0526

LIMESTONE-GRAVEYARD CREEKS WATERSHED

BENT COUNTY, COLORADO

PROWERS COUNTY, COLORADO

WATERSHED PLAN

AND

ENVIRONMENTAL ASSESSMENT

SPONSORED BY
BENT SOIL CONSERVATION DISTRICT
PROWERS SOIL CONSERVATION DISTRICT
COLORADO STATE SOIL CONSERVATION BOARD
FORT LYON CANAL COMPANY

ASSISTED BY
NATURAL RESOURCES CONSERVATION SERVICE
LAKEWOOD, COLORADO

September, 1996

"The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited bases apply to all programs). Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-5881 (Voice) or (202) 720-7808 (TDD).

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C. 20250, or call (202) 720-7327 (Voice) or (202) 720-1127 (TDD). USDA is an Equal Employment Opportunity Employer (EEOE).

ABSTRACT OF THE PLAN:

This Watershed Plan-Environmental Assessment is to improve the surface and groundwater quality by reducing the agricultural contribution of heavy metals, salts, sediment, and nitrate contamination. This will be accomplished through accelerated technical and financial assistance for the installation of on-farm land treatment measures. The measures are to reduce contaminants in the groundwater, surface water, and the Arkansas River to an acceptable level and protect the soil resource base from excessive irrigation induced erosion.

Responsible Agency:

USDA Natural Resources Conservation Service

Title of Proposed Action:

Draft PL 83-566 Watershed Plan-Environmental Assessment
Limestone-Graveyard Creeks Watershed Project

Location:

Bent and Prowers Counties, Colorado

For Further Information Contact:

Duane L. Johnson, State Conservationist
USDA Natural Resources Conservation Service
655 Parfet Street, Room E200C
Lakewood, CO 80215-5517
Phone:(303)236-2886

Plan Status:

FINAL PLAN

0528

Watershed Agreement

between the

Bent Soil Conservation District
Prowers Soil Conservation District
Colorado State Soil Conservation Board
Fort Lyon Canal Company

(referred to herein as sponsors)

State of Colorado

and the

Natural Resources Conservation Service
United States Department of Agriculture

(referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the sponsors for assistance in preparing a plan for works of improvement for the Limestone-Graveyard Creeks Watershed, State of Colorado, under the authority of the Watershed Protection and Flood Prevention Act (16 U.S.C.. 10001-1008); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the sponsors and NRCS a plan for works of improvement for the Limestone-Graveyard Creeks Watershed, State of Colorado, hereinafter referred to as the Watershed Plan-Environmental Assessment, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the sponsors hereby agree on this plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this watershed plan and including the following:

1. Cost-sharing rate for the establishment of enduring land treatment practices is 50 percent of the average cost of installing the enduring practices in the selected plan for the evaluation unit. Cost-sharing rate for the erosion

0529 for the evaluation unit. Cost-sharing rate for the erosion control practice (polyacrylamide) will be 50% of the actual cost not to exceed 50% of the specified maximum of $30/Ac. The estimated total financial assistance cost for enduring and polyacrylamide practices is $1,834,300.

2. The NRCS will assist the sponsors in providing technical assistance to landowners or operators to plan and install land treatment practices shown in the plan. Percentages of technical assistance costs to be borne by the sponsors and NRCS are as follows:

Works of improvement	Sponsors (%)	NRCS (%)	Estimated technical assistance costs ($)
Land treatment practices	0	100	1,050,200

3. The sponsors will obtain applications from owners of not less than 30 percent of the land in the problem area, indicating that they will carry out the planned land treatment measures. These applications will be obtained before the first long-term land treatment contract is executed.

4. The sponsors will obtain agreements with landowners or operators to operate and maintain the land treatment practices for the protection and improvement of the watershed.

5. The sponsors and NRCS will each bear the cost of project administration that each incurs, estimated to be $30,000 and $172,000, respectively.

6. The cost of relocation payments in connection with the displacements under the Uniform Act will be shared by the sponsors and NRCS as follows:

	Sponsor %	NRCS %	Estimated relocation payment costs [1] $
Relocation Payments	42.7	57.3	0

7. The sponsors will acquire, or ensure that the landowners or water users have acquired, such rights pursuant to State law as may be needed for the installation and operation of the works of improvement.

[1] Investigation of the watershed project area indicates that no displacements will be involved under present

conditions. However, in the event that displacement becomes necessary at a later date, the cost of relocation assistance and payments will be cost shared in accordance with the percentages shown.

8. The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto, will be the average costs incurred in the installation of works of improvement or an approved variation.

9. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

10. A separate agreement will be entered into between NRCS and sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

11. This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsor has failed to comply with the conditions of this agreement. In this case, NRCS shall promptly notify the sponsor in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsor or recoveries by NRCS shall be in accord with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsor(s) having specific responsibilities for the measure involved.

12. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

13. The program conducted will be in compliance with the nondiscrimination provisions as contained in Titles VI and VII of the Civil Rights Act of 1964, as amended, the Civil Rights Restoration Act of 1987 (Public Law 100-259) and other nondiscrimination statutes, namely, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and in accordance with regulations of the Secretary of Agriculture (7 FR. 15, Subparts A & B), which provide that no person in the United States shall, on the grounds of

race, color, national origin, age, sex, religion, marital status, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving Federal financial assistance from the Department of Agriculture or any agency thereof.

14. Certification Regarding Drug-Free Workplace Requirements (7 CFR 3017.Subpart F.)

By signing this watershed agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

Controlled substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. 812) and as further defined by regulation (21 CFR 1308.11 through 1308.15);

Conviction means a finding of (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statues;

Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of subrecipients or subcontractors in covered workplaces).

Certification:

A. The sponsors certify that they will or will continue to provide a drug-free workplace by:

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the

grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(2) Establishing an ongoing drug-free awareness program to inform employees about -

(a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;

(c) Any available drug counseling, rehabilitation, and employee assistance programs; and

(d) The penalties that may be imposed upon for drug abuse violations occurring in the workplace

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1);

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will -

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statue occurring in the workplace no later than five calendar days after such conviction;

(5) Notifying the NRCS in writing, within ten calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4)(b), with respect to any employee who is so convicted -

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6)

0533

B. The sponsors may provide a list of the site(s) for the performance of work done in connection with a specific project or other agreement.

C. Agencies shall keep the original of all disclosure reports in the official files of the agency.

15. Certification Regarding Lobbying (7 CFR 3018) (applicable if this agreement exceeds $100,000).

(1) The sponsors certify to the best of their knowledge and belief, that:

(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, modification of any Federal contract, grant, loan, or cooperative agreement.

(c) The sponsors shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

(2) This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

16. Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions (7 CFR 3017).

(1) The sponsors certify to the best of their knowledge and belief, that they and their principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

(2) Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this agreement.

053 Bent Soil Conservation District

_____ By _____
(Type name below signature)

Title _____

_____ Date _____

Address

_____

Zip Code

The signing of this plan was authorized by a resolution of the governing body of the (name of sponsor) adopted at a meeting held on _____

_____ _____
(Type name below signature) Address
Secretary (or other title)
Date: _____
Zip Code

Prowers Soil Conservation District

_____ By _____
(Type name below signature)

Title _____

_____ Date _____

Address

_____

Zip Code

The signing of this plan was authorized by a resolution of the governing body of the (name of sponsor) adopted at a meeting held on _____

_____ _____
(Type name below signature) Address
Secretary (or other title)
Date: _____
Zip Code

0536

Fort Lyon Canal Company

_____ By _____
(Type name below signature)

Title _____

_____ Date _____

Address

_____

Zip Code

The signing of this plan was authorized by a resolution of the governing body of the (name of sponsor) adopted at a meeting held on _____

_____ _____

(Type name below signature) Address
Secretary (or other title)
Date: _____

Zip Code

Colorado State Soil Conservation Board

_____ By _____
(Type name below signature)

Title _____

_____ Date _____

Address

_____

Zip Code

The signing of this plan was authorized by a resolution of the governing body of the (name of sponsor) adopted at a meeting held on _____

_____ _____

(Type name below signature) Address
Secretary (or other title)
Date: _____

Zip Code

0537

Natural Resources Conservation Service
United States Department of Agriculture

Approved by:

_____

(Type name below signature)
State Conservationist

Date: _____

0538

Draft Watershed Plan-Environmental Assessment for Limestone-Graveyard Creeks Watershed Project

Table of Contents **page**

Contents:

Tables:

Appendices:

0539

Watershed Plan - Environmental Assessment
for
Limestone-Graveyard Creeks Watershed
Colorado
Summary of Watershed Plan

Project Name: Limestone-Graveyard Creeks Watershed

County: Bent, Prowers

State: Colorado

Sponsors: Bent Soil Conservation District, Prowers Soil Conservation District, Colorado State Soil Conservation Board, Fort Lyon Canal Company

Description of Recommended Plan:

The recommended plan is composed of management and enduring conservation practices. The management and enduring practices are to reduce deep percolation, runoff and irrigation induced erosion which will improve water quality of both surface and groundwater, the Arkansas River, as well as protect the resource base.

Resource Information:

Size of watershed (acres)	59,250
Land cover - Total cropland (acres)	44,500
Rangeland (acres)	14,050
Forest land (acres)	
Miscellaneous (acres)	700
Land ownership-Private (%)	98
State-Local (%)	2
Number of Farms	166
Average farm size (acres)	360
Prime and important farmland (acres)	44,500
Number of minority farmers	43
Number of limited resources farmers	27

Project Beneficiary Profile:

The economy of the watershed is based on irrigated agriculture. The 1989 per capita income for the area was $9,500, whereas the Colorado per capita income was $14,800 for the same period. The population within the watershed is 74% White, 24% Hispanic, and 2% other with an average age of 34. The average age of a Colorado resident is 29. The November 1994 unemployment rate for Bent and Prowers, CO was 4% which compares with 3.5% for Colorado. The median house value for the watershed is $32,700 compared to the state median value of $82,700.

Wetlands:	Type I	- less than	90 Ac.
	Type III	- approximately	844 Ac.
	Type V	- approximately	73 Ac.
	Type VI/VII	- approximately	2,300 Ac.

Nearly all the wetlands are along the Arkansas River, the creeks, and drains. There will be no net loss of wetland values.

Flood Plains: The floodplain along the Arkansas River will not be significantly affected by the project.

Highly erodible cropland: There are 44,500 acres of HEL lands in the watershed.

