

VOLUME 3 TABLE OF CONTENTS

WATER RESOURCES AND WATER QUALITY CD

Water Resources Appendix

Central and North Platte
South Platte

Ground Water Appendix

Flooding Appendix

South Platte River Model

Hydrosphere Resource Consultants, Inc. 2001. Hydrosphere South Platte EIS Model, Inc., Dated June 8, 2001.
Wolvington, Roger, L. Rozaclis, and Donald Anderson. 2001. User's Guide for the South Platte River EIS Model (SPREISM), Version 1.0, Dated May 21, 2001.

Central Platte River Model

Central Platte River Model (OPSTUDY8). Technical Documentation and Users Guide. Platte River EIS Office, Lakewood, Colorado. February 2006.
Phillips, Mark. 1999. Review of Present-Conditions Stream Reach Flow Gains for the Central Platte River OPSTUDY Model. Bureau of Reclamation, Great Plains Regional Office, Billings, Montana, Dated May 1999.
Rodney, Mark. 2002. Calibration and Validation of the Central Platte OPSTUDY Model. U.S. Fish and Wildlife Service, January 2002 [most recent date].

North Platte River Model

EIS Model, Update 2006
Myler, Lyle. 1997. North Platte River Water Utilization Model Documentation. Dated June 1997.

Sanders, Glen. 2001. Ground Water and River Flow Analyses. Bureau of Reclamation and U.S. Fish and Wildlife Service, Denver, Colorado, Dated May 2001.

Stroup, Duane, Mark Rodney, and Donald Anderson. 2006. Flow Characterizations for the Platte River Basin in Colorado, Wyoming, and Nebraska. Prepared for the Platte River Recovery Implementation Program EIS Office. February 2006.

Troendle, Charles A. and Jame M. Nankervis. 2000. Estimating Additional Water Yield From Changes in Management of National Forests in the North Platte Basin. Final Report. MATCOM Corporation, Fort Collins, Colorado, and Blue Mountain Consultants, Berthoud, Colorado, Dated May 12, 2000.

Water Quality Appendix

Yahnke, James. 2000 (Platte River). Existing Water Quality Conditions in the Platte River. Bureau of Reclamation, Denver, Colorado, Dated July 2000.

Water Resources Appendix

Central and North Platte

1.0 Introduction.....	1
2.0 Hydrologic Models.....	3
3.0 Model Simulations, Analysis, and Results.....	33

South Platte

1. The South Platte River EIS Model (SPREISM).....	2
1.1 SPREISM Modeling Configuration.....	3
1.2 Model Adjustments to Reflect Current Conditions.....	3
1.3 Model Representation of EIS Alternatives.....	4
1.4 EIS Alternatives Modeled.....	5
2. Modeling the Effects of First-Increment Water Development in Colorado.....	8
3. Modeling the Effects of Tamarack I, II, and III.....	14
Appendix A: Estimates of Changes in South Platte Reservoir Surface Areas Under the Colorado Water Leasing Scenarios.....	16
Appendix B: South Platte River Basin Population Estimates/Projections (2003).....	18
Appendix C: Description of the “121 KAF Scenario” (98 KAF February-July Scenario) of Colorado Peak Flow Development.....	19
Appendix D: FWS Adjustments to Monthly Inflows at Julesburg for the OPSTUDY Model.....	21

Ground Water Appendix

Executive Summary	
Introduction	
Proposed Endangered Species Recovery Program	
Ground Water Issues	
Scope of Analysis	
Main Factors Affecting Ground Water	
Local River and Stream Levels	
Topography	
Geology and Soils	
Climate and Precipitation	
Crop Consumptive Use	
Irrigation	
Urbanization and Development	
Ditches and Drains	
Historic Conditions	
Ground Water Influences in the Central Platte Valley	
1. Central Nebraska Public Power and Irrigation District Ground Water Mound	
2. Riverside Drains	
3. Dawson/Gothenburg Canals	
4. Shallow Ground Water	
Ground Water Influences in the South Platte Valley	
Tamarack	
Beebe Draw	
Ground Water Influences in the North Platte Valley	

Ground Water Appendix—Continued

- Appendix A: Bank Storage
- Appendix B: Daily Analysis of Transects
- Appendix C: Statistical Analysis of Ground Water Data
- Appendix D: USGS Snapshot of Ground Water in the Central Platte Valley on May 25-27, 1999 [See Sanders (2001) in the Water Resources and Water Quality CD.]
- Appendix E: Historic Precipitation [See Sanders (2001) in the Water Resources and Water Quality CD.]
- Appendix F: Well Transects and Data
- Appendix G: Source Information on Precipitation Data
- Appendix H: Year 2000 Monitoring Results

Flooding Appendix

Executive Summary	v
Analyses and Report.....	1
Historic Surface and Ground Water Regimes	1
Long-Term Trends	2
Current Local Ground Water Levels	3
Ground Water Influences in the Platte River Valley	4
Local River and Stream Levels	13
Relationships Between Precipitation, River Stage, and Ground Water Levels	14
Potential Effect on Ground Water From the Proposed Platte River Endangered Species Recovery Program	22
Conclusions	24
References	24

South Platte River Model

Hydrosphere Resource Consultants, Inc. 2001. Hydrosphere South Platte EIS Model, Inc., Dated June 8, 2001.

See Wolvington et al., 2001.

South Platte River Model Output and Results—Spreadsheets, reports, and memorandums that describe various assumptions, projections, and modeling results used to evaluate Platte River Recovery Program alternatives from the perspective of effects on the South Platte River Basin in Colorado.

Wolvington, Roger, L. Rozaclis, and Donald Anderson. 2001. User’s Guide for the South Platte River EIS Model (SPREISM), Version 1.0, Dated May 21, 2001.

1. Introduction
 - 1.1 Description and Purpose of the Model
 - 1.2 Caveats and Limitations
 - 1.3 The CRAM Modeling Tool
 - 1.4 Modeling Approach
 - 1.5 Modeling Scenarios
2. Installation
 - 2.1 System Requirements
 - 2.2 Quick Start

South Platte River Model—Continued

Wolvington, Roger, L. Rozaclis, and Donald Anderson. 2001. User’s Guide for the South Platte River EIS Model (SPREISM), Version 1.0, Dated May 21, 2001.—Continued

- 3. Running the Model
 - 3.1 Loading the Model
 - 3.2 Running in Binary vs. Worksheet Output Model
 - 3.3 Model Input and Output Worksheets
 - 3.4 Reviewing Model Input
 - 3.5 Running the Model
 - 3.6 Reviewing the Model Results

Appendix A: SPREISM File Types (.BIN, .SRT, .XLA, .XCW)

Central Platte River Model

Central Platte River Model (OPSTUDY8). Technical Documentation and Users Guide. Platte River EIS Office, Lakewood, Colorado. February 2006.

Chapter 1: Background

- 1.1 Objectives of the Model 3
- 1.2 Objectives and Organization of This Documentation..... 3
- 1.3 Development History 4
- 1.4 Model Maintenance..... 4
- 1.5 General Applications and Limitations of the Model 5
- 1.6 Calibration and Validation of the Model 5
- 1.7 System Requirements for the Model 5

Chapter 2: Conceptual Design of the Model 8

- 2.1 Physical System Representation..... 8
- 2.2 Boundary Conditions..... 8
- 2.3 Time Steps..... 11
- 2.4 General Model Assumptions..... 12
- 2.5 Definition of the “Present Condition” 13
- 2.6 Model Structure 13
- 2.7 Input Files..... 15
- 2.8 Output Files 16
- 2.9 Conceptual Flow of the Computer Model..... 17
- 2.10 Scoring of Alternatives 20

Chapter 3: Representation of Historic System Elements 22

- 3.1 Lake McConaughy and Kingsley Hydroelectric Dam..... 22
- 3.2 Keystone Diversion and Sutherland Canal System 28
- 3.3 Western Canal Diversion..... 31
- 3.4 Korty Canal Diversion..... 32
- 3.5 Birdwood Creek..... 33
- 3.6 Tri-County (Central District) Canal Diversions..... 34
- 3.7 Kearney Canal 38
- 3.8 Additional Irrigation Demands by Stream Reach..... 39
- 3.9 Hydroelectric Power Generation..... 40
- 3.10 Stream Reach Gains and Losses..... 42
- 3.11 Gage Location Flows..... 43

Central Platte River Model—Continued

Central Platte River Model (OPSTUDY8). Technical Documentation and Users Guide. Platte River EIS Office, Lakewood, Colorado. February 2006.—Continued

Chapter 4: Representation of New/Proposed System Elements	46
4.1 Environmental Account.....	46
4.2 EA Wildlife Release.....	49
4.3 EA Pulse Flows.....	51
4.4 Colorado Conservation Water.....	56
4.5 Central Platte Re-Regulating Reservoir Project.....	56
4.6 Groundwater Management Project.....	59
4.7 North Dry Creek Groundwater Pumping.....	60
4.8 Power Interference Project.....	61
4.9 Pathfinder Modification Project.....	62
4.10 Central Platte River Irrigation Conservation/Leasing.....	62
4.11 Conservation Water From USBR funds	63
4.12 Excess-to-ownership in USBR North Platte System	64
4.13 Tamarack Plan	64
4.14 Riverside Drains.....	68
4.15 Johnson Lake Flow Attenuation Plan	69
Chapter 5: Operation of the Model (A User’s Guide).....	70
5.1 “Cortex” Interface	70
5.2 OPSTUDY Input Files and Format	75
5.3 Tools for Building Input Files.....	81
5.4 Initialized Model State Variables.....	98
5.5 “RAW” Output Files.....	99
5.6 Tools for Evaluating and Graphing Output.....	105
5.7 Common Run-Time Errors and Troubleshooting.....	113
References	115
Appendix A: DATA, CDATA, and HDATA Input Variables Descriptions.	
Appendix B: Central Platte River Model OPSTUDY Code Variables Dictionary.	
Appendix C: Operating Rules for Releases to Be Made From Lake McConaughy	
Appendix D: OPSTUDY Assumptions Regarding Water Operations for Diversions at the Keystone Diversion Dam and Central District Supply Canal	
Appendix E: Sample Main Input File (Present.inp)	

Phillips, Mark. 1999. Review of Present-Conditions Stream Reach Flow Gains for the Central Platte River OPSTUDY Model. Bureau of Reclamation, Great Plains Regional Office, Billings, Montana, Dated May 1999.

