Inventory of Critical Biological Resources for the South Platte River Watershed

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Final Report
2nd Edition

BY:

THE NATURE CONSERVANCY
COLORADO NATURAL HERITAGE PROGRAM
WYOMING NATURAL DIVERSITY DATABASE
NEBRASKA NATURAL HERITAGE PROGRAM

June 1996

Inventory of the Critical Biological Resources for the South Platte River Watershed

Final project report submitted by The Nature Conservancy[1] in cooperation with the Colorado Natural Heritage Program[2], the Wyoming Natural Diversity Database[3], and the Nebraska Natural Heritage Program.[4]

Preface

In January of 1994, The Nature Conservancy in cooperation with the Natural Heritage Programs of Colorado, Wyoming and Nebraska, the Environmental Protection Agency (Region VIII) and the Denver Water Board, began a project which has subsequently led to major improvements in the quality and quantity of information about the biological resources of the South Platte River Watershed.

The majority of Colorado's human population dwells and works in the South Platte River watershed, which supports a significant agricultural and recreational economy. It also possesses numerous biological values. With so many opportunities available, it is not surprising that there are conflicting proposals for land and water use. Thus, any tool that can synthesize information for the purposes of proactively planning for conflict-resolution will be an asset.

Building on the EPA's Watershed Protection Approach, using The Nature Conservancy's Biological and Conservation Database System, and using the information and expertise of the Natural Heritage Programs and their state/federal partners, the parties catalogued occurrences of threatened, endangered and candidate species, as well as species of special concern. Information on populations of wetland, riparian, aquatic and terrestrial species was assembled from as many existing sources of data as possible, and used to determine species and ecological community occurrences and overall quality of biological diversity in the South Platte Watershed.

This information was spatially analyzed to determine the boundaries of Potential Conservation Sites that encompass the ecological processes affecting the survival of one or more occurrences of species and ecological communities of concern. Known threats to the Sites were reported.

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[2]Colorado Natural Heritage Program, 254 General Services Building, Colorado State University, Fort Collins, CO 80523 (970-491-1150).

[3]Wyoming Natural Diversity Database, 1604 Grand Avenue, Suite 2, Laramie, WY 82070 (307-745-5026).

[4]Nebraska Natural Heritage Program, Game and Parks Commission, 2200 North 33rd Street, P.O. Box 30370, Lincoln, NE 68503 (402-471-5421).

The resulting GIS databases, maps, and this report will serve as an important information resource for EPA and Denver Water Board managers whose decisions may potentially affect critical biological resources. In addition, these products will be made widely available to the public, enhancing the resource conservation programs of numerous other organizations and agencies including, but not limited to:

- ✓ County and other local planning offices
- ✓ Community involvement in land and water use decisions
- ✓ Denver Water Board and Water Conservation District watershed management programs
- ✓ USFWS listed species protection programs
- ✓ the Western Governors' Association Great Plains Initiative
- ✓ The Nature Conservancy's bioreserve and natural heritage inventory programs
- ✓ Gap Analysis programs

Acknowledgments

This project would not have been possible without the generous support of the Environmental Protection Agency whose grant of $110,000 over 3 years was instrumental in providing the seed money and the framework for all that was accomplished. In particular, Bill Wuerthele of EPA Region VIII and John Pai of EPA Washington Office, Office of Water, provided the vision and partnership that allowed this project to achieve such a high level of success.

In addition, the Denver Water Board's matching contribution of $5,500 helped to strengthen the public-private partnerships that were key to the widespread support for this project in local communities and the South Platte Forum.

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Products Delivered

The following products have been delivered to the EPA and the Denver Water Board under this project. Use of these products will ensure that the agencies and their cooperators have access to the information they need to make informed decisions regarding the protection of biological resources in the South Platte watershed:

- ✓ Three GIS data layers containing the verified boundaries of Potential Conservation Sites (PC Arc/Info format)
- ✓ A set of 8 ASCII tables containing detailed information about the Potential Conservation Sites and the Element Occurrences on which their boundaries are based
- ✓ A set of 5 ASCII tables containing detailed information about the Element Occurrences that do not fall within the boundaries of any of the Potential Conservation Sites
- ✓ An annotated list of data sources contacted, including comments on data usefulness
- ✓ Assessment of the accuracy and precision of the current South Platte databases
- ✓ Assessment of project efficiency and problems encountered, with recommendations for enhancing the quality of future projects

Potential Conservation Sites

For places known to encompass species or ecological communities of concern that met specific quality and locational precision criteria, the Natural Heritage Program biologists estimated an area within which conservation attention is needed. These Potential Conservation Sites ("Sites") have various management requirements that are directly related to the biological needs of the species or ecological communities for which they were drawn. Advance knowledge of the location and quality of these Sites will provide opportunities for planning and conservation success through the identification and management of potential threats, allowing managers to balance multiple watershed uses.

These Sites were developed by biologists from the Natural Heritage Programs through scientific literature and map review, as well as field inspection. They are not based upon any land-ownership boundaries. Instead, the Sites are intended to encompass the ecological processes most-directly affecting one or more known populations of species of concern, or high-quality ecological communities. Where appropriate, critical habitat designated by the US Fish & Wildlife Service is included. A justification for the current boundaries is always included in the accompanying database (BOUNDJUST field). As additional information about the Site, or the habitat needs of the key species becomes available, the boundaries of the Site are adjusted to reflect the new data.

In the South Platte Inventory, Potential Conservation Sites were created when the underlying species and ecological community data met the following criteria:

- The location of at least one of the occurrences of species or ecological communities is precisely known (e.g., PRECISION field = 'S'),
  OR, in the case of fish, known within 1.5 miles (e.g., PRECISION field = 'M').

- The Natural Heritage Program biologists determined that the species or ecological communities have a high likelihood of being extant, based upon the date the species or ecological community was last observed at that location (typically more recently than 1980).

There are 29 Potential Conservation Sites in the watershed that existed in the database prior to the start of this project, and which do not meet the above criteria. These Sites have been included in the products delivered to the EPA and the Denver Water Board to ensure that the South Platte database matches the state Natural Heritage databases.

Three of the PC Arc/Info data layers delivered to the EPA and Denver Water Board contain polygons representing Potential Conservation Sites. The Site boundaries were digitized at a scale of at least 1:100,000. Each polygon is identified by a unique code.

The three, GIS, polygon layers contain Sites that represent different levels of precision and ecological complexity. Appropriate interpretation of the GIS polygons depends upon an understanding of the differences between the three tiers:

Standard Potential Conservation Sites

These Sites are typically smaller in size. They may contain relatively small numbers of key species or ecological communities. The boundary delineations for Standard Sites are more precise than for the other two categories of Sites. There is a high degree of certainty that the land within these Site boundaries represents crucial habitat for the species and ecological communities of concern. With appropriate consideration given to the dates that the species and ecological communities were **last observed** at the Site (LASTOBS field), these Standard Sites represent the most precise level of biodiversity data.

Potential Conservation Macro-sites

Macro-sites are typically larger than Standard Potential Conservation Sites, and they contain greater numbers of species and ecological communities of concern. Boundary delineation for Macro-sites is somewhat less precise than for Standard Sites. Macro-site boundaries may encompass areas that would not be considered crucial habitat for all species at the Site (e.g., patches of unsuitable habitat or commercial development).

Potential Conservation Mega-sites

Mega-sites typically cover very large areas and contain large numbers of key species and ecological communities. In particular, Mega-sites are designed to encompass the area required to sustain viable populations of wide-ranging, low-density animal species. The boundaries of Mega-sites are not very precise, and they encompass areas that definitely do not represent crucial habitats. For example, the city of Cheyenne, WY, falls within the very extensive High Plains Mega-site. But the species that were used to define the Site (mountain plover, ferruginous hawk, swift fox) occur in low densities throughout the Site, and should be managed at this larger scale.

It is important to note that smaller Sites of one tier can reside within the larger Sites from the other tiers.

For all three types of Sites, the accompanying ASCII data include:

- the full list of species and ecological communities of concern that are known to occur at the Site
- species type (animal, plant, ecological community)
- species listing status (US Fish & Wildlife Service Endangered Species Act and state endangered species laws)
- TNC rarity ranks (both overall for the Site and for each species or ecological community found there)
- information about known threats to the Site
- sensitivity of the data
- overall description of the qualities of the Site

See Appendix 2 for detailed descriptions of the data fields delivered to the EPA and Denver Water Board.

Element Occurrence Points

The term Element is short for "element of biological diversity." In the context of Natural Heritage methodology, this refers to plants, animals, and ecological communities of concern.

Thus, an Element Occurrence is a specific geographic location occupied by an Element which sustains or contributes directly to the Element's persistence. In effect, it is an area of habitat known, or confidently thought, to be occupied by a local population or ecological community type. Distinct Element Occurrences are generally separated by an area of unsuitable habitat. Individuals in captivity or cultivation are never considered to be Element Occurrences.

Within the South Platte watershed, 701 Element Occurrences have been identified based upon historical and/or imprecise records from museums, herbaria, and the literature. These records did not satisfy the criteria for creating Potential Conservation Sites because either:

- they were last seen at that location too long ago (pre-1980), reducing confidence that the Element is still present at that location, OR
- the location information was not precise enough to permit Natural Heritage biologists to identify the actual location of the population with confidence.

These Element Occurrence records were supplied as latitude/longitude points for incorporation into a GIS data layer. They represent the lowest degree of certainty that a species or ecological community of concern will be found at the location specified--below all three types of Potential Conservation Sites. The data fields of particular interest in evaluating the quality of this data are the last observed date (LASTOBS) and the precision (PRECISION).

These data were supplied to EPA and Denver Water Board with three specific uses in mind:

- to provide historical perspective on the potential ranges of the Elements of concern
- to encourage biologists who use the data to search for the Elements at these locations with the hopes of re-locating historical populations
- to alert policy makers and permit officers to the possibility that additional Element Occurrences may exist, although their precise location is not currently known

Sensitive Data and Terms of Data Use

Some of the data collected by Natural Heritage Programs and stored in the databases are considered sensitive information, usually for one of the following reasons:

- the species in question is particularly vulnerable to poaching (e.g., certain raptors, cacti, and butterflies), or
- the landowner has requested that the data be so designated.

A data field has been provided with the South Platte database that identifies which records are considered sensitive. The DATASENS field will contain a 'Y' if the record is sensitive. All users of the database within EPA and the Denver Water Board should be alert to the existence of these sensitive data, and should release them only to parties that have a compelling interest in the locations of these sensitive species.

To address overall concerns regarding the generally sensitive nature of rare species databases, the Conservancy, the Natural Heritage Programs and the EPA agreed that the South Platte watershed databases should somehow mask the data. Two options were considered. One idea was to randomize the locations of the Elements, so that they could not be accurately located on the landscape. The other idea was to provide precise location data, but to withhold species names from database users.

After some discussion, all parties agreed that being able to accurately locate the Element Occurrences on the landscape was critical to successful use of the databases for planning and permitting. Thus, the South Platte watershed databases delivered to the EPA and the Denver Water Board contain precise location information. But species and ecological community names are not included. Instead, all Elements are assigned to one of the following categories: mammal, bird, fish, amphibian, reptile, invertebrate, plant, or ecological community.

Because of this data masking, the EPA and Denver Water Board will be free to use the South Platte watershed databases for their own, internal purposes and to distribute them to any cooperators who desire access. In all cases, if a database user discovers that s/he needs to make a management or development decision about a specific location where an Element Occurrence exists, s/he may contact the appropriate Natural Heritage Program to learn the name of the Element, and discuss species or ecological community biological and management needs with experienced biologists.

For Further Information:

(Natural Heritage Contact List)

When questions arise about the data for specific locations in the South Platte watershed database, your best source for answers will be the state Natural Heritage Program that encompasses that location. As of June, 1996, the contacts are:

Colorado Natural Heritage Program
254 General Services Building
Colorado State University
Fort Collins, CO 80523
Senior Information Manager: Katie Pague (970-491-0992)
Information Manager: Doug Shinneman (970-491-2847)
Information Technician: Ian Barnett (970-491-3763)

Nebraska Natural Heritage Program
Game and Parks Commission
2200 North 33rd Street
P.O. Box 30370
Lincoln, NE 68503
Information Manager: Jennifer Delisle (402-471-5421)
Botanist/Data Manager: Gerry Steinauer (402-471-5469)

Wyoming Natural Diversity Database
1604 Grand Avenue, Suite 2
Laramie, WY 82070
Information Manager/Botany Assistant: Mary Neighbours (307-745-5026)
Botanist: Walter Fertig (307-745-5026)

If you have questions about the GIS databases or project administration, contact:

The Nature Conservancy
Western Regional Office
2060 Broadway, Suite 230
Boulder, CO 80302
Project Manager: Mary Klein (303-541-0344)
GIS Manager: Brooke Wallace (303-541-0355)

Cooperators and Sources of Data

In Phase I of the South Platte Watershed Inventory, the state Natural Heritage Programs identified existing sources of information that would enhance the content of the Natural Heritage databases. Sources were asked to provide information, which was then entered into the Element Occurrence databases at the appropriate Heritage Program.

Many of the sources contacted during Phase I, particularly in Wyoming and Nebraska, were of limited utility. There are three probable reasons why this was so:

- Most of the land in the South Platte watershed is private. It is possible that other watersheds which encompass more public land would have more existing data.

- Some sources were not forthcoming with their data until the field-verification stage of the project. When a few individuals and organizations learned that we were really going to send staff into the field to look for Element Occurrences, they became more inclined to share their existing knowledge to help Natural Heritage Program staff do more effective field work.
- In Wyoming and Nebraska, the bulk of information for the entire project was already part of the database. Little inventory work is done in the South Platte section of Nebraska. And in Wyoming, most of the data were already in-hand.

In Wyoming and Nebraska, Phase I was probably most helpful in providing funding for editing existing Natural Heritage data and the creation/refinement of Potential Conservation Sites.

Assessment of Data Provided by Cooperators

The following table lists the sources contacted for data, and describes the usefulness for this project of data obtained.

Table 1: Data Contacts and Usefulness Evaluation

Name and Address of Contact	Usefulness Comments
Adams, Rick University of Colorado, recent PhD	Helpful in evaluating Colorado bat data.
American Museum of Natural History New York, NY	Indirectly assessed for early zoological data. Low priority because nearly all information is historic and more recent data can be obtained through other sources.
Andelt, Dr. William Extension Wildlife Specialist CSU Cooperative Extension Service Fort Collins, CO 80523	Mailed letter of request. No reply.
Andrews, Tom Research Natural Area Ecologist USFS Experimental Station 240 W. Prospect Fort Collins, CO 80526	Provided report of lynx and wolverine surveys in Rocky Mountain National Park and Indian Peaks Wilderness Area. Conclusions: no sign of either animal in study area in the 1980's. As RNA Ecologist, provided occurrence information on Elements found in areas he visited; only a few were in the South Platte watershed and most were updates to existing records.
Armstrong, Dr. David University of CO Museum Henderson Bldg., Campus Box 218 Boulder, CO 80309-0315	Provided access to CU Museum and served as reference for individual mammal species biology and occurrences. Provided referrals to other potential experts.
Ball, Mark Pawnee National Grasslands	Provided extensive original information on fish, raptors, mountain plovers, and swift fox distributions in the Grasslands.
Bringham Young University Herbarium	BYU was visited by Colorado Natural Heritage Program staff members. All specimen and label information for plants and vertebrates was collected.