Endangered Species - known range for the following:
Black-Footed Ferret,
Bald Eagle, Whooping Crane
Piping Plover, Least Tern
Eskimo Curlew

Cultural Resources

Sites*
1. Santa Fe Trail; Eligible for NRHP
2. West Bent Signature; Eligible for NRHP
3. Rock Art; Eligible for NRHP
4. Bents New Fort; Eligible for NRHP
5. Fort Wise; Eligible for NRHP
6. Prowers Bridge 4A; on HRHP Register

*None are in the irrigated area that work is anticipated.

Problem Identification

Major problems identifed in the watershed are: poor water quality in the Arkansas River as well as in surface and groundwater in the watershed, poor irrigation water management, and excessive irrigation induced erosion to the irrigated cropland.

Alternative plans considered

1. Future without - no action
2. Management practices
3. Management practices plus enduring irrigation systems improvements.

Other alternatives considered, but did not adequately address problems, included:

a.) canal lining
b.) change from surface systems to center pivots
c.) purchase of irrigation rights from land owners

Project Purposes

The primary purposes are (1) (agricultural water management) - reduce negative water quality impacts to surface and groundwater, including the Arkansas River from selenium, sediment, salts and nitrate loading; (2) (agriculture water management) - improve application uniformity; (3) (watershed protection) - protect the soil resource base from excessive irrigation induced erosion and sedimentation.

Principal Project Measures:

It is expected that 108 long-term land treatment contracts will be written during the project's life. Approximately 26,700 acres will be treated through project action.

Practices to be installed for this project action include:

26,700	acres with irrigation water management, nutrient and pest management.
8,800	acres of conservation tillage, crop residue use & polyacrylamides
149,610	ft. of ditch lining
213,710	ft. of pipelines
3,300	ac. of land leveling
48	water control structures
56	appurtenant structures
10	multipurpose mitigation ponds
20	acres of wetland habitat development

PROJECT COSTS

	PL-566 Funds		Other Funds		Total	
	$	%	$	%	$	%
Managment Practices						
Irrigation Water Management	0	0	106,800	100	106,800	100
Nutrient Management	0	0	53,400	100	53,400	100
Conservation Tillage & Crop Residue Use	0	0	58,100	100	58,100	100
Pest Management	0	0	186,900	100	186,900	100
Polyacrylamide	37,500	50	37,500	50	75,000	100
Enduring Practices						
Ditch Lining (concrete)	598,400	50	598,400	50	1,196,800	100
Pipeline Systems	619,800	50	619,800	50	1,239,800	100
Land Leveling	268,800	50	268,800	50	537,600	100
Water Control Structures	23,000	50	23,000	50	46,000	100
Appurtenant Structures	270,300	50	270,300	50	540,600	100
Mitigation costs	16,500	50	16,500	50	33,000	100
Technical Assistance	1,050,200	0	0	0	1,050,200	100
Administrative Costs	172,000	85	30,000	15	202,000	100
Total Costs	3,056,000		2,269,500		5,326,000	

0543

Project Benefits

. There will be a 32% decrease in nitrate loading to the groundwater in the watershed area.

. Increasing Selenium levels (19.7 micrograms/liter) in the Arkansas River at the Lamar gaging station will be reduced by 17% and meet EPA and State standards.

. Present salt loading from the watershed to the Arkansas River of 116,000 tons/yr will be reduced 30%.

. Uranium concentration at the Lamar gaging station will be reduced by .4ug/l in the Arkansas River

. Irrigation induced erosion on 8,800 acres averaging 42T/ac/yr will be reduced by 88% to an acceptable level.

. Wetland and fisheries will be enhanced due to reduced heavy metal loading.

. Reduced sediment to creeks, drains and the Arkansas River.

Other Impacts

Land use changes (acres)-NONE

Environmental values changed or lost:

Wetlands and fisheries will be improved due to better water quality from reduced heavy metals, nutrients, and sediment. Erosion on prime farmland will be reduced to acceptable levels. Cultural Resources - not effected. Wildlife Habitat - increase in cropland wildlife habitat value.

Compensatory mitigation included in the plan

None

Major conclusions

Overall, improved surface and groundwater quality, improved human health and safety, significant sediment and erosion reduction, improved water quality in Arkansas River, improved wetlands and fisheries from improved water quality, improved wildlife habitat, reduced irrigation labor costs, reduced irrigation system operation and maintenance, and improved irrigation efficiency results in increased available water supply on and offsite.

Areas of Controversy

The Colorado Attorney General and the Colorado Water Conservation Board expressed a concern that the project would effect the flows in the Arkansas River by increasing crop consumptive use. This concern is due to the Kansas/Colorado water compact, as it

relates to flows in the Arkansas river. The Colorado Department of Health expressed a concern over wetland impacts.

Issues to be resolved:

Will the Arkansas river compact be violated by project action? Refer to Appendix C, which includes an analyses of measure implementation impacts.

Other:

None

INTRODUCTION

The Plan was prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (126 USC 10011008), and in accordance with Section 102 (2) (c) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 U.S. C. 4321, et seq). Responsibility for compliance with the National Environmental Policy Act rests with the Natural Resources Conservation Service.

This watershed plan describes the plan formulation process, discloses expected project impacts, and provides the basis for authorizing federal assistance for implementation under the Public Law 566 Program. There were no significant adverse environmental impacts identified during the scoping process. The sponsoring local organizations are Bent Soil Conservation District (BSCD), Prowers Soil Conservation District (PSCD), Fort Lyon Canal Company (FLCC), and the Colorado State Soil Conservation Board (CSSCB).

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) assisted the sponsors with the development of the plan.

This plan was prepared to document the findings of planning studies to date as a PL-566 project. The report identifies problems, effects, and alternatives which are being considered. It further explains, in some detail, a Recommended Plan (RP), including its cost, benefits, and environmentally adverse and beneficial effects. No significant adverse environmental impact has been identified at this stage of the environmental evaluation process. The U.S. Fish and Wildlife Service (F&WS), U.S. Geological Survey (USGS), the Colorado State Historic Preservation Officer (SHPO), and the Colorado Department of Natural Resources (DNR), and EPA have been and will continue to be contacted.

Purposes to be served by the project are agricultural water management and watershed protection. Specifically, this project has been formulated to improve both surface and groundwater quality, reduce irrigation induced erosion to acceptable levels, and more effectively use available water. Irrigation induced erosion will be reduced in the treatment area on 8,800 acres now eroding at an average of eight times the maximum rate necessary to maintain the productive capacity of the soil resource. Poor water quality from heavy metals and salts in wells and drains will be improved in the watershed as well as in the Arkansas River. Better irrigation water application will occur on 26,700 Acres. The Recommended Plan (RP) includes ditch lining, pipe lines, multipurpose ponds, water control structures, appurtenant structures, leveling, Irrigation Water Management (IWM), nutrient and pest management, wetland mitigation practices and conservation tillage. The estimated cost of the Recommended Plan alternative is $5,326,000 with $3,056,500 in PL-566 costs.

PROJECT SETTING

Location and Size

The Limestone-Graveyard Creeks Watershed is located in eastern Bent and western Prowers Counties in Southeastern Colorado. The watershed consists of 59,250 acres and averages about 5 miles wide and 16 miles long. Lamar, Colorado is on the east edge and Las Animas is slightly west of the watershed. Pueblo, Colorado is 100 miles west of the watershed area.

The watershed is bounded on the west by the Prowers Arroyo, north by the Fort Lyon Canal, east by the Pleasant Valley Drain, and south by the Arkansas River. It includes Limestone and Graveyard Creeks, Prowers Arroyo, Pleasant Valley and Wiley Drains which outlet into the Arkansas River.

Topography and Drainage

The highest elevation in the watershed is the Fort Lyon Canal. It varies from an elevation of 3950 ft. on the west edge to 3860 ft. on the east edge. The Arkansas River, or southern boundary, is the lowest elevation in the watershed. It varies from 3740 ft. at the west edge to 3630 ft. at the east edge. The watershed is gently sloping with approximately 1/2 of the drop in elevation occurring below the irrigation area in the final mile as the drainages enter the Arkansas River Valley.

The drainages of the watershed all outlet into the Arkansas River. Prowers Arroyo, Limestone Creek, Graveyard Creek, Wiley Drain, and Pleasant Valley Drain all have small year around flows.

Geology [1/]

The watershed is located within the Colorado Piedment Section of the Great Plains Physiographic Province (Fenneman, 1931). The Colorado Piedmont represents an old erosion surface. It is a mature to old, broadly rolling, elevated plain with local scarps.

Bedrock consists primarily of cretaceous marine shales and limestones. These formations dip slightly to the northwest, toward the Denver structural basin. The oldest formation that crops out in the watershed is the Lower Cretaceous Dakota sandstone, which is found along the valley side above the Arkansas River flood plain. Overlying the Dakota Formation (from oldest to youngest) is the Graneros shale, Greenhorn limestone, Carlile shale, and the Fort Hays limestone member of the Niobrara Formation. Younger Quaternary deposits overlay the bedrock over much of the watershed area.

Shales and limestones have higher concentrations of some minerals than other rock types have. This is particularly true of minerals such as sulfur and trace minerals such as arsenic, boron, and selenium (Turekian and Wedepohl, 1961).

Studies by Schultz and others (1980) also showed elevated sulfur and trace mineral concentrations in studies done of the Upper Cretaceous Pierre shale and equivalent formations. The sediment source areas for these formations was to the west. The watershed area is far from the source area, so sediments are almost exclusively fine-grained marine shale and muddy limestone. As the amount of clays increase with distance from the sediment source area, so does the amount of organic carbon. Adsorption from seawater and concentration by organic matter have increased the concentrations of arsenic, chromium, copper, selenium, uranium, and other trace minerals in the formations present in the watershed area.

1/ Check in Reference Section for Geology Reports.

Soils

The soils in the watershed are mainly of the Rocky Ford series. Soils of the Rocky Ford series are moderately shallow to deep, calcareous, and medium textured. They are on terraces of the Arkansas River and its major tributaries.

All of these soils are irrigated with water from the Fort Lyon Canal Company and are silted. Generally, the surface layer is heavily silted because the muddy water used to irrigate this soil has deposited silt and clay. In many places where water tends to pond at the lower end of a field, the soil is more deeply silted than it is in the other areas. In many of the steeper areas, the surface layer is coarser than it is in nearly level areas. In some of these areas, plowing has mixed part of the lighter colored subsoil with the surface layer. In places land leveling or deep tillage has greatly altered or affected some of the soils.

The surface layer of these soils is dark grayish-brown clay loam and is 10 to 15 inches thick. It is hard when dry and firm when moist. The Subsoil, or horizon underlying the silted surface layer, is brown silt loam that is slightly hard when dry and friable when moist. This silt loam grades to lighter colored silt loam. These soils are calcareous throughout.