Birdwood Creek Near Hershey, Nebraska	2
North Platte River From Keystone to Sutherland, Nebraska.....	3
North Platte River From Sutherland to North Platte, Nebraska.....	3
South Platte River From Julesburg to Paxton, Nebraska	4
South Platte River From Paxton to North Platte, Nebraska	4
Platte River From North Platte to Brady, Nebraska	5
Platte River From Brady to Cozad, Nebraska	5
Platte River From Cozad to Overton, Nebraska	5
Platte River From Overton to Odessa, Nebraska.....	6
Platte River From Odessa to Grand Island, Nebraska.....	6
Platte River From Grand Island to Duncan, Nebraska.....	7
Summarized Gain Adjustments.....	8

Rodney, Mark. 2002. Calibration and Validation of the Central Platte OPSTUDY Model. U.S. Fish and Wildlife Service, January 2002 [most recent date].

1. Introduction.....	1
2. Selection of Calibration and Validation Periods.....	1
3. Calibration/Validation Analysis	1
3.1 General Operating Criteria.....	1
3.2 Discussion of Results	1
3.3 Comparison With “Present Conditions” Analysis.....	54
3.4 Conclusion.....	57

North Platte River Model

EIS Model, Update 2006

3.1 Description of the Model	82
3.2 Input Files	84
3.3 Output Files.....	87
3.4 System Requirements for the NPREISM	92
3.5 Description of Model Options.....	94

Myler, Lyle. 1997. North Platte River Water Utilization Model Documentation. Dated June 1997.

1.0 Background.....	1
1.1 Introduction	1
1.2 Explanation of the NPRWUM Documentation.....	3
1.3 Description of the Reclamation’s Projects.....	3
2.0 Operating Criteria	11
2.1 Introduction	11
2.2 Operational Criteria.....	12
2.3 Physical Reservoir and Storage Ownership Evaporation	12
2.4 Physical Operation of the North Platte River Reservoirs	17
2.5 Power Generation/Reservoir Releases	28
2.7 Storage Ownership Accounting	39
2.8 Return Flow	49
2.9 Operation of the River Downstream of Guernsey Reservoir	58
3.0 Operation of the NPRWUM	68
3.1 Description of the Model.....	68
3.2 Input Files.....	71
3.3 Output Files	75
3.4 System Requirements for the NPRWUM.....	80
3.5 Description of Model Options	82
4.0 Calibration/Validation of the NPRWUM	88
4.1 Introduction	88
4.2 Selection of Calibration/Validation Periods.....	88
4.3 Water Balance	88
4.4 Verification	89
4.5 Calibration/Validation	90
4.5.6 Return Flow	95
5.0 Selected References.....	98

North Platte River Model—Continued

Myler, Lyle. 1997. North Platte River Water Utilization Model Documentation. Dated June 1997.—Continued

Appendix A: Reservoir Area-Capacity Tables	
Appendix B: Storage Ownership and Natural Flow Accounting Procedures	
Appendix C: Parameters for GLOVER Subroutine	
Appendix D: Glendo Operating Release Criteria	
Appendix E: Flowcharts	
Appendix F: Input/Output Item Descriptions	
Appendix G: Calibration/Validation Results	
Appendix H: NPRWUM Source Code, Executable, Input/Output Files, and List of Variables	
Appendix I: Glendo Reservoir Operating Policy and Marketing Principles	
Appendix J: Comments/Responses	

Sanders, Glen. 2001. Ground Water and River Flow Analyses. Bureau of Reclamation and U.S. Fish and Wildlife Service, Denver, Colorado, Dated May 2001.

Executive Summary	iii
Analyses and Report.....	1
Historic Surface and Ground Water Regimes	2
Long-Term Trends	3
Current Local Ground Water Levels	3
Ground Water Influences in the Platte River Valley	5
Local River and Stream Levels	14
Relationships Between Precipitation, River Stage, and Ground Water Levels	17
Potential Effect on Ground Water From the Proposed Platte River Endangered Species Recovery Program	22
Conclusions	23
References	24

Stroup, Duane, Mark Rodney, and Donald Anderson. 2006. Flow Characterizations for the Platte River Basin in Colorado, Wyoming, and Nebraska. Prepared for the Platte River Recovery Program EIS Office. February 2006.

1. Purpose and Method	1
2. Introduction.....	1
3. Physical Setting.....	4
4. Previous Studies	7
5. Climate	8
5.1 Precipitation.....	8
5.2 Palmer Hydrologic Drought Index	10
6. Flow Characterization at Specific Gage Locations.....	12
6.1 Overview	14
6.2 Summary: Peak Mean Daily Flow and Annual Flow Volume.....	15
6.3 Summary: Flow Averaging.....	18
6.4 Summary: Flow Frequency.....	19
6.5 Summary: Median Daily Flow by Calendar Day	19
7. References	21

Appendix A: Flow Characterizations at Specific Gage Locations

Troendle, Charles A. and James M. Nankervis. 2000. Estimating Additional Water Yield From Changes in Management of National Forests in the North Platte Basin. Final Report. MATCOM Corporation, Fort Collins, Colorado, and Blue Mountain Consultants, Berthoud, Colorado, Dated May 12, 2000.

Executive Summary 1
 The Effects of Timber Harvest on Water Yield 2
 Analysis 22
 The Database 22
 Summary of Data Set..... 27
 Historical Trends in Water Yield 27
 Opportunity to Increase Water Yield From the North Platte River Basin..... 37
 The Potential Impact of Catastrophic Events on Water Yield..... 42
 Summary 43
 Literature Cited 45

Water Quality Appendix

North Platte River Basin, Wyoming
 Affected Environment
 TDS and Selenium
 Temperature and DO
 Environmental Consequences
 TDS
 Pathfinder Temperature Model
 DO in Seminoe and Pathfinder Reservoirs
 North Platte River Basin, Nebraska
 TDS
 North Platte Tributaries
 Inland Lakes
 South Platte River Basin
 Tamarack
 Platte River Basin
 Lakes McConaughy and Ogallala
 Middle Platte Basin
 Temperature
 Turbidity
 Sediment Chemistry
 Ground Water Mound
 Platte River Basin Water Quality – Impairments.doc
 South Platte River – Colorado-Nebraska
 North Platte River – Wyoming-Nebraska
 Middle Platte River – Nebraska
 Special Studies
 Contaminants in Platte River Fish
 Contaminants in Platte River Bird Eggs

Yahnke, James. 2000 (Platte River). Existing Water Quality Conditions in the Platte River. Bureau of Reclamation, Denver, Colorado, Dated July 2000.

- Chapter 1: Water Quality
- Chapter 2: Water Quality in the Central Platte River Basin
- Chapter 3: Water Quality Standards
- Chapter 4: Water Quality Trends in the Middle Platte River
- Chapter 5: Platte River Sediment Composition
- Chapter 6: Contaminants in Platte River Fish
- Chapter 7: Biological Contaminants in Bird Eggs From the Platte River

VOLUME 3 TABLE OF CONTENTS—CONTINUED

RIVER GEOMORPHOLOGY CD, PART 1

River Geomorphology Appendix

SEDVEG Model

River Geomorphology Appendix

- A. Geomorphology Study Reports [See the River Geomorphology Appendix in the River Geomorphology CD, Part 2.]
- B. Notes on the Geomorphic Conceptual Model
- C. SEDVEG Model Input and Output Data
- D. Supporting Data for Changes in River Width (Chapter 2)
- E. Supporting Data for Changes in Slope (Chapter 2)

SEDVEG Model

[See the Murphy et al. (2006) report in section A of the River Geomorphology Appendix in the River Geomorphology CD, Part 2, for a description of the SEDVEG model, and section C of the River Geomorphology Appendix above for model input and output data for EIS alternatives.]

