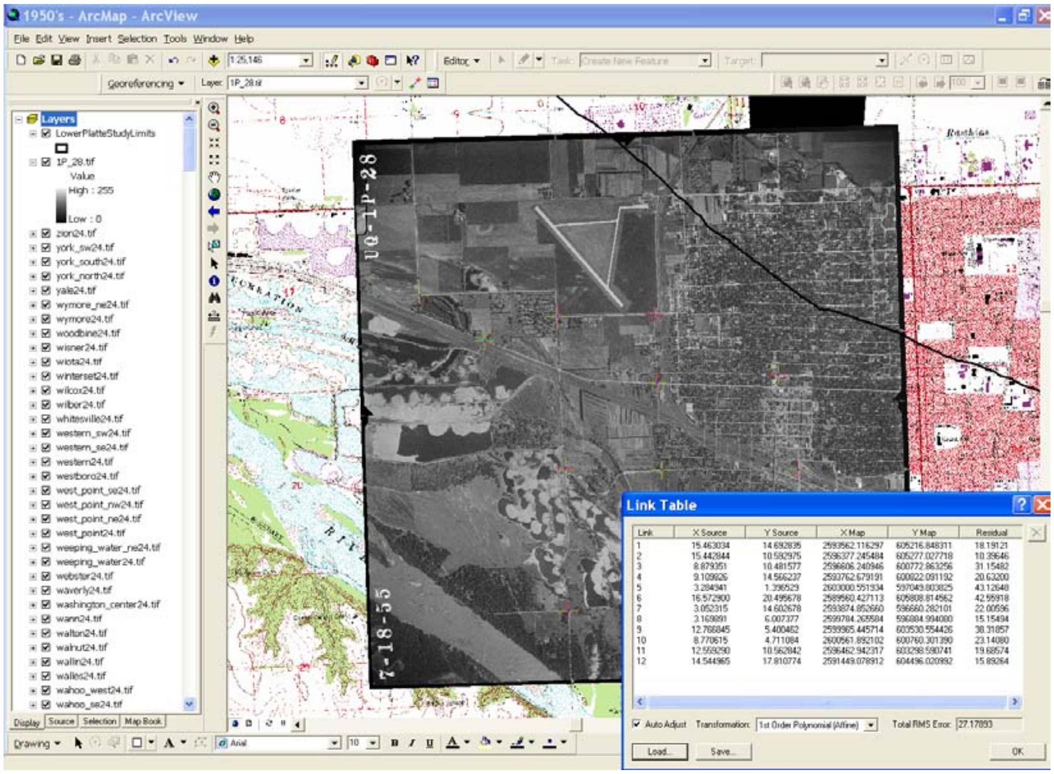




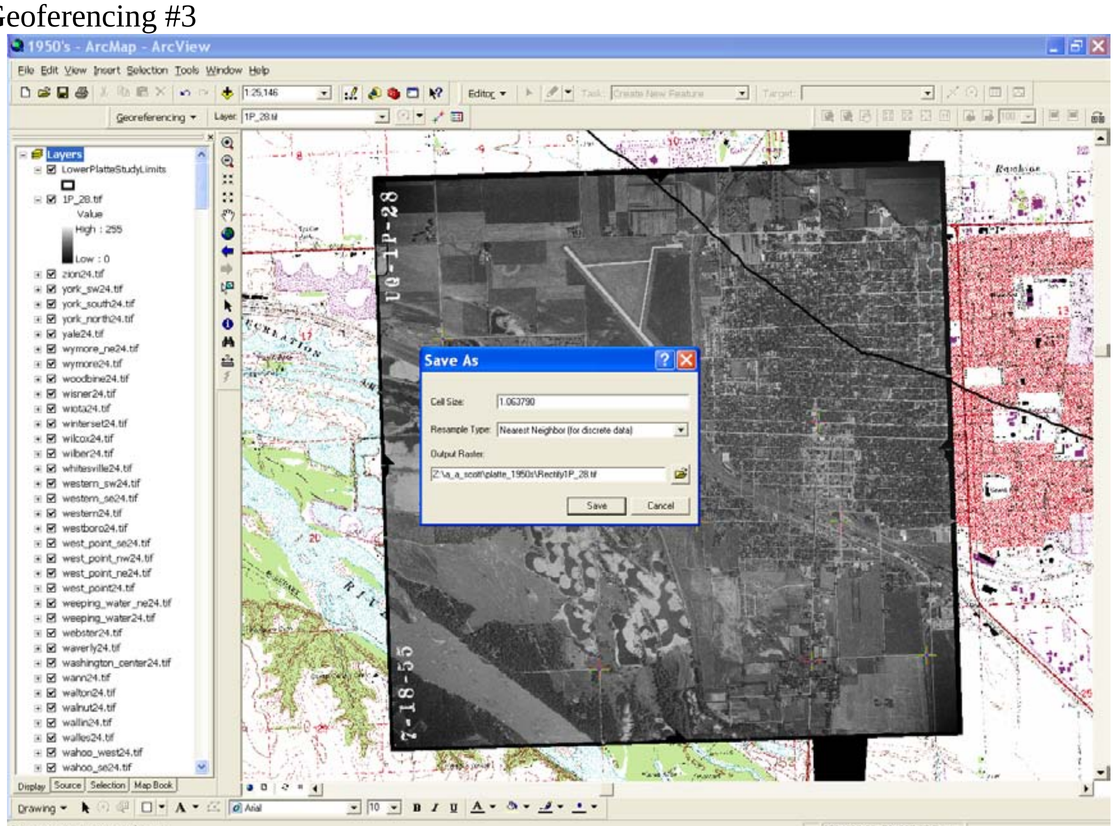
Geoferencing #1



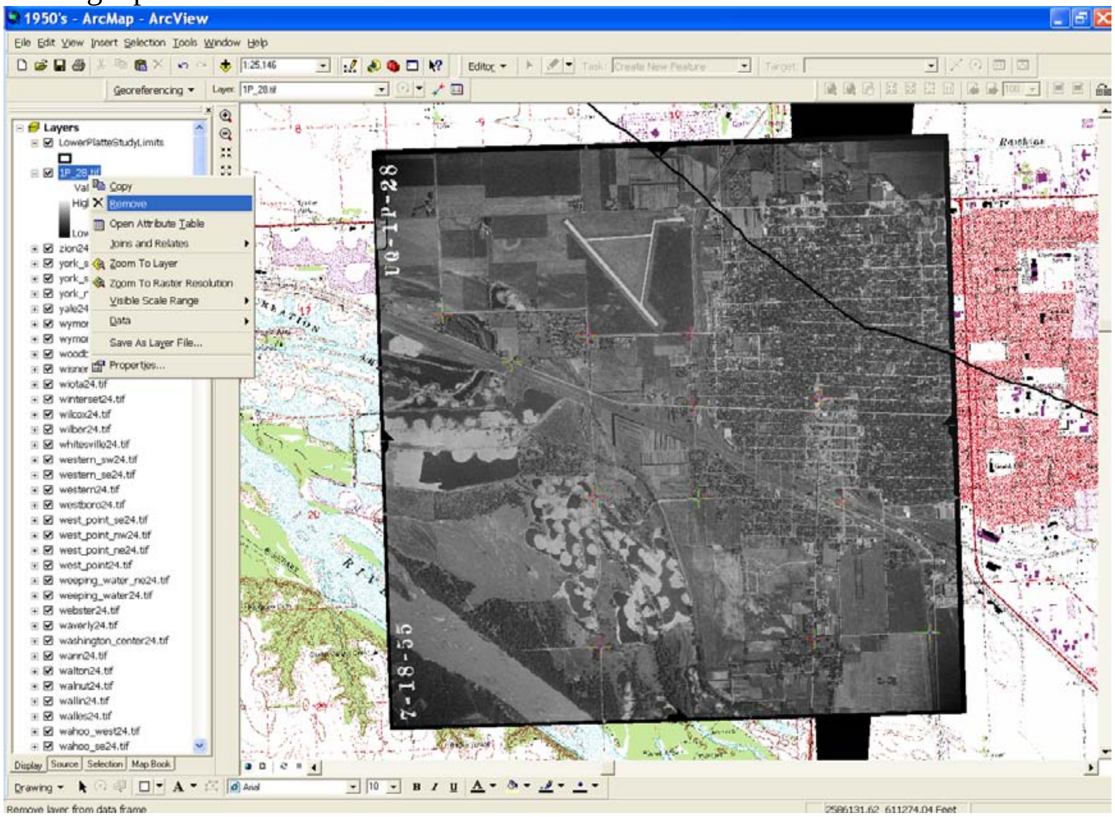
Geoferencing #2



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 <u>Mosaic Images</u> 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:

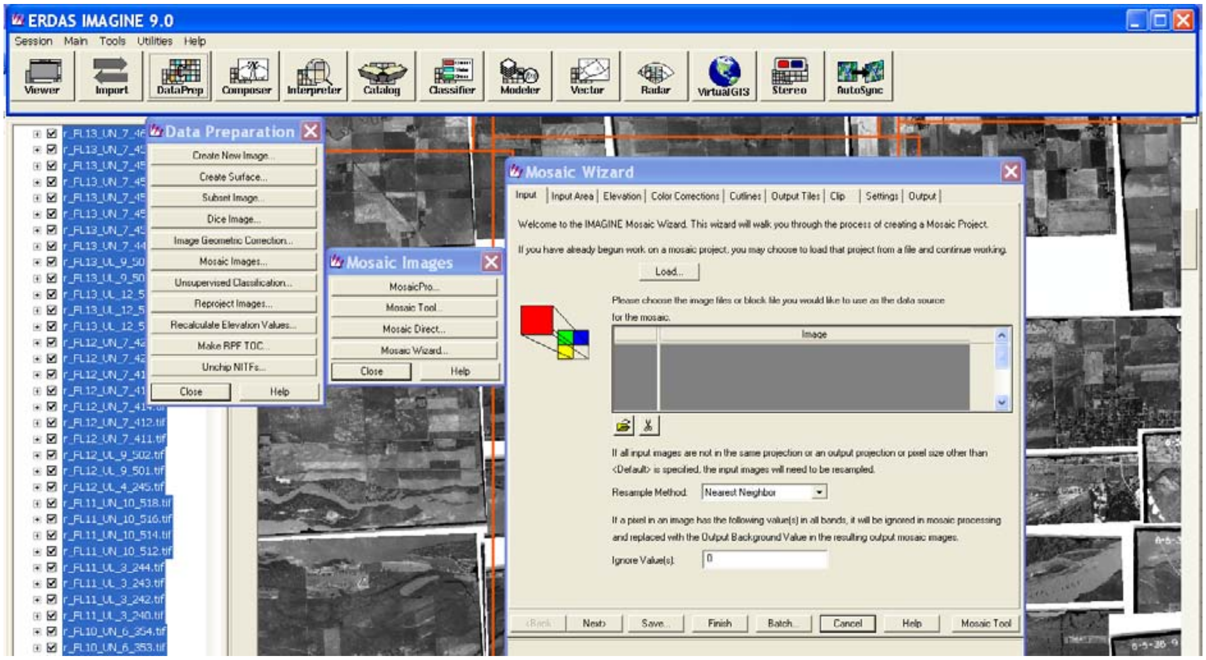
<u>Mxd Setup</u>

- ✓ After opening the mxd named <u>Mosaic QQuads</u>, 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 <u>Mosaic Images</u> 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.