Name and Address of Contact	Usefulness Comments
Brockman, Steve US Fish & Wildlife Service	Very helpful in providing qualitative information that substantiates the presence of several animal species in the Wyoming section of the watershed. A couple of new Elements were identified, but the Natural Heritage Program was unable to pinpoint definite locations.
Bureau of Land Management Craig District Herbarium	Not visited. Low liklihood of many rare species records in the South Platte watershed.
CadWest University of Colorado Boulder, CO 80309	Mailed letter of request. No reply.
Carter, Michael Colorado Bird Observatory 13401 Piccadilly Road Brighton, CO 80601	Mailed letter of request. No reply. Verbally contacted by Colorado Natural Heritage Program director. CBO has very little site-specific information. Colorado Natural Heritage Program received a report on the distribution of burrowing owls. Reviewed the priority ranks being developed by the Colorado Partners in Flight.
Chamberlain, Kate US Forest Service Medicine Bow National Forest	Told us that the Forest depends on the Wyoming Natural Diversity Database for Element Occurrence information.
City of Boulder, Open Space Tamara Naumann and Nina Williams	Assisted in updating information on *Spiranthes diluvialis* (Ute ladies' tresses) on Open Space properties.
Colorado Breeding Bird Atlas Hugh Kingery	A complete copy of the database will be made available to Colorado Natural Heritage Program, but not within the timeline of the South Platte project. Data included in this study are generally not site-specific. Rather, they are at the level of 1/6 of a 1:24,000 USGS quadrangle.
Colorado College Herbarium Biology Department Colorado Springs, CO 80903	Visited by Colorado Natural Heritage Program staff members. All specimen label information for plants of special concern was collected. No pertinent animal collections are available at Colorado College.
Colorado Division of Wildlife Research Center Library 317 West Prospect Fort Collins, CO 80526	Mailed letter of request. No reply. Colorado Natural Heritage Program Senior Information Manager contacted Librarian Jackie Boss by letter, requesting an updated copy of a 1978 publication *Essential Habitat for Threatened and Endangered Wildlife in Colorado*. Phone reply indicated that the publication has apparently not been updated since 1978.
Colorado Natural Areas Program Department of Natural Resources 1313 Sherman Street, Room 618 Denver, CO 80203	Janet Coles was contacted by phone. Since the databases housed by the Colorado Natural Heritage Program were formerly with the CNAP, virtually all data collected by CNAP are current in the databases. In the last three years, CNAP's inventory efforts have been focused on state lands in southeast Colorado, the San Luis Valley, and South Park. Inventory data have been incorporated into the Colorado Natural Heritage Program system.
Colorado State University Fort Collins, CO	Contacted larval fish laboratory: no pertinent information. Also contacted Boris Kondratief, Curator of the Entomology Collections. Specimen and label information was collected for all insects known to

Name and Address of Contact	Usefulness Comments
	be of special concern. Specimen label information for plants has been computerized. A copy of the database was obtained late in the project, so only the highest priority records were incorporated into the Colorado Natural Heritage database. Mary Alice Evans reviewed the rarity ranks of the Odonata.
Chadron State College Museum Nebraska	Visited by Nebraska Natural Heritage Program staff members. All specimen label information for Elements of special concern was collected.
Dennehy, Kevin, Project Manager South Platte National Water Quality Assessment Program Denver Federal Center P.O. Box 25046, MS 415 Denver, CO 80225	Contacted by phone. Kevin was unable to provide specific information or references within the NWQA Program. We were referred to the Colorado Division of Wildlife.
Denver Water Board Bob Crifasi and Bob Kennedy 1600 W 12th Avenue Mail Code 415 Denver, CO 80254	Provided reports on the Pawnee montane skipper in South Platte Canyon.
Dorn, Dr. Robert D. Mountain West Consulting, Inc. P.O. Box 1471 Cheyenne, WY 82003	Wanted to be paid for his rare plant information. Plant specimens that Dorn collects are usually deposited at the Rocky Mountain herbarium, so the information was collected that way.
F.E. Warren Air Force Base 90 CES/CEV 300 Vesle Drive, Suite 600 F.E. Warren AFB, WY 82005-2788	Spoke with Tom Smith. No location information available.
Floyd, Sandy EPO-Biology University of Colorado Campus Box 344 Boulder, CO 80309-0344	Sandy reviewed current information on *Gaura neomexicana* ssp. *coloradensis* (Colorado butterfly-plant). She did not have anything new to add.
Graul, Walt Northeast District Wildlife Manager Colorado Division of Wildlife 711 Independent Avenue Grand Junction, CO 82505	Latest publications regarding the plains sharp-tailed grouse were sent to Colorado Natural Heritage Program. Referred to CDOW biologist in central region for annual updates. Colorado Natural Heritage biologist visited the grouse lek sites in Douglas County.
Hammerson, Geoff Herpetologist 12 Red Orange Road Middletown, CT 06457	Under contract with CDOW to provide database of all amphibian and reptile collection and observation locations. A copy of this database was received via CDOW.
Harrington, Fred EG&G, Rocky Flats	Provided extensive information on the ecology of *Zapus hudsonius preblei* (Preble's meadow jumping mouse) at the Rocky Flats Plant.

Name and Address of Contact	Usefulness Comments
Jones, Paul Colorado Division of Wildlife	Provided assistance in contacting CDOW information sources.
Jordan, Lucy and Terry Ireland US Fish & Wildlife Service 764 Horizon Drive South, Annex A Grand Junction, CO 80206	Contact with Colorado Natural Heritage was fairly constant with good exchange of information until Lucy's position was eliminated. Terry referred CNHP to biologists at the State Office, where data for the eastern part of the state are maintained. Bernardo Garza at the state office was helpful in providing locational information on *Zapus hudsonius preblei* (Preble's meadow jumping mouse) and several rare plant locations. Colorado Natural Heritage also received a report on the distribution of *Acroloxus coloradensis* (Rocky Mountain capshell).
Kathryn Kalmbach Herbarium Denver Botanical Gardens 909 York Street Denver, CO 80206	Visited by staff botanists. All specimen and label information pertaining to plants of special concern was collected.
Kearney State College Nebraska	Visited by Nebraska Natural Heritage Program staff members. All specimen label information for Elements of special concern was collected.
Law, Marian Lower S. Platte Water Conservancy District P.O. Box 1725 Sterling, CO 80751	Mailed letter of request. No reply.
Leachman, Bob US Fish and Wildlife Service Grand Junction, CO	Provided extensive bibliographic information on prairie dogs and black-footed ferrets. Locational data not provided.
Livo, Lauren, Contractor Colorado Division of Wildlife	Provided 1994 data on *Bufo boreas* (boreal toad) for the Clear Creek watershed.
Loesche, Jeffrey District Manager Pawnee National Grassland 660 O Street Greely, CO 80631	Contact was made via Mark Ball, who was extremely helpful in providing information on raptor nest locations, as well as swift fox and mountain plover observations.
Museum of Natural History University of Kansas Lawrence, KS 66047	Sent Colorado Natural Heritage a printout of all mammal data from Colorado. Most of the data were already included in Armstrong, 1972. Herpetological data were already included in Geoff Hammerson's database.
National Biological Service Midcontinent Ecological Sci. Center Fort Collins, CO	Contacted Steve Corn, Research Biologist, regarding locations of *Bufo boreas boreas* (boreal toad). Fruitful contact was also made with Paul Opler, Chief of Publications, for information regarding rare lepidoptera. Paul was very helpful in providing data on nomenclature, scientific information critical to designing preliminary conservation planning boundaries for regal fritillary, and in directing our search efforts for lepidoptera specimens.

Name and Address of Contact	Usefulness Comments
National Museum of Natural History Washington, DC	Low priority because nearly all information is historic and can be obtained through other sources. Not contacted. Pertinent mammal data were available through Armstrong. *Bufo boreas* (boreal toad) data are expected from Steve Corn, NBS.
Neely, Betsy The Nature Conservancy 1244 Pine Street Boulder, CO 80302	Extremely helpful in providing unpublished observations on ecological community and plant occurrences. Especially helpful in West Bijou Creek, North Fork Poudre, Pawnee Grasslands, and South Park.
Nesler, Tom, Aquatic Program and Judy Sheppard, Terrestrial Program Colorado Division of Wildlife 6060 Broadway Denver, CO 80216	Some native fish information obtained through the Northeastern and Central Region offices of CDOW. All other fish data were delivered under a separate agreement.
Northern CO Water Conservancy District P.O. Box 679 Loveland, CO 80539	Mailed information request letter. No reply.
Opler, Paul	See National Biological Service, above.
Parmenter, Becky and Darryl Yeakley US Forest Service Arapaho National Forest, Clear Creek District	Provided original observations on boreal toads, cutthroat trout, rare plant locations, and other possible Elements. Also provided numerous contacts.
Peterson, Kathy US Dept of Agriculture High Plains Grassland Research Sta.	Research at the station is more applied in nature (e.g., seedling establishment, mine reclamation, sewage sludge effects, and grazing studies).
R.L. McGregor Herbarium University of Kansas Birdwell Botanical Research Lab 2045 Constant Ave, Campus West Lawrence, KS 66047	Exchanged specimen label information via mail in cooperation with Kansas Natural Heritage Program.
Rocky Mountain Herbarium Department of Botany University of Wyoming Box 3165 Laramie, WY 82071	Botanists collected specimen label information pertinent to plants of special concern for all three states.
Rocky Mountain National Park Estes Park, CO	Mailed letter of request. No reply. Scientists from Colorado Natural Heritage Program visited the collections and libraries.
Rosenlund, Bruce Us Fish and Wildlife Service	Provided data on the greenback cutthroat trout (historic & current).
St. Vrain and Left Hand Water Conservation District 9595 Nelson Road, Box C Longmont, CO 80501	Mailed letter of information request. No reply.

Name and Address of Contact	Usefulness Comments
Slater, Charles Central City, CO	Provided extensive information on butterflies of the Clear Creek watershed, particularly one rare subspecies of arctic.
Smith, Hobart Professor Emeritus of Herpetology University of Colorado	Assisted in verification of South Platte records for amphibians and reptiles. Provided updated distribution records.
Spurrier, Carol (Botanist) Bureau of Land Management Colorado State Office 2850 Youngfield Street Lakewood, CO 80631	Mailed letter of request. No reply, although Colorado Natural Heritage Program staff believe that they already have information that she could provide in the databases.
Stafford, Jay Colorado Division of Wildlife	Provided recent collection data for fish in the South Platte watershed.
Stanford, Ray (Lepidopterist) Denver, CO	Trained interns visited the Stanford butterfly collection and documented specimen label information for all of the most rare species of special concern, including all candidate and listed species.
Tate, Cathy Water Resources Division, USGS Box 25046, MS 415 Denver, CO 80225	Mailed letter of information request. No reply.
University of Colorado Herbarium Box 350 Boulder, CO 80309-0350	Trained intern documented specimen label information for all species of special concern. Tom Ranker, Curator, and Tim Hogan, Asst. Curator, were exceedingly helpful. William Weber assisted in the identification and elaboration of several specimens.
University of Colorado Museum of Natural History Henerson, Campus Box 218 Boulder, CO 80309-0218	Trained intern documented specimen label information for all species of special concern. Fish data are almost exclusively historic and the collection is in disarray. We believe that most pertinent data were collected.
University of Northern Colorado Herbarium & other collections Greeley, CO	Visited in winter 1994-95. Herpetological data and older mammalian data acquired through other means. Bat data available from Armstrong.
University of Nebraska Herbarium and State Museum Lincoln, NE	Label information for rare plants documented by Nebraska Natural Heritage Program and sent to Colorado Natural Heritage Program in exchange for same from University of Colorado herbarium search. Similar process for vertebrates indicated few animal data available.
University of Oklahoma Norman, OK	Few pertinent data available for animals, all available through secondary sources.
University of WY Vertebrate Museum Dept. of Zoology and Physiology Box 3166 Laramie, WY 82071	Museum database provided new specimen data, primarily for amphibians and reptiles.
Verner, John US Forest Service Center for Excellence, Owls	Contacted for spotted owl data. Extremely helpful, but no breeding occurrences in South Platte watershed. However, we note that this species is very close to the South Platte Canyon.

Name and Address of Contact	Usefulness Comments
Weber, Dave District Wildlife Manager Colorado Division of Wildlife	Helpful in directing Colorado Natural Heritage Program to Mr. Straley who provided rare fish information. Assisted in the acquisition of colonial nesting bird data for the Central Region of CDOW.
Wu, Shei Qui (Curator) University of Colorado Museum	Trained intern documented specimen label information for mollusk species of special concern. Assisted in the review of Natural Heritage ranks for aquatic mollusks in Colorado.
Wyoming Dept. of Game & Fish 5400 Bishop Blvd. Cheyenne, WY 82002	Received data on species of concern from the Wildlife Observation System. Data are not user-friendly and required extensive translation. Most data are single observations with no data regarding quality assurance. Most helpful for alerting Natural Heritage program staff of possible new locations, and confirming existing occurrences.
WY Dept. of Environmental Quality Land Quality Division 122 W. 25th street Herschler Building Cheyenne, WY 82002	Spoke with Paige Smith. She said that they contact the Wyoming Natural Diversity Database for occurrence information.
Wyoming Gap Analysis Project Dept. of Zoology and Physiology University of Wyoming Box 3166 Laramie, WY 82071	Met with Tom Kohley. All of their point-location data were originally supplied by the Wyoming Natural Diversity Database or the Wyoming Game & Fish Department's Wildlife Observation System (see above).

Contributions and Funding from Other Sources

Many other projects were underway in the South Platte watershed during the course of the South Platte Watershed Inventory. These projects leveraged the amount of data collected over the course of this inventory:

Great Outdoors Colorado (2 years)	$264,000
Great Plains Initiative	14,000
Boulder County Open Space Inventory	25,000
Park County, mountain plover study	2,500
Park County Wetlands Inventory	10,000
Douglas County Inventory	74,000
Larimer County Inventory (ongoing)	30,000
Larimer County Wetlands Inventory (ongoing)	15,000
EPA/DNR South Platte Riparian Survey	50,000
US Forest Service, Arapaho-Roosevelt RNA Study	20,000
Clear Creek Ranger District Inventory	6,000
Bureau of Land Management, mountain plover study	12,000
	$522,500

The Nature Conservancy's Western Regional Office also contributed an additional $1,800 in salary for the project manager.

Considering the original EPA and Denver Water Board grants of $114,700, this adds up to a leveraging ratio of nearly 5:1.

Conservation Status and Inventory Priorities[5]

Resources available for conservation of species and ecological communities invariably are in short supply relative to the need. Targeting conservation and management actions toward those Elements in greatest need, and where opportunities for success are greatest, requires clearly established priorities.

Among the most widely-applied systems for setting priorities is the status-ranking system developed and used by the Natural Heritage Programs and The Nature Conservancy. This approach is designed to evaluate the biological and conservation status of species and ecological communities.

The status ranks are based upon objective factors including a species' **rarity**, population **trends**, **threats**, inherent **fragility** in the face of ecological change, and the current **protection-status** of known populations. Four aspects of rarity are considered:

1) number of individuals
2) number of populations or occurrences
3) scarcity of suitable habitat
4) size of geographic range

The categories used in the ranking process are based on an approximately logarithmic scale, ranging from a value of "1" (critically imperiled), to "5" (demonstrably secure). Typically, species or ecological communities assigned rank values from 1 to 3 would be considered of conservation concern.

Within the United States, ranking is carried out at two scales: state (S) and global (G). Thus, a species may be relatively common and secure globally (G4), but within a given state may be critically imperiled (S1). The combined rank within that state (G4S1) allows priorities to be set within a local and global context. Table 2 gives the commonly-used definitions for Natural Heritage status ranks at the global level.