GEOMORPHOLOGY APPENDIX

Index

A. Foundation Reports for the Central Platte River Geomorphology Study	1
B. Notes on the Geomorphic Conceptual Model	3
C. Output from the Central Platte River 1-Dimensional Sediment Transport Model	5
D. Supporting Data for Changes in River Width (Chapter 2)	6
E. Supporting Data for Changes in Slope (Chapter 2)	8

A. Foundation Reports for the Central Platte River Geomorphology Study

1. Provides historic information on mean annual flows, peak flows, and effective flows, and estimates of historic sediment transport:

Randle, T.J., and M.A. Samad (2003). "Platte River flow and sediment transport between North Platte and Grand Island, Nebraska (1895-1999)". Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group. Denver, Colorado. 60 p.

2. Addresses impacts of development on flow and sediment transport from the 1800s to the present including flow consumption and groundwater impacts. Also considers climate effects and provides background information on geology and Platte River morphology in geologic time. The processes of degradation and incision, grain size coarsening, vegetation impacts on sediment transport, and the concept of continuum of channel pattern are introduced with respect to the Central Platte River.

Murphy, P.J., T.J. Randle, L.M. Fotherby, and J.A. Daraio, 2004. "Platte River channel: history and restoration". Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 167 p.

3. Data report presenting cross section measurements of the Central Platte River noting locations of degradation, aggradation and stable river conditions.

Holburn, E.R., L.M. Fotherby, T.J. Randle and D. Carlson (2006), "Trends of degradation and aggradation along the central Platte River, Nebraska 1985 – 2005", Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group. Denver, Colorado.

4. The one-dimensional sediment transport model of the Central Platte Habitat (SedVeg Gen3) is described, including model history, program code, input cross sections and parameters, output for present conditions and summaries of modeled future trends. Sensitivity and calibrations to past and present conditions, and an evaluation of the model are also included.

Murphy, P.J., L.M. Fotherby, and R.K. Simons (2006). "Platte River Sediment Transport and Vegetation Model" Bureau of Reclamation, Technical Service Center. Denver, Colorado.

B. Notes on the Geomorphic Conceptual Model

The geomorphic study of the Central Platte River has acquired more detail since the Draft Environmental Impact Study (DEIS). Table A-G-1 outlines key points and shifts in approach associated with the land plan, resulting from further studies of river geomorphic processes.

Table A-G-1. Chronological Development of Geomorphic Land Plan Concepts

Year	Report/ Summary	Focus of Geomorphic Study	Primary Factors*	Secondary Factors*	Primary Land Plan Restoration Methods	Secondary Land Plan Restoration Methods
2003	Randle & Samad	Wide river with sand bars	Flow		Clear vegetation	Consolidate flows
2003	DEIS		Sediment load		Level islands (to augment sand and widen river)	Identify negative effects from some bridges & revetments~
2004	Murphy et al.		Grain size Vegetation			
2005	Holburn et al.	Braided river	Flow	Slope	Identify positive effects from some bridges & revetments~	Develop alternative sand augmentation methods & a master plan
2005	FEIS		Sediment load	Vegetation Grain size		
2006	Murphy et al.		Topography		Consolidate flows Augment sand	Lower banks and level islands (to widen river and augment sand) Clear vegetation

* Factors affecting river channel form, and subsequently habitat for Whooping Crane, Least Tern and Piping Plover

The flow chart shown in Figure A-G-1 illustrates the steps for developing a feasible restoration program. Restoration actions originate from a geomorphic conceptual model of the river. The conceptual model is based on available field data and is consistent with geomorphic theory. Proposed land and water plans, are in turn, consistent with the geomorphic model that describes ongoing processes and trends. A numerical model, which has the significant geomorphic processes incorporated into the program code, is used to test the proposed restoration actions. Because numerical modeling is cost and time effective, this step allows a wider range of options to be evaluated and improves the quality of the implemented restoration program. The last box in the flow chart (figure A-G-1) represents field testing of the most promising restoration actions. Under the adaptive management plan, restoration actions are tested in small steps in the field. If

the actions produce the desired degree of success, implementation of these actions is expanded within the framework of the Program. As shown in the flow chart, feedback from any succeeding step can revise and improve the conceptual model, the land and water plans, and the numerical model(s). The FEIS presents the geomorphic conceptual model and the restoration actions that have survived iterations through numerical modeling. Under the Adaptive Management Plan in the First Increment of the Program, continued iterations of the flow paths in Figure A-G-1 are anticipated.

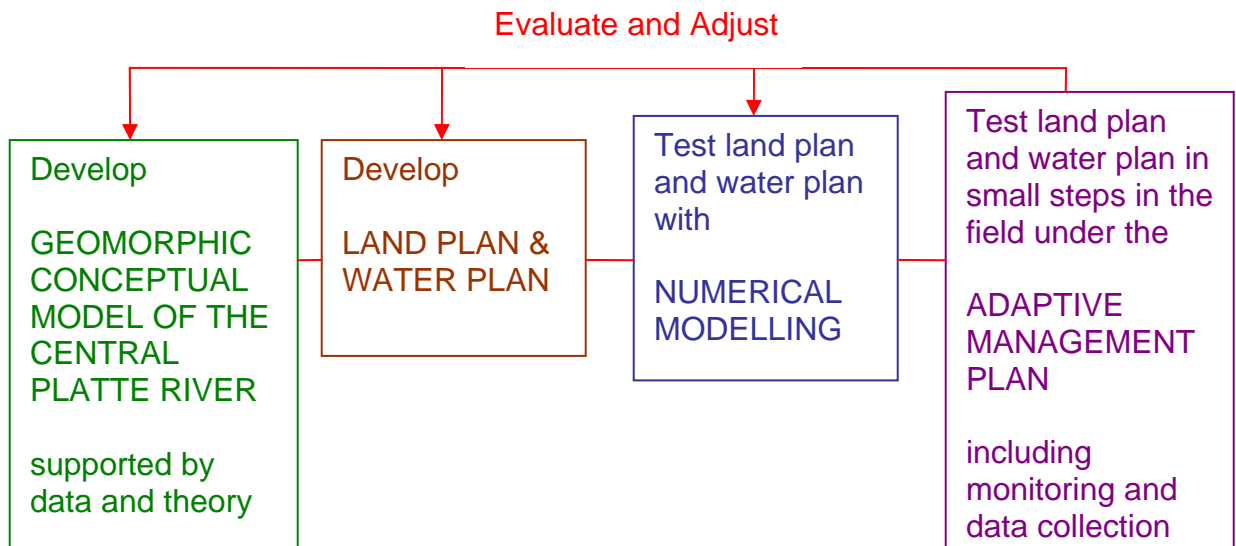


Figure A-G-1. Methods of evaluating the impacts of land and water plans (restoration efforts) on the river form.

C. Output from the Central Platte River 1-Dimensional Sediment Transport Model

The evaluation of alternatives in Chapter 5 of the FEIS was aided in some sections by output from the 1-D sediment transport model, SEDVEG Gen3 that incorporates vegetation processes and the land and water actions of the Program. The SEDVEG Gen3 code and Central Platte River model are described in the Technical Report:

Murphy, P.J., L.M. Fotherby, and R.K. Simons (2006). "Platte River Sediment Transport and Vegetation Model" Bureau of Reclamation, Technical Service Center. Denver, Colorado.

Murphy et al. (2006) is available in electronic format in Volume III of the FEIS. The output data used in the FEIS from SEDVEG Gen3, including Present Conditions and the alternatives, Governance Committee, Full Water Leasing, Wet Meadow, and Water Emphasis, are available in compressed electronic format in Volume III of the FEIS.

D. Supporting Data for Changes in River Width (Chapter 2)

The observed response to reductions in Platte River mean annual flows and peak flows in the twentieth century, was a narrowing of the active channel width from North Platte to Grand Island, Nebraska. Measured values are presented in Table A-G-2. The earliest channel-width data is from the first land surveys in the 1860s and pre-dates the first USGS topographic surveys at the turn of the century. The average channel widths for the 1860s period are from the original township, range, and section surveys of the General Land Office (Peake et al., 1985). The channel width from both these surveys would include some wooded islands, too small to survey, so the actual un-vegetated width has been estimated as less by different investigators (See Chapter 2- Vegetation Expansion). A set of county property maps, showing the acreage and ownership of land along the Platte River, was prepared between 1905 and 1920. These maps showed all river islands with economic value. Average channel widths from the subsequent years (1938, 1957, 1983, and 1998) were determined from aerial photographs. The average widths from aerial photographs do not include any wooded islands. The 1983 widths were measured after the occurrence of a peak flow earlier that year.