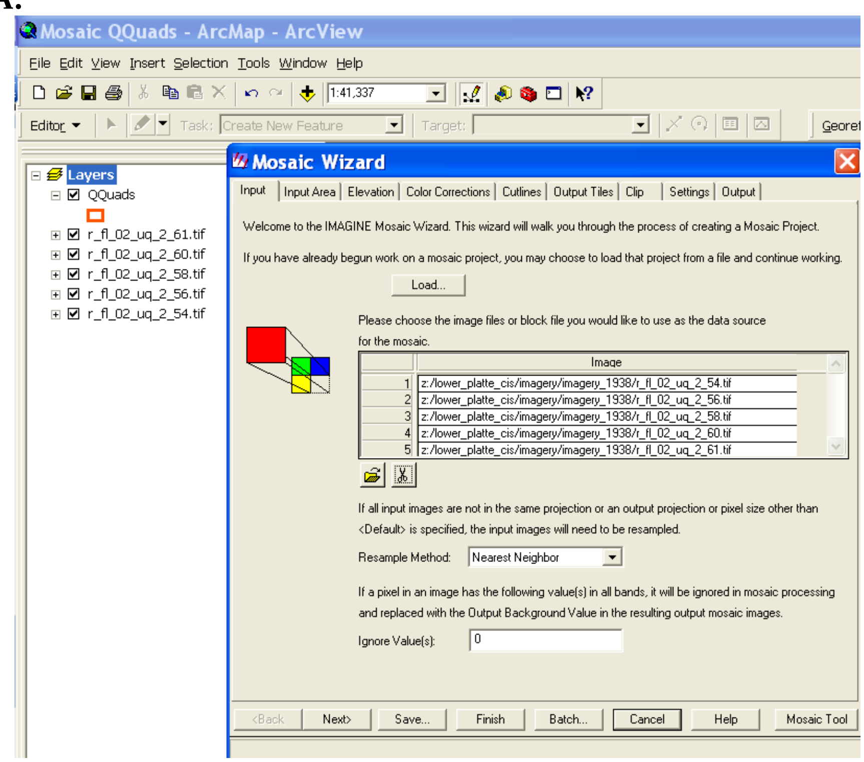
<u>Setting up the Mosaic Process</u>

- ✓ **(#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. (**see example A**)
- ✓ **(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. (**see example B**)
- ✓ 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.* (**see example C**)
- ✓ 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. (**see example D**)
  With your exported polygon shapefile, under imagename column in the attributes table this what you are going to name the new 50's or 70s QQuads except for a couple of things. First get rid of the .jpg and instead add 50 for the images in the 50's or 70 for the images in the 70's.
  Example: 41096d7se.jpg turn to 41096d7se50 for the 1950's or 41096d7se70 for he 1970's.
  There may be some QQuads that have no images

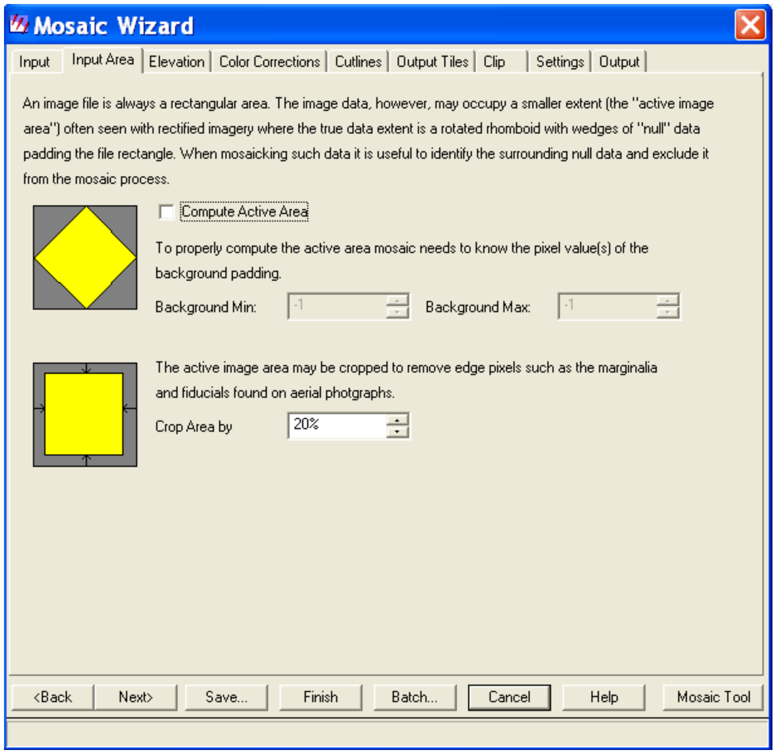
(#1)



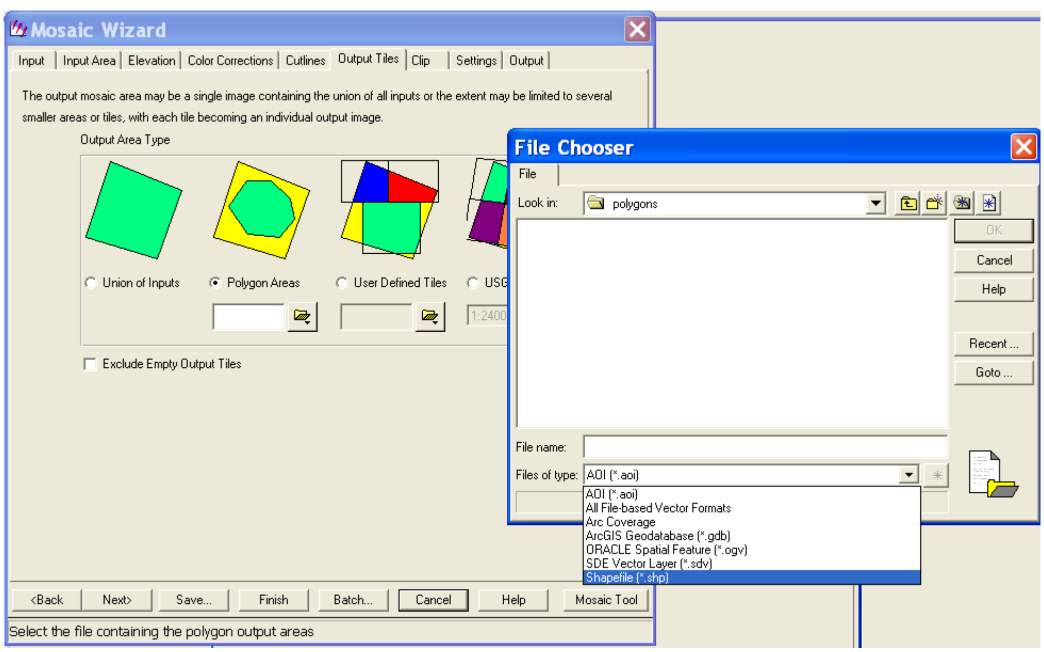
Example A:



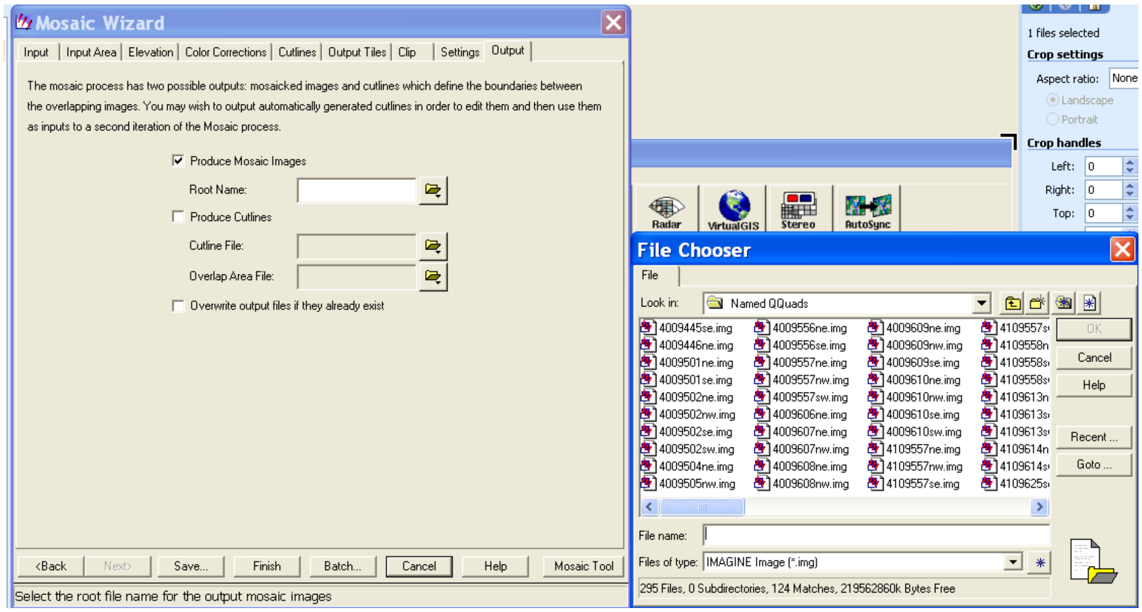
Example B:


Mosaic Wizard
Input
Input Area
Elevation
Color Corrections
Cutlines
Output Tiles
Clip
Settings
Output
An image file is always a rectangular area. The image data, however, may occupy a smaller extent (the "active image area") often seen with rectified imagery where the true data extent is a rotated rhomboid with wedges of "null" data padding the file rectangle. When mosaicking such data it is useful to identify the surrounding null data and exclude it from the mosaic process.
Compute Active Area
To properly compute the active area mosaic needs to know the pixel value(s) of the background padding.
Background Min:
Background Max:
The active image area may be cropped to remove edge pixels such as the marginalia and fiducials found on aerial photgraphs.
Crop Area by
20%
<Back
Next>
Save...
Finish
Batch...
Cancel
Help
Mosaic Tool

Example C:


Mosaic Wizard
Input
Input Area
Elevation
Color Corrections
Cutlines
Output Tiles
Clip
Settings
Output
The output mosaic area may be a single image containing the union of all inputs or the extent may be limited to several smaller areas or tiles, with each tile becoming an individual output image.
Output Area Type
Union of Inputs
Polygon Areas
User Defined Tiles
Exclude Empty Output Tiles
<Back
Next>
Save...
Finish
Batch...
Cancel
Help
Mosaic Tool
Select the file containing the polygon output areas
File Chooser
File
Look in:
polygons
OK
Cancel
Help
Recent ...
Goto ...
File name:
Files of type:
AOI (*.aoi)
AOI (*.aoi)
All File-based Vector Formats
Arc Coverage
ArcGIS Geodatabase (*.gdb)
ORACLE Spatial Feature (*.ogv)
SDE Vector Layer (*.sdv)
Shapefile (*.shp)

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

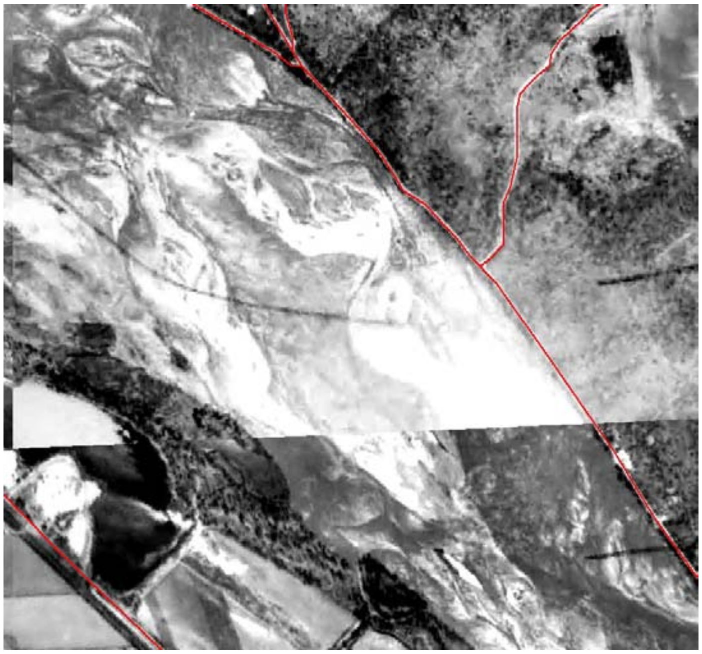
The Lower Platte CIS group came to an agreement to use level 1 of the Anderson Level 1 Land use classification system and define the limits to 2.5 miles from the center of the Platte River. The Level 1 Anderson Land Use classification system is listed below.