[5]From: 1995. Stein, Bruce, et al. Status of US species: Setting conservation priorities. *In* Our Living Resources, E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran and M.J. Mac, eds. US Department of the Interior, National Biological Service. pp. 399-400.

Table 2: Natural Heritage Status Ranks

Rank	Definition
GX	**Extinct**: believed to be extinct throughout its range with virtually no likelihood that it will be rediscovered.
GH	**Historical**: of historical occurrence throughout its range; formerly part of the established biota, with the expectation that it may be rediscovered.
G1	**Critically imperiled** because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction; typically 5 or fewer occurrences or very few remaining individuals or acres.
G2	**Imperiled** because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction; typically 6 to 20 occurrences or few remaining individuals or acres.
G3	**Vulnerable**: typically either very rare and local throughout its range, or found locally (even abundantly at some of its locations) in a restricted range, or because of other factors making it vulnerable to extinction throughout its range; typically 21 to 100 occurrences.
G4	**Apparently Secure**: usually widespread, though it may be quite rare in parts of its range, especially at the periphery, and may be somewhat uncommon generally, thus possibly of long-term concern; typically more than 100 occurrences.
G5	**Demonstrably Secure**: typically widespread and abundant, though it may be quite rare in parts of its range, especially at the periphery.
G?	Not yet ranked.

For example:

Passenger Pigeon is ranked GX
Whooping Crane is ranked G1
Red-cockaded Woodpecker is ranked G3
Mallard is ranked G5

For plants and animals, subspecies and varieties are treated by adding a "T" designation after the "G" or "S", with an appropriate numeric rank for the subspecies to indicate its rarity status. For example, the rank G5T1 for a subspecies reflects the fact that it is a critically imperiled subspecies of an otherwise common species.

The natural world is extremely dynamic, due to both intrinsic ecological factors and increasing human influences. At the same time, our knowledge of the distribution, abundance, and basic biology of

species and ecological communities is imperfect, but continually improving. It follows that Element status ranks should be viewed as working estimates, based upon the best available information.

Global-level ranks have been assigned to all U.S. vertebrate species, selected groups of invertebrates (including all federally listed, proposed and candidate species), all vascular plant species, and selected nonvascular plant species (e.g., many lichens and bryophytes). Preliminary ranks have also been assigned to all rare terrestrial, ecological communities found within the U.S. All of the Elements being tracked within the South Platte watershed have been assigned both State and Global ranks.

For some Element groups (e.g., mammals, birds and reptiles), the Global status-ranks assigned by the Natural Heritage Programs closely parallel federal listing status. But for other groups (e.g., amphibians, fishes, unionid mussels), the Element status-ranks recognize many more imperiled species than the U.S. Endangered Species Act.

Assessment of the Quality of South Platte Biological Data

Improvements to the Element Occurrence Data

Prior to this project 955 Element Occurrences representing 264 Elements were documented in the Natural Heritage databases for the South Platte watershed. After Phases 1 & 2, information from partners helped identify an additional 702 Element Occurrences. And during Phase 3, the data collected through field work using EPA/Denver Water Board and matching funds resulted in the identification of an additional 349 Element Occurrences.

At the end of the project, 2,006 Element Occurrences representing a total of 394 Elements were documented in the South Platte Watershed. Thus, 130 additional Elements were added to the South Platte tracking list: an increase of 50%. Elements were added either because new Element Occurrences were identified in the watershed or because additional species were determined to be more rare than previously thought, and hence added to the state tracking list by at least one of the state Natural Heritage Programs.

Table 3 provides a full list of species and ecological communities documented. The Elements shown in **bold** type are the 130 that were added to the tracking list since the beginning of the South Platte Inventory project. As described in the section of this report titled "Conservation Status and Inventory Priorities", some of these Elements are common globally, but are on the tracking list because they are of special concern within one or more of the states that contain the watershed (e.g., Colorado, Wyoming or Nebraska).

Table 3: Complete Element List for the South Platte Watershed, April 1996

Elements shown in **bold** were added to the South Platte tracking list during the course of the South Platte Inventory project.

Element Scientific Name (Global)	Element Common Name (Global)
Fish	
Carpiodes carpio	River carpsucker
Couesius plumbeus	**Lake chub**
Culaea inconstans	Brook stickleback
Etheostoma exile	Iowa darter
Etheostoma nigrum	Johnny darter
Etheostoma spectabile	Orangethroat darter
Fundulus sciadicus	Plains topminnow
Gila robusta	**Roundtail chub**
Hybognathus hankinsoni	Brassy minnow
Hybognathus placitus	**Plains minnow**
Luxilus cornutus	Common shiner
Nocomis biguttatus	Hornyhead chub
Noturus flavus	**Stonecat**
Oncorhynchus clarki stomias	Greenback cutthroat
Phenacobius mirabilis	Suckermouth minnow
Phoxinus eos	**Northern redbelly dace**
Amphibians	
Acris crepitans blanchardi	Blanchard's cricket frog
Ambystoma tigrinum	**Tiger salamander**
Bufo boreas pop 1	Boreal toad (southern rocky mountain population)
Rana pipiens	**Northern leopard frog**
Rana sylvatica	Wood frog
Reptiles	
Holbrookia maculata	**Lesser earless lizard**
Phrynosoma douglasi	Short-horned lizard
Tantilla nigriceps	Plains blackhead snake
Tropidoclonion lineatum	Lined snake
Birds	
Accipiter gentilis	Northern goshawk
Aechmophorus occidentalis	Western grebe
Aegolius funereus	**Boreal owl**
Aquila chrysaetos	Golden eagle
Ardea herodias	Great blue heron
Aythya valisineria	**Canvasback**

Element Scientific Name (Global)	Element Common Name (Global)
Bombycilla cedrorum	**Cedar waxwing**
Buteo regalis	Ferruginous hawk
Buteo swainsoni	Swainson's hawk
Calcarius mccownii	Mccown's longspur
Calcarius ornatus	Chestnut-collared longspur
Casmerodius albus	**Great egret**
Charadrius melodus	Piping plover
Charadrius montanus	Mountain plover
Coccyzus americanus americanus	
Cypseloides niger	Black swift
Dolichonyx oryzivorus	**Bobolink**
Egretta thula	**Snowy egret**
Falco columbarius	Merlin
Falco mexicanus	**Prairie falcon**
Falco peregrinus anatum	American peregrine falcon
Falco peregrinus anatum	American peregrine falcon
Gallinago gallinago	Common snipe
Grus americana	Whooping crane
Haliaeetus leucocephalus	Bald eagle
Loxia leucoptera	**White-winged crossbill**
Melanerpes lewis	Lewis' woodpecker
Melospiza georgiana	Swamp sparrow
Numenius americanus	Long-billed curlew
Nycticorax nycticorax	Black-crowned night-heron
Pandion haliaetus	**Osprey**
Pelecanus erythrorhynchos	American white pelican
Plegadis chihi	White-faced ibis
Progne subis	**Purple martin**
Seiurus aurocapillus	**Ovenbird**
Setophaga ruticilla	**American redstart**
Speotyto cunicularia	Burrowing owl
Sterna antillarum athalassos	Interior least tern
Strix occidentalis lucida	**Mexican spotted owl**
Tympanuchus phasianellus jamesi	Plains sharp-tailed grouse
Mammals	
Corynorhinus townsendii	**Townsend's big-eared bat**
Gulo gulo	**Wolverine**
Lasionycteris noctivagans	Silver-haired bat
Lynx canadensis	Lynx
Mustela nigripes	Black-footed ferret
Mustela nivalis	Least weasel
Neotoma cinerea rupicola	
Perognathus flavescens	**Plains pocket mouse**

Element Scientific Name (Global)	Element Common Name (Global)
Scalopus aquaticus	Eastern mole
Sorex hoyi montanus	Pygmy shrew
Sorex merriami	Merriam's shrew
Spermophilus lateralis lateralis	**Wind river golden-mantled ground squirrel**
Thomomys talpoides macrotis	
Ursus arctos	Grizzly or brown bear
Vulpes velox	Swift fox
Zapus hudsonius preblei	Meadow jumping mouse
Invertebrates	
Acroloxus coloradensis	**Rocky mountain capshell**
Adelpha bredowii	California sister
Aeshna eremita	**Lake darner**
Aeshna juncea	**Sedge darner**
Aeshna verticalis	**Green-striped darner**
Amblyscirtes simius	**Simius roadside skipper**
Anodonta grandis	**Giant floater**
Anodontoides ferussacianus	**Cylindrical papershell**
Aphaenogaster huachucana	An ant
Archilestes grandis	**Great spreadwing**
Argia sedula	**Blue-ringed dancer**
Atrytone arogos	Arogos skipper
Atrytonopsis hianna	Dusted skipper
Boloria selene sabulocollis	Kohler's fritillary
Calopteryx aequabilis	**River jewelwing**
Celastrina sp 1	**A tiger beetle**
Cicindela nebraskana	**American emerald**
Cordulia shurtleffi	
Doa ampla	**Double-striped bluet**
Enallagma basidens	**Theano alpine**
Erebia theano	Mottled dusky wing
Erynnis martialis	Two-spotted skipper
Euphilotes rita coloradensis	**Wiest's sphinx moth**
Euphyes bimacula	An ant
Euproserpinus wiesti	
Formica laeviceps	**Montana skipper**
Grammia sp 1	Ottoe skipper
Hesperia leonardus montana	**Moss elfin**
Hesperia ottoe	**Desert forktail**
Incisalia mossi	American burying beetle
Ischnura barberi	**Snow's skipper**
Nicrophorus americanus	
Ochlodes snowi	

Element Scientific Name (Global)	Element Common Name (Global)
Oeneis alberta	**Alberta arctic**
Oeneis jutta reducta	**Rocky mountain jutta artic**
Oeneis polixenes	Polixenes arctic
Physa skinneri	**Glass physa**
Physella utahensis	**Utah physa**
Promenetus exacuous	**Sharp sprite**
Promenetus umbilicatellus	**Umbilicate sprite**
Pyganodon grandis	**Giant floater**
Pyrgus ruralis	Two-banded checkered skipper
Satyrodes eurydice fumosa	**Smoky-eyed brown**
Somatochlora hudsonica	**Hudsonian emerald**
Somatochlora minor	**Ocellated emerald**
Speyeria idalia	Regal fritillary
Stigmatomma pallipes	An ant
Sympetrum costiferum	**Saffron-bordered meadowfly**
Sympetrum vicinum	**Yellow-legged meadowfly**
Sympheidole elecebra	An ant
Plants	
Acorus calamus	Sweetflag
Agastache foeniculum	Blue giant hyssop
Aletes humilis	Colorado aletes
Amaranthus californicus	California amaranth
Ambrosia linearis	Linear-leaf bursage
Ambrosia tomentosa	**Skeleton-leaf bursage**
Amorpha nana	**Fragrant indigobush**
Apios americana	American groundnut
Aquilegia saximontana	Rocky mountain columbine
Arabidopsis salsuginea	Saltwater cress
Arabis fendleri var spatifolia	**A fendler rock-cress**
Argyrochosma fendleri	Fendler cloak-fern
Aristida basiramea	Forked three-awned grass
Armeria maritima ssp sibirica	Sea pink
Asclepias engelmanniana	Englemann milkweed
Asclepias uncialis	Greene milkweed
Asplenium adiantum-nigrum	Black spleenwort
Asplenium septentrionale	**Northern spleenwort**
Asplenium trichomanes	**Maidenhair spleenwort**
Asplenium trichomanes-ramosum	Green spleenwort
Aster alpinus var vierhapperi	**Alpine aster**
Aster borealis	**Boreal aster**
Aster junciformis	**Rush aster**
Aster porteri	Porter's aster
Astragalus bodinii	**Bodin milkvetch**

Element Scientific Name (Global)	Element Common Name (Global)
Astragalus mollissimus var mollissimus	A milk-vetch
Astragalus molybdenus	Molybdenum milk-vetch
Astragalus plattensis	**Platte river milk-vetch**
Astragalus tridactylicus	A milk-vetch
Bahia dissecta	Dissected bahia
Besseya plantaginea	White river coral-drops
Botrychium campestre	**Prairie dunewort**
Botrychium echo	Reflected moonwort
Botrychium hesperium	Western moonwort
Botrychium lanceolatum var lanceolatum	Lance-leaved moonwort
Botrychium lineare	
Botrychium lunaria	Moonwort grape-fern
Botrychium minganense	Mingan's moonwort
Botrychium multifidum	**Leathery grape-fern**
Botrychium pallidum	Pale moonwort
Bouteloua hirsuta var hirsuta	Hairy gramma
Bouteloua simplex	Mat grammagrass
Bráya humilis	Low braya
Carex capitata ssp arctogena	**Capitate sedge**
Carex concinna	**Beautiful sedge**
Carex diandra	**Lesser panicled sedge**
Carex hallii	**Hall's sedge**
Carex lasiocarpa	**Slender sedge**
Carex leptalea	Bristly-stalk sedge
Carex limosa	**Mud sedge**
Carex livida	Livid sedge
Carex oreocharis	A sedge
Carex peckii	White-tinged sedge
Carex sartwellii var sartwellii	A sartwell sedge
Carex saximontana	Rocky mountain sedge
Carex scirpoidea	Bulrush sedge
Carex sychnocephala	Many-headed sedge
Carex tenuiflora	Sparse-flowered sedge
Carex torreyi	Torrey sedge
Carex viridula	Little green sedge
Chenopodium pallescens	**Narrow-leaved goosefoot**
Chenopodium watsonii	Watson goosefoot
Chionophila jamesii	**Rocky mountain snowlover**
Crataegus chrysocarpa	**Fineberry hawthorn**
Crepis nana	Dwarf alpine hawksbeard
Cryptantha cana	Mountain cat's-eye
Cypripedium fasciculatum	Clustered lady's-slipper
Cypripedium pubescens	Large yellow lady's-slipper
Delphinium geyeri	

Element Scientific Name (Global)	Element Common Name (Global)
Delphinium nuttallianum	Nuttall larkspur
Downingia laeta	**Great basin downingia**
Draba borealis	Boreal whitlow-grass
Draba crassa	**Thick-leaf whitlow-grass**
Draba exunguiculata	A whitlow-wort
Draba fladnizensis	White arctic whitlow-grass
Draba grayana	Gray's whitlow-grass
Draba incerta	Yellowstone whitlow-grass
Draba oligosperma	**Few-seeded whitlow-grass**
Draba porsildii	Porsild's whitlow-grass
Draba streptobrachia	Colorado divide whitlow-grass
Dryopteris expansa	Spreading woodfern
Echinocereus viridiflorus	Green-flowered hedgehog-cactus
Epilobium palustre	**Marsh willow-herb**
Erigeron canus	Hoary fleabane
Erigeron elatior	**Tall fleabane**
Erigeron humilis	Low fleabane
Erigeron melanocephalus	**Black-head fleabane**
Erigeron pinnatisectus	**Pinnate fleabane**
Eriogonum coloradense	Colorado wild-buckwheat
Eriogonum jamesii var flavescens	James wild-buckwheat
Eriogonum pauciflorum var gnaphalodes	A wild-buckwheat
Eriogonum x nebraskense	Hybrid
Eriophorum altaicum var neogaeum	Altai cotton-grass
Eriophorum gracile	Slender cotton-grass
Eustoma russellianum	Showy prairie-gentain
Euthamia graminifolia var graminifolia	
Euthamia occidentalis	Western fragrant goldenrod
Eutrema penlandii	Penland's eutrema
Gaura neomexicana ssp coloradensis	Colorado butterfly-weed
Gentiana affinis var bigelovii	Prairie gentian
Goodyera repens	Dwarf rattlesnake-plantain
Heuchera richardsonii	**Richardson alumroot**
Hymenoxys scaposa	
Ipomopsis spicata	Spiked standing-cypress
Ipomopsis spicata ssp capitata	Globe gilia
Iris missouriensis	Western blue iris
Isoetes echinospora	**Spiny-spore quillwort**
Jamesia americana	Cliff jamesia
Juncus tweedyi	Tweedy's rush
Juncus vaseyi	Vasey rush
Lesquerella montana	Mountain bladderpod
Liatris ligulistylis	Strap-style gay-feather
Ligusticum tenuifolium	**Slender-leaf lovage**