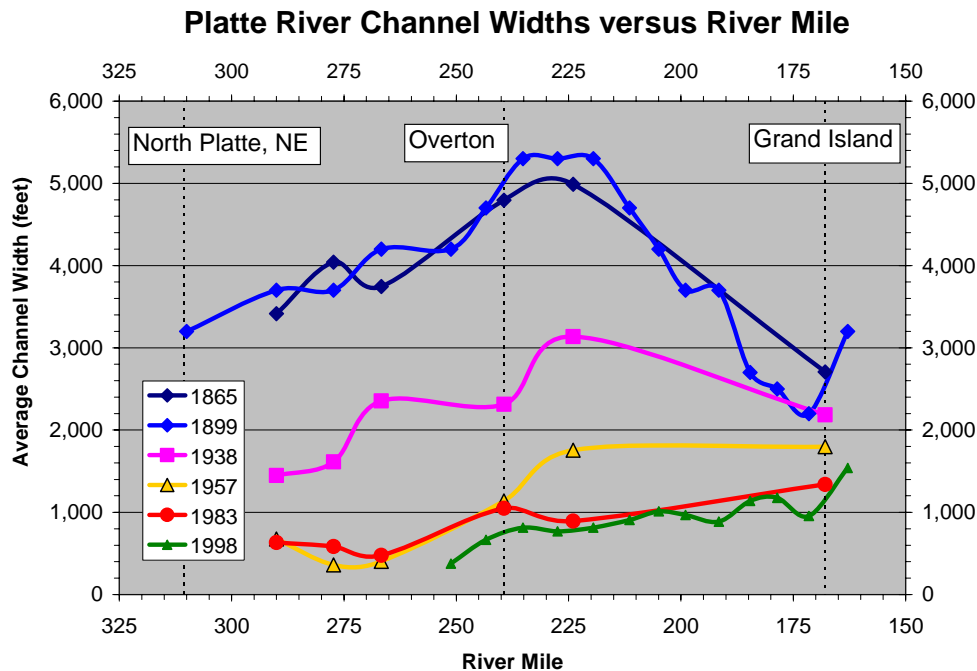


Figure A-G-2. Reductions in unvegetated channel width in the central Platte River. Distance along the Platte River is denoted as river mileage beginning at Plattsmouth, Nebraska (River Mile 0) and increasing in the upstream direction.

The 1898 and 1998 average channel widths were calculated at the Platte River EIS Office in Lakewood Colorado using the 1898 to 1902 USGS maps (figure A-G-2) and GIS coverage of 1998 aerial photos (Friesen et al., 2000). Measurements of channel area in 1998 and 1898 were made of entire bridge segment areas (13) in the habitat study area between Lexington and Chapman, Nebraska (see Geographic Markers table, Chapter 4). Areas were then divided by longitudinal channel length per bridge segment for average channel width. The 1898 values at four upstream areas: North Platte, Brady, Gothenburg and Cozad, are section measurements.

Based on maps from the 1860s and aerial photographs from 1938, 1957, and 1983, Peake et al. (1985) provided estimates of the channel area, produced on a USGS 7.5-minute quadrangle map base. The reach lengths were measured from USGS 1:24,000 scale topographic maps corresponding to the areas reported in Peake et al (1985). An estimate of average channel width in the vicinity of the gage station was determined by dividing channel area by reach length.

Table A-G-2. Historic un-vegetated or active channel widths of the Platte River as measured from historic maps and aerial photography.

River Mile	Platte River location	1865 ^P Average channel width (feet)	1899 ^{EIS} Average channel width (feet)	1938 ^P Average channel width (feet)	1957 ^P Average channel width (feet)	*1983 ^P Average channel width (feet)	1998 ^{EIS} Average channel width (feet)
166	near Grand Island, NE	2,710	2,500	2,190	1,800	1,340	1,250
224	near Odessa, NE	4,990	5,300	3,140	1,760	890	790
239	near Overton, NE	4,800	5,300	2,310	1,140	1,050	740
266	near Cozad, NE	3,750	4,200	2,360	400	480	
277	near Gothenburg, NE	4,040	3,700	1,610	360	580	
290	near Brady, NE	3,420	3,700	1,450	680	630	

* 1983 widths are measured after the occurrence of a major peak flow event earlier that year.
^P Channel areas from Peake et al., 1985.
^{EIS} Channel areas from Platte River EIS Office in Lakewood, Colorado.

E. Supporting Data for Changes in Slope (Chapter 2)

Figure A-G-3 presents bed slope values of the **Central Platte River**, beginning at the Johnson-2 Return in the South Channel of Jeffreys Island. The profile is constructed from the thalweg elevations of 1989 surveyed cross sections. The average spacing of the cross sections is 1.5 miles. Platte river flows are diverted by a dike from the entrance of the South Channel of Jeffreys Island, to the entrance of the North Channel of Jeffreys Island. The dike was constructed by a private landowner. Subsequently, bed erosion in the South Channel of Jeffreys Island at the Johnson-2 Return is not dampened by sediment inputs from upstream flows, and the slope at the Johnson-2 Return (RM 247) is 0.0008 ft per ft. The slope increases in the downstream direction, reaching 0.0012 ft per ft at Overton. Downstream of Overton, the slope of the central Platte River is generally 0.0012 ft per ft.

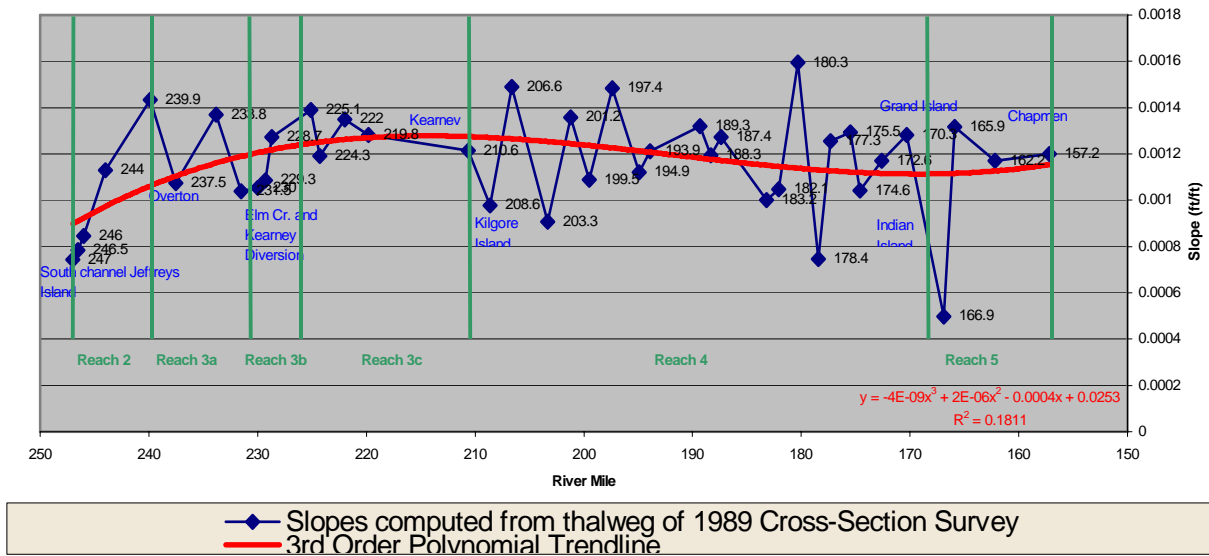


Figure A-G-3 Slope values for the **Central Platte River** measured to the downstream surveyed cross section.

VOLUME 3 TABLE OF CONTENTS—CONTINUED

RIVER GEOMORPHOLOGY CD, PART 2

River Geomorphology Appendix

A. Geomorphology Study Reports:

Holburn, E.R., L.M. Fotherby, T.J. Randle, and D.E. Carlson. 2006. "Trends of Aggradation and Degradation Along the Central Platte River: 1985 – 2005." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 180 p.

Murphy, P.J., T.J. Randle, L.M. Fotherby, and J.A. Daraio. 2004. "Platte River Channel: History and Restoration." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 167 p.

Murphy, P.J., L.M. Fotherby, T.J. Randle, and R.K. Simons. 2006. "Platte River Sediment Transport and Riparian Vegetation Model." Technical Report. Bureau of Reclamation, Technical Service Center, Denver, Colorado, 136 p.

Randle, T.J. and M.A. Samad. 2003. "Platte River Flow and Sediment Transport Between North Platte and Grand Island, Nebraska (1895-1999)." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 60 p.

Simons and Associates, Inc. and URS Greiner Woodward Clyde. 2000. Physical History of the Platte River in Nebraska: Focusing Upon Flow, Sediment Transport, Geomorphology, and Vegetation. Prepared for Bureau of Reclamation and U.S. Fish and Wildlife Service. Platte River EIS Office, Dated August 2000.

River Geomorphology Appendix

A. Geomorphology Study Reports:

Holburn, E.R., L.M. Fotherby, T.J. Randle, and D.E. Carlson. 2006. "Trends of Aggradation and Degradation Along the Central Platte River: 1985 – 2005." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 180 p.

I. Executive Summary	v
1.0 Brief History of The Central Platte River	1
2.0 Study Background and Objectives	5
3.0 Surveys	6
4.0 Vertical Transformations of Data	40
5.0 Development of Plots of Repeat Cross Sections and Habitat Transects	43
6.0 Calculations of Aggradation and Degradation	46
7.0 Trends of Aggradation and Degradation	51
8.0 Limitations of Study Findings and Future Directions.....	58
9.0 References	62
Appendix A: Plots of Repeat Cross Sections	68
Appendix B: Control Points Summary Table	159
Appendix C: Flow on Date of Survey Table	169
Appendix D: Electronic Form of 1989 USBR Survey Data and Photographs	178
Appendix E: Electronic Form of All Other Survey Data Used	179
Appendix F: Electronic Form of 1989 USBR Sediment Sample Data	180

Murphy, P.J., T.J. Randle, L.M. Fotherby, and J.A. Daraio. 2004. "Platte River Channel: History and Restoration." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 167 p.