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)

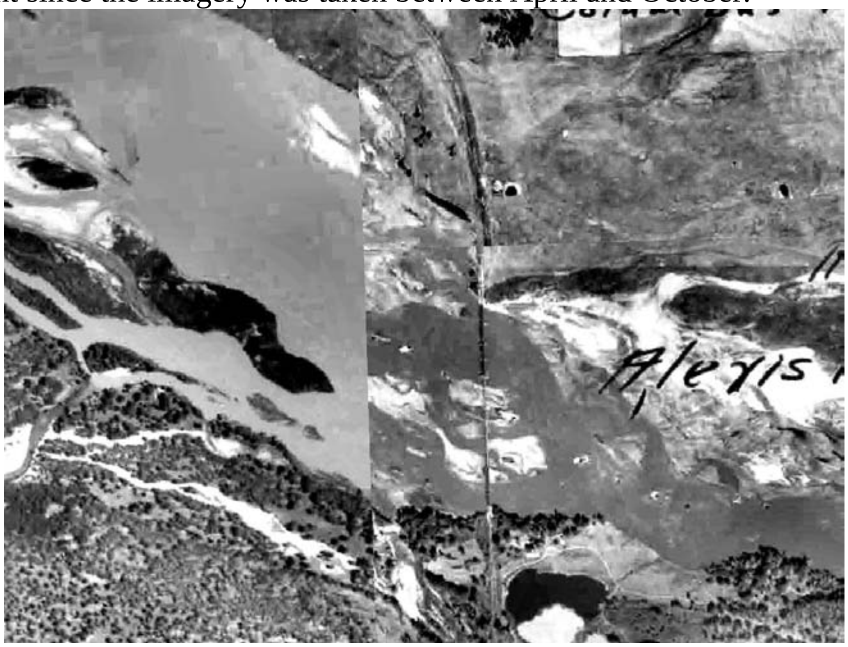


Problems also exist with the georeferenced imagery compared to the orthorectificed imagery. The georeferenced imagery had problems with the imagery being seamless from tile to tile and lining up properly. Line work was smoothed/averaged between images that were not lining up properly.

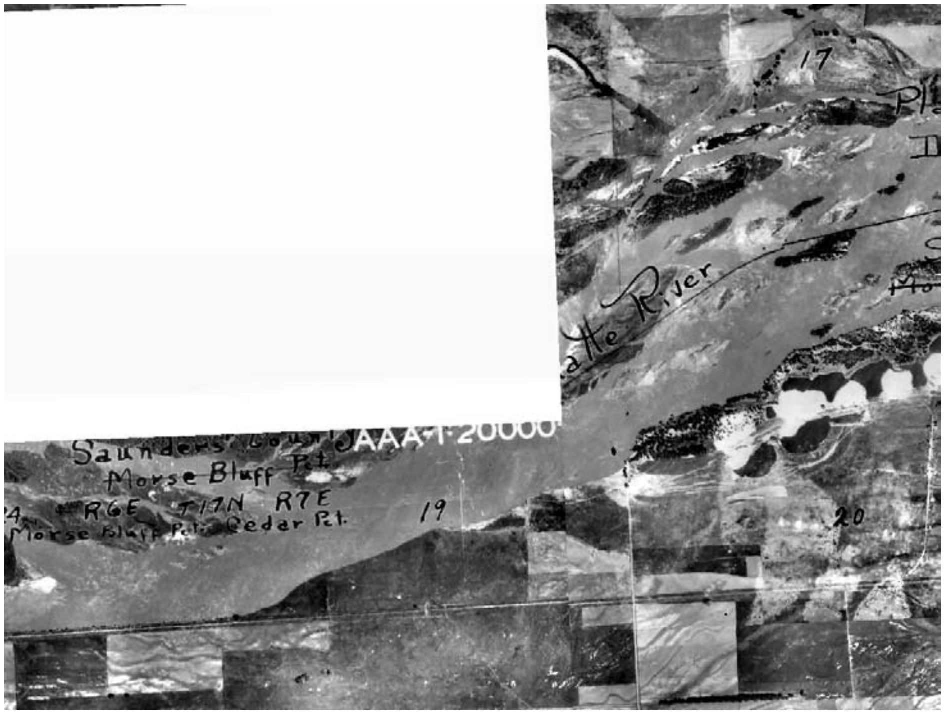
See the example of adjacent images not lining up below.

The ESRI products of ArcGIS 9.x and ArcView 3.x were used to digitized 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

LEVEL_1	TYPE_1	USE	WATER_BODY	F_AREA	ACRES
Water	Excavated	Mineral_Op	Lake	518293.15665055300	11.90
Water	Excavated	Mineral_Op	Lake	6271922.81340216000	143.98
Water	Excavated	Unknown	Lake	140114.34775389800	3.22
Water	Excavated	Mineral_Op	Lake	1409711.60488333000	32.36

Water	Excavated	Mineral_Op	Lake	1892824.59677883000	43.45
Water	Excavated	Unknown	Lake	175095.82004002300	4.02
Water	Excavated	Mineral_Op	Lake	46918.75662973300	1.08
Water	Excavated	Recreation	Lake	2088678.72880992000	47.95
Water	Excavated	Unknown	Lake	43919.98179162950	1.01

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.

LENGTH	WIDTH	CLASS	BUFFER
5644.876	25	Unknown	12.5
681.226	25	Unknown	12.5
6009.902	40	5th St	20
790.375	30	Unknown	15
3990.095	35	72nd St	17.5
5807.873	25	Fairview Rd	12.5
4302.690	35	Fairview Rd	17.5
13072.238	30	63rd St	15
5298.301	30	87th St	15
7388.215	40	99th St	20

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

Karr, J.R., and Chu, E.W., 1999, Restoring life in running waters: better biological monitoring. Island Press, Washington, D.C. (as cited in Karr, J.R., 1999, Defining and measuring river health: Freshwater Biology, 41:221-234).

Olden, J.D., and Poff, N.L., 2003, Redundancy and the choice of hydrologic indices for characterizing streamflow regimes: River Research and Applications, v. 19, p. 101-121.

Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg, 1997. The natural flow regime: a paradigm for conservation and restoration of river ecosytems. BioScience 47:769-784.

Richter, R.D., Baumgartner, J.V., Powell, J., and Braun, D.P., 1996, A method for assessing hydrologic alteration within ecosystems: Conservation Biology, v. 10, p. 1163-1174.

Richter, R.D., Baumgartner, J.V., Wigington, R., and Braun, D.P., 1997, How much water does a river need?: Freshwater Biology, v. 37, p. 231-249.

Table.—Summary of project timeline and tasks.