Element Scientific Name (Global)	Element Common Name (Global)
Lilium philadelphicum	Wood lily
Linaria canadensis	Old-field toadflax
Linum puberulum	Plains flax
Listera borealis	Northern twayblade
Listera convallarioides	Broad-leaved twayblade
Lomatogonium rotatum	**Marsh felwort**
Lycopodium annotinum var pungens	
Machaeranthera bigelovii	Bigelow's tansy-aster
Machaeranthera grindelioides	Western aster
Malaxis brachypoda	White adder's-mouth
Mimulus gemmiparus	Weber's monkey-flower
Muhlenbergia montana	Mountain muhly
Muhlenbergia torreyi	**Ring muhly**
Notholaena fendleri	Fendler cloak-fern
Nuttalanthus canadensis	Old-field toadflax
Oenothera brachycarpa	Short-fruit evening-primrose
Oenothera canescens	Spotted evening-primrose
Oenothera howardii	
Onoclea sensibilis	Sensitive fern
Opuntia macrorhiza var macrorhiza	
Oxytropis multiceps	Rocky mountain oxytrope
Papaver lapponicum ssp occidentale	
Parnassia kotzebuei	Kotzebue's grass-of-parnassus
Paronychia jamesii	James nailwort
Parthenium alpinum	Alpine fever-few
Pediomelum hypogaeum var hypogaeum	**Edible scurf pea**
Pediomelum linearifolium	Narrowleaf scurf-pea
Pellaea atropurpurea	Purple-stem cliff-brake
Petasites sagittatus	Arrow-leaved sweet-coltsfoot
Phacelia alba	**White scorpion-weed**
Phacelia denticulata	Rocky moutain phacelia
Phippsia algida	Ice grass
Physaria bellii	Bell's twinpod
Pinus flexilis	Limber pine
Plagiobothrys scouleri	Meadow popcorn-flower
Polemonium brandegei	Brandegee's jacob's-ladder
Polypodium saximontanum	
Potentilla ambigens	Southern rocky mountain cinquefoil
Potentilla effusa var rupincola	Rocky mountain cinquefoil
Potentilla plattensis	Platte cinquefoil
Primula egaliksensis	Greenland primrose
Psoralea linearifolia	Narrowleaf scurf-pea
Ptilagrostis mongholica ssp porteri	Porter feathergrass
Pyrola picta	White-vein wintergreen

Element Scientific Name (Global)	Element Common Name (Global)
Ranunculus karelinii	
Rhododendron albiflorum	**White-flowered rhododendron**
Ribes americanum	Wild black currant
Rorippa coloradensis	**Colorado watercress**
Rotala ramosior	Toothcup
Rubus arcticus ssp acaulis	Nagoon berry
Salix candida	Hoary willow
Salix lanata ssp calcicola	Lanate willow
Salix myrtillifolia	Myrtle-leaf willow
Salix serissima	Autumn willow
Saussurea weberi	Weber's saw-wort
Saxifraga cespitosa ssp monticola	Tundra saxifrage
Saxifraga foliolosa	Leafy saxifrage
Scirpus rollandii	Rolland bulrush
Scirpus saximontanus	**Rocky mountain bulrush**
Scutellaria brittonii	Britton skullcap
Selaginella mutica	Blunt-leaf spike-moss
Selaginella underwoodii	**Underwood's spike-moss**
Senecio pauciflorus	Few-flower ragwort
Silphium integrifolium var laeve	
Sisyrinchium demissum	**Stiff blue-eye-grass**
Sisyrinchium pallidum	Pale blue-eye-grass
Solidago ptarmicoides	Prairie goldenrod
Sophora nuttalliana	Silky sophora
Spiranthes diluvialis	Ute ladies' tresses
Stenotus armerioides var armerioides	Skyline golden-weed
Subularia aquatica	**Water awlwort**
Suckleya suckleyana	Poison suckleya
Talinum parviflorum	Small-flowered flame-flower
Teucrium canadense var occidentale	**American germander**
Vaccinium myrtillus var oreophilum	
Verbesina encelioides ssp exauriculata	
Viola pedatifida	Prairie violet
Viola selkirkii	Great-spurred violet
Woodsia neomexicana	

Ecological Communities

- **Andropogon gerardii-Calamovilfa longifolia**
- Andropogon gerardii-Schizachyrium scoparium
- Andropogon gerardii-Sorghastrum nutans
- Andropogon gerardii-Sporobolus heterolepis

Element Scientific Name (Global)	Element Common Name (Global)
Andropogon hallii-Calamovilfa longifolia phase Stipa comata	
Artemisia filifolia/Andropogon hallii	
Artemisia tridentata wyomingensis/Leymus ambiguus	
Artemisia tripartita/Festuca idahoensis	
Atriplex canescens/Bouteloua gracilis	
Betula occidentalis/Mesic forb	**Foothills riparian shrubland**
Bocu-Scsc phase Eriogonum flavum	
Carex diandra quaking fen	**Quaking fen**
Carex nebrascensis wetland	
Carex rostrata wetland	
Carex rupestris-Geum rossii	
Cercocarpus montanus-Rhus trilobata/Andropogon gerardii	
Cercocarpus montanus/Stipa comata	
Cercocarpus montanus/Stipa neomexicana	**Foothills shrubland**
Cercocarpus montanus/Stipa scribneri	
Danthonia parryi	
Deschampsia cespitosa-Geum rossii	
Distichlis spicata var stricta	
Eleocharis quinqueflora-Triglochin spp.	
Festuca arizonica-Muhlenbergia filiculmis	
Festuca arizonica-Muhlenbergia montana	
Juniperus scopulorum/Cercocarpus montanus	
Juniperus scopulorum/Purshia tridentata	
Juniperus scopulorum/Schizachyrium scoparium	
Kobresia myosuroides-Geum rossii	
Kobresia myosuroides-Thalictrum alpinum	
Kobresia simpliciuscula-Scirpus pumilus	
Muhlenbergia montana-Danthonia parryi	
Muhlenbergia montana-Stipa comata	
Paronychia pulvinata-Silene acaulis var subacaulis	
Pentaphylloides floribunda-Salix brachycarpa/Kobresia myosuroides	
Phippsia algida	
Picea engelmannii/Calamagrostis canadensis	
Picea pungens/Alnus incana	
Pinus aristata/Trifolium dasyphyllum	

Element Scientific Name (Global)	Element Common Name (Global)
Pinus flexilis/Arctostaphylos uva-Ursi	
Pinus ponderosa/Arctostaphylos uva-Ursi	
Pinus ponderosa/Carex inops	
Pinus ponderosa/Cercocarpus montanus	
Pinus ponderosa/Cercocarpus montanus/Andropogon gerardii	
Pinus ponderosa/Festuca arizonica	
Pinus ponderosa/Leucopoa kingii	
Pinus ponderosa/Muhlenbergia montana	
Pinus ponderosa/Quercus gambelii	
Populus angustifolia/Alnus incana	
Populus deltoides-(salix amygdaloides)/Spartina pectinata	**Plains cottonwood riparian woodland**
Populus deltoides-Salix amygdaloides/Salix exigua	Plains cottonwood riparian woodland
Populus deltoides/Carex lanuginosa	
Populus deltoides/Symphoricarpos occidentalis	**Plains cottonwood riparian woodland**
Pseudotsuga menziesii/Carex geyeri	
Pseudotsuga menziesii/Jamesia americana	
Puccinellia airoides	
Purshia tridentata/Muhlenbergia montana	
Purshia tridentata/Stipa comata	
Quercus gambelii-Cercocarpus montanus/Muhlenbergia montana	
Ribes cereum/Leymus ambiguus	
Salicornia rubra	
Salix exigua/Mesic graminoid	**Sandbar willow/mesic graminoid**
Salix exigua/Barren soil	**Sandbar willow/barren soil**
Salix geyeriana-Salix monticola/Calamagrostis canadensis	
Salix planifolia-Salix brachycarpa/Caltha leptosepala	
Salix planifolia-Salix wolfii/Caltha leptosepala	
Salix planifolia/Calamagrostis canadensis-Carex aquatilis	
Salix planifolia/Carex aquatilis	
Stipa comata - east	
Stipa comata-Bouteloua gracilis	
Stipa neomexicana	

All of the original 955 Element Occurrences were updated with new information in at least a few of the data fields. But significantly, 175 (18%) of the original 955 Element Occurrences

received updates to the date that the Element was last observed at that location. Thus, nearly 1 in 5 Element Occurrences now has information available from more recent sightings in the field.

Significant improvements have also been made to the level of precision with which the databases represent the exact locations of Elements on the landscape. During the course of this project, 311 (33%) of the original 955 Element Occurrences had their original 'Precision' values updated to indicate that the location of occurrence could be more confidently interpreted from the information in the databases.

A new data component that was added to the system specifically for this project was a field called 'Water'. This field was populated for all of the Elements to flag them as either dependent upon riparian/wetland/aquatic habitats or as upland species and ecological communities. This new data field will allow EPA and Denver Water Board database users to quickly ascertain whether water-based impacts will have potential consequences on specific Element Occurrences or the Potential Conservation Sites that contain them.

Improvements to the Potential Conservation Site Data

Prior to this project 158 Potential Conservation Sites were documented in the Natural Heritage databases for the South Platte watershed. After Phases 1 & 2, which included an intensive Site Design component, an additional 237 Sites were identified and documented. And during Phase 3, the data collected through field work using EPA/Denver Water Board and matching funds resulted in the creation of an additional 95 Sites.

At the end of the project, 490 Potential Conservation Sites were documented in the South Platte Watershed: an increase of more than 200%.

All of the original 158 Sites were updated with new information in at least a few of the fields. But significantly, 58 (37%) of the original 158 Sites received updates to the 'Biodiversity Significance' field, indicating a better understanding of the significance of these areas. This improvement in data is mostly a reflection of increased information regarding the Element Occurrences upon which the Sites were based.

Effects of *de novo* Inventory

The standard methodology for conducting a Natural Heritage inventory includes

1) collection of existing information and incorporation of it into the Natural Heritage databases;
2) aerial photograph analysis to identify potential natural areas and target on-the-ground inventory areas;
3) conduct of on-the-ground surveys to verify existing locations, document new locations, and design Potential Conservation Sites;
4) incorporation of all new data into the Natural Heritage databases.

A considerable increase in information typically comes from each step. Recent experience in Colorado's Douglas County, Jefferson County, and Air Force Academy inventories indicates that the increase in the number of Potential Conservation Sites due to *de novo* field work based upon aerial photo analysis is upward of 75%.

The many concurrent projects that supported field inventory in the South Platte watershed (see page 12) made significant contributions towards the large numbers of new records described above. Without these concurrent projects, it is unlikely that we would have seen the big increases in numbers of Element Occurrences and Potential Conservation Sites. In fact, most of the *de novo* field work was conducted in Colorado, resulting in correspondingly less dramatic improvements to the Wyoming and Nebraska portions of the database.

The biological diversity of the Nebraska portion of the watershed is particularly poorly known. Few biological surveys have been done in that part of the state, and little information is available. A project supporting aerial photo analysis and *de novo* field work would be particularly effective in increasing our knowledge of this area. It is unfortunate that this area is data-poor, because it represents the farthest downstream reaches of the watershed. Impacts on the water throughout the upper watershed are concentrated in the Nebraska portion. We are unlikely to thoroughly understand the effects of these impacts on Nebraska's biological diversity without additional field work in that area.

The picture is somewhat better for Wyoming and Colorado.

In Colorado, the Natural Heritage Program biologists feel that enough Potential Conservation Sites and Element Occurrences have been identified to assure that, if properly protected and managed, none of the species being tracked will be lost from the state. For ecological communities, they also feel that they have identified most of the major Sites that represent the variety of habitats that need protection.

In Wyoming, much more work could be done to identify new Element Occurrences, although there are probably not any species missing from the tracking list. As in Colorado, appropriate protection of existing Potential Conservation Sites and Element Occurrences would go a long way towards ensuring the perpetuation of these Elements within the state.

The staff of the Wyoming Natural Diversity Database estimates that they have information on approximately 50-60% of the animal Element Occurrences in the watershed. Plants are more well known. They estimate that the Natural Heritage databases contain approximately 80% of the plant Element Occurrences, and that they have identified just about all of the occurrences of the highest-priority plants.

The main reason that additional Element Occurrences are expected to be found in the Wyoming section of the watershed is that so much of the land is private (especially in riparian areas), and few surveys have been done on private lands. Even now the political climate is not conducive to private land surveys.

For the more common species, the Natural Heritage Programs of Colorado, Kansas, Nebraska, Wyoming, Oklahoma, New Mexico and The Nature Conservancy have just embarked on a program to develop ecoregional plans for biodiversity protection (based upon Bailey's ecoregional provinces). In the meantime, many of the more common species will be protected in the Potential Conservation Sites that we have already identified, especially the larger Sites such as the Western High Plains Mega-site, Laramie Foothills, South Park, South Platte Canyon, West Plum Creek, and the Lower South Platte River.

Assessment of the Project

Phase 1: Locate, compile and evaluate existing data on threatened and endangered species, candidate species, species of concern, critical habitats, essential habitats, and/or Potential Conservation Sites. Rank the Sites according to their global biodiversity significance. Evaluate sources of data according to their usefulness for identifying locations of these elements on the landscape.

There were three major tasks in this phase: 1) locate and compile existing information, 2) design and rank potential conservation sites, and 3) evaluate data sources for usefulness. The usefulness of the data sources is reported elsewhere in this document (see page 6). This section deals exclusively with an assessment of the procedures used.

In the original proposal, 6 months were set aside for this phase. While the time frame was appropriate for collecting and reporting on the usefulness of data sources, it turned out to be somewhat short for mapping all of the new information and getting it into the Natural Heritage databases.

In the South Platte project only one month was budgeted for the assimilation of new Element Occurrence data and the mapping/documentation of Sites because we did not anticipate the very large numbers of new Element Occurrences (702) and Sites (237) that would need to be added. In future applications of this methodology, we recommend setting aside three months for these tasks. It would be especially useful to take the time to host a coordination meeting with other scientists working in the watershed.

In spite of the fact that additional time is needed for this phase, in many cases it will probably not be necessary to substantially increase the funding for this phase (set at $36,900 for the South Platte project). Less resources were required for the collection of data from existing sources that was originally projected, so the balance is nearly the same.

Phase 2: Digitize the information collected in Phase 1, and enter it into The Nature Conservancy's regional GIS systems.

The purpose for this phase was mainly to allow some GIS products to be developed at relatively low cost ($9,700) in the event that the third phase did not get funded. But having this phase in the middle is not necessarily the most efficient way to conduct the entire, three-phase project. Basically, the Element Occurrences are plotted and the Potential Conservation Sites are digitized without being verified in the field. As a consequence, Phase 3 resulted in many minor, yet time-consuming changes to the GIS coverages, plus a significant amount of Natural Heritage staff time for editing digital output. It would be much more effective, from a GIS perspective, to have most of the Element Occurrence and field-verification data in-hand before the final Site-boundaries are digitized.