Dedication	ii
List of Figures	ix
List of Tables	xiii
Glossary	xiv
1.0 Introduction	1
1.1 Location	2
1.2 The Concern	3
1.3 Objective of the Paper	3
1.4 Study Approach	4
1.5 Factors Considered	5
1.6 Organization of the Paper	5
1.7 Principal Findings	6
2.0 Historic Setting of the Platte River	9
2.1 The Pre-Development River	9
2.2 The Nineteenth Century	17
2.3 The Twentieth Century.....	45
3.0 Changes to Primary Elements of River Morphology in the Twentieth Century	55
3.1 Changes to Flow	55
3.2 Changes to the Temporal Distribution of Flows	73
3.3 Changes to Sediment Transport and Sediment Size	76
3.4 Changes to the Basin Structure.....	85

**Murphy, P.J., T.J. Randle, L.M. Fotherby, and J.A. Daraio. 2004. "Platte River Channel: History and Restoration." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 167 p.—
 Continued**

4.0 Channel Response to Changed Conditions	89
4.1 Reductions in Unvegetated Channel Widths	90
4.2 Flow Reductions	92
4.3 Vegetation and Vegetation Expansion.....	95
4.4 Reductions in Sediment Supply and Channel Incision.....	100
4.5 Coarsening Sediment and Channel Changes.....	115
4.6 Changes in Plan Form	121
4.7 Channel Changes From Bridges, Diversion Dams, and Bank Protection	126
4.8 Time Scales of Channel Processes in the Platte River.....	128
5.0 Options for Restoring Channel Habitat	131
5.1 Mechanical Widening of the Channel and Augmentation of Medium Sand.....	132
5.2 Increased Annual High Flows.....	133
6.0 Summary and Conclusions.....	137
6.1 The Historic River.....	137
6.2 The Processes of Habitat Reduction and River Narrowing.....	139
6.3 Option for Restoring Habitat	143
6.4 Future Directions	144
7.0 References.....	145
Geology Appendix	159
A. Geology of South-Central Nebraska.....	159
B. Geomorphic History	163

Murphy, P.J., L.M. Fotherby, T.J. Randle, and R.K. Simons. 2006. "Platte River Sediment Transport and Riparian Vegetation Model." Technical Report. Bureau of Reclamation, Technical Service Center, Denver, Colorado, 136 p.

Acknowledgements	i
Executive Summary	iii
1.0 Introduction	1
1.1 Background.....	2
1.2 Approach	3
1.3 Objectives.....	3
2.0 General Methods and Assumptions	5
2.1 Input Data.....	5
2.1.1 Flow Data	5
2.1.2 Cross Section Data	6
2.1.3 Sediment Data.....	6
2.1.4 Mechanical Actions.....	7
2.1.5 Vegetation Inputs	7
2.2 General Description of Model Computations	7
2.2.1 Hydraulic Computations.....	7
2.2.2 Sediment Transport and Grain Size Computations.....	8
2.3 Vegetation Computations	10
2.3.1 Vegetation Accounting.....	12
2.3.2 Vegetation Subroutines.....	12
2.3.3 Germination/Growth.....	13
2.3.4 Inundation.....	13
2.3.5 Desiccation	14
2.3.6 Ice Scour.....	14
2.3.7 Flow Scour.....	15

Murphy, P.J., L.M. Fotherby, T.J. Randle, and R.K. Simons. 2006. "Platte River Sediment Transport and Riparian Vegetation Model." Technical Report. Bureau of Reclamation, Technical Service Center, Denver, Colorado, 136 p.—Continued

2.4	Active Layer Scour	15
2.5	Stream Power Scour	15
2.6	Model Run and Output	16
2.6.1	SEDVEG Model Run	16
2.6.2	SEDVEG Output Files.....	16
3.0	Governing Equations	19
3.1	Hydraulics	19
3.2	Uniform Flow Equations for Water Surface Elevation.....	19
3.2.1	Manning’s Equation	19
3.2.2	Transverse Distribution for Velocity and Depth.....	20
3.3	Sediment Transport	20
3.3.1	Transport Capacity Equations	21
3.3.2	Transverse Distribution of Transport Capacity	21
3.3.3	Transverse Distribution of Mass Balance	22
3.3.4	Changes in Bed Elevation	22
4.0	Development of Earlier Versions of SEDVEG	25
4.1	SEDVEG Gen1	26
4.1.1	Development of SEDVEG Gen1 Platte River Model and Historic Platte River Model.....	26
4.1.2	Calibration of SEDVEG Gen1	27
4.1.3	Verification of SEDVEG Gen1	27
4.1.4	Sensitivity Testing of SEDVEG Gen1	28
4.1.5	External Reviews of SEDVEG Gen1	35
4.2	SEDVEG Gen2 Platte River Model	37
4.2.1	Revisions to SEDVEG Gen1 Platte River Model.....	37
4.2.2	Description of SEDVEG Gen2 Platte River Model.....	38
4.2.3	Calibration and Sensitivity Studies for the SEDVEG Gen2 Platte River Model.....	43
4.2.4	External Reviews of SEDVEG Gen2 Platte River Model.....	44
5.0	SEDVEG Gen3 Platte River Model.....	47
5.1	Revisions to the SEDVEG Gen2 Platte River Model.....	47
5.1.1	Revisions to the Code.....	47
5.1.2	Revisions to the Platte River Model	49
5.2	Description of the SEDVEG Gen3 Platte River Model.....	51
5.2.1	Cross Section Information	51
5.2.2	Flow Information.....	54
5.2.3	Sediment and Vegetation Coefficients and Parameters	61
5.2.4	Mechanical Actions and Sediment Augmentation Plan	61
5.3	Calibration and Sensitivity Studies	63
5.3.1	Calibration Studies	63
5.3.2	Sensitivity Studies	65
5.4	Results and Verification	68
5.4.1	Calibration and Sediment Transport (Absolute Values)	68
5.4.2	Verification of Sediment Transport (Relative Values)	70
5.4.3	Description of Sediment Transport in the Central Platte River	73
5.4.4	Sediment Transport Budget	76
6.0	Assessment of the SEDVEG Gen3 and Recommendations for Future Studies	77
6.1	Assessment of the SEDVEG Gen3 Platte River Model.....	77
6.2	Benefits From the SEDVEG Model Studies.....	77
6.3	Recommendations for Future Directions.....	78
6.3.1	Recommendations for the SEDVEG Gen3 Platte River Model	78
6.3.2	Recommended Areas for Future Sediment Studies	80
References	81

Murphy, P.J., L.M. Fotherby, T.J. Randle, and R.K. Simons. 2006. "Platte River Sediment Transport and Riparian Vegetation Model." Technical Report. Bureau of Reclamation, Technical Service Center, Denver, Colorado, 136 p.—Continued

Appendix A: SEDVEG Gen3 Platte River Model.....	87
Appendix B: Comments and Responses on SEDVEG Gen1 and SEDVEG Gen2 Platte River Models	89
Appendix C: Basis of River Flows.....	121
Appendix D: Basis of Vegetation Subroutines.....	123
Appendix E: Calibration and Verification of SEDVEG Gen1, Including the Historic Platte River Model.....	127

Randle, T.J. and M.A. Samad. 2003. "Platte River Flow and Sediment transport Between North Platte and Grand Island, Nebraska (1895-1999)." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 60 p.

1.0 Introduction	11
2.0 Stream Flow Analysis	13
2.1 Mean Platte River Flows	16
2.2 Median Platte River Flows	18
2.3 1.5-Year Flood Peak Flows	19
2.4 Streamflow Trends.....	22
3.0 Sediment Transport Analysis	25
3.1 Sediment-Discharge Equations.....	26
3.1.1 Sediment-Discharge Equations by Simons and Associates, Inc. (August 2000).....	27
3.1.2 Sediment-Discharge Equations by Kircher (1983).....	29
3.1.3 Sediment-Discharge Equations by Lyons and Randle (1988).....	31
3.2 Sediment Transport Model	33
3.3 Comparison of Sediment Transport Functions.....	34
3.4 Sediment Load Trends.....	36
4.0 Effective Discharge Analysis	38
4.1 Effective Discharge by Equal Discharge Interval Method.....	40
4.2 Effective Discharge by Probability Method.....	49
4.3 Median Sediment Transporting Discharge Method.....	52
4.4 Comparison of Effective Discharge Methods	53
4.5 Effective Discharge Trends	56
5.0 Conclusions.....	57
6.0 References.....	59

[Figures are in a separate file (Randle and Samad 2003 figure.pdf)]

- Figure 1: Platte River Basin location map.
- Figure 2: Platte River reach location map.
- Figure 3: Annual flow volume and annual peak flow for North Platte River at North Platte, Nebraska.
- Figure 4: Platte River mean flows.
- Figure 5: Platte River median flows.
- Figure 6: Platte River 1.5-year flood peak flows.
- Figure 7: North Platte River at North Platte, Nebraska, flow-durations curves.
- Figure 8: South Platte River at North Platte, Nebraska, flow-durations curve.
- Figure 9: Platte River near Cozad, Nebraska, flow-durations curves.
- Figure 10: Platte River near Overton, Nebraska, flow-durations curves.
- Figure 11: Platte River near Grand Island, Nebraska, flow-durations curves.
- Figure 12: Platte River mean annual sediment load based on sediment-discharge equations by Simons and Associates, Inc. (2000).
- Figure 13: Platte River mean annual sediment load based on sediment-discharge equations by Kircher (1983).
- Figure 14: Platte River mean annual sediment load based on sediment-discharge equations by Lyons and Randle (1988).