Date	Task
4/06	Grant notification. Complete workplan.
5/06	Complete topical outline and list of figures.
6/06	Complete compilation of daily discharge data sets (thru WY05).
7/06	Complete compilation/review of available measurements data.
8/06	Finalize data entry procedure and train student technician.
--------- 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					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	4606	4539	5823	5697	4697
Barren	860	177	18	105	120
Forest	1173	1875	1250	1380	1597
Range	1590	2003	1127	420	1152
Urban	182	252	342	1013	910
Water	885	450	736	681	820
TOTAL SEG A Acres	9296	9296	9296	9296	9296

SEGMENT B - U.S. Highway 75 to NE Highway 50					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	31333	30135	28952	30882	28704
Barren	842	1819	948	1095	1216
Forest	5296	5013	5474	5965	7454
No Data*	2173	0	0	0	0
Range	3168	6485	6090	3286	3142
Urban	179	250	806	1622	2209
Water	2807	2096	3528	2948	3074
TOTAL SEG B Acres	45798	45798	45798	45798	45798
No Data = areas where no imagery was available					

SEGMENT C - NE HWY 50 U/S to I-80					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	14788	17565	17096	17789	17353
Barren	399	550	244	276	360
Forest	5208	4517	4716	5837	6428
No Data*	5890	0	0	0	0
Range	743	4561	4633	2240	1533
Urban	134	158	249	840	1392
Water	1574	1385	1798	1753	1670
TOTAL SEG C Acres	28736	28736	28736	28736	28736
No Data = areas where no imagery was available					

SEGMENT D - I-80 U/S to NE Highway 92					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	25519	36532	37163	37507	36843
Barren	767	1031	744	1114	1374
Forest	3203	4184	3936	6128	6918
No Data*	15212	0	0	0	0
Range	7124	10411	9181	5169	4065
Urban	35	342	789	1260	2240
Water	3436	2796	3483	4118	3856
TOTAL SEG D Acres	55296	55296	55296	55296	55296
No Data = areas where no imagery was available					

SEGMENT E - NE HWY 92 U/S to NE HWY 64					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	9030	16060	16081	15010	13307
Barren	418	520	449	941	669
Forest	173	857	825	995	1408
No Data*	7268	0	0	0	0
Range	5619	5242	4659	3035	3538
Urban	258	303	586	2067	2582
Water	1480	1264	1646	2197	2742
TOTAL SEG E Acres	24246	24246	24246	24246	24246
No Data = areas where no imagery was available					

SEGMENT F - NE HWY 64 U/S to U.S. HWY 77					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	16393	20996	20891	22260	20793
Barren	631	532	369	352	389
Forest	762	1416	1562	1854	2002
No Data*	2951	0	0	0	0
Range	5017	3542	2823	189	1352
Urban	916	779	1316	1954	2310
Water	1796	1201	1505	1857	1620
TOTAL SEG F Acres	28466	28466	28466	28466	28466
No Data = areas where no imagery was available					

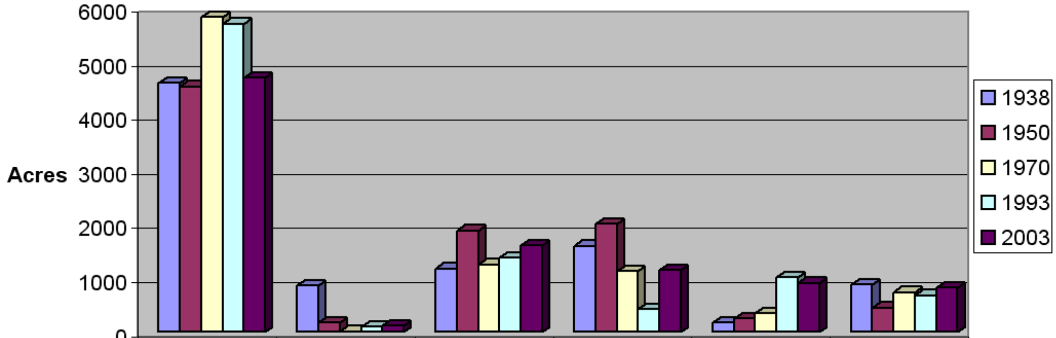
SEGMENT G - U.S. HWY 77 U/S to NE HWY 79					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	26523	37559	36420	39032	37509
Barren	802	1446	809	670	523
Forest	2931	3346	3662	4504	4470
No Data*	14724	0	0	0	0
Range	4115	7148	6671	2284	2024
Urban	1094	1339	1888	2835	5171
Water	3191	2542	3930	4055	3683
TOTAL SEG G Acres	53380	53380	53380	53380	53380
No Data = areas where no imagery was available					

SEGMENT H - NE HWY 79 U/S to NE HWY 15					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	33326	37851	39155	46108	44633
Barren	900	864	563	722	443
Forest	2990	3199	3873	4713	5041
No Data*	2977	0	0	0	0
Range	12392	11646	9254	994	1919
Urban	644	565	612	676	1270
Water	3061	2165	2833	3077	2984
TOTAL SEG H Acres	56290	56290	56290	56290	56290
No Data = areas where no imagery was available					

SEGMENT I - NE HWY 15 U/S to Project Limit (vic of U.S. HWY 81)					
Level 1	**1938**	**1950**	**1970**	**1993**	**2003**
Agriculture	32079	32374	36388	42522	40941
Barren	1219	1182	1152	952	1597
Forest	4468	3687	4020	5013	5652
No Data*	4216	0	0	0	0
Range	13661	19021	13809	4674	4888
Urban	1493	1982	2738	4478	5418
Water	3465	2355	2494	2963	2105
TOTAL SEG I Acres	60601	N/A	60601	60601	60601
No Data = areas where no imagery was available					