In the proposals contained later in this document, the Phase 2 is maintained to allow for a phased-approach to watershed biodiversity inventory. However, if a commitment to all three phases can be made early in the project (e.g., before a full-blown Phase 2 is underway), then substantial cost-savings could be realized.

If, however, a full Phase 2 is implemented, its cost will probably exceed that budgeted for the South Platte project. Similar to the situation encountered in Phase 1, the very large number of new Element Occurrences and Sites required more editing than was originally anticipated. In Phase 2, there was no other source of funds to balance the work, and the South Platte goals were met by finding matching funds in other projects (see page 12).

If at all possible, it would also be preferable to use workstation Arc/Info instead of PC Arc/Info. Workstation Arc/Info negates the need to produce three, separate coverages for the three different types of Potential Conservation Sites (Mega-sites, Macro-sites, and Standard Sites). The workstation software allows multiple, overlapping and nested polygons to be combined into one coverage, while still retaining their unique identities. With this capability, the Natural Heritage Programs and the Conservancy could deliver a cleaner final product, and editing of the Site boundaries would be much easier.

Phase 3: Verify and assess data quality by way of on-site evaluation (ground-truthing). Data verification will focus on Element Occurrences and Sites of the highest priority in the watershed as funds permit.

In the South Platte project, this field-verification step was actually split over two summers due to funding constraints. If possible, it would be substantially more efficient to conduct a complete watershed inventory in a single summer, particularly if the watershed is more remote. In fact, most watershed field-verifications will not be as inexpensive as the South Platte because the Colorado Natural Heritage Program's costs were very low due to the location of the Program within the watershed. In the additional proposals included in this document, small increases in the funding for Phase 3 are almost entirely attributable to extra travel costs.

Another note with respect to scheduling, the South Platte project was originally scheduled to end on January 15. This turned out to be impractical because of the holidays. A much better schedule would run through the end of March. Funding resources would not need to be

increased, this simply reflects an effort to realistically judge how much staff-time will be available in the winter months.

There is considerable concern among the Natural Heritage Programs that the EPA will be reluctant to fund additional field-verification work. Populations change over time and monitoring is necessary to ensure data quality and accuracy. Field-verification is simply a form of biological monitoring.

Perhaps the most fascinating thing that we learned from this project was the positive effect of field-verification work on the relationships of the Natural Heritage staff with other data providers. Individuals, agencies and organizations who did not choose to get involved in Phase 1 were willing to participate once they found out that the Natural Heritage biologists were going to do field-work. The best example was the Colorado Division of Wildlife. They provided a little data during Phase 1, and definitely treated the request as a low priority. But when Colorado Natural Heritage staff met with DoW staff to coordinate field work in the South Platte, Division staff were very concerned that Natural Heritage staff not contact landowners with whom the Division had already developed a working relationship. The Division staff volunteered to sample fish sites for virtually all areas that were needed. This gave the Colorado Natural Heritage Program an excellent fish database, with nearly all records verified within the last five years. And it left more resources to be directed towards other Element groups.

Another example occurred with a University of Denver student. The Colorado Natural Heritage Program provided Tom Ryan with 23 historical sampling locations for Preble's meadow jumping mouse (*Zapus hudsonius preblei*). He sampled 11 of the locations, and provided the data to the Natural Heritage program (no mice found). This supplemented the sampling efforts of historical locations in Weld and Larimer counties, and those of Dave Armstrong of the University of Colorado.

Many valuable discoveries came from the field-inventory portion of the project:

- a plant location last documented in 1880 was rediscovered near Georgetown
- two occurrences of the globally rare wetland plant *Spiranthes diluvialis* were verified
- a 1970s record of black swifts, whose nesting habitat is waterfalls, was rediscovered
- 75% of all plant records in Wyoming were field-verified, resulting in great precision and accuracy of the data
- several historical, boreal toad records from the headwaters of Clear Creek were confirmed
- some globally imperiled (G2) ecological community records not documented since the 1970s and 1980s were re-located

Recommendations for Improvement

In our view, there are essentially four areas in which this methodology could be improved when applied to additional watersheds:

Better Coordination with Other Scientists

The effectiveness of Phase 1 (gathering existing information) would be greatly enhanced by a coordination meeting that would bring together scientists with expertise in the watershed. Not only would it increase partners' comfort-level with the project, but the focus could be on identifying those Elements within the watershed that are of greatest concern, e.g., those whose long-term conservation will depend on good stewardship within the watershed being inventoried. Such a priority-setting meeting would help set appropriate targets for field verification, reducing the number of Sites that would need to be visited.

Better Scheduling

Our experience in the South Platte suggests that a watershed field-inventory would best be conducted in a single, summer field season. This would reduce the number of times that the same types of tasks (e.g., editing records in the database, reviewing and editing GIS data) would need to be conducted.

In addition, several tasks should be budgeted to take a little more time. In particular, the data management phases involving designation and review of Potential Conservation Site boundaries. Also, some extra time at the end of the project would ease the crunch during the holidays.

More Efficient use of GIS Technology

As discussed above in the Phase 2 assessment, it would be preferable to conduct the GIS work in workstation Arc/Info, and to postpone the digitizing of the Site boundaries until after the field-verification is complete.

It is also recommended that the GIS lab be located as close as possible to each Natural Heritage Program to streamline Site boundary digitizing and quality checking. Ideally, the GIS would reside within each Natural Heritage Program. With current resources, this will not be an option for many states, but it should be the goal. EPA or other partners in the watershed inventories would be making a great investment by helping Natural Heritage Programs to achieve GIS sufficiency. Much time and energy was spent shipping multiple revisions of the digitized data between offices.

Database Structure Development

The original plan for the South Platte involved using dBase file structures as the relational database for the bulk of the data. A substantial amount of effort was devoted to developing file structures on that platform before the decision was made to switch to ASCII tables, which were significantly more versatile for incorporation of lengthy text and complex file relationships. In future applications of this methodology, the database transfer and export templates for the ASCII structures will already exist, resulting in several thousand dollars of cost savings.

Proposals for Continued Progress in Watershed Inventory

The following proposals were developed by The Nature Conservancy's Western Regional Office, in consultation with the Natural Heritage Programs that contain the watersheds described:

Upper Colorado River

A Survey of Biological Resources including Federally Listed Threatened and Endangered Species, Species of Concern, and Potential Conservation Sites in the Upper Colorado River Watershed: A Cooperative Project Among The Nature Conservancy, the USDA Forest Service, and the Environmental Protection Agency.

Project Description:

The Colorado Natural Heritage Program, Wyoming Natural Diversity Database, Utah Natural Heritage Program and TNC's Western Regional Office, working with EPA, 3 National Forests[6], and Mesa County, CO, will catalogue occurrences of threatened and endangered species, candidate species, species of concern, and ecological communities in the Upper Colorado River Watershed. They will use rarity as the criteria for assessing biological diversity of the watershed. This survey will build on EPA's Watershed Protection Approach using The Nature Conservancy's extensive biological database, and using the information and expertise of the USDA Forest Service, and Colorado Division of Wildlife. Information on populations of wetland, riparian, aquatic, and terrestrial species of special concern will be assembled from existing sources and used to determine species occurrences and potential conservation sites within the Upper Colorado River Watershed, using standard Natural Heritage methodology. Known threats to the sites will be reported. Cooperative research efforts with local communities will be sought, such as those negotiated with Boulder and Larimer Counties in the South Platte watershed.

The resulting maps, GIS data sets and report will serve as an important information resource for Agency managers whose decisions may potentially affect critical biological resources and will complement EPA's community-based, ecosystem management projects. In addition, the project outputs will benefit the resource conservation programs of numerous other organizations including: USFWS listed species protection programs, Forest Service sensitive species program, the Western Governors' Assoc. Great Plains Initiative, The Nature Conservancy's bioreserve and natural heritage inventory programs, and current Gap Analysis efforts. This project is one element of EPA Region VIII's Watershed Inventory and community-based protection strategy, following closely on the heels of the highly successful South Platte Watershed Survey. This critical biological resources information will fill an important knowledge gap in the EPA Inventory. EPA's Regional Watershed Inventory will bring together, in one place, sufficient information to allow a structured approach to geographic

[6]Routt NF, White River NF and Medicine Bow NF

targeting of resource protection efforts by EPA and its partners working on ecological resource management. An additional benefit of the EPA Regional Inventory is that it will provide an overall assessment of the current condition of the Regional water resources, including habitat information, and a description of the stressors which pose a threat to those water resources. Lessons learned from the South Platte Survey project will be applied to the EPA Regional Inventory of the Upper Colorado River, improving the quality of the product the efficiency of the database development.

Geographic Focus:

The Upper Colorado River Watershed from its headwaters near the continental divide in north-central Colorado and south-central Wyoming to its confluence with the White River in northeastern Utah. The study area includes the Yampa River drainage which is typically considered to be part of the Upper Colorado watershed.

Ecological Focus:

- Occurrences of federally listed threatened or endangered species;
- Occurrences of federal candidate species;
- Occurrences of species of concern to the states and National Forests;
- Occurrences of ecological communities;
- Locations and boundaries of potential conservation sites;
- Ranking of biodiversity by global and statewide significance

Project Implementation:

The project will be funded by EPA and implemented jointly by the Western Regional Office of The Nature Conservancy, the Colorado Natural Heritage Program, the Wyoming Natural Diversity Database, and the Utah Natural Heritage Program. As appropriate, partnerships will be negotiated with other agencies and local governments.

Project Work Plan:

Phase 1: Locate, compile, and evaluate existing data on threatened and endangered species, candidate species, species of concern, ecological communities, and conservation sites. Rank potential conservation sites according to their global biodiversity significance. Evaluate sources of data according to their usefulness for identifying locations of these elements on the landscape.

Phase 1 Cost: $43,000

Schedule: 8/1/96 - 6/16/97

Tasks	Completion Date
1. Compile preliminary list of contacts for existing data (federal, state, local agencies, museums, herbaria, universities)	9/11/96
2. Collect existing Element information and add to the list of contacts as needed.	1/31/97
3. Assimilate any new Element data into the state BCDs, including latitude and longitude data.	2/21/97
4. Host a coordination meeting for scientists	2/28/97
5. Map the boundaries of the sites on 1:100,000 scale maps	4/25/97
6. Create and update Site Basic Records for the most biologically significant conservation sites.	5/30/97
7. Report on the usefulness of the data sources contacted, including sources contacted that did not have useful data.	6/16/97

Deliverables: BCD data (EORs, SBRs, SAs); mapped Sites; list of data sources and contacts; usefulness report.

Phase 2: Digitize information and enter it into TNC's Regional GIS systems.

Phase 2 Cost: $12,700

Schedule: 3/3/97 - 10/17/97

Tasks	Completion Date
1. Combine data from the three states into a single, preliminary, temporary BCD data set.	3/3/97
2. Import preliminary Element information into the WCS GIS using latitude and longitude for points.	3/10/97
3. Create Element Occurrence GIS overlays. Distribute overlays to Natural Heritage Programs to help them design Site boundaries.	3/21/97
4. Digitize the conservation sites	5/23/97
5. Produce draft maps containing the Element and Site data and additional data layers for reference.	5/30/97
6. Quality control draft maps at the Natural Heritage Programs.	7/30/97
7. Produce maps and GIS files for the Upper Colorado watershed, in formats useful to EPA Region VIII. Suggest appropriate formats for using the data.	9/30/97
8. Report on challenges encountered while implementing the GIS portion of this pilot project.	10/17/97

Deliverables: Digitized GIS database; maps; analysis of problems encountered in implementing this pilot project; suggested approaches to "user friendly" application of the information.

Phase 3: Verify and assess data quality by way of on-site evaluation (ground-truthing). Data verification will focus on element occurrences and sites of the highest priority in the watershed, including the Great Plains Initiative landscape conservation site and areas of potential impact from the New World Mine.

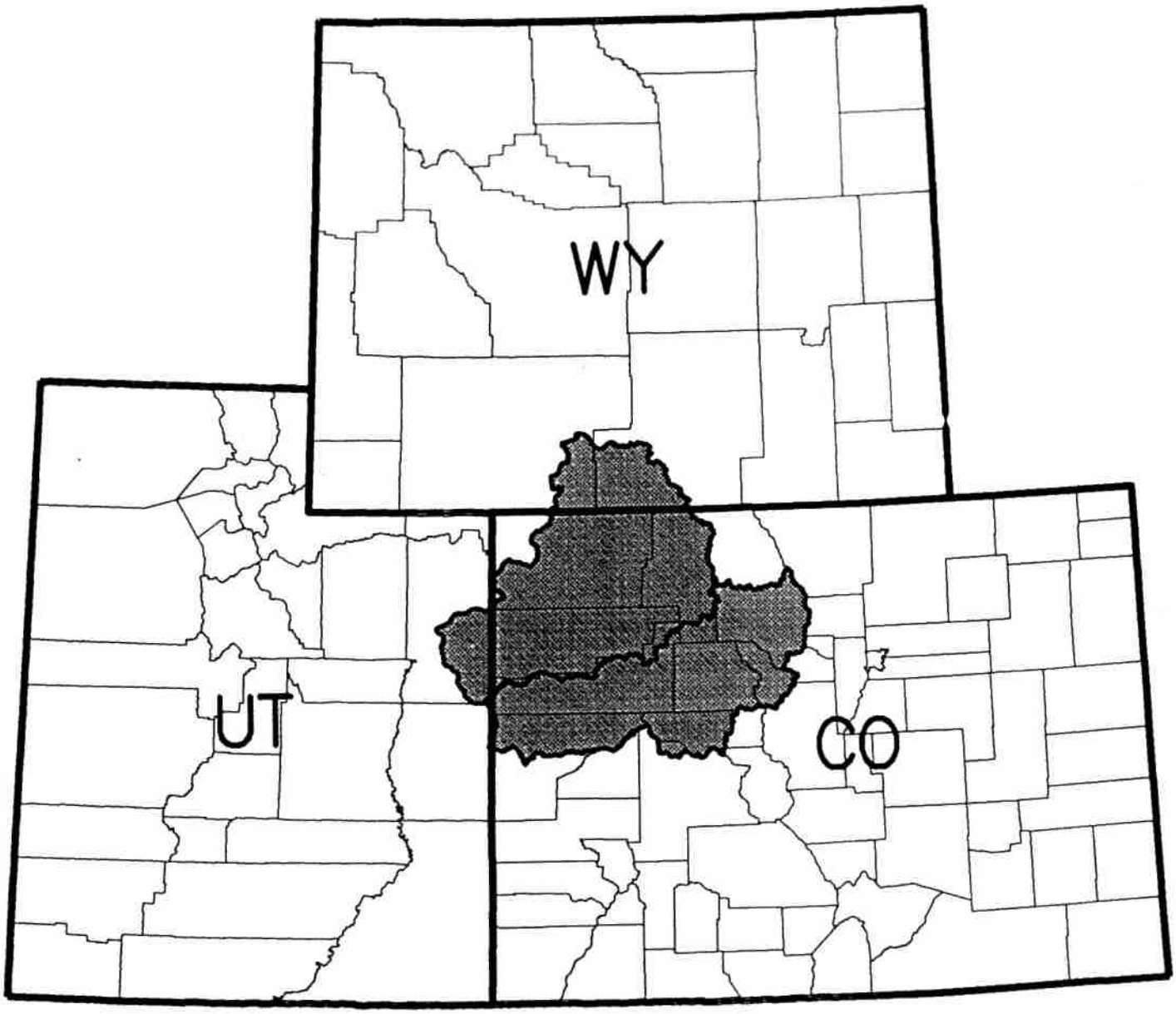
Phase 3 Cost: $131,000

Schedule: 5/1/97 - 4/30/98

Tasks	Completion Date
1. Field work--ground-truthing of highest priority data and Landscape Conservation Sites as funds permit.	9/30/97
2. Enter the new Element Occurrence information from the field work into the BCD.	12/1/97
3. Produce draft GIS maps. Include the old Site boundaries and new/revised Element data (from field work).	1/16/98
4. Revise the Site boundaries as needed, using the draft maps.	2/16/98
5. Revise the Site Basic Records as needed.	2/16/98
6. Digitize the revised site boundaries and produce draft maps for quality control of revised Sites.	3/6/98
7. Quality control the draft maps at the Natural Heritage programs.	3/20/98
8. Produce the final GIS files, databases and hardcopy maps.	4/10/98
9. Report on the verification process, assessing the accuracy and precision of the existing databases.	4/30/98
10. Make recommendations for minimizing the costs of data verification in future applications of this protocol.	4/30/98

Deliverables: Verified database; report explaining the verification process, assessing the accuracy and precision of the existing databases for the Upper Colorado River Watershed, and making recommendations for minimizing the cost of data verification in future applications of this protocol.