Randle, T.J. and M.A. Samad. 2003. "Platte River Flow and Sediment transport Between North Platte and Grand Island, Nebraska (1895-1999)." Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado, 60 p.—Continued

- Figure 15: Platte River mean annual sediment load based on the sediment transport model by Murphy and Randle (2001).
- Figure 16: Platte River effective discharges for the Platte River near Overton, Nebraska, based on the equal discharge increment method.
- Figure 17: Comparison of effective discharge results for the North Platte River at North Platte, Nebraska.
- Figure 18: Comparison of effective discharge results for the South Platte River at North Platte, Nebraska.
- Figure 19: Comparison of effective discharge results for the North Platte River near Cozad, Nebraska.
- Figure 20: Comparison of effective discharge results for the Platte River near Overton, Nebraska.
- Figure 21: Comparison of effective discharge results for the Platte River near Grand Island, Nebraska.
- Figure 22: Platte River effective discharges for the Platte River near Overton, Nebraska, based on the probability increment method.
- Figure 23: Quartiles of cumulative sediment load for various gauging stations along the Platte River.

Simons and Associates, Inc. and URS Greiner Woodward Clyde. 2000. Physical History of the Platte River in Nebraska: Focusing Upon Flow, Sediment Transport, Geomorphology, and Vegetation. Prepared for Bureau of Reclamation and U.S. Fish and Wildlife Service. Platte River EIS Office, Dated August 2000.

1. Introduction.....	1
2. Description of the Platte River Basin	2
2.1 Water Resources Development History	5
2.2 Flow History	15
2.3 Groundwater History.....	18
2.4 Sediment Supply and Transport History	19
2.5 Channel Geometry	22
2.6 Woody Vegetation	24
3. Current Baseline Conditions	30
3.1 Current Level of Water Resource Development	30
3.2 Flow Characteristics	30
3.3 Groundwater and Surface Water Interactions	33
3.4 Sediment Transport and Supply	34
3.5 Channel Geometry	43
3.6 Woody Vegetation	43
3.7 Summary of Current Conditions	43
3.8 Discussion of Current Trends of Channel	44
3.9 Morphology and Vegetation	45
4. Channel Processes and Causes of Change	46
4.1 Resource Linkages	46
4.2 Analysis of Factors that May Affect Channel Morphology and Vegetation	49
4.3 Potential Effect of Mitigation Measures	70
References	80

- Appendix A: Sediment Data
- Appendix B: Bed Elevation Change
- Appendix C: Hydraulic Analysis of Woodland Expansion
- Appendix D: Timing of Woodland Expansion
- Appendix E: Computer Modeling of Woodland Expansion
- Appendix F: Structures

VOLUME 3 TABLE OF CONTENTS—CONTINUED

LAND CD

Land and GIS Appendix

Wetland Appendix

Friesen, Beverly, Jim Von Loh, Joyce Schrott, Jack Butler, Doug Crawford, and Mike Pucherelli. 2000. Central Platte River 1998 Land Cover/Use Mapping Project Nebraska. Bureau of Reclamation, U.S. Fish and Wildlife Service, Denver, Colorado, Dated October 2000.

McKee and Butler. 2001. Vegetation Classification of the Central Platte River 1998 Land Coverage Mapping Project. Prepared for: U.S. Fish and Wildlife Service, Platte River EIS Office. By: Remote Sensing and GIS Group, U.S Bureau of Reclamation, May 22, 2001.

Land and GIS Appendix

- Development of GIS Database
 - GIS Land Plan Modeling
 - Objectives and Formulation of Land Plans for Program Alternatives
 - Methods
 - Analysis
 - Results
- GIS Channel Width Analysis
 - Methods
 - Results
 - Present Condition
 - Action Alternative
- 1982 and 1998 Trend Analysis
 - Methods
 - Results
 - Channel Width
 - Percent Change Calculations
- Tern and Plover GIS Analysis
 - Methods
 - Results

Wetland Appendix

- Introduction 1
- Program Purposes and Actions 1
- Program Land Management Goals and Objectives 1
- Program Land Habitat Restoration 2
 - Habitat Complexes..... 2
 - Non-Complex Habitat 3
 - Channel Consolidation..... 4
- Program Study Area 5
- Methods 7
 - Wetland Characteristics and Definitions 7
 - Programmatic Natural Resources Characterization Method..... 8
 - Methods Used to Determine Wetland Classifications of Central Platte River Vegetation Communities..... 14
 - Methods Used to Assess Potential Impacts to Wetlands 16
 - Analysis of Wetland Vegetation Communities 17
- Description of Central Platte River Wetlands 25
 - Inside the Floodplain..... 25
 - Inside the Channel 29
- Analysis of Impacts of Program Land Activities on Wetlands (by Alternative) 32
 - Habitat Complexes 32
 - Non-Complex Habitat 32
 - Initial Focus for Habitat Complexes 32
 - Land Management Plans 34
- Clean Water Act, Section 404 Permitting..... 41
 - Land Acquisition 41
 - Site Restoration Management Planning and Implementation..... 41
- Bibliography 42

***Friesen, Beverly, Jim Von Loh, Joyce Schrott, Jack Butler,
Doug Crawford, and Mike Pucherelli. 2000. Central Platte River
1998 Land Cover/Use Mapping Project Nebraska. Bureau of
Reclamation, U.S. Fish and Wildlife Service, Denver, Colorado, Dated
October 2000.***

Executive Summary	viii
1. Introduction	1-1 to 1-3
2. Project Area	2-1 to 2-16
2.1 Location and Regional Setting	2-2
2.2 Climate	2-4
2.3 Geology, Soils, and Topography	2-5
2.4 Hydrology	2-6
2.5 Vegetation	2-9
2.6 Wildlife	2-14
3. Materials and Methods	3-1 to 3-14
3.1 Planning and Scoping	3-1
3.2 Review of Existing Information	3-2
3.3 Aerial Photography and Orthophoto Basemap	3-3
3.4 Field Work and Vegetation Classification	3-5
3.5 Basinwide Database Development	3-7
3.6 Map Production	3-8
3.7 Training	3-9
3.8 Map Validation and Accuracy Assessment	3-10
3.9 Metadata	3-14
4. Results	4-1 to 4-30
4.1 Basinwide Data Development	4-1
4.2 Training	4-1
4.3 Map Classification and Photo-Interpretation	4-2
4.4 GIS Database and Maps	4-20
4.5 Field Inventory and Vegetation Characterization	4-22
5. Discussion	5-1 to 5-7
5.1 1988 Central Platte River Database	5-2
5.2 Field Inventory and Vegetation Classification	5-2
5.3 GIS Database Production	5-3
5.4 Accuracy Assessment	5-4
5.5 Recommendations for Future Land Cover/Use Mapping	5-6
5.6 Future Applications of the 1998 Photography and Land Cover/Use Database	5-7
6. Bibliography	6-1 to 6-3
7. List of Contributors and Contacts	7-1 to 7-6

McKee and Butler. 2001. Vegetation Classification of the Central Platte River 1998 Land Coverage Mapping Project. Prepared for: U.S. Fish and Wildlife Service, Platte River EIS Office. By: Remote Sensing and GIS Group, Bureau of Reclamation, May 22, 2001.

Introduction 1
Preliminary Data Analysis 2
Riparian Forests, Woodlands, and Shrublands Classification 3
 Ordination 25
Lowland Grasslands and Wetlands Classification 26
 Ordination 32
Literature Cited 43

Appendix A: Vegetation Descriptions of NVCS Associations 45

VOLUME 3 TABLE OF CONTENTS—CONTINUED

SPECIES CD

Target Species Appendix

Whooping Cranes
Piping Plovers and Interior Least Terns
Pallid Sturgeon

Sandhill Cranes Appendix

North Platte River Basin Fisheries Appendix

Nebraska Sport Fisheries Appendix

Central Platte Fisheries Appendix

Broderick, Susan. 2000. North Platte River Fish Survey Casper to the Nebraska State Line. Bureau of Reclamation, Denver Office, Technical Service Center, Dated March 2000.

Carlson, D., D. Woodward, and D. Holz. 1994. Supplemental Information Pertaining to the Whooping Crane Roost Habitat Model. Memorandum to the Biology Work Group of the Platte River Management Joint Study.

Lutey, James M. 2002. Species Recovery Objectives for Four Target Species in the Central and Lower Platte River (Whooping Crane, Interior Least Tern, Piping Plover, Pallid Sturgeon). Prepared for the U.S. Fish and Wildlife Service by James M. Lutey, Subcontractor for URS Greiner Woodward Clyde, Dated June 26, 2002.

Platte River Management Joint Study. 1990. Final Report of the Biology Workgroup. U.S. Fish and Wildlife Service, Denver, Colorado.

Ziewitz, J.W. 1992. Whooping Crane Riverine Roosting Habitat Suitability Model. D. Woods (ed.). Proceeding 1988 North American Crane Workshop, 1988, Lake Wales, Florida. Florida Game and Fresh Water Fish Commission, Nongame Program Technical Report #12.