Crop yields are high, but some of these soils need more careful management than others because they are shallow over limestone or sand and gravel. The main problems are managing irrigation water, maintaining fertility, and controlling erosion on the steeper slopes.

Land Cover

The land cover in the watershed is estimated in Table A:

Table A - Land Cover

Land Cover	%	Acres
Cropland, irrigated	75.1	44,500
Rangeland	23.7	14,050
Other(roads/towns)	1.2	700
Total	100.0	59,250

The crops being grown on the irrigated cropland are estimated in Table B:

Table B - Cropland Distribution

Crop	%	Acres
Alfalfa	61.3	27275
Grain Corn	9.0	4025
Grain Sorghum	13.1	5825
Small Grain	7.2	3200
Pasture & Hayland	2.2	975
Misc. other crops and fallow	7.2	3200
Total	100.0	44,500 acres

No significant land cover and cropland distribution change is anticipated in the future. 98% of land in the watershed is privately owned and 2% is state land.

Climate

The semiarid climate of the study area is characterized by low to moderate precipitation, substantial evaporation, low humidity, moderate to intense winds, and a large daily range in temperature. At Las Animas, the mean annual temperature is 54.5 deg. F, with the mean January temperature of 29.6 deg.F, and the mean July temperature of 79.3 deg F. The average high temperature in July is 96.9 deg. F and the average low is 62 deg F. The average time between killing frosts is about 175 days. The last killing frost generally occurs in late April, and the first killing frost occurs in mid-October.

The mean annual precipitation at John Martin Dam is 11.7 inches. About 75 to 80 percent of the annual precipitation falls as rain during the growing season. Lamar's conditions are nearly the same.

Economic and Demographic Data

The economy of the watershed and surrounding area is heavily dependent on agriculture. Family farms are the predominate type. Within the watershed boundaries there are about 95 rural landowners with individual irrigated units 320 acres or less in size. There are about 71 landowners with units 321 acres or more in size. Cash crop production and livestock operations are the major enterprises. Irrigation water is supplied to the watershed by the Fort Lyon Canal Company. The Fort Lyons' earliest water right decrees date prior to 1884 making it one of the earliest decreed ditches on the Arkansas River. Between 100,000 and 400,000 acre feet of water are diverted for 91,000 acres by the Fort Lyon Canal Company each year with an average of 232,000 acre feet. The total average annual water supply is about 400,000 acre feet. The 91,000 acres are supplied with irrigation water by the Fort Lyon Canal Company diversions, reservoir storage, and by approximately 40 private irrigation wells.

The population of the watershed and surrounding area consists of 74% white, 24% Hispanic, and 2% other races. An estimated 50.4% of the watershed is comprised of women. The per capita income of the area (1990 census) is $9500 as compared to the state average of $14,800. 16.5% of the families are below the poverty level. 9.7 % Of the population have a work disability. The average age is 34. The March 1994 unemployment rate is 6.2% .

The McClave subdivision of Bent County (population 816) and the Prowers County town of Wiley (population 421) are located within the watershed. Lamar (population 8343) is on the east edge and Las Animas (population 2362) is just west of the watershed. Transportation routes include U.S. highways 287 running north and south and U.S. highway 50 running east and west. There are also many secondary and county roads.

Wildlife

Unpredictable precipitation is part of the climatic picture that combines with other climate factors to create a harsh environment for wildlife. The watershed rests in what is considered a historical short grass prairie. Many of the traditional wildlife species still exist in the area. Suitable habitat for the following threatened or endangered species is found in or near the watershed: bald eagle (Haliaeetus leucocephalus), whooping crane (Grus americana), eskimo curlew (Numenius borealis), least tern (Sterna antillarum), piping plover (Charadrius melodus), and black-footed ferret (Mustela nigripes).

Several other species are proposed for listing as threatened or endangered species including the Texas horned lizard (Phrynosoma cornutum), white-faced ibis (Plegadis chihi), mountain plover (Charadrius montanus), ferruginous hawk (Buteo regalis), southwestern willow flycatcher (Empidonax railli extimus), black tern (Chlidonias niger), swift fox (vulpes velox), Arkansas darter (Estheostoma cragini), speckled chub (Extrarius aestivalis tetranemus), and Colorado green gentian (Frasera Coloradensis).

0550

Most of the above threatened, endangered, or proposed species are also on Colorado's state list of threatened or endangered list or are a species of special concern.

The watershed project is not expected to have adverse impacts on any of these threatened, endangered, proposed, or special concern species.

Numerous popular game species are found in the area including: scaled quail, pronghorn, white-tailed and mule deer, cottontail and jackrabbits, ring-necked pheasant, a variety of waterfowl species and numerous fish species.

Non-game species are widely represented in the watershed with a variety of shorebirds, songbirds, mammals, reptiles, amphibians, and fish adding diversity to the wildlife in the area. A complete list is available in Appendix C that could potentially be in the watershed.

Wetlands

Many wetlands in the watershed are located along ditches, drains, and the Arkansas River bottom. These wetlands are primarily Types 5 and 6 (Shaw and Fredine, Circular 39, 1956); or PFO (palustrine forested), R40W (riverine, intermittent, open water), and R20W (the Arkansas River) (Cowardin, 1979). Irrigated fields also contain a small acreage of wetlands caused by seeps and inefficient water management practices. These wetlands are generally Type 1 (Circular 39) or PEM (palustrine emergent). The project may result in loss or reduction in size of irrigation induced wetlands in irrigated fields. Estimated acreage of wetlands in the watershed are:

Type I	90 Acs.	(PEM)
Type III	844 Acs.	(PEM)
Type V	73 Acs.	(POW)
Type VI	2300 Acs.	(PFO, R20W, R40W)

These acreages were measured off the 1975 NWI (National Wetland Inventory, USFWS) and compared with NRCS wetland inventory maps from 1990. The USF&WS acreage estimate exceeded the NRCS inventory acreage, therefore NRCS chose to agree on the higher acreage estimate. The actual acres estimated to be affected were adjusted to account for project participation. There will be no net losses of values of wetlands due to project action. Mitigation actions will compensate for wetland losses (see alternative "Effects" sections).

Archeology and Historic

The Indians of the plains occupied the project area, but apparently left few traces. Conversion of the short-grass plains to cropland has destroyed most surface vestiges of their past occupancy through various cultivation practices.

Portions of a branch of the Sante Fe Trail are visible in those parts of the watershed still utilized as rangeland. However, conversion of rangeland to cropland has destroyed the continuity of the existing trail.

In recognition of the important role played by the Santa Fe Trail and the "Big Timbers" area in Southeastern Colorado, a monument, "The Madonna of the Trail" was dedicated at Lamar in 1928. This marker was sponsored by the Daughters of the American Revolution and is one of twelve in the United States which denote a place of outstanding historical significance.

In the early history of this portion of Colorado, two military and trading posts (forts) existed next to the Arkansas River where water and shelter were available. The ruins of Bent's New Fort (it served as an Indian Agency and Trading Post) and Fort Wise (the Army's old Fort Lyon) are in the rangeland area just north of the Arkansas River. Cans, glass, rock foundations, and other objects can be found on these sites.

Two graffiti sites are on the rock ledges on the north bank of the Arkansas River in the area of these Forts, the Rock Art, and West Bent Signature sites.

The Prowers Bridge, is an early 1900's steel bridge crossing the Arkansas River to the community of Prowers.

WATERSHED PROBLEMS AND OPPORTUNITIES

This section identifies the types of problems which exist in the watershed. The problem areas are identified and the extent of the problems within each area are quantified. Potential opportunities to improve the quality of life and enhance environmental values are also discussed.

The problems within the watershed include: water quality, water quantity, and irrigation induced erosion. Additional problems include rural water quality, and fish and wildlife habitat.

Water Quality

Local geology and current land use practices are adversely affecting the water quality of the surface drainage and groundwater. Salts are a water and soil quality problem in the basin. During the last several years, there has been an increasing indication of heavy metals in irrigation drainages and the Arkansas River. The Colorado Nonpoint Assessment Report identified sediment and salinity as water quality problems in the reach of the Arkansas River which is impacted by the project.

The drains in the project area are major contributors of heavy metals, salts, and sediment. As observed by USGS [3/], dissolved uranium and selenium shows a particularly strong positive correlation with specific conductance. The study shows strong positive correlations with sodium, magnesium, sulfate, and chloride that contribute heavily to total dissolved solids and specific conductance in these waters. Lithium, boron, strontium, iron and selenium are also positively correlated. The combination of natural weathering of heavy metal bearing soils and sediments, extensive soil leaching by irrigation waters and evaporative concentration in a semiarid climate produce concentrations of dissolved heavy metals may threaten local water supplies.

The Department of Interior also has studied water quality of the Arkansas River in the vicinity of the project. 2/ Concentrations of sulfate, boron, and uranium were present in waters that drain from irrigated land underlain by marine shales. Selenium was the only inorganic trace constituent associated with irrigation drainage that was found at significantly elevated concentrations in water, bottom sediment, and biota. Selenium is an element which is subject to bioaccumulation in the food chain. Selenium becomes concentrated in green plants as they take up water. 4/5/6/ As drains within the irrigation system pick up water, selenium concentrations can become high and a health hazard for humans and other animal life.

The Colorado Department of Public Health and Environment dissolved selenium standard for aquatic life, which pertains to Class I and Class II streams, is 17 micrograms/liter. The EPA STORET data set had 17 values collected from 1988 through 1992 for the Lamar, Colorado gaging site. The mean value was 12.9 micrograms/liter. The data show the levels of dissolved selenium are high, and on occasion, exceed the

aquatic life standard. The increase in dissolved selenium is similar to the total selenium concentration trend.

The maximum selenium concentration detected in fish from the stream sites was 18.5 micrograms/gram in a sample of common acarp from the Arkansas River near Lamar, Colorado guaging station. 2/ Five species of fish in the Arkansas River had selenium concentrations ranging from 2.1 to 18.5 micrograms/gram. Three species in the tributaries had selenium concentrations ranging from 3.6 to 16.9 micrograms/gram. All but 3 of the 59 total fish samples exceeded the 85th percentile national baseline for selenium in fish (2.45 micrograms/gram dry weight), and 21 of the samples had concentrations exceeding the range asscciated with reproductive failure in bluegill. About one-half of the samples had selenium concentrations that exceeded the dietary concentration known to increase the rate of mortalities and deformities in mallard embryos. Selenium levels in aquatic plants exceeded acceptable dietary limits of avion species.