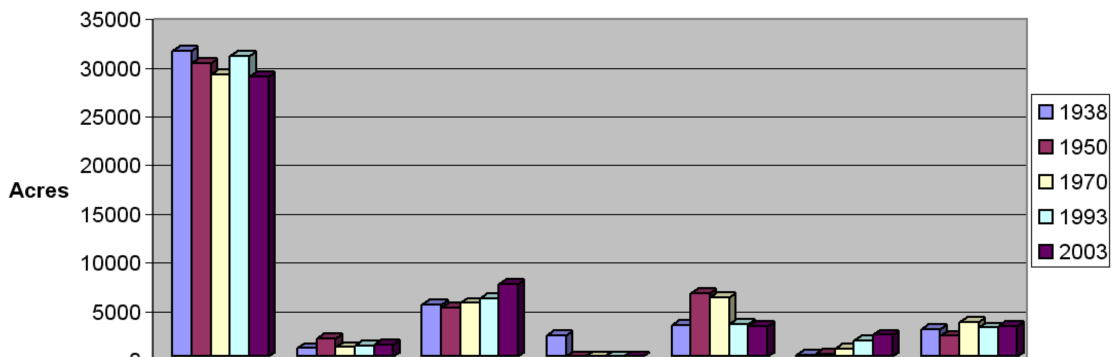
Appendix C – Land Classification Trends

Segment A Landuse Acreage Changes



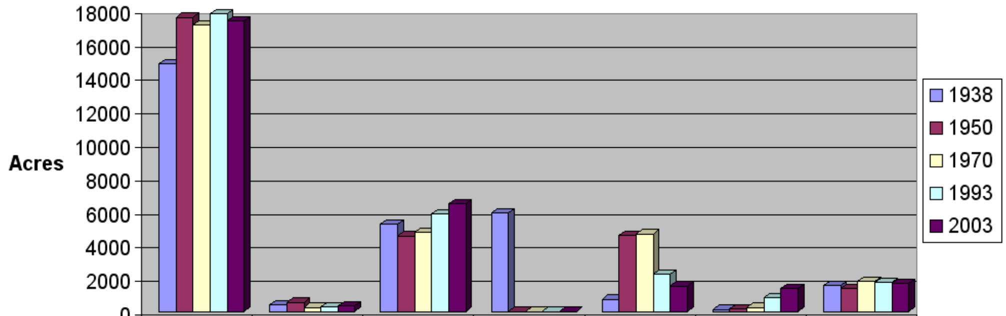
	Agriculture	Barren	Forest	Range	Urban	Water
1938	4606	860	1173	1590	182	885
1950	4539	177	1875	2003	252	450
1970	5823	18	1250	1127	342	736
1993	5697	105	1380	420	1013	681
2003	4697	120	1597	1152	910	820

Segment B Landuse Acreage Changes



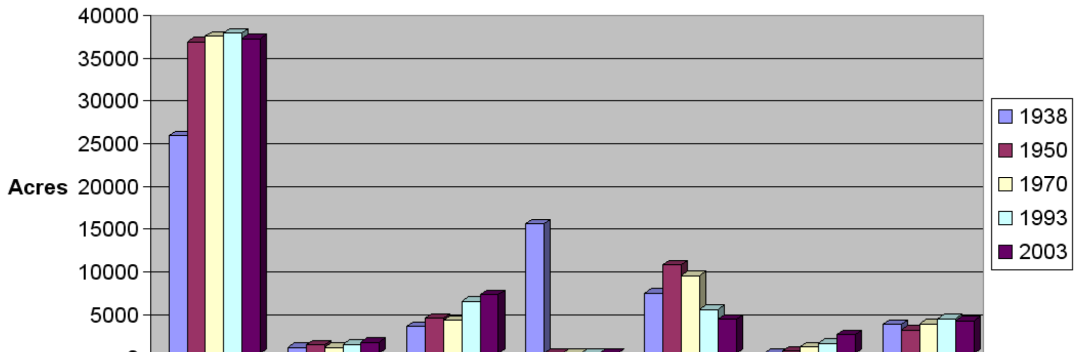
	Agriculture	Barren	Forest	Range	Urban	Water	
1938	31333	842	5296	2173	3168	179	2807
1950	30135	1819	5013	0	6485	250	2096
1970	28952	948	5474	0	6090	806	3528
1993	30882	1095	5965	0	3286	1622	2948
2003	28704	1216	7454	0	3142	2209	3074

Segment C Landuse Acreage Changes



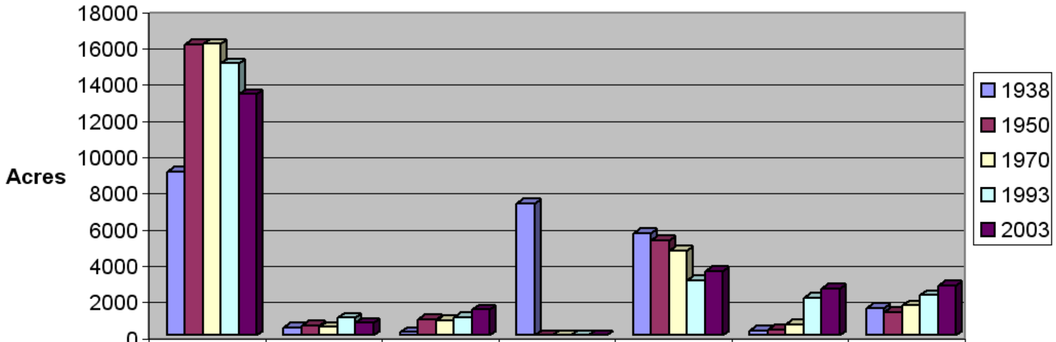
	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	14788	399	5208	5890	743	134	1574
1950	17565	550	4517	0	4561	158	1385
1970	17096	244	4716	0	4633	249	1798
1993	17789	276	5837	0	2240	840	1753
2003	17353	360	6428	0	1533	1392	1670

Segment D Landuse Acreage Changes



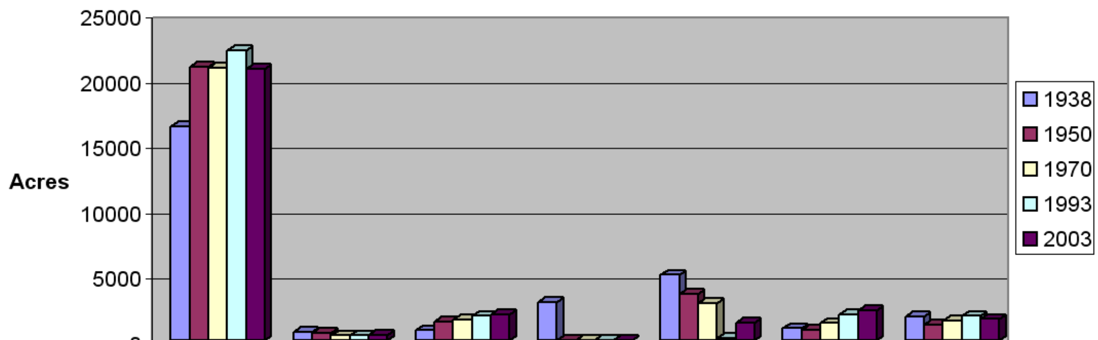
	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	25519	767	3203	15212	7124	35	3436
1950	36532	1031	4184	0	10411	342	2796
1970	37163	744	3936	0	9181	789	3483
1993	37507	1114	6128	0	5169	1260	4118
2003	36843	1374	6918	0	4065	2240	3856