Total Cost Phases 1 - 3: $186,700



Upper Colorado River Watershed
USGS Catalog #140100; 9,840 mi²
Yampa River Watershed
USGS Catalog #140500; 13,200 mi²

Upper Arkansas River

A Survey of Biological Resources including Federally Listed Threatened and Endangered Species, Species of Concern, and Potential Conservation Sites in the Upper Arkansas River Watershed: A Cooperative Project Among The Nature Conservancy, the USDA Forest Service, and the Environmental Protection Agency.

Project Description:

The Colorado Natural Heritage Program and TNC's Western Regional Office, working with EPA, San Isabel National Forest and the local governments of Pueblo and Colorado Springs, will catalogue occurrences of threatened and endangered species, candidate species, species of concern, and ecological communities in the Upper Arkansas River Watershed. They will use rarity as the criteria for assessing biological diversity of the watershed. This survey will build on EPA's Watershed Protection Approach using The Nature Conservancy's extensive biological database, and using the information and expertise of the USDA Forest Service and Colorado Division of Wildlife. Information on populations of wetland, riparian, aquatic, and terrestrial species of special concern will be assembled from existing sources and used to determine species occurrences and potential conservation sites within the Upper Arkansas River Watershed, using standard Natural Heritage methodology. Known threats to the sites will be reported. Cooperative research efforts with local communities will be sought, such as those negotiated with Boulder and Larimer Counties in the South Platte watershed project.

The resulting maps, GIS data sets and report will serve as an important information resource for Agency managers whose decisions may potentially affect critical biological resources and will complement EPA's community-based, ecosystem management projects. In addition, the project outputs will benefit the resource conservation programs of numerous other organizations including: USFWS listed species protection programs, Forest Service sensitive species program, the Western Governors' Assoc. Great Plains Initiative, The Nature Conservancy's bioreserve and natural heritage inventory programs, and current Gap Analysis efforts. This project is one element of EPA Region VIII's Watershed Inventory and community-based protection strategy, following closely on the heels of the highly successful South Platte Watershed Survey. This critical biological resources information will fill an important knowledge gap in the EPA Inventory. EPA's Regional Watershed Inventory will bring together, in one place, sufficient information to allow a structured approach to geographic targeting of resource protection efforts by EPA and its partners working on ecological resource management. An additional benefit of the EPA Regional Inventory is that it will provide an overall assessment of the current condition of the Regional water resources, including habitat information, and a description of the stressors which pose a threat to those water resources. Lessons learned from the South Platte Survey project will be applied to the EPA Regional Inventory of the Upper Arkansas River, improving the quality of the product the efficiency of the database development.

Geographic Focus:

The Upper Arkansas River Watershed from its headwaters near the continental divide in central Colorado to the Kansas and New Mexico borders.

Ecological Focus:

- Occurrences of federally listed threatened or endangered species;
- Occurrences of federal candidate species;
- Occurrences of species of concern to the states and National Forests;
- Occurrences of ecological communities;
- Locations and boundaries of potential conservation sites;
- Ranking of biodiversity by global and statewide significance

Project Implementation:

The project will be funded by EPA and implemented jointly by the Western Regional Office of The Nature Conservancy and the Colorado Natural Heritage Program. As appropriate, partnerships will be negotiated with other agencies and local governments.

Project Work Plan:

Phase 1: Locate, compile, and evaluate existing data on threatened and endangered species, candidate species, species of concern, ecological communities, and conservation sites. Rank potential conservation sites according to their global biodiversity significance. Evaluate sources of data according to their usefulness for identifying locations of these elements on the landscape.

Phase 1 Cost: $36,800

Schedule: 8/1/96 - 6/16/97

Tasks	Completion Date
1. Compile preliminary list of contacts for existing data (federal, state, local agencies, museums, herbaria, universities)	9/11/96
2. Collect existing Element information and add to the list of contacts as needed.	1/31/97
3. Assimilate any new Element data into the state BCDs, including latitude and longitude data.	2/21/97
4. Map boundaries of the sites at 1:100,000 scale	4/25/97
5. Create and update Site Basic Records for the most biologically significant conservation sites.	5/30/97

Tasks	Completion Date
6. Report on the usefulness of the data sources contacted, including sources contacted that did not have useful data.	6/16/97

Deliverables: BCD data (EORs, SBRs, SAs); mapped Sites; list of data sources and contacts; usefulness report.

Phase 2: Digitize information and enter it into TNC's Regional GIS systems.

Phase 2 Cost: $12,700

Schedule: 3/3/97 - 10/17/97

Tasks	Completion Date
1. Import preliminary Element information into the WCS GIS using latitude and longitude for points.	3/10/97
2. Create Element Occurrence GIS overlays. Distribute overlays to Natural Heritage Programs to help them design Site boundaries.	3/21/97
3. Digitize the conservation sites	5/23/97
4. Produce draft maps containing the Element and Site data and additional data layers for reference.	5/30/97
5. Quality control draft maps at the Natural Heritage Programs.	7/30/97
6. Produce maps and GIS files for the Upper Arkansas watershed, in formats useful to EPA Region VIII. Suggest appropriate formats for using the data.	9/30/97
7. Report on challenges encountered while implementing the GIS portion of this pilot project.	10/17/97

Deliverables: Digitized GIS database; maps; analysis of problems encountered in implementing this pilot project; suggested approaches to "user friendly" application of the information.

Phase 3: Verify and assess data quality by way of on-site evaluation (ground-truthing). Data verification will focus on element occurrences and sites of the highest priority in the watershed, including the Great Plains Initiative landscape conservation site and areas of potential impact from the New World Mine.

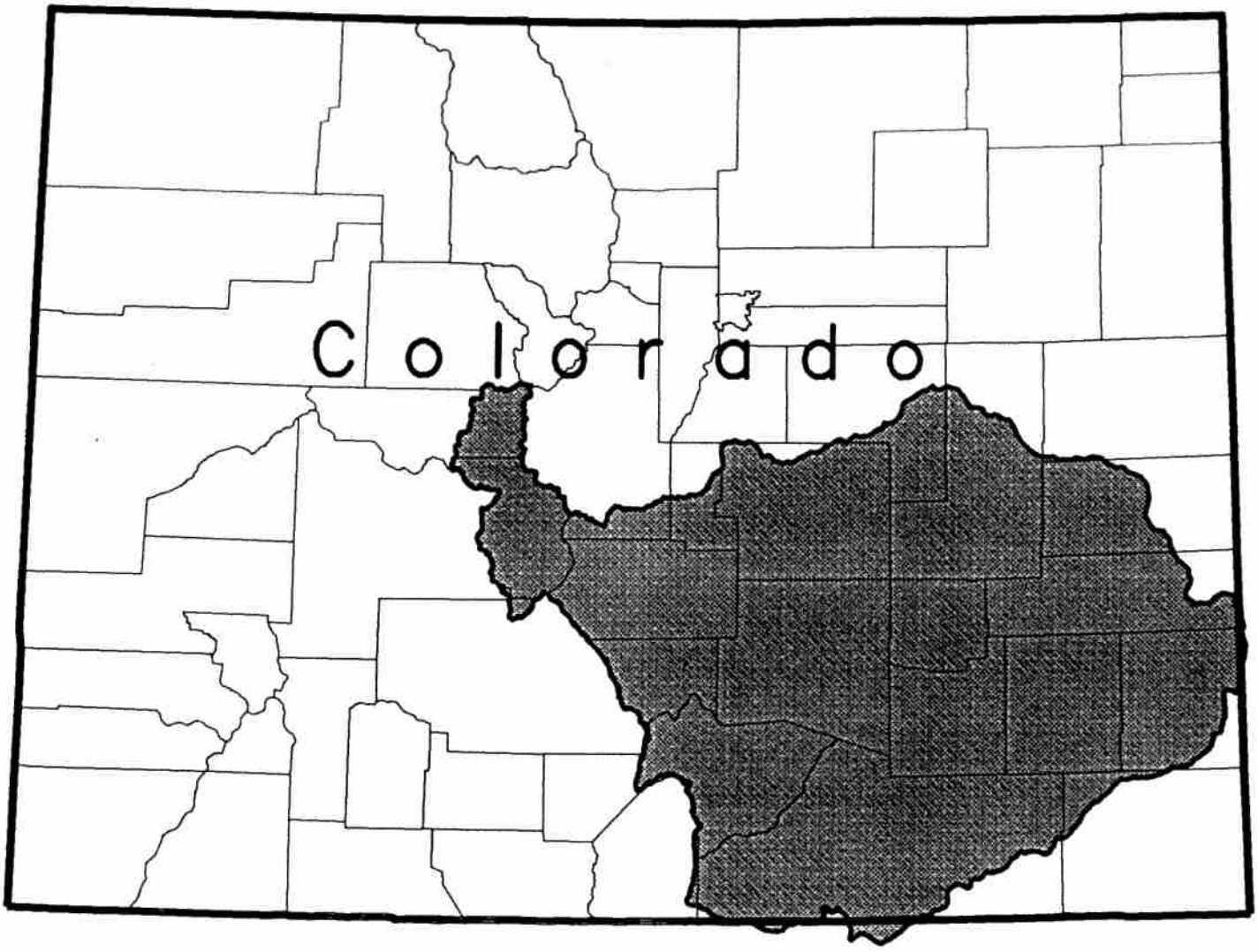
Phase 3 Cost: $121,600

Schedule: 5/1/97 - 4/30/98

Tasks	Completion Date
1. Field work--ground-truthing of highest priority data and Landscape Conservation Sites as funds permit.	9/30/97
2. Enter the new Element Occurrence information from the field work into the BCD.	12/1/97
3. Produce draft GIS maps. Include the old Site boundaries and new/revised Element data (from field work).	1/16/98
4. Revise the Site boundaries as needed, using the draft maps.	2/16/98
5. Revise the Site Basic Records as needed.	2/16/98
6. Digitize the revised site boundaries and produce draft maps for quality control of revised Sites.	3/6/98
7. Quality control the draft maps at the Natural Heritage programs.	3/20/98
8. Produce the final GIS files, databases and hardcopy maps.	4/10/98
9. Report on the verification process, assessing the accuracy and precision of the existing databases.	4/30/98
10. Make recommendations for minimizing the costs of data verification in future applications of this protocol.	4/30/98

Deliverables: Verified database; report explaining the verification process, assessing the accuracy and precision of the existing databases for the Upper Arkansas River, and making recommendations for minimizing the cost of data verification in future applications of this protocol.

Total Cost Phases 1 - 3: $171,100



Upper Arkansas River Watershed
USGS Catalog #110200; 24,900 mi²

Upper Yellowstone River

A Survey of Biological Resources including Federally Listed Threatened and Endangered Species, Species of Concern, and Potential Conservation Sites in the Upper Yellowstone River Watershed: A Cooperative Project Among The Nature Conservancy, the USDA Forest Service, the National Park Service and the Environmental Protection Agency.

Project Description:

The Montana Natural Heritage Program, Wyoming Natural Diversity Database and TNC's Western Regional Office, working with EPA, Yellowstone National Park and 5 National Forests[7] will catalogue occurrences of threatened and endangered species, candidate species, species of concern, and ecological communities in the Upper Yellowstone River Watershed. They will use rarity as the criteria for assessing biological diversity of the watershed. This survey will build on EPA's Watershed Protection Approach using The Nature Conservancy's extensive biological database, and using the information and expertise of the USDA Forest Service and National Park Service. Information on populations of wetland, riparian, aquatic, and terrestrial species of special concern will be assembled from existing sources and used to determine species occurrences and potential conservation sites within the Upper Yellowstone River Watershed, using standard Natural Heritage methodology. Known threats to the sites will be reported. Cooperative research efforts with local communities will be sought, such as those negotiated with Boulder and Larimer Counties in the South Platte watershed.

The resulting maps, GIS data sets and report will serve as an important information resource for Agency managers whose decisions may potentially affect critical biological resources and will complement EPA's community-based, ecosystem management projects. In addition, the project outputs will benefit the resource conservation programs of numerous other organizations including: USFWS listed species protection programs, National Park Service species protection programs, Forest Service sensitive species program, the Western Governors' Assoc. Great Plains Initiative, The Nature Conservancy's bioreserve and natural heritage inventory programs, and current Gap Analysis efforts. This project is one element of EPA Region VIII's Watershed Inventory and community-based protection strategy, following closely on the heels of the highly successful South Platte Watershed Survey. This critical biological resources information will fill an important knowledge gap in the EPA Inventory. EPA's Regional Watershed Inventory will bring together, in one place, sufficient information to allow a structured approach to geographic targeting of resource protection efforts by EPA and its partners working on ecological resource management. An additional benefit of the EPA Regional Inventory is that it will provide an overall assessment of the current condition of the Regional water resources, including habitat information, and a description of the stressors which pose a threat to those water resources. Lessons learned from the South Platte Survey project will be applied to the EPA Regional Inventory of the Upper Yellowstone River, improving the quality of the product the efficiency of the database development.

[7]Bridger-Teton NF, Shoshone NF, Custer NF, Gallatin NF, and Lewis and Clark NF

Geographic Focus:

The Upper Yellowstone River Watershed from its headwaters near the continental divide in Yellowstone National Park to its confluence with the Bighorn River northeast of Billings, Montana (near the border of Yellowstone and Treasure Counties). The study area includes the Clark's Fork of the Yellowstone River and the upstream section of the Upper Missouri/ Yellowstone Landscape Conservation Area (LCA) of the Great Plains Initiative.

Ecological Focus:

- Occurrences of federally listed threatened or endangered species;
- Occurrences of federal candidate species;
- Occurrences of species of concern to the states and National Forests;
- Occurrences of ecological communities;
- Locations and boundaries of potential conservation sites;
- Ranking of biodiversity by global and statewide significance

Project Implementation:

The project will be funded by EPA and implemented jointly by the Western Regional Office of The Nature Conservancy, the Montana Natural Heritage Program and Wyoming Natural Diversity Database. As appropriate, partnerships will be negotiated with other agencies and local governments.

Project Work Plan:

Phase 1: Locate, compile, and evaluate existing data on threatened and endangered species, candidate species, species of concern, ecological communities, and conservation sites. Rank potential conservation sites according to their global biodiversity significance. Evaluate sources of data according to their usefulness for identifying locations of these elements on the landscape.