Selenium concentrations in surface water was 1 microgram/liter in Pueblo Reservoir upstream from the project area. Data from EPA, STORET database, indicates that the stretch of the Arkansas River from below John Martin Reservoir to Lamar, Colorado, has significant higher levels of selenium. 117 Samples taken indicated average total selenium concentration increases from 7.2 micrograms/liter to 19.7 micrograms/liter between the two gage stations. The mean value of 19.7 micrograms/liter total selenium was determined using 96 values from 1968 to 1994.

Additional USGS outflow data from John Martin Reservoir indicates a trend in increased selenium concentrations. Data from 1980 and 1981 that was used with comparison data from 1988 through 1993 indicates that dissolved selenium is increasing by .2 micrograms/liter annually. The trend indicates that selenium standards for agriculture use, 20 micrograms/liter, will be exceeded in the near future.

Although the project was not formulated to reduce other toxic trace elements or heavy metals, project action will help reduce those problems and improve water quality. Dissolved uranium levels of the Arkansas River are also increasing. Uranium ingested by humans and wildlife goes to both the kidneys and bone. It is a chemical poison to the kidneys. Kidney inflammation and failure can occur.

Sampling of the Arkansas River from Manzanola to Lamar found that dissolved uranium increases at a much higher rate than in the upper reaches. An abrupt increase in dissolved uranium is observed along the section of river where flow is greatly reduced because of extensive diversions for irrigation and the remaining flow is largely composed of irrigation return water. Water samples in this section of river are more enriched in dissolved uranium compared to the average concentration found in water outside the irrigated areas.

The mean concentration of uranium in ground water was 19.4 micro grams/liter for uranium in the Lamar Quadrangle of Southeastern Colorado (825 samples). Wells of less than 100 feet depth were

affected by deep percolation of irrigation waters and were markedly higher than the mean. The current proposed EPA drinking water regulation for uranium is 20 micro grams/liter. This 19.4 micro grams/liter concentration is 2-4 times as high as other quadrangles tested in western U.S. Future levels are anticipated to continue to be high if irrigation practices remain the same.

Uranium concentrations in the drains and creeks flowing into the Arkansas River from the watershed area have readings at times from 20-50 micro grams/liter. The extensive irrigation in this reach of the Arkansas River significantly elevates the dissolved concentrations of uranium. This combination of natural and man made effects could compromise the water quality for domestic use (farms, communities,) and agricultural use (irrigation, livestock) that derive water from the alluvial aquifer as well as the high concentrations in the river itself. Excessive levels may also be dangerous to wildlife including endangered species. Downstream water quality is also decreased to irrigators who reuse the Arkansas River water.

There are a number of shallow wells in the area that are also high in nitrates. EPA Storet Data indicates there are six wells in the watershed found to exceed the EPA standards (10 mg/lppm) NO_3-N. The Arkansas Rivers' water approaches the nitrate level standard at times. The sources of the nitrates are a combination of naturally occurring and applied. The top two feet of soil were generally found to have very high concentrations of nitrates. The higher nitrate well concentrations generally occur in the lower portions of the watershed. There are about 26 wells that were found to have nitrate levels approaching or exceeding standards in the watershed area.

Salinity is another serious water quality problem in the Arkansas Valley. There are 3 important factors in the salinity problem: salt pick up, concentration, and the management of water, soils, and crops.

Although it is desirable to control salt loading, high salt levels will remain as long as the water is used. Therefore, the greatest potential for reducing salinity is through more effectively using water throughout the valley. Irrigation water diverted into the Fort Lyon Canal, upstream 53 channel miles from the project, has a mean TDS of 807 milligrams/liter (obtained from USGS records). The mean TDS in the Arkansas River at Las Animas which is just above the project area is 1041 milligrams/liter. Just downstream from the project at the Lamar gaging station the mean total dissolved solids (TDS) is 1694 milligrams/liter for the Arkansas River. The TDS levels are therefore increasing downstream due to concentrations of salt in the remaining water. No TDS standards have been set for Colorado, however, TDS levels of 500 is deemed desirable and below 1000 is acceptable for agricultural purposes. It is anticipated that total TDS will be lowered through project action.

Eight organochlorine pesticides were detected in some samples of bird livers and eggs and in fish from the reservoirs. All concentrations were well within the ranges of reported background concentrations and were less than levels of biological concern. [2/]

Project action will reduce deep percolation which will improve ground water and Arkansas River water quality. This is achieved through reduced loading of heavy metals, pesticides, salts, nutrients and sediment.

Water Quantity

The Fort Lyon canal company's estimated amount of water available from diversions, reservoirs and pumping averages approximately 400,000 acre feet for 91,000 irrigated acres served by this canal. This equates to an average of 4.44 acre feet/acre/year for this watershed's 44,500 irrigated acres. However, it varies considerably from year to year. Present irrigation systems in the Limestone-Graveyard Creeks Watershed contribute to poor irrigation application. The average irrigation requirements for the crop rotation for the project area are about 20 inches per acre per year over and above normal precipitation. Serious crop production reductions occur in the watershed during water short years. This issue was evaluated in light of the Arkansas River Compact. It was considered in the alternative section. Analysis information can be found in Appendix C.

The compact states in Article IV-D that, "This compact is not intended to impede or prevent future beneficial development of the Arkansas river basin in Colorado and Kansas by federal or state agencies, by private enterprise, or by combinations thereof, which may involve construction of dams, reservoirs and other works for the purposes of water utilization and control, as well as the improved or prolonged functioning of existing works: Provided, that the waters of the Arkansas river, as defined in article II, shall not be materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas under this compact by such future development or construction".

Irrigation Induced Erosion

Excessive irrigation induced furrow erosion is occurring on approximately 15,000 acres. This occurs mainly in the upper portions (300 feet) of the fields. This erosion averages 42 tons per acre per year. Lower portions of fields are damaged by sediment disposition. An estimated 2-3 tons of sediment is contributed to the Arkansas each year per acre eroded. This sediment travels to the Arkansas River through drains and creeks, frequently clogging channels and restricting flows. The sediment is contributing to the reduction in flow capacity of the Arkansas River downstream. Some areas of the river are becoming seriously restricted, increasing flooding problems downstream. In addition to sediment, high concentrations of total dissolved solids (TDS), heavy metals, and nutrients are being carried downstream to other users. Yield reductions from the erosion and sedimentation may occur on the fields in the watershed.

Rural Water Problems

The towns of McClave, Wiley, Hasty, and Lamar obtain their water supply from wells. This is adequate for current needs and expansion is not anticipated.

Many of the farms are on a rural water supply system. Some farms not on the system, as well as most livestock watering facilities are from wells and may experience degrading water quality, therefore increasing the potential for future problems.

Fish and Wildlife Habitat

The major factors influencing environmental and fish and wildlife conditions in the watershed are land use, water quality and quantity. Past land use changes due to irrigation, in some cases have increased the food supply and cover. No changes in land use in the future are anticipated.

There is an opportunity to improve stream fisheries by reducing the amount of sediment, heavy metals, salts, pesticides and nutrients entering the hydrologic system. Sediment and other pollutants affect downstream fisheries diversity and populations by filling pool segments and changing bottom composition and water temperature. The stressing effects of high concentrations of suspended sediment also causes a reduction of the quality of fish habitat. Selenium and uranium, potentially threaten fish and wildlife using the watershed. This could include some endangered species.

On-site Problems

Irrigation induced erosion- 42T/ac/yr on 15,000 acres (630,000 T)

Productivity on irrigated land	decreasing
Maintenances on irrigation systems	high
Irrigation water application	fair

Off-site Problems

Annual Sediment deposition on irrigated areas-	600,000 T.
Sediment deposited annually into channels of Arkansas R.-	30,000 T. (20AcFt)
Average Selenium level in Arkansas River at Lamar-	19.7 mcgr/l.
Average Nitrate Level of groundwater-	Exceeds state standards on 6 wells
Selenium level in groundwater-	increasing
Salt load to Arkansas River from watershed-	387,000 T/yr

0557

Aquatic and wildlife habitat quality-	decreasing
Heavy metal levels in Arkansas River-	high,
Water quality in drains and creeks in watershed-	low
The average uranium concentration in ground water.	19.4 micro grams per liter.

There are significant opportunities to improve the environment within the watershed. Analysis of the watershed identified the problems discussed in this section. The problems are similar over the entire irrigated acreage and the drains that contribute the pollutants to the Arkansas River. Management and enduring irrigation practices provide the opportunities to reduce the heavy metals, sediment, nutrient and pesticide problems in the watershed and downstream in the Arkansas River. Wildlife and aquatic habitat is expected to improve through practice installation. The resource base including 44,500 acres of important farmland will be maintained which will help increase on farm benefits through reduced farming inputs and better yields and thereby improving the local economy. No land use change is anticipated, including irrigated acreages.

2/ Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage in the Middle Arkansas River Basin. USGS Water Resources Investigations Report 91-4060, Colorado and Kansas, 1988-89.

3/ Uranium Waters of Southeastern Colorado: A Function of Geology Climate, and Land Use by Robert A. Zielinski and Sigrud Asher-Bolinder. U.S. Geological Survey, Denver, CO.

4/ Selenium In Agriculture, Agricultural Handbook No. 200, 1961

5/ Aquatic Cycling of Selenium:, United States Department of the Interior, USFWS Leaflet 12, 1987

6/ Selenium in Agriculture and the Environment, Soil Science Society of America, Special Publication #23, 1990.

0553

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The problems and opportunities of the watershed are directly related to the capabilities and the degree of management of the watershed's resources. The inventory and analysis phases for this plan used a scoping process to identify those economic, environmental, and social areas of primary concern. This was a public participation process, that led to further investigation and analysis by NRCS.

NRCS gathered detailed information on current resource conditions. A projection of future conditions was made in order to formulate and compare alternatives and estimate their impacts.

During the initial stages of planning an analysis of a broad range of economic, environmental, and social factors in the watershed was carried out. Those factors that were directly related to the problems and opportunities and/or those that might be significantly affected by any potential project were considered. Also, each of the problems and concerns identified by the public at the scoping meeting, as well as those requiring consideration in any federally funded project, were reviewed and their significance to decision making was determined.

Table C lists the factors considered in this scoping process and their perceived significance to project formulation and decision-making. Factor rating "Low" or "None" in Table C were not likely to be affected by the project and were considered insignificant to decision making. Therefore, these factors are not discussed in this document. Those factors that have a "High" or "Medium" impact on the watershed would be affected by the project and were significant in decision making. A detailed study was then made on these factors by assessing the current conditions, formulating and comparing alternatives, and determining impacts of a selected plan.