Target Species Appendix

Whooping Cranes

- I. Whooping Crane Channel Roosting Habitat
 - A. Wide Channel Availability (GIS Analysis)
 - B. Characteristics of Wide Channels (PHABSIM Analysis)
 - C. Wide Channel Sustainability
 - 1. SEDVEG Gen3 Analysis of Open View
 - 2. Hydrology of Channel-Forming Flows Events
- II. Riparian Meadow Hydrology
 - A. River Stage/Groundwater
 - 1. 30-Consecutive-Day Early Spring Period
 - 2. 30-Consecutive-Day Late Spring Period
 - B. Surface Water Connectivity—Over-bank flows

Piping Plovers and Interior Least Terns

Introduction	1
Background	1
Modifications to Original Indicators.....	4
Invertebrate Food.....	8
Forage Fish.....	9
Impact Indicators and Assessment Methods	9
Flow Potential to Build Sandbars	10
Fledging Days.....	11
Non-Channel Nest Sites	12
Channel Resources.....	13
Present Conditions.....	15
Flow Potential to Build Sandbars	15
Fledging Days.....	15
Non-Channel Nest Sites	16
Channel Resources.....	16
Comparison of Alternatives via Resource Indicators	17
Flow Potential to Build Sandbars	17
Fledging Days.....	18
Non-Channel Nest Sites	19
Channel Resources.....	19
Summary of Possible Effects	22
Literature Cited	26

Pallid Sturgeon

Description of Habitat Area	1
Historic Trends.....	2
Current Conditions	5
Methods of Analysis.....	6
Results of Analysis.....	9

Sandhill Cranes Appendix

Abstract	
Introduction	
Background	
Study Area	
Importance of Migration Stopover Sites	
Historic Resource Conditions and Use	
Sandhill Crane Habitat Resources	
Resource Use by Sandhill Cranes	
Habitat Components	
Resource Complex	
Resource Factors Not Addressed	
Impact Indicators and Assessment Methods	
Changes in Analysis Focus	
Assumptions	
Analysis	
Roosting Suitability at the Site Scale—Roosting Depth Abundance	
Roosting Suitability at the Bridge Segment Scale	
Unobstructed Channel Width Roosting Suitability at the System Scale—North Platte River Hydrology	
Food Suitability at the Bridge Segment Scale—Food Abundance	
Present Conditions	
Roosting Suitability at the Site Scale—Roosting Depth Abundance	
Roosting Suitability at the Bridge Segment Site Scale	
Unobstructed Channel Width Roosting Suitability at the System Scale—North Platte River Hydrology	
Food Suitability at the Bridge Segment Scale—Food Abundance	
Comparison of Alternatives via Resource Indicators	
Roosting Suitability at the Site Scale—Roosting Depth Abundance	
Roosting Suitability at the Bridge Segment Scale	
Unobstructed Channel Width Roosting Suitability at the System Scale—North Platte River Hydrology	
Food Suitability at the Bridge Segment Scale—Food Abundance	
Summary and Discussion of Potential Effects	
Roosting Depth Abundance	
Unobstructed Channel Width	
North Platte River Hydrology	
Food Abundance	
Conclusions	
Literature Cited	

North Platte River Basin Fisheries Appendix

Background	4
Methods	8
Results	10
Lacustrine Fish Communities	11
Seminole Reservoir	11
Pathfinder Reservoir	13
Alcova Reservoir	16
Glendo Reservoir	19
Guernsey Reservoir	25

North Platte River Basin Fisheries Appendix—Continued

Riverine Fish Communities 27
 Kortes Reservoir Outflow 27
 Fremont Canyon Powerplant Bypass 29
 Alcova Reservoir Outflow 37
 Gray Reef Outflow..... 37
 Glendo Reservoir Outflow 40
 Guernsey Reservoir Outflow 42
 Panhandle Streams 44
 Literature Cited 45

Nebraska Sport Fisheries Appendix

Background and Indicators 1
 Littoral Habitat 1
 Open Water Habitat 2
 Walleye 2
 White Bass 3
 Smallmouth Bass 3
 Channel Catfish 3
 Gizzard Shad 3
 Lake Ogallala Trout..... 4
 Lower Platte River Catfish and Shovelnose Sturgeon..... 6
 Methods of Analyses 6
 Resources Bound to Reservoir Elevations..... 6
 Resources Bound to Area of Habitat..... 6
 Resources Bound to Reservoir Inflows 7
 Resources Bound to Lower Platte River Flows 7
 Results 7

Central Platte Fisheries Appendix

Introduction..... 3
 Background..... 4
 Fish Community 4
 Physical Habitat..... 4
 Water Temperature 5
 Methods 6
 Physical Habitat..... 6
 Water Temperature 9
 Other Impacts 15
 Alternatives Analysis..... 16
 Physical Habitat..... 16
 Overton 16
 Grand Island 20
 Water Temperature 24
 Water Quality 27
 SEDVEG..... 29
 References 31

Broderick, Susan. 2000. North Platte River Fish Survey Casper to the Nebraska State Line. Bureau of Reclamation, Denver Office, Technical Service Center, Dated March 2000.

Introduction	1
Study Area	1
Methods	3
Results	5
Fish Sampling	5
Casper to Douglas	5
Douglas to Glendo Inlet	15
Glendo Dam to Guernsey Inlet	23
Guernsey Dam to Laramie River Confluence.....	28
Laramie River Confluence to Nebraska State Line	34
Water Temperature Monitoring.....	44
PP&L Bridge	44
Anderson Dairy Bridge	44
Orin Bridge (Highway 319)	52
Camp Guernsey	52
Fort Laramie Bridge	52
Comparison of Temperature Profiles Above Glendo Reservoir	53
Comparison of Temperature Profiles Below Guernsey Reservoir	53
Comparison of Temperature Profiles Above and Below the Reservoirs	53
Discussion	53
Turbidity Tolerance	54
Native Species	54
Species Observations	57
Literature Cited	61

Carlson, D., D. Woodward, and D. Holz. 1994. Supplemental Information Pertaining to the Whooping Crane Roost Habitat Model. Memorandum to the Biology Work Group of the Platte River Management Joint Study.

- I. The Study Area
- II. Hydraulic Modeling and Simulation Procedures
- III. Whooping Crane Roosting Habitat Suitability Criteria
- IV. Application of the Whooping Crane Criteria and Hydraulic Models Using IFIM
- V. Results of the Model Application

Lutey, James M. 2002. Species Recovery Objectives for Four Target Species in the Central and Lower Platte River (Whooping Crane, Interior Least Tern, Piping Plover, Pallid Sturgeon). Prepared for the U.S. Fish and Wildlife Service by James M. Lutey, Subcontractor for URS Greiner Woodward Clyde, Dated June 26, 2002.

Executive Summary I

I. Introduction

 A. Background 1

 B. Purpose of Report 1

II. Methodology

 A. Species Experts 3

 B. Technical Workshops 3

 C. River Reach Definitions 4

III. Species Recovery Objectives and Recommendations..... 5

 A. Interior Least Tern and Piping Plover 5

 B. Whooping Crane 18

 C. Pallid Sturgeon 28

IV. Summary of Recommendations

 A. Interior Least Tern and Piping Plover 33

 B. Whooping Crane 35

 C. Pallid Sturgeon 36

Appendix A: Species Experts Identified by the FWS

Appendix B: Participants at September 26-27, 2000, Workshop

Appendix C: Participants at February 15, 2001, Follow-Up Whooping Crane Workshop

Platte River Management Joint Study. 1990. Final Report of the Biology Workgroup. U.S. Fish and Wildlife Service, Denver, Colorado.

Introduction 1

Objectives 5

Background/History 6

Habitat Use by Endangered and Threatened Species on the Platte River 33

Modeling Endangered and Threatened Species Habitat Needs 44

Habitat Management Alternative 92

The Future 119

Summary 123

Literature Cited 124

Ziewitz, J.W. 1992. Whooping Crane Riverine Roosting Habitat Suitability Model. D. Woods (ed.). Proceeding 1988 North American Crane Workshop, 1988, Lake Wales, Florida. Florida Game and Fresh Water Fish Commission, Nongame Program Technical Report #12.

[PDF contains article reprinted from these proceedings and full table of contents from these proceedings.]

VOLUME 3 TABLE OF CONTENTS—CONTINUED

ECONOMICS, SOCIAL ANALYSIS, AND SCOPING CD

Economics Appendix

Hydropower

Recreation

Regional Economics

Agricultural Economics

PRAM Platte River Agricultural Model—Model Documentation

Social Environment Appendix

Cultural Resources Appendix

Indian Trust Assets Appendix

Environmental Justice Appendix

Brook, Anthony, David Kendrick, Alexander Meeraus, and Ramesh Raman. 1998. GAMS—A User's Guide. GAMS Development Corporation, Dated December 1998.

Harpman, David A. 2003. The P_GENV4 and P_CAPV6 Models—Reconnaissance Level Analysis of Hydropower Effects in the Platte River Basin. Bureau of Reclamation, Denver, Colorado, Dated May 9, 2003.