Total Cost: $36,800

Schedule: 8/1/96 - 6/16/97

Tasks	Completion Date
1. Compile preliminary list of contacts for existing data (federal, state, local agencies, museums, herbaria, universities)	9/11/96
2. Collect existing Element information and add to the list of contacts as needed.	1/31/97
3. Assimilate any new Element data into the state BCDs, including latitude and longitude data.	2/21/97

Tasks	Completion Date
4. Map the boundaries of the sites on 1:100,000 scale maps.	4/25/97
5. Create and update Site Basic Records for the most biologically significant conservation sites.	5/30/97
6. Report on the usefulness of the data sources contacted, including sources contacted that did not have useful data.	6/16/97

Deliverables: BCD data (EORs, SBRs, SAs); mapped Sites; list of data sources and contacts; usefulness report.

Phase 2: Digitize information and enter it into TNC's Regional GIS systems.

Total Cost: $13,600

Schedule: 3/3/97 - 10/17/97

Tasks	Completion Date
1. Combine data from the two states into a single, preliminary, temporary BCD data set.	3/3/97
2. Import preliminary Element information into the WCS GIS using latitude and longitude for points.	3/10/97
3. Create Element Occurrence GIS overlays. Distribute overlays to Natural Heritage Programs to help them design Site boundaries.	3/21/97
4. Digitize the conservation sites	5/23/97
5. Produce draft maps containing the Element and Site data and additional data layers for reference.	5/30/97
6. Quality control draft maps at the Natural Heritage Programs.	7/30/97
7. Produce maps and GIS files for the Upper Yellowstone watershed, in formats useful to EPA Region VIII. Suggest appropriate formats for using the data.	9/30/97
8. Report on challenges encountered while implementing the GIS portion of this pilot project.	10/17/97

Deliverables: Digitized GIS database; maps; analysis of problems encountered in implementing this pilot project; suggested approaches to "user friendly" application of the information.

Phase 3: Verify and assess data quality by way of on-site evaluation (ground-truthing). Data verification will focus on element occurrences and sites of the highest priority in the watershed, including the Great Plains Initiative landscape conservation site and areas of potential impact from the New World Mine.

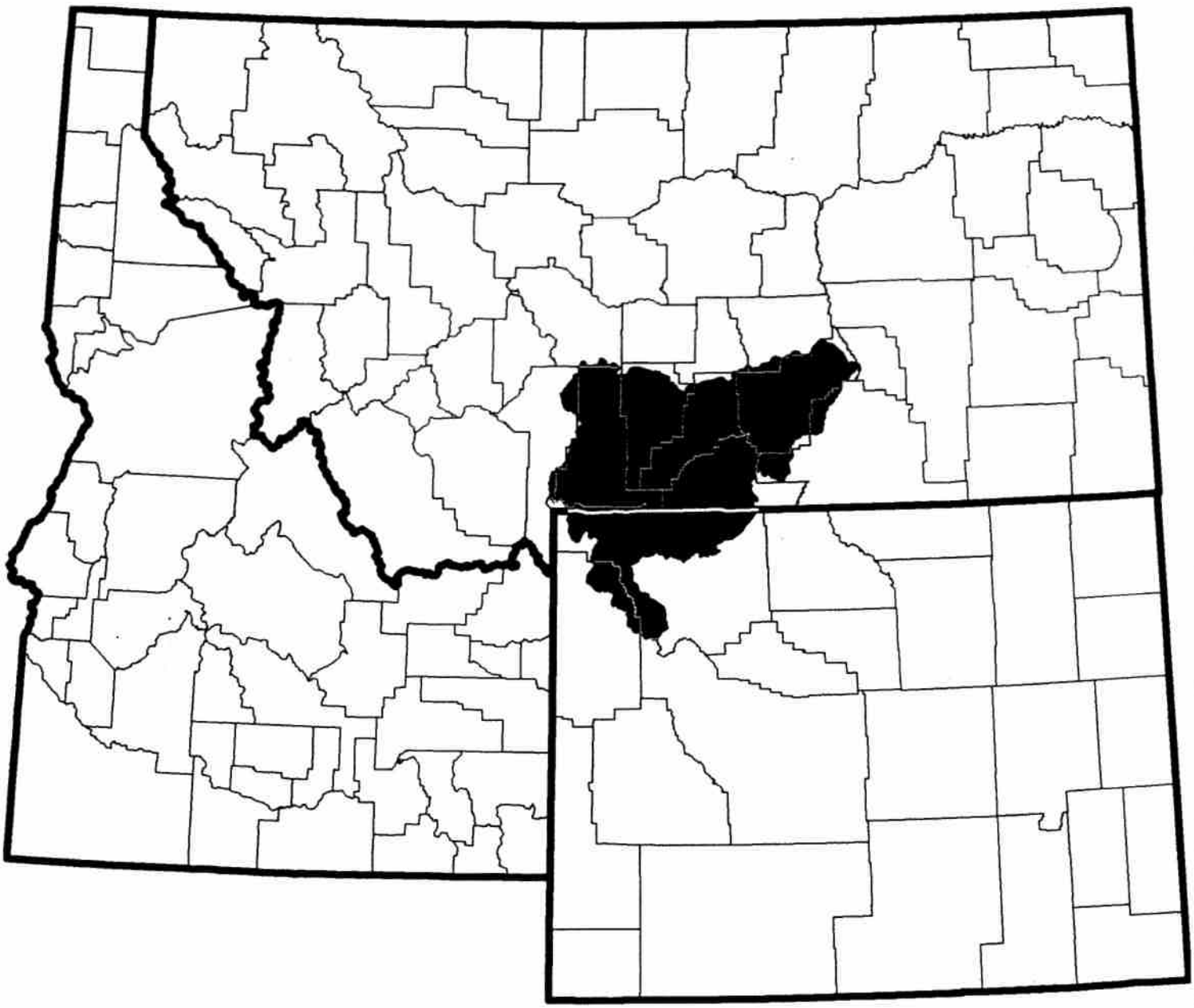
Total Cost: $102,000

Schedule: 5/1/97 - 4/30/98

Tasks	Completion Date
1. Field work--ground-truthing of highest priority data and Landscape Conservation Sites as funds permit.	9/30/97
2. Enter the new Element Occurrence information from the field work into the BCD.	12/1/97
3. Produce draft GIS maps. Include the old Site boundaries and new/revised Element data (from field work).	1/16/98
4. Revise the Site boundaries as needed, using the draft maps.	2/16/98
5. Revise the Site Basic Records as needed.	2/16/98
6. Digitize the revised site boundaries and produce draft maps for quality control of revised Sites.	3/6/98
7. Quality control the draft maps at the Natural Heritage programs.	3/20/98
8. Produce the final GIS files, databases and hardcopy maps.	4/10/98
9. Report on the verification process, assessing the accuracy and precision of the existing databases.	4/30/98
10. Make recommendations for minimizing the costs of data verification in future applications of this protocol.	4/30/98

Deliverables: Verified database; report explaining the verification process, assessing the accuracy and precision of the existing databases for the Upper Yellowstone River Watershed, and making recommendations for minimizing the cost of data verification in future applications of this protocol.

Total Cost Phases 1 - 3: $152,400



Upper Yellowstone River Watershed

USGS Catalog #100700, 14,420 mi²

Additional Investment in the South Platte River

Critical Biological Resources of the South Platte Ecosystem

(Proposal prepared October 17, 1996)

Community-based ecosystem management begins with the concerns and passions of local citizens. But planning and management require current and accurate data sources to inform decision-makers and lead to wise management of resources. Over the last two years, many cooperators in the South Platte watershed of Colorado, Wyoming and Nebraska have contributed to the building of an outstanding information resource on the critical biological elements of the ecosystem. The partners have included:

- Denver Water Board
- The Nature Conservancy
- Larimer County, CO
- Boulder County, CO
- Nebraska Game and Parks Commission
- Colorado Division of Wildlife
- Local landowners
- USDA Forest Service

The Colorado Natural Heritage Program, Wyoming Natural Diversity Database, and TNC's Western Regional Office, working in cooperation with EPA, will update the South Platte Inventory of Critical Biological Resources. At an ecosystem scale, this database catalogues occurrences of threatened and endangered species, candidate species, species of concern, and ecological communities in the South Platte River Watershed. Information collected through other projects for wetland, riparian, aquatic, and terrestrial species of special concern will be assembled and the databases will be revised as needed. Potential conservation sites within the watershed will have their boundaries reviewed and revised according to standard Natural Heritage methodology. All of the updated information will be made available to cooperating agency, local, industry and non-profit partners.

Unless the databases are updated regularly, they will become obsolete. While the original South Platte Watershed database is remarkably complete, it will be important to update it annually because over time:

- data about the critical biological resources will change based upon new field studies and human-use of the watershed
- potential conservation site boundaries will change based upon new species data and or better knowledge of species ecological needs
- new occurrences of species and ecological communities will be discovered
- some occurrences of species and ecological communities will undoubtedly be extirpated
- some species and ecological communities will be found to be more common than previously known, and thus will drop off of the tracking list

If funded, this project will ensure that permitting, management, and conservation planning are conducted using current and accurate data that will lead to the desired outcomes, and will result in good decision-making. The federal, state, local, non-profit and industry groups of the South Platte Forum, and all of the stakeholders in the South Platte Watershed, must have access to reliable information when planning and negotiating the future uses of the watershed resources.

Geographic Focus:
The South Platte River Watershed from its headwaters near the continental divide in Colorado to its confluence with the Platte River near North Platte, Nebraska.

Deliverables: BCD data in ASCII tables; updated site boundaries; report on changes to the database.
Schedule: 1/1/97 - 3/31/97

Total Cost: $25,000 (Including 19.4% federally-approved overhead)

Critical Biological Resources of the South Platte Ecosystem - Identification of Species and Ecological Communities of Outstanding Significance

(Proposal prepared October 17, 1996)

Community-based ecosystem management begins with the concerns and passions of local citizens. But planning and management require current and accurate data sources to inform decision-makers and lead to wise management of resources. Over the last two years, many cooperators in the South Platte watershed of Colorado, Wyoming and Nebraska have contributed to the building of an outstanding information resource on the critical biological elements of the ecosystem. The partners have included:

- Denver Water Board
- The Nature Conservancy
- Larimer County, CO
- Boulder County, CO
- Nebraska Game and Parks Commission
- Colorado Division of Wildlife
- Local landowners
- USDA Forest Service

The Colorado Natural Heritage Program, Wyoming Natural Diversity Database, Nebraska Natural Heritage Program and TNC's Western Regional Office, propose to host a meeting within the watershed to address the question of which species and ecological communities pose the most outstanding conservation opportunities within the South Platte watershed. Of the 395 species and ecological communities included in the original South Platte Inventory, 104 (26%) are of global conservation significance.[8] The remaining species are being tracked by the state Natural Heritage Programs for a variety of reasons including state rarity or conservation concern and state or federal listing status.

Which of the remaining 291 species present the greatest opportunities for conservation within the South Platte Watershed, as opposed to those that may best be preserved elsewhere? For example, a species may reach the edge of its range within the South Platte watershed. Are the occurrences of this species, which may not be robust, of the same conservation priority as a species which has its most viable and vigorous populations within the watershed?

To address these questions, the proposed 1-day meeting will bring together regional scientific experts, EPA, and other stakeholders from the South Platte Forum to specifically identify those species whose greatest need for conservation action occurs within the South Platte watershed. The species identified at this meeting will be marked in the South Platte biological resources database as having a higher conservation priority within the watershed.

Geographic Focus:
The South Platte Watershed from its headwaters near the continental divide in Colorado to its confluence with the Platte River near North Platte, Nebraska.

Deliverables: List of species of outstanding biological significance to ecosystem management in the South Platte watershed

Total Cost: $14,000 (Includes a $3,000 travel support fund to ensure a wide range of participants, and 19.4% federally-approved overhead.)

Schedule: 9/1/96 - 11/30/96

[8]These species are ranked according to the Natural Heritage methodology as having a global rarity rank of G1, G2, G3, or equivalent.

Appendix 1: Methods

Phase 1:

1. Natural Heritage staff compiled preliminary lists of contacts, for existing data (federal, state, local agencies, museums, herbaria, universities, etc.), based upon known contacts.
2. Natural Heritage staff collected existing Element Occurrence information from the sources identified in step 1, and added to the list of contacts as needed, based upon leads provided by earlier contacts.
3. Natural Heritage staff assimilated the new Element Occurrence data into the state Natural Heritage databases, including latitude and longitude data where available.
4. Natural Heritage biologists mapped the boundaries of the Potential Conservation Sites on 7.5 minute 1:24,000, USGS topographic maps on which known Element Occurrences had already been mapped. These boundaries were then transferred to 30 x 60 minute 1:100,000 laminated maps. (Maps were laminated to increase durability, allow for easier corrections to boundaries, and to provide a more stable medium for digitizing in Phase 2.)
5. Natural Heritage staff created and updated Site Basic Records for the most biologically significant Potential Conservation Sites in the state Natural Heritage databases.
6. All parties reported on the usefulness of the data sources contacted, including sources contacted that did not have useful data.

Phase 2:

1. TNC staff combined the data from the three states into a single, temporary BCD data set.
2. TNC staff generated an Element Occurrence GIS coverage by exporting the unique ELCODE, precision, latitude and longitude field values for each record from the temporary BCD data set into dBase III+. A point coverage was generated from the dBase III+ file in PC Arc/Info.
3. TNC staff created Element Occurrence GIS overlays, and distributed the overlays to the Natural Heritage Programs to help them design Site boundaries.
4. TNC staff digitized the Potential Conservation Sites using 30 x 60 minute, 1:100,000 scale, USGS topographic maps, using UTM Zone 13 map projection and meters for map units.
   - Smaller Sites often occur within larger Sites. PC Arc/Info interprets these nested Sites as exclusive "islands" within larger polygons (i.e., the larger area has a hole where the smaller Site is located). Therefore, in order to ensure that larger Sites would retain the area also occupied by smaller "nested" Sites, it was necessary to develop 3 different coverages for the three types of Sites (Standard Sites, Macro-sites and Mega-sites).
   - Once a Site was digitized, its unique SITECODE was added to enable it to be linked to additional information in the ASCII data tables.
5. TNC staff produced draft maps containing the Element and Site data and additional data layers for reference. The draft maps were plotted on 1:100,000 scale vellum. Sites were identified on the plots by SITECODE, and Element Occurrences were labeled by EOCODE. Precision values for the individual occurrences were represented by plot symbols.

6. Natural Heritage biologists quality checked the draft maps at the Natural Heritage Programs by placing the draft, vellum maps over the original 1:100,000 Site design maps.
7. TNC staff edited the GIS data layers, and produced maps and GIS files for the South Platte watershed, in formats useful to EPA Region VIII. Initially we thought that this would be a dBase format, but after evaluation of the databases by EPA, we switched to related ASCII tables.

Phase 3: (Including field verification of data throughout the watershed, over two summers)

1. Natural Heritage biologists conducted field work (e.g., ground-truthing) of highest priority data and Potential Conservation Sites as funds permitted. Approximately 50% of the Sites were visited. Priority was given to occurrences of rare or imperiled animals, plants and ecological communities, particularly those dependent on aquatic, wetland or riparian habitats. Priority was also given to occurrences not seen within the past five years.