The following issues were raised by the public during initial planning meetings. These issues necessitated NRCS to perform more detailed investigations as planning progressed.

IWM/Water Conservation

The watershed has an inefficient irrigation water delivery system as well as poor on farm water application. Poor water application increases the deep percolation and runoff which carries the heavy metals, nutrients, salts and sediment to the drains and creeks and finally back to the Arkansas River. The groundwater quality is also deteriorated.

Water Quality/Surface and Groundwater

The poor irrigation water application reduces surface and groundwater quality.

0553

Irrigation Induced Erosion

Upper portions of irrigated fields have been deteriorated by erosion. Productivity is also being lost.

Sedimentation

The sediment coming off the upper portions of the irrigated fields is being deposited on the lower portions of fields and into drains, creeks, and the Arkansas River. This sediment deposition on fields lowers the productivity potential. The sediment also carries heavy metals, and other pollutants into the streams and reduces channel capacity and the quality of fish and wildlife habitat.

Prime and Important Farmlands

The resource base is being deteriorated by irrigation induced erosion and sedimentation.

Social/Economic

Reduced water quality, inadequate irrigation system, as well as irrigation induced erosion has reduced yield, changed cropping patterns from higher valued crops and thereby reduced the income of the watershed area. Irrigated agriculture and livestock are the major portions of the economy of the area.

Wildlife Habitat

Erosion and sedimentation degrade upland wildlife habitat. Riparian vegetation along streams will continue to be impacted by pollutants.

Fish Habitat

Pollutants including sediment have reduced fisheries potential and habitat in the Arkansas River. The diversity of fish species and quantity of fish are also affected.

Municipal and Rural Water Supply/Groundwater

Pollutants are affecting the Arkansas River water quality and on-farm wells for humans and livestock. EPA and State standards are not met in some cases.

Wetlands

Wetlands are found along drains, the Arkansas River, and seeps in irrigated crop fields. Sediment and pollutants getting into wetlands should be reduced and therefore improve the water quality of the remaining wetlands.

Cultural Resources of National Significance

The problems and concerns found in the scoping process were not affecting the known cultural resources in the area. The Colorado Office of Archaeology and Historic Preservation conducted a search of the Colorado inventory of cultural resources.

In the event additional sites are identified and potentially altered or damaged by project action, work will be stopped until the applicable provisions of Public Law 93-291 and or Public Law 89-665 have been addressed. Applicable state laws dealing with Archaeological and Historical Site Preservation will also be met.

Threatened and Endangered Species

There are no known threatened or endangered plants or animals in the watershed that will be adversely affected by the project. Though not known to presently exist, the watershed is in the historic range for black footed ferrets. Bald eagles, piping plover, whooping crane, eskimo curlew, and least tern are known to exist in Colorado but no concentrated or preferred use areas are known or have been identified where project action will occur.

Recreation

The scoping meeting found that there was interest in developing a state park for Southeastern Colorado on a lake just north of our watershed area. It was brought up that there is a need for additional water quantity and better water quality for the State Park. Aquatic and upland wildlife, hunting and water sports are being considered.

Human Health and Safety

A concern was raised on the human and livestock use of water that doesn't meet state and EPA standards.

Pesticide

Samples show low levels of certain pesticides. However, levels are well within EPA and State standards.

Nutrients

The publics identified that high levels of nitrates above State and EPA standards have been found in some wells. Some areas of cropland have high nitrate levels in the upper 2 feet of the soil.

Civil Rights

Civil rights will be considered throughout the process to evaluate the effects of any proposed action on all segments of the populous.

Coordinating Other Activities

Through past and present monitoring, the U.S. Geological Survey has conducted studies and continues to study the surface and subsurface

water quality in the Arkansas River Basin. The USDA, Natural Resources Conservation Service (NRCS) investigation has and continues to identify water quality problem areas within the watershed.

A 319 demonstration project has been funded to show the effects of IWM including surge irrigation in the watershed area to improve water quality and quantity.

The Colorado Water Conservation Board has funded a project to demonstrate new initiatives in water management. Both projects and their data will be useful in encouraging farmer support and cooperation.

The state of Colorado is in the planning stage in the development of a water based fish and wildlife recreation area approximately 5 miles north of this watershed. It would be the only state park in Southeastern Colorado. The State is interested in any positive effects that this project may have on their project.

The Colorado Department of Public Health and Environment Water Quality Control Division is starting a monitoring program on the Arkansas River. This data may be useful to evaluate the beneficial effects of the project.

Table C - Identified Concerns

Economic, Social, Environmental, and Cultural Concerns	Degree of Concern	Degree of Significance to Decision making [1]	Remarks
Irrigation Water Management/ Water Conservation	high	high	Low efficiency and water short onsite
Water Quality/Surface and Ground water [2]	high	high	Arkansas River and wells, don't meet standards
Irrigation Induced Erosion [2]	high	high	
Sedimentation	high	high	Onsite and offsite
Land Use Change	low	low	No land use change to protect resource base
Sheet and Rill Erosion	low	low	
Prime/Important Farm Land [2]	high	low	
Social/Economic	high	high	
Wildlife Habitat [2]	high	high	Potential to improve
Fish Habitat [2]	high	medium	Potential to improve slightly
Flood Plain	low	low	
Floodwater	low	low	
Municipal and Rural Water Supply/Ground Water	high	high	Sediment and water quality
Gully Erosion	low	low	
Streambank Erosion	low	low	
Wetlands [2]	high	medium	Low groundwater quality
Windbreaks and Woodlands	low	low	
Air Quality	low	low	
Cultural Resources of National Significance [2]	high	medium	No effects expected
Threatened/Endangered Species [2]	high	medium	No effects expected
Mineral Resources	low	low	
Recreation	high	medium	Low water quality and quantity
Landscape Resource	low	low	
Human Health and Safety [2]	high	high	Determining water quality
Pesticides	medium	medium	Low concentrations
Nutrients	high	high	Reducing water quality
Civil Rights [2]	high	medium	Need to evaluate the effects
Coordinating Other Activities	high	medium	Need to evaluate data

[1] Factors important to decision making were used as a basis for formulating alternatives.

[2] Concern of Federal agency that must be considred in all analyses.

0563

FORMULATION AND COMPARISON OF ALTERNATIVES

The following objectives were defined by project sponsors at the onset of the project: (1) Reduce negative water quality impacts to surface and groundwater from selenium, sediment, salts and nitrate loading; (2) Achieve better water application to more effectively use available water for on and off-site uses; (3) Protect the soil resource base from excessive irrigation induced erosion.

Data were collected during field inventories and expanded to reflect the condition and needs for the entire watershed. Treatment alternatives were considered and defined, based on the types and extent of the problems taking place. The sponsors and publics participated in the formulation of several treatment alternatives. The effectiveness of each alternative in reaching the goals of the sponsors was evaluated and a recommended plan selected.

Formulation Process

With the sponsors objectives identified, two levels of inventories were conducted. A cursory inventory of the entire watershed, followed by a detailed inventory of 80 percent of the area was carried out. The total needs for the sampled area were identified. A list of potential measures to deal with the identified problems was drafted based on measure effectiveness, efficiency, completeness and acceptability.

Also considered during alternative development were aspects of the Arkansas River Compact. It was determined that none of the alternatives to be considered would change the amount of water to be diverted from the river or to project area laterals and field ditches.

Since the majority of the soils and underlying geologic formations in the watershed are similar, the problems and needs are similar. The watershed was therefore evaluated as one treatment unit during the formulation process.

Project formulation followed the inventory, forecasting, and analysis of the resource conditions that were found relevant to the identified problems and opportunities. Measures considered in the formulation of alternative plans included various approaches. Approaches believed to be effective in addressing one or more of the problems or opportunities as well as protecting the environment were further analyzed.

Civil rights impacts were considered during project formulation and alternative comparison. Consideration was given during data gathering, and documentation and alternative development. Each alternative developed will not limit accessibility or exclude potential program beneficiaries based on race, color, sex, national origin, religion, age, disability, marital or familial status when compared to other persons.

Alternatives were formulated to: reduce selenium concentrations in the ground water to acceptable limits, conserve and more effectively use

available water, and reduce irrigation induced erosion to acceptable limits.

Development of tillage, planting, and irrigation enduring and management practices specifically for the Limestone-Graveyard Creeks Watershed area conditions and development of a better understanding of nutrient, heavy metals and salinity management hold considerable potential for reducing heavy metals, nutrients and salinity damages. From the conservation practices in the NRCS Field Office Technical Guide, a list of practices was developed. Combining the practices in various ways, alternative solutions, with varying costs and impacts, were formulated. The formulation process, evaluation and comparison of alternatives, and the rationale for plan selection are presented in the following sections.

Appendix C contains water budget information for the various alternatives considered. A detailed discussion of alternative analyses are presented in this appendix. Analyses were carried out for, current irrigation management activities, a static irrigation set time, a system based on crop needs, and a surge irrigation system tied to crop needs. Data indicates that soil moisture depletion does not exceed 50 percent. Therefore it was concluded from the analyses that deep percolation could be reduced significantly with system and management changes without increasing crop consumptive use Hanks (1974) and Ritchie (1973). This reduction in deep percolation will reduce ground water pollution from selenium leaching, the problem for which the project has been formulated. The total quantity of Arkansas River water reaching the Kansas border is not anticipated to change with project implementation.

Each alternative solution was considered using four criteria:
- **Completeness** (extent the alternative provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects)
- **Effectiveness** (extent to which the alternative alleviates the problems and achieves the specified opportunities)
- **Efficiency** (extent to which the alternative is the most cost effective means of alleviating the specified problems and realizing the specified opportunities)
- **Acceptability** (extent to which the alternative is acceptable to State, local entities, and the public).

Civil rights issues were considered during alternative formulation.

DESCRIPTION AND EFFECTS OF ALTERNATIVE PLANS

Three approaches to treatment were considered and various alternatives were developed incorporating these various approaches. The approaches included large structural measures, only changing management, and a combination of management changes and enduring measures.

Each of the alternatives included examining the civil rights implications of proposed agency and project actions that could negatively impact agency employees and decisions related to employment and program beneficiaries, namely, the socially and economically disadvantaged, minorities, women, and persons with disabilities. None of the alternatives considered in detail were found to show any program action effects if implemented, that would result in denial or reduced program benefits of any form related to discrimination against any clientele group or employee.

The following alternatives were considered during this process:

Alternative 1. Future without Project

Studies of past achievements of land users in the watershed indicate that funds from the on-going programs are adequate to treat less than two percent annually of those areas with erosion, water quality and quantity problems. An analysis of available ongoing monies indicate that $40,000-50,000 is available in the watershed on an average annual basis from ACP and other programs. At this rate of funding, it would take at least 75-100 years to complete the work proposed without PL-566 cost-share program funding.