Hazen and Sawyer. 2000. Identification and Evaluation of Potential Third Party Impacts Related to the Habitat Component of the Proposed Platte River Recovery. Hazen and Sawyer for Land Committee, Third Party Subcommittee. Prepared for the Platte River EIS Office, Bureau of Reclamation, Dated June 13, 2000.

Minnesota IMPLAN Group, Inc. 2000. IMPLAN Professional. 2nd Edition, Stillwater, Minnesota, Dated June 2000.

Platte River EIS Office. 1998. Final Summary of Scoping Input. Bureau of Reclamation and U.S. Fish and Wildlife Service, Dated July 1998.

Economics Appendix

Hydropower

Economic Analysis Concepts.....	1
Background	1
Hydropower and the Interconnected Power System.....	3
The Economic Value of Hydropower.....	3
Geographic Descriptors	4
Hydropower Resources in the Platte Basin.....	5
Power Marketing.....	8
Institutional Considerations	8
Hydrologic Period.....	9
Absence of a South Platte Analysis.....	9
Reconnaissance Level Analysis	9
Analysis Assumptions	9
Analysis Approach	9
Methodology	10
Data and Sources.....	11
Known Analysis Limitations.....	12
Present Condition Baseline.....	12
Full Water Leasing Alternative.....	14
Governance Committee Alternative.....	15
Water Emphasis Alternative	16
Wet Meadow Alternative.....	17
Summary of Hydropower Impacts	18
References Cited	21

Recreation

Wyoming	1
Wyoming Travel Cost Model.....	1
Source of Data.....	2
The Wyoming Recreation Visitation Model.....	3
Per Capita Visitation Model Estimation.....	5
Impact of Changes in Surface Water Acreage on Visitation	6
Results.....	6
Methodology and Modeling Results for Lake McConaughy, Nebraska.....	7
Sources of Data.....	8
Impacts of the Proposed Plan on Recreation at Lake McConaughy.....	10
Bibliography	12

Regional Economics

Platte River Basin Economic Impact Regions.....	2
Significance of Regional Economic Impacts.....	3
Land Acquisition for Habitat	4
Agriculture	6
Land Retirement	8
Recreational Impacts	10
Model Input/Direct Effects	15

Economics Appendix—Continued

Regional Economics—Continued

Structural Projects	15
Pathfinder Modification	15
Tamarack (Tamarack I).....	16
Enlarged Tamarack (Tamarack III).....	16
Channel Maintenance Projects	17
North Platte Channel Modification	17
Kingsley EA	17
North Platte Excess to Ownership (ETO) 100 kaf Right	18
Central Platte Power Interference.....	18
Water Leasing	18
Water Action Plan	19
CNPPID Re-Regulating Reservoir	20
Water Management Incentives.....	20
Groundwater Management.....	20
Dry Creek/Fort Kearny Cutoff Project	21
Dawson and Gothenburg Canal Groundwater Recharge	21
Pathfinder Modification.....	21
Tamarack III	22
IMPLAN Output	22
Other Third Party Impacts	23
Hydrology Changes Between the PRDEIS and the PRFEIS.....	23
South Platte River Basin Modeling Changes Between DPREIS and FPREIS	24
Changes in Regional Impacts From DPREIS to FPREIS	24

Agricultural Economics

Affected Environment	1
Economic Impact Regions	1
Impact Indicators	1
Methods	1
Present Conditions	4
Irrigated Acreage and Crop Data	4
Cropping Patterns and Yields.....	4
Crop Revenues	7
Crop Prices Received	9
Irrigation Water Deliveries	9
Agricultural Economic Impacts	10
Irrigation Water Deliveries	10
Irrigated Acres and Cropping Patterns.....	12
Agricultural Revenues	15
Habitat Acquisition and Management Effects.....	18
Summary of Agricultural Economic Effects	19

Addendum to Water Resources: Hydrology and Agricultural Economics Appendices follows page 19

PRAM Platte River Agricultural Model—Model Documentation

Introduction	1
RAM Model	1
PRAM Impact Regions.....	2
Sources of Information	3
Crop Data	5
Interactions With Other Models	10
Dryland Crop Substitutions.....	26

Social Environment Appendix

Introduction	1
Social Analysis.....	1
Study Area	2
Background	14
Summary of Impacts.....	5
Indicators	5
Methodology	6
Affected Environment/Present Conditions.....	8
Environmental Impacts/Consequences	25
Summary	35
Bibliography	36
Attachments	follows page 39

Cultural Resources Appendix

Introduction	1
The Program and the FEIS	1
Area Cultural Resources Background.....	1
Cultural Resources Laws and Regulations.....	2
National Historic Preservation Act (NHPA)	2
Sacred Sites	2
Consultation	3
Study Area	5
Summary of Impacts	6
Impact Indicators	6
Methodology	6
Class I, II, and III Surveys.....	6
Platte River Basin Cultural Resources Background and History	7
Native American Tribes in the Platte River Basin	7
Present Condition.....	9
Reservoir and River Levels	10
Land Disturbance Activities	11
Environmental Consequences Impact Analysis	12
Effects of Changes in Reservoir Elevations	13
Effects of Construction and Habitat Restoration.....	16
Sacred Sites	17
Summary	18
Bibliography	21
Attachments	follows page 22

Indian Trust Assets Appendix

Introduction	1
The Recovery Program and FEIS	1
Indian Trust Assets	1
Study Area	2
Indicators	3
Methods	4
Background and History	4
Introduction	4
Overview—Treaties, Indian Claims Commission, and Federal Indian Policies.....	5
History that Lead to the Need for, and Development of Treaties	6
Present Condition	7
Summary	7
Consultation Process	8
Treaty and Related Research by American Indian Tribe/Nation.....	8
Indian Claims Commission.....	11
Summary	11
Bibliography	11
Attachments	follows page 13

Environmental Justice Appendix

Introduction	1
The Program and FEIS.....	1
Environmental Justice	2
Potential Environment.....	3
Study Area	5
Indicators	5
Methods	5
Present Conditions.....	6
Poverty Levels Median Household Incomes	10
Summary	14
Bibliography	15
Attachment	follows page 15

Brook, Anthony, David Kendrick, Alexander Meeraus, and Ramesh Raman. 1998. GAMS—A User's Guide. GAMS Development Corporation, Dated December 1998.

[This is a commercial product. It can be ordered from: < <http://www.gams.com/>>.]

Harpman, David A. 2003. The P_GENV4 and P_CAPV6 Models—Reconnaissance Level Analysis of Hydropower Effects in the Platte River Basin. Bureau of Reclamation, Denver, Colorado, Dated May 9, 2003.

The P_GENV4 and P_CAPV6Models	1
Intended Use	1
Reconnaissance Level Analysis	1
Hydrologic Period	1
Methodology	2
Known Analysis Limitations.....	3
Economic Analysis Assumptions.....	3
Data and Data Sources	3
Operation of the P_GENV4 Model	4
Operation of the P_CAPV6Model	6
Known Program Deficiencies	9
Data File Specifications	9
Run-Time Errors and Support	12
Literature Cited	12
Appendix 1: Central Platte Price File	14
Appendix 2: North Platte Price File	16
Appendix 3: Example Central Platte Generation File	18
Appendix 4: Example North Platte Generation File	21
Appendix 5: Example Central Platte Capacity File	23
Appendix 6: Example North Platte Capacity File	26
Appendix 7: Example P_GENV4 Output File	28
Appendix 8: Example P_CAPV6 Output File	31

Hazen and Sawyer. 2000. Identification and Evaluation of Potential Third Party Impacts Related to the Habitat Component of the Proposed Platte River Recovery. Hazen and Sawyer for Land Committee, Third Party Subcommittee. Prepared for the Platte River EIS Office, Bureau of Reclamation, Dated June 13, 2000.

Executive Summary	
Chapter 1.0 Introduction	
Chapter 2.0 Study Area	
Chapter 3.0 Definition of Baseline Conditions	
Chapter 4.0 Habitat Protection Scenarios	
Chapter 5.0 Economic Impact of Land Use Change to Protected Habitat	
Chapter 6.0 Economic Impact of Habitat Restoration and Management	
Chapter 7.0 Economic Impact of Increased Recreation	
Chapter 8.0 Fiscal Impacts	
Chapter 9.0 Environmental and Social Impacts of Land Use Changes From Agriculture to Protected Habitat	
Chapter 10.0 Identification and Evaluation of Potential Methods to Eliminate or Mitigate Adverse Third Party Impacts	
Appendix A: Land Use Conversions for the Habitat Protection Scenarios	
Appendix B: Grazing and Hay Production Rates on Program Lands	
Appendix C: Estimated Restoration and Management Cost for the Habitat Protection Scenarios	

***Minnesota IMPLAN Group, Inc. 2000. IMPLAN Professional.
2nd Edition, Stillwater, Minnesota, Dated June 2000.***

[This is a commercial product. It can be ordered from: <www.implan.com>.]

***Platte River EIS Office. 1998. Final Summary of Scoping Input.
Bureau of Reclamation and U.S. Fish and Wildlife Service, Dated
July 1998.***

Chapter One: Description of the Scoping Process	2
Chapter Two: Suggested Alternatives From the Public	5
Chapter Three: Possible Impacts of Proposed Program Identified by the Public	10
Chapter Four: General Public Comments	16