Attempts to gain landowner permission were aimed at the priority areas. Colorado Natural heritage Program reports a 95% response rate, which is considered excellent. Of those who responded, 50% provided permission for access. The response and access rate for landowner contacts in Nebraska were even higher. We attribute this to the fact that Nebraska landowners were contacted by telephone. Occasionally, a landowner refused access because the project was funded in-part by the EPA. In a few cases, Natural Heritage staff were allowed to survey the property, but agreed not to include the results in the database. All landowners did appreciate Natural Heritage staff approaching them to ask for permission, and respecting their response whether positive or negative.

2. Natural Heritage staff entered the new Element Occurrence information from the field work into the state Natural Heritage Databases.
3. TNC staff imported the new Element Occurrence information into the temporary, regional BCD data set.
4. TNC staff produced draft GIS maps, including the old boundaries and new/revised Element data.
5. Natural Heritage staff revised the Site boundaries as needed, using the draft maps.
6. Natural Heritage staff revised the Site data as needed in the Natural Heritage databases.
7. TNC staff digitized the revised Site boundaries and produced draft maps for quality control of revised Sites.

Many new Sites were identified, and some Site boundaries were changed or deleted based on the new information. Several stages of checking and editing the Site boundaries were needed before the final data sets were available.

8. Natural Heritage staff quality checked the second-draft maps at the Natural Heritage programs.
9. TNC staff produced the final GIS files, databases and hardcopy maps.
10. All programs reported on the verification process, assessing the accuracy and precision of the existing databases, and made recommendations for improving the efficiency of this protocol in future applications.

Appendix 2: ASCII Tables (Files and Fields)

Database Fields for Element Occurrences

The following data fields comprise the structure of the ASCII files provided with the South Platte GIS coverages. The data were supplied on April 18, 1996, by the Colorado Natural Heritage Program, the Wyoming Natural Diversity Database, and the Nebraska Natural Heritage Program, in cooperation with The Nature Conservancy.

EOCODE (Element Occurrence Code)	17-digit, alpha-numeric, code unique to the Element Occurrence. It contains three parts, separated by an asterisk (*): Element Code: 10-digit code unique to the species or ecological community Element Occurrence number: 3-digit number identifying the specific occurrence State: US Postal Service state code
ELCLASS (Element Class)	The type of Element: fish, amphibian, reptile, bird, mammal, invertebrate, plant, or ecological community.
WATER (Water-dependent Status)	All species and ecological communities were assigned one of two values: Water-dependent or Upland. For species, water-dependence was defined to include all wetland species plus animals that depend on aquatic food sources (e.g., bald eagles that eat fish). For ecological communities, both wetland and riparian communities are considered water-dependent.
GRANK (Global Rank)	A rank assigned by The Nature Conservancy in cooperation with the Natural Heritage Programs characterizing the relative rarity or endangerment of the Element worldwide. Brief definitions are provided below. For a detailed explanation, see Attachment 1: G# = Numeric Rank G1 = Critically imperiled globally (typically 5 or fewer occurrences) G2 = Imperiled globally (typically 6 to 20 occurrences) G3 = Rare or uncommon (typically 21 to 100 occurrences) G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern (usually more than 100 occurrences) G5 = Demonstrably widespread, abundant, and secure G#G# = Numeric range rank G? = Unranked, usually because not all available data have been processed GU = Unrankable, usually for lack of sufficient data GH = Historical GX = Extinct HYB = Hybrid T# = Subrank for taxonomic subdivision (trinomial) G#? = Inexact numeric rank G#Q = Questionable taxonomy

GRANK5CAT (5-category Global Rank)	A calculation that lumps all of the various possible Global Ranks into 5 broad categories of rarity, with 1=most rare and 5=most common
SRANK (State Rank)	A rank assigned by the Natural Heritage Programs characterizing the relative rarity or endangerment of the Element within a specific state. Most State Ranks have the same format as the Global Ranks above, except that there are a few additional qualifiers. For a detailed explanation, see Attachment 2: SE = Exotic in state SA = Accidental in state SSYN = Synonym S#B = Breeding Status (for migrants only) S#N - Non-breeding Status (for migrants only)
SRANK5CAT (5-category State Rank)	A calculation that lumps all of the various possible State Ranks into 5 broad categories of rarity, with 1=most rare and 5=most common. An "N" value in this field indicates that the species has been assigned a non-standard State Rank, which cannot easily be lumped into a single category. For example, migratory species are often assigned differing State Ranks depending on their breeding and non-breeding status in the state.
LAT (Latitude in Decimal Degrees)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the decimal-latitude location is provided using values calculated to 4 decimal places. If an occurrence falls within a Site polygon, this field will be blank.
LONG (Longitude in Decimal Degrees)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the decimal-longitude location is provided using values calculated to 4 decimal places. If an occurrence falls within a Site polygon, this field will be blank.
LASTOBS 1-4 (Last Observed Year)	The most recent year for which the Natural Heritage Program has data indicating that the Element is still extant at that location. This is not necessarily the date that the area was last visited.
LASTOBS 6-7 (Last Observed Month)	The month of the most recent last observed date.
LASTOBS 9-10 (Last Observed Day)	The day-date of the most recent last observed date.
SIZE (Area of Occurrence)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the area covered by the Element Occurrence is provided. This value is typically in acres. In cases where the value is not in acres, the unit of measure is included. If an occurrence falls within a Site polygon, this field will read "See Site Data".

PROTCOM (Protection Comments)	Text comments regarding specific protection needed to ensure continued existence of the Element Occurrence.
DATASENS (Data Sensitivity)	Some data are considered sensitive either because the species is subject to poaching or collection, or because the landowner requested that data be so designated. This is a single-valued Y/N field.
UPDATE (Date Record was Updated)	The date of the most recent changes made to this record (YY-MM-DD)
USESA (US Endangered Species Act)	For species Elements only. Contains the standard US Federal Registry abbreviations for listed and candidate species, as designated by the US Fish and Wildlife Service:[9] LE = Listed Endangered LT = Listed Threatened PE = Proposed Endangered PT = Proposed Threatened C1 = Candidate, Category 1 C2 = Candidate, Category 2 3A = Former candidate, rejected because presumed extinct 3B = Former candidate, rejected because synonym or hybrid 3C = Former candidate, rejected because sufficiently common or adequately protected
SPROT (State Protected Status)	Abbreviations and/or categories used by each state in the watershed to indicate the official endangerment status or level of legal protection assigned by the state. See individual state laws for clarification of codes.
PRECISION (Precision)	Code showing the precision used to map the Element Occurrence: S = Location precisely known M = Location known within 1.5 miles G = Location known within 5 miles
DISCLAIMER	A text disclaimer that describes the limitations of the data. The content of this field is identical for all Element Occurrence records.
TOWNRANGE (Township and Range)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the legal township and range values occupied by the Element Occurrence are provided. There may be multiple values per occurrence. If an occurrence falls within a Site polygon, this field will read "See Site Data".

[9]Note: In the spring of 1996, the US Fish & Wildlife Service officially eliminated the C2, 3A, 3B, and 3C categories. This change is not yet reflected in the South Platte databases, as The Nature Conservancy deliberates over how to maintain data regarding former C2, 3A, 3B or 3C species.

SECTION (Section)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the legal section numbers for each township and range occupied by the Element Occurrence provided. There may be multiple values per occurrence. Separate values within a single township/range are separated by a slash (/). Ranges of inclusive values are separated by a dash (-).
MACODE (Managed Area Codes)	A unique code for tracking specific Managed Areas
MANAME (Managed Area Names)found.	A list of the land management units in which the Element Occurrence is This may include private property, but private owners are never listed by name.
QUADNAME (Topographic Quad Names)	For Element Occurrences that fall outside of the Potential Conservation Site polygons, a list of the 7.5 minute topographic quads occupied by the Element Occurrence is provided. There may be multiple values per occurrence. If an occurrence falls within a Site polygon, this field will read "See Site Data".
WATERSHED	For Element Occurrences that fall outside of the Potential Conservation Site polygons, the 8-digit codes from the US Geological Survey Hydrologic Unit maps are provided. There may be multiple values per occurrence. If an occurrence falls within a Site polygon, this field will read "See Site Data".

Database Fields for Potential Conservation Sites

The following data fields comprise the structure of the GIS coverages MICRO, MACRO and MEGA. These coverages contain polygon-data on Potential Conservation Sites that include exceptional Element Occurrences for rare, threatened and endangered species plus high-quality ecological communities. The data were supplied on April 18, 1996, by the Colorado Natural Heritage Program, the Wyoming Natural Diversity Database, and the Nebraska Natural Heritage Program. Boundaries for these Potential Conservation Sites are based upon desktop review of scientific references and 1:100,000 scale maps, and in some cases on data provided by biologists who visited the Site in the field. The Sites are meant to encompass ecological processes affecting the rare Elements of biodiversity identified at the location. Where appropriate, they also include Critical Habitat as designated by the US Fish & Wildlife Service.

SITECODE (Site Identifying Code)	A unique code for tracking specific Potential Conservation Sites
SITENAME (Site Name)	The official Natural Heritage Program name for the Site.
SITEDESC (Site Description)	Text that provides a visual description (word picture) of the principal physical and natural features of the Potential Conservation Site.

BOUNDJST (Boundary Justification)	Text that explains the biological rationale used to determine the location of the Site's boundaries.
BIODIVSIG (Biodiversity Significance)	A rating assigned by the Natural Heritage Program to describe the significance of the Site in terms of its biological diversity. Brief definitions are provided below. For a detailed explanation, see Attachment 3: B1 = Outstanding significance B2 = Very high significance B3 = High significance B4 = Moderate significance B5 = Of general biodiversity interest or open space
PROTCOM (Protection Comments)	Text comments regarding any protection needed to ensure continued existence of the Element Occurrences found at the Site.
UPDATE (Date Record was Updated)	The date of the most recent changes made to this record (YY-MM-DD)
WATERSHED (Watershed)	The 8-digit codes from the US Geological Survey Hydrologic Unit maps in which the Potential Conservation Site is mapped. There may be multiple values per Site.
DISCLAIMER	A text disclaimer that describes the limitations of the data. The contents of this field is identical for all Potential Conservation Site records.

Appendix 3: Glossary of Terms

Element - The concept of an Element is fundamental to Natural Heritage Program methodology and to the inventory of biological diversity. An Element is a unit of natural biological diversity. These include plant and animal species and infraspecies, and ecological communities (repeatable assemblages of species that share a common environment).
Biological diversity can be measured at many different scales, ranging from a landscape level to a genetic level:

Landscape
Ecosystem

Ecological Community
Species
Infraspecies

Population
Individual
Gene

The species (and infraspecies) and ecological community levels have been selected as the best representation of biological diversity to be used in the Natural Heritage inventories for practical conservation reasons. Species and ecological communities represent the most tangible, manageable entities that can be relatively easily inventoried, mapped and protected. Including both species and ecological communities in the Natural Heritage inventory process ensures a broad, practical, and well balanced representation of an area's biological diversity.

Element Occurrence - A specific, geographic location that represents an area occupied by an Element. This is an area of habitat known or confidently thought to be occupied by a local population or ecological community. Element Occurrences are generally separated by an area of unsuitable or unoccupied habitat. Individuals in captivity or cultivation are not Element Occurrences. Individuals introduced outside their historic range are not Element Occurrences unless they are critical to the survival of the taxon.

Natural Heritage Program - One member of the Natural Heritage and Conservation Data Center Network, that comprises 85 data centers throughout the western hemisphere. Its scientists and information managers collect, organize and share data from one of the most comprehensive inventories or rare species and ecological communities in the world. Each Natural Heritage Program helps inform land-use decisions for developers, corporations, conservationists, and government agencies and is also consulted for research and educational purposes. The staff piece together facts on the location and status of rare and endangered species and ecological communities within their geographic distribution

(usually a state or province). They maintain this information in manual files, maps, computer databases, and computerized mapping systems. They also use this information to rank species and ecological communities according to their conservation status and degree of vulnerability.

Potential Conservation Site - For places known to encompass species or ecological communities of concern that meet specific quality and locational precision criteria, Natural Heritage Program biologists estimate an area within which conservation attention is needed. These Potential Conservation Sites have various management requirements that are directly related to the biological needs of the species or ecological communities for which they were drawn. Advance knowledge of the location and quality of these Sites will provide opportunities for planning and conservation success through the identification and management of potential threats.

The Nature Conservancy - A non-profit corporation whose mission is: "To preserve the plants, animals, and ecological communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive." The Nature Conservancy developed, holds the copyright to, and supports the basic Natural Heritage methodology as well as the Biological and Conservation Data System (BCD) software. The Conservancy has developed and maintains range-wide data on the ecosystems and biota of the US and Canada, and contributes to the development of location data in collaboration with the Natural Heritage Programs.

Appendix 4: Selected South Platte Watershed Maps

These five maps were generated using the South Platte Watershed Inventory databases delivered to the EPA and Denver Water Board. They demonstrate four different aspects of the data:

- ✓ Biodiversity Significance Ranks
- ✓ Aquatic, wetland or riparian habitat dependence of Elements
- ✓ Federal Status under the US Endangered Species Act
- ✓ Development of new Potential Conservation Sites during the different phases of this project

On the first 4 maps, all of the Potential Conservation Sites are shown **except** for the Western High Plains Mega-site. This very large Site was left off of the maps because it obscures the view of the smaller Sites nested within it. The fifth map shows the location and extent of the Western High Plains Mega-site.

WYOMING

NEBRASKA

COLORADO

Cheyenne

North Platte

Fort Collins

Sterling

Denver

South Platte Watershed
Potential Conservation Sites
Biodiversity Significance Ranks

- B1 – Outstanding (6)
- B2 – Very High (85)
- B3 – High (124)
- B4 – Moderate (135)
- B5 – General biological interest (140)

Watershed boundary
Drainages
County boundaries

North

0 50 MILES

The Nature Conservancy

WYOMING

Cheyenne

North Platte

Fort Collins

Sterling

NEBRASKA

Denver

COLORADO

South Platte Watershed
Potential Conservation Sites

Water dependence of Species and Natural Communities

- Sites (301) with at least one species or natural community dependant on aquatic, wetland or riparian habitat
- Sites (189) with only species and/or natural communities dependant on upland habitat

- Watershed boundary
- Drainages
- County boundaries

North

0 — 50 MILES

The Nature Conservancy

WYOMING

Cheyenne

Fort Collins

Sterling

North Platte

NEBRASKA

Denver

COLORADO

South Platte Watershed
Potential Conservation Sites
Federal Status of Species known within Sites

- Sites (5) with at least one species listed ENDANGERED
- Sites (65) with at least one species listed THREATENED and none listed endangered
- Sites (18) with species whose only status is CANDIDATE
- Sites (402) with NO candidate or listed species known

Watershed boundary

Drainages

County boundaries

North

0 50 MILES

The Nature Conservancy

WYOMING

Cheyenne

North Platte

Fort Collins

Sterling

NEBRASKA

Denver

COLORADO

South Platte Watershed
Potential Conservation Sites
Additional Sites defined during South Platte Inventory

- Sites (158) existing before Project – before January 1994
- Phase 2 Sites (237) – January 1994 to August 1995
- Phase 3 Sites (95) – August 1995 to March 1996

- Watershed boundary
- Drainages
- County boundaries

North

0 50 MILES

The Nature Conservancy

WYOMING

NEBRASKA

COLORADO

Cheyenne

Fort Collins

Sterling

North Platte

Denver

South Platte Watershed
Potential Conservation Sites

Western High Plains Mega Site

and all other sites

Western High Plains Megasite

All other conservation sites

Watershed boundary

Drainages

County boundaries

North

0 50 MILES

The Nature Conservancy