Components - None -

Effects - Without Irrigation system improvement, deep percolation and runoff will continue at its current unacceptable level. Poor irrigation water management will continue. Irrigation induced erosion will continue to damage the upper portions of the fields resulting in topsoil and yield losses. Sedimentation of the lower end of the fields and the carrying of salts, nutrients and heavy metals on to the Arkansas River will continue.

The water quality problems will continue in the surface and ground water. The municipal and rural water supply will continue to be impacted by these problems. This will continue to add to the water quality problems of the Arkansas River.

Recreational opportunities related to fish and wildlife, will continue to decline. The endangered species habitat value will continue to deteriorate as selenium accumulates in the food chain. Wetland plants, fish, and wildlife will continue to take up heavy metals at the current rate. These conditions also pose a potential health threat to livestock, wildlife, and humans.

The local economy is dependent on agriculture. As the soil resource is lost so is the economic base of the project area. Waterfowl hunting

also contributes to the local economy. Waterfowl populations may begin to be impacted by the accumulation of selenium in the ecological system. The Arkansas River fisheries will also be impacted by selenium concentrations. These facets of the local economy will be negatively effected by the existing water quality problems. The social implications are that some people may choose to move out of the area due to the water quality problems and continued loss of income to the economy of the area. The known cultural resources in the area will not be impacted.

Alternative 2. Management Measures

8,900 Acres of nutrient management practices,
2,900 Acres of conservation tillage, crop residue use, and polyacrylamides,
8,900 Acres of irrigation water management,
8,900 Acres of pest management.

Total Project cost is $616,000.

Components -
8,900 Acres of nutrient management practices,
2,900 Acres of crop residue use, conservation tillage, and polyacrylamides,
8,900 Acres of irrigation water management,
8,900 Acres of pest management.

Effects -
Implementation of management practices will more effectively use irrigation water by reducing deep percolation. Reduced irrigation induced erosion, sediment movement, and improved water quality of the surface and ground water will also occur. The overall effect is an improvement in the water quality of return flows and groundwater within the watershed.

The management practices associated with this alternative would slightly improve wildlife and fish habitat by reducing sedimentation and deep percolation. The additional ground cover along with water management would reduce the amount of irrigation induced erosion occurring. This would decrease the amount of sediment available for transport through the hydrologic system. The amount of contaminants entering the ecological system from agriculture would be reduced by utilizing this alternative. The impact of agriculture on endangered species would be lessened due to improved water quality and conservation.

The social and economic conditions would improve as improved water application allows the agricultural producers to better meet crop needs and contribute to the goal of improved water quality. The protection of the soil resource base from irrigation induced erosion will also have a positive effect on the local economy. The environmental conditions related to fish and wildlife will show a slight improvement

thus providing a similar impact on the social economic conditions in the area.

The known cultural resources in the area would not be impacted.

In analyzing the beneficial effects to the project area and off-site, it is necessary to make every effort to address the sponsors concerns. These concerns include protection of the water resource from pollution, protection of the soil resource from irrigation induced erosion and effective irrigation water application. Irrigation water management is an essential component in addressing these concerns. However, the on-farm irrigation water conveyance and application systems must also be improved to achieve an adequate level of irrigation water management.

The benefits previously mentioned are directly correlated to the degree of irrigation water management attained in the project area. Sponsors concerns and objectives cannot be met by management practices alone even if cost shared. Meeting water quality standards could not be reached with this alternative. The effects shown in the summary and comparison of the candidate plans in Table D used a 20% participation level by farmers.

Sponsors and farmers input was also obtained on a participation rate that would actually occur if technical assistance were available with out cost sharing management practices. It was their opinion that due to the risk and uncertainty of applying just management practices, the participation rate would actually be in 20-25% range. The benefits derived from this alternative were therefore be proportionally reduced.

Alternative 3. Management Plus Enduring Irrigation System Improvements (NED and recommended plan)

149,610 Feet of concrete ditch lining,
213,710 Feet of irrigation pipeline,
Mitigation practices including (10 multi-purpose ponds and 20 acres of wetland development),
3,300 Acres of land leveling,
56 Water control structures, and appurtenances, for irrigation pipeline and lined ditch systems,
Management practices which include; 26,700 acres of nutrient management, 8,800 acres of conservation tillage, crop residue use, and polyacrylamides; 26,700 acres of pest management and 26,700 acres of irrigation water management.

Costs -	Total Project	$5,326,000
	PL - 566	$3,056,500
	Other	$2,269,500

See Table 1 for further cost breakdown and Appendix B for map of area to be treated.

Effects -
The combination of irrigation enduring practices along with the management practices will facilitate the best water application of any of the alternatives. The deep percolation would be reduced by 40%. Irrigation induced erosion would be reduced by 88%. This alternative provides the greatest reduction of irrigation induced erosion of any of the alternatives. A significantly greater degree of improvement in the surface and ground water quality would be achieved over previously mentioned alternatives.

Appendix C contains information regarding the methodology used in the alternative evaluations. A primary concern of Kansas and Colorado is that this project should not adversely affect the Arkansas River Compact. The project will not reduce the amount of water that is to be available in the Arkansas River system for Kansas. Appendix C contains information to support this fact. In summary, NRCS methodology for predicting water utilization is based on individual field analysis models. The models suggest that crop consumptive use will not change as a result of the project actions. Irrigation efficiency will be increased from 29 percent to 50 percent, thereby making more effective use of diverted surface water. Additional, there are approximately 40 wells in the treated area, producing 5,600 acre feet per irrigation season for supplemental irrigation water. The need to utilize these wells will be reduced as a result of improved utilization of diverted surface irrigation water. The estimated amount of reduced well water needed for supplemental irrigation is based on the above mentioned wells being used on 9,700 acres and a 60 percent participation level of watershed clients. Support documentation is available upon request.

The total selenium concentration levels at the gage at Lamar will be reduced from 19.7 micrograms/liter by approximately 17 percent through project action. A similar reduction will occur in the wells in the irrigated area. Both will be reduced to within EPA standards. The reduction will improve the quality downstream as well. Other heavy metals, salts, and nutrients will be similarly reduced which have a corresponding improvement in surface and ground water quality.

Selenium uptake by wetland plants along the river will be reduced, thus benefiting wetlands and wildlife. The river's selenium level will be reduced to within EPA and state standards.

The fishery habitat in the Arkansas River will be improved. This should also improve the fishing potential.

Project implementation will cause a 32% reduction of nitrates concentration in groundwater.

Project implementation will result in an 30% reduction of salts being delivered to the Arkansas River.

Conservation tillage, use of Polyacrylamides (PAM) and or crop residue use practices will reduce the irrigation induced erosion in the watershed from 42 T/AC./YR. on the upper 1/3 of the fields to 5 T/AC./YR. with alternative implementation. This will also reduce the

amount of sediment available for delivery to irrigation ditches and drains and the Arkansas River. The sediment associated heavy metals, salts and nutrients reaching the river will also be reduced. These practices will also help preserve the remaining river channel capacity. The downstream water users will benefit by receiving higher quality water and reduced maintenance.

The fish and wildlife habitat of some species within the watershed will be enhanced through the implementation of this alternative. The overall value of the wildlife habitat in the area will not be changed significantly. Recreation opportunities related to the fisheries and wildlife should see some improvement. Acres affected by the project area estimated at less than 50% of the Type I wetlands (45 acres) and less than 1% of the Type VI wetlands (2 acres). NRCS arrived at the acres of Type I wetlands by estimating 60% participation in the project, and 80% of the wetlands on participating farm will be affected. The majority of the Type VI wetlands are along the Arkansas River and the major ditches and drains. It is expected to have no adverse effects on these Type VI wetlands, however, a very small number of on farm drains or ditches could have woody vegetation and associated wetlands. The 1% figure was used to cover these cases. The Types III and V wetlands represent lakes, ponds, and areas with shallow water most of the growing season. The project is not expected to have any effect on these wetlands. However, if a negative effect occurs due to project action, a mitigation strategy has been developed.

The cultural resources located within the project area are close to the Arkansas River and are not effected by the irrigated cropland activities.

The greatest social and economic benefits would be realized with this alternative. These benefits will be achieved as improved water management allows the agricultural producers to better meet crop needs and contribute to the goal of improved water quality. This alternative will provide the greatest protection of the soil resource base from irrigation induced erosion which will also have a positive effect on the local economy. The environmental conditions related to fish and wildlife will see significant improvement thus providing a similar impact on the social and economic conditions of the area.

Alternative 3 (Recommended Plan) Monitoring Plan

The National Water Quality Assessment Program (NAWQA) is anticipated to begin in 1996 by the USDI Geological Survey in the Arkansas River Basin. NRCS will utilize data to evaluate project effectiveness in regards to selenium.

The Colorado Department of Public Health and Environment is beginning an intensive alluvial ground water quality monitoring program for the Arkansas River in Colorado. Part of this study will be in the project area and the data will be utilized by NRCS to help measure project effectiveness in regards to selenium and nitrate reduction in groundwater.

The Colorado Water Conservation Board has funded a demonstration project within the watershed. The effects of practices applied will be monitored to determine the impacts on deep percolation which effects water quality.

There is also a 319 Best Management Practice (BMP) Demonstration Area in the project area. A monitoring plan has been developed to demonstrate how BMPs effect water quality. Water budget data will be collected from irrigation producers on the fields monitored. NRCS will continue this on-farm water budget monitoring as necessary to evaluate the Limestone-Graveyard Creeks project effectiveness in relation to project goals established by the sponsors.

Other alternatives considered but not developed into alternatives plans due to not meeting the 4 criteria include:

1.) Canal lining did not reduce pollutant problems to an acceptable level and was too costly.

2.) Change to center pivots was far too costly.

3.) Purchase of the irrigation rights from the land owners within the watershed, and purchase the feed lots. This would have effectively eliminate the agricultural contribution of pollutant to the surface and to the groundwater. The negative effect on the local economy as well as not being locally acceptable kept this from being developed.

Comparison of Alternative Plans
The Alternative Plans are displayed for comparison on Table D.