Segment E Landuse Acreage Changes



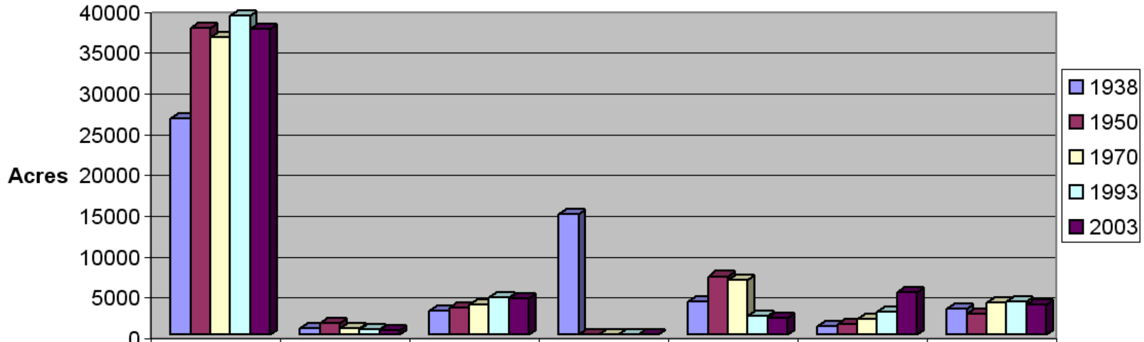
	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	9030	418	173	7268	5619	258	1480
1950	16060	520	857	0	5242	303	1264
1970	16081	449	825	0	4659	586	1646
1993	15010	941	995	0	3035	2067	2197
2003	13307	669	1408	0	3538	2582	2742

Segment F Landuse Acreage



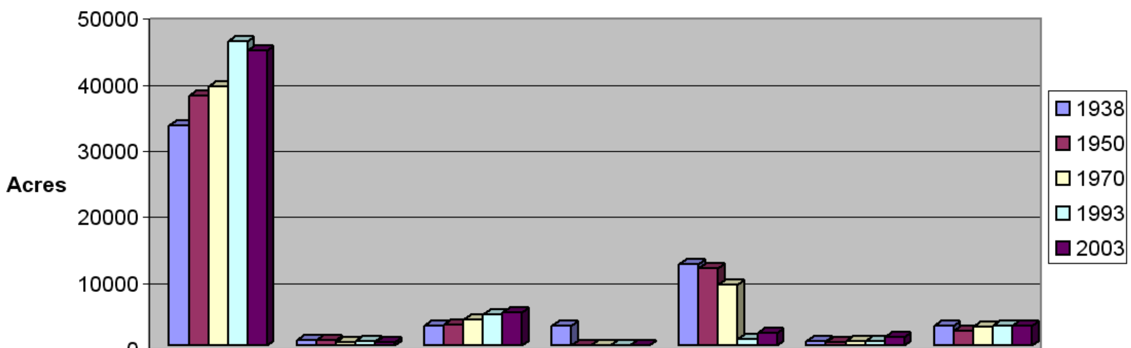
	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	16393	631	762	2951	5017	916	1796
1950	20996	532	1416	0	3542	779	1201
1970	20891	369	1562	0	2823	1316	1505
1993	22260	352	1854	0	189	1954	1857
2003	20793	389	2002	0	1352	2310	1620

Segment G Landuse Acreage Changes



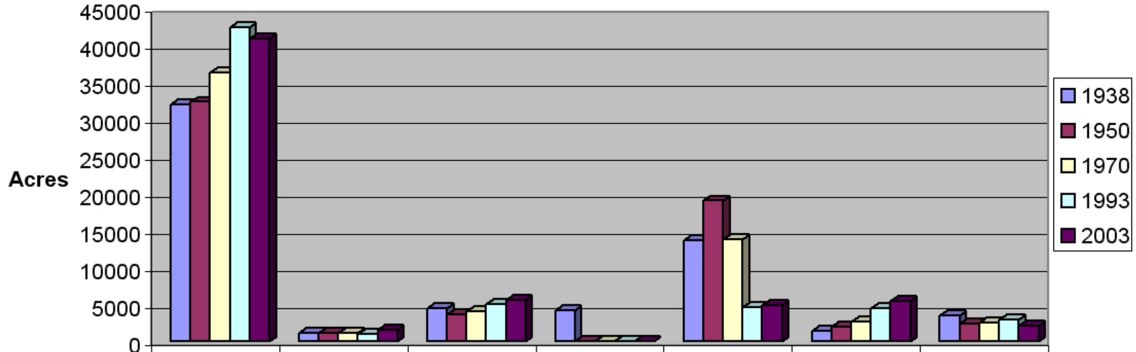
	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	26523	802	2931	14724	4115	1094	3191
1950	37559	1446	3346	0	7148	1339	2542
1970	36420	809	3662	0	6671	1888	3930
1993	39032	670	4504	0	2284	2835	4055
2003	37509	523	4470	0	2024	5171	3683

Segment H Landuse Acreage Changes



	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	33326	900	2990	2977	12392	644	3061
1950	37851	864	3199	0	11646	565	2165
1970	39155	563	3873	0	9254	612	2833
1993	46108	722	4713	0	994	676	3077
2003	44633	443	5041	0	1919	1270	2984

Segment I Landuse Acreage Changes



	Agriculture	Barren	Forest	No Data*	Range	Urban	Water
1938	32079	1219	4468	4216	13661	1493	3465
1950	32374	1182	3687	0	19021	1982	2355
1970	36388	1152	4020	0	13809	2738	2494
1993	42522	952	5013	0	4674	4478	2963
2003	40941	1597	5652	0	4888	5418	2105

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.