0571

Table D
Summary and Comparison of Candidate Plans

Effects	Alternative 1 No Action	Alternative 2 Management Measures	Alternative 3 TRP - (NED)
Measures	------	Conservation tillage/crop residue use/polyacrylamides 2,900 Ac., Nutrient Mgnt. 8,900 Ac., Irr. water Mgnt. 8,900 Ac., Pest Mgnt. 8,900 Ac..	Conservation tillage which may include crop residue use, 3,000 Ac. polyacrylamides 5,800 Ac., Nutrient Mgnt. 26,700 Ac., Irr. water Mgnt. 26,700 Ac., Pest Mgnt. 26,700 Ac., Land leveling 3,300 Ac., Irr. ditch lining 149,610 lf., Irr. pipeline 213,710 lf., Surge irrigation appurtenances 56, Water control structures 48, mitigation 10 ponds and 20 acres of water development
Project invest.	$0	$616,000	$5,326,000
National Econ. Devel. Acct.			
Beneficial annual	$0	$148,800	$730,100
Adverse, annual	$0	$147,800	$561,600
Net beneficial	$0	$1,000	$168,500
Environmental Quality Acct.			
Wetlands	Some plants highly contaminated with selenium.	Reduced selenium delivered to wetlands from irrigation.	Reduced selenium delivered to wetlands from irrigation.
Prime & Unique farm land	44,500 Ac.	44,500 Ac.	44,500 Ac.
Threatened & Endangered Species	No population impact, No decrease in habitat quantity	No population impact, No decrease in habitat quantity	No population impact, No decrease in habitat quantity

Table D
Summary and Comparison of Candidate Plans

Effects	Alternative 1 No Action	Alternative 2 Management Measures	Alternative 3 TRP - (NED)
Ground water quality	Of the well records reviewed, six exceeded the state standard for nitrates and twenty were approaching it.	14% decrease in nitrate concentration	32% decrease in nitrate concentration
	Selenium contamination will continue at an unacceptable rate	Selenium contamination will be reduced slightly	Selenium contamination will be reduced significantly
Surface water quality	Arkansas river @ Lamar, Selenium 19.7 Ug/L with an estimated increase of .2 Ug/L/year	Selenium concentration decreased by 7%	Selenium concentration decreased by 17%
	Uranium concentration is 5% greater at Lamar than at John Martin Reservoir (1 Ug/L)	Uranium concentration is reduced by .19 Ug/L at Lamar	Uranium concentration is reduced by .4 Ug/L at Lamar
	Salt loading to the Arkansas river through surface flows and ground water recharge, 387,000 T/Yr.	19% reduction in salt loading	30% reduction in salt loading
	Fisheries and wildlife habitat will continue to be significantly impacted by heavy metals	Fisheries and wildlife habitat will continue to be significantly impacted by heavy metals	Fisheries and wildlife habitat will continue to be significantly impacted by heavy metals
	Livestock water will continue decrease in quality due to heavy metals	Livestock water will improve	Considerable improvement in livestock water quality will be achieved

Table D
Summary and Comparison of Candidate Plans

Effects	Alternative 1 No Action	Alternative 2 Management Measures	Alternative 3 TRP - (NED)
	Wetland plants along the Arkansas River and in ponded areas will continue to contain high heavy metal concentrations	Wetland plants along the Arkansas River and in ponded areas will continue to contain high heavy metal concentrations	Wetland plants along the Arkansas River and in ponded areas will continue to contain high heavy metal concentrations
Soil resource	42 T/Ac./Yr. of irrigation induced erosion on upper 1/3 of fields	86% reduction in irrigation induced erosion on upper 1/3 of fields	88% reduction in irrigation induced erosion on upper 1/3 of fields
Irrigation induced erosion	15,000 Ac. damaged by moderate irrigation induced erosion	Irrigation erosion reduced to nearly "T"	Irrigation erosion reduced to below "T"
Arkansas river channel capacity	Impacted by irrigation erosion sediment	Moderate sediment reduction from furrow erosion	Significant sediment load reduction from furrow erosion and irrigation ditch erosion
	Fisheries habitat will continue to be negatively impacted by sedimentation	Fisheries habitat will continue to be negatively impacted by sedimentation	Fisheries habitat will continue to be negatively impacted by sedimentation
Cultural Resources			
Santa Fe Trail	No effect	No effect	No effect
Bent's Fort	No effect	No effect	No effect
Ft. Lyons ruins	No effect	No effect	No effect
Other Social Effects Acct.			
Health and Safety	Continue to deteriorate	Moderate improvement	Significant improvement
Local economy	Continue to deteriorate	Moderate improvement	Significant improvement
Irrigation water	Considerable loss to deep percolation	Reduced deep percolation losses	Minimal loss due to deep percolation

0574

RISK AND UNCERTAINTY

There is some uncertainty with regard to the benefits from implementing the recommended plan. Some of this work will be accomplished with farm labor. The availability of this type of labor will have an impact on the cost and extent of certain practice application. The economic atmosphere surrounding agriculture will have a bearing on how much and how fast conservation treatment is attained.

Weather patterns also affect project implementation. If a wet period of years occurs, more people may see a need to reduce water erosion, which may increase conservation practice application. Water short years also improve IWM interest.

The accelerated land treatment practices are part of a voluntary program, so it cannot accurately predict the number or location of land users that will participate. However, a 30% participation level is required prior to any expenditure of federal implementation funds.

The non-cost share management practices must be performed even after NRCS Long Term Contracts with participants expire to ensure the enduring practices continue to function as planned. Crop rotations, though not expected, could change and create unexpected conditions.

Implementation using PL 83-566 funds is subject to appropriation of funds by the United States Congress for the PL 83-566 program.

RATIONALE FOR PLAN SELECTION

Table D presents a comparison of the costs, benefits, and impacts of the NED recommended plan with the "No Action" plan. The recommended plan consists of management as well as enduring practices. These practices will be applied on irrigated cropland. All the resource concerns are addressed in the plan.

A combination of practices were used for each increment (See Appendix C for incremental analysis). The first increment included management practices, and the 2nd increment added irrigation system improvements that met the test of effectiveness, efficiency, acceptability, and completeness. To determine benefits versus cost, emphasis was placed on achieving the greatest net return for planned actions. It was on this basis that an alternative was selected as the National Economic Development (NED) plan and the Recommended Plan (RP).

There are no significant long-term negative effects related to the recommended plan. In the short-term, however, there may be a slight increase in erosion due to the soil disturbance which will occur during the implementation of enduring practices.

All the beneficial effects of the recommended plan cannot be expressed in terms of dollars. Erosion reduction helps improve the resource base

and increases yields, which in turn improves the water quality of the Arkansas River. Also as deep percolation is reduced there is a reduction pollutants into the water system. These pollutants include sediment, heavy metals, nutrients, and salts. Some wetlands may have less water available to them. If an impact occurs in any wetlands, they will be mitigated for. The aquatic macrophytes will be extracting less selenium due to its reduced levels. Surface and ground water quality are improved.

CONSULTATION AND PUBLIC PARTICIPATION

Consideration as a PL566 watershed project was requested in March 1989. A field review was made on March 23, 1989. The review team found that significant irrigation water management, water quality, and watershed protection treatment was needed. The Soil Conservation District and Natural Resource Conservation Service Field Office decided that detailed information collection would be the first priority. Data on water quantity, quality, and practice needs were gathered. 90% of the landowners expressed interest. Significant resource problems were found and the sponsors made an application for PL-566 planning assistance June 16, 1989.

The State Soil Conservation Board formally accepted the application on September 6, 1989. The Soil Conservation Services' West National Technical Center (WNTC) made a field reconnaissance October 25, 1989. They met with the irrigation company personnel, field offices, and conservation district officials. It was decided further data was needed to quantify the off-site effects from project action. In January 1993, the Natural Resource Conservation Service Field Office, area staff and state staff developed a schedule to complete a preauthorization plan and plan of work.

On June 24, 1993, a public scoping meeting was held to discuss the problems, needs, and possible effects from a project. Federal, State, local agencies, and interested public were invited. This group helped give direction to the NRCS planners. A public response analysis was completed on the responses. A summary of those responses is shown on Table C.

An environmental evaluation meeting was also held on June 24, 1993, to identify environmental concerns and issues and discuss how best to address those concerns.

Numerous newspaper articles, newsletters, and radio public service announcements have been aired to provide public information. Public meetings with the news media in attendance were held to gain input and inform the public.

A public meeting in the morning and a sponsors meeting in the afternoon were held December 2, 1993, to determine the desirability of pursuing a planning authorization and review the preliminary plan. The sponsors felt that cost shared management practices were essential to get adequate water quality improvement. Potential alternatives and the responsibilities of each sponsor and NRCS were stressed in discussions. The SCDs have the right of eminent domain under authority established by state law. They are willing to fulfill their agreements to see that a plan is formulated and implemented.

The public and sponsors encouraged NRCS to go forth with the request for planning. Potential practices and alternatives were reviewed to inform what may be needed. A revised application was developed and approved by the sponsors to slightly change the watershed size and sponsors in January 1994.

The sponsors reviewed the preauthorization report in March 1994 and concurred with the report. However, the sponsors requested cost share on management practices. NRCS agreed to pursue cost sharing for management practices. The preauthorization report was transmitted to the West National Technical Center in Portland for technical review in April 1994. A review by the West National Technical Center was completed on June 30, 1994. Comments were incorporated, and on July 28, 1994, the SCD boards reviewed WNTC comments on the Preauthorization Plan, and agreed to continue their support of the plan even though cost sharing for management practices were not approved.

The SCD boards have met regularly and provided positive leadership to the furthering of conservation and improvement of the watershed. Ongoing water quality, quantity and management practices are being installed by a combination of landowner, district and state funds. The two district boards cooperated in getting a 319 demonstration project, approved in February 1994, to show the value and monitor the effects of surge irrigation and irrigation water management on 6 fields in the watershed area.

The Colorado Water Conservation Board also awarded the Bent SCD a grant to demonstrate new irrigation technology and monitor the results in January 1994 on 10 farms.

Incorporation of the comments and sponsor support was received in August 1994. Federal approval and authorization for planning assistance for the watershed was received on September 26, 1994. A meeting was held in December 1994 with field and area staffs, the State Water Resources Planning staff, and sponsors to review the Plan of Work and develop assignments to complete the watershed plan.

During January 1995, a geologic reconnaissance and reference search and report was developed.

The Watershed Plan was developed and reviewed with the sponsors at their board meetings in May, 1995. They requested that NRCS have a public meeting to present the plan to all interested publics. On June 1, 1995, a public meeting was held in Lamar, CO. It was the consensus of those present to move forward into inter-agency review.

A request was made to the Watershed Planning and Restoration Division on August 7,1995 to include Polyacylamide as a cost-shared practice. Approval was granted for this new technique on September 7,1995 and has been incorporated into the plan.

The Interagency review was completed May 20, 1996. Comments were incorporated into this plan. The FONSI was entered into the Federal Register August 29th, 1996. No comments were received after publishing.

RECOMMENDED PLAN

Purpose and Summary

Management plus enduring irrigation systems improvements (Alternative Number 3) was selected as the recommended plan. The purposes of this plan are Agricultural Water Management and Watershed Protection. The practices will improve water quality and conserve water. Practices will also be installed to protect the resource base by reducing irrigation induced erosion and sediment. The measures needed are shown in Table 1. The measures effects coincide with the sponsors goals.

Measures to be Installed

Land Treatment Practices

The current programs available to address conservation concerns within the watershed will remain functional. This project's actions will supplement and accelerate, not replace, on-going activities. All landowners and operators wishing to participate in this project may, unless their land already is involved in an existing contractual program. It is the landowner's or operator's decision as to which treatment measures to implement or if they want to participate. The estimated participation rate is 60% of the irrigated cropland acreage.

Technical assistance in a PL566 project is distributed between planning, education/training, implementation, and follow-up. Long-term contracts with individual participants will be the vehicle used to accomplish implementation. An estimated 5 staff years is necessary for developing conservation plans. Implementation of contracts will require approximately 9 staff years. The follow-up will create a need for an estimated 5 staff years. The educational component will be developed by the sponsors, districts and field offices. It will include technology transfers through workshops, onsite demonstrations, and one on one contacts. It will be carried out through a cooperative effort between the Soil Conservation District, NRCS, and Colorado Cooperative Extension Service.

Financial assistance, as it relates to planned practice extents, can be derived from Table 1. Also a schedule of obligations for the project maybe found on table E.

The major land treatment practices, and estimated construction costs are:

Pest and nutrient management practices will insure that proper amounts of nutrients and pesticides are applied to minimize negative environmental effects and achieve production goals.

Mechanical furrow modification will be used to attain application goals. This is a non-cost shared item. Furrow modification through the use of polyacrylamides will be cost shared.

Conservation tillage and or crop residue use will increase residue to reduce irrigation induced erosion on the upper 300 feet of the

irrigated cropland. The use of PAM will also achieve this effect. This will reduce sediment on the lower portions of the fields and into the Arkansas River. No cost sharing is available through PL-566 for conservation tillage or crop residue use.

Irrigation water utilization will be improved by changing water irrigation methods and procedures. This is a non-cost share practice through PL-566.

Wetland mitigation practices anticipated will include approximately 10 multi-purpose ponds and 20 Acres of wetland development.

Improved Surface Systems - about 26,700 acres will have present surface irrigation systems improved. An estimated 1/2 of the acres will be converted to surge irrigation. Improvements include land leveling, plastic pipe, ditch lining gated pipe, and related practices. Land leveling will improve irrigation water application and reduce deep percolation. Plastic pipe will be installed to deliver water to surge valves, and also to gated pipe in fields proposed for shorter lengths of run. Total estimated cost of improved surface irrigating systems is $1,834,300 for federal share and the same for the local share.

Mitigation

Where wetlands are impacted by installation of conservation measures, mitigation will be carried out in accordance with Natural Resource Conservation Service Policy. This policy states that where mitigation is needed, it will replace wetlands on a value for value basis. Any needed mitigation will be required to be included in participants contracts. Other mitigation arrangements will be considered as options become available.

Permits and Compliance

It is the contractees' responsibility to obtain any federal permits or formal land rights that will be needed to install the project (40 CFR 1502.25). In the event that land rights or permits become necessary, the responsibility to acquire these items will occur before construction.

Costs

The total cost of the project which includes both federal and local money is $5,326,000. Table 1 itemizes the costs by measure. Those measures showing no cost will not be cost-shared under this project. Table 1 displays how the costs of each measure are shared between federal and local dollars.

The federal cost-share rate is 50 percent for enduring irrigation practices. The federal Cost-share rate for other enduring practices is based on the rate presently used by other federal programs for similar practices. Polyacrylamide application, an innovative approach to reducing irrigation erosion in the watershed has been approved for cost

sharing (see page iii of Agreement for rate). Other management practices will not be cost shared.

The estimated technical assistance costs for the above measures are $1,050,200. This assistance will be in the form of education, conservation planning, designing, and follow-up. The cost for this technical assistance is borne by the NRCS. Project administration costs are estimated to be $202,000 of which $172,000 is federal and $30,000 is local. This local cost is borne by the local Soil Conservation Districts.

TABLE E - Schedule of Obligations
Limestone-Graveyard Creeks Watershed

Year	Item	$ PL-566	$ Other	$ Total
1	Financial Assistance	350000	425000	775000
	Technical Assistance	95000		95000
	Administation	20000	5000	25000
2	Financial Assistance	400000	500000	900000
	Technical Assistance	110000		110000
	Administation	22000	3000	25000
3	Financial Assistance	400000	500000	900000
	Technical Assistance	110000		110000
	Administation	22000	3000	25000
4	Financial Assistance	400000	500000	900000
	Technical Assistance	110000		110000
	Administation	22000	3000	25000
5	Financial Assistance	284300	314500	598800
	Technical Assistance	100000		100000
	Administation	22000	3000	25000
6	Financial Assistance			0
	Technical Assistance	80000		80000
	Administation	15000	2000	17000
7	Financial Assistance			0
	Technical Assistance	80000		80000
	Administation	15000	2000	17000
8	Financial Assistance			0
	Technical Assistance	75000		75000
	Administation	8000	2000	10000
9	Financial Assistance			0
	Technical Assistance	75000		75000
	Administation	5000	1000	6000
10	Financial Assistance			0
	Technical Assistance	75000		75000
	Administation	5000	1000	6000

TABLE E - Schedule of Obligations
Limestone-Graveyard Creeks Watershed

Year	Item	$ PL-566	$ Other	$ Total
11	Financial Assistance			0
	Technical Assistance	70000		70000
	Administation	5000	1000	6000
12	Financial Assistance			0
	Technical Assistance	40200		40200
	Administation	5000	1000	6000
13	Financial Assistance			0
	Technical Assistance	10000		10000
	Administation	2000	1000	3000
14	Financial Assistance			0
	Technical Assistance	10000		10000
	Administation	2000	1000	3000
15	Financial Assistance			0
	Technical Assistance	10000		10000
	Administation	2000	1000	3000
	TOTALS			
	Financial Assistance	1834300	2239500	4073800
	Technical Assistance	1050200	0	1050200
	Administation	172000	30000	202000
	Grand Total	3056500	2269500	5326000

Installation and Financing

Implementation of planned on-farm land treatment measures will be through individual long term contracts (LTC).

Framework for Carrying Out Plan

The project installation period is fifteen years. Long Term Contracts (LTC) development will be accomplished during the first five years. Installation of practices will begin the first year and continue through year thirteen. Peak years for installation of practices (construction) will be the second through the eighth year. Participation in the project is voluntary. Landowners or entities wishing to participate must submit an application to enter into a contract with the NRCS. The application must contain a legal description of the property to be considered for the contract. A copy of an affidavit which indicates the individual or entity has control over the land which would be involved in the contract. If a lease is used, it should indicate the terms and length. The Soil Conservation Districts and the NRCS will determine the eligibility of an individual or entity to enter into a contract. They will also review the applications and set priorities for approval based on the concerns of the sponsors.

Planned Sequence of Installation

Assistance for planning, design, construction layout, and maintenance of practices will be provided by NRCS. The treatment expenditures for the project are those anticipated for installation, technical assistance, and administration of land treatment contracts. The NRCS will assist the SCDs with the educational component of the technical assistance.

Costs associated with installation of practices will be borne in part by the NRCS. NRCS funds for technical and financial assistance will be contingent upon and obtained from an appropriation from the Watershed Protection and Flood Prevention Act (PL-566). Table E displays the planned sequence of obligating funds for the project and the installation schedule.

Responsibilities

The Bent Soil Conservation District, the Prowers Soil Conservation District, The Fort Lyon Canal Company and the Colorado State Soil Conservation Board are the sponsors for the small watershed program (PL83-566) Land Treatment Watershed. The SCDs will coordinate activities.

During the first years of the project the educational component of the "Technical Assistance" will be implemented. Workshops are the chosen method of implementation. These workshops will present resource management concepts, methods, and technologies.

Cooperators will be strongly encouraged to participate in a workshop as a prerequisite for receiving PL-566 cost-share funds. NRCS will certify landowner or entity participation.

The NRCS will be responsible for technical services, writing and administering the land treatment contracts, providing follow-up assistance for operating and maintaining practices, and certifying installation of land treatment practices. The plans will be written in accordance with the guidelines found in the Field Office Technical Guide, National Conservation Planning Manual and the National Long-term Contracting Manual. Resource management systems will be installed by landowners who will enter into Long-term Land Treatment Contracts with the NRCS.

The Conservation practices will be applied by the participants or through contractors hired be the project participants. The NRCS will administer all contracts and provide cost-share funds. Cost-share payments will be based on county average costs, or in some cases the actual cost not to exceed a specified maximum, for that practice. County average costs will be updated annually by the NRCS. The participants will be responsible for their share of the cost of each installation. In addition, the participants will be responsible for following management plans prepared for the operating unit.

Contracting

Approximately 108 individual Long Term Contracts on 26,700 acres will be developed with assistance from NRCS. Participants representing at least 30 percent of the irrigated land needing treatment must apply for an LTC before any LTC will be approved. The participants share of the cost of installing practices may come from any source other than Federal funds without a reduction in NRCS funding as long as the total financial assistance to be received does not exceed 100 percent of the cost. If other Federal funds are used, the NRCS share will be reduced by the amount of the other Federal funding.

The basis for each LTC will be a conservation plan of operations (CPOs) that will detail the kind, amount, location and installation schedule of the planned practices. CPOs will be reviewed and approved by the SCDs prior to finalization of the contract between NRCS and the participant.

Primary considerations in establishing the installation schedule include: the seasonal nature of the practices; the inter-relationship of practices; the availability of contractors and materials; the landowners' financial situation; and the need for and availability of technical services. These considerations will provide land users the maximum time possible to finance their share of the project installation cost.

Each contract may range in length from 3 to 10 years. All cost-share practices must be installed two years before the end of the contract,

to allow two years of management, and operation and maintenance. The installation schedule will include the necessary management practices.

LTCs will be approved by NRCS and the SCDs'. All LTC's must be signed within 5 years of the date the watershed plan is approved. Contracts can be modified or revised as long as project objectives, as identified in the watershed plan are achieved.

Real Property and Relocations

No real property acquisition or relocations will be necessary.

Other Agencies

Monitoring of the surface water and groundwater in the watershed area will continue in the future. NRCS will obtain copies of the tests from the USGS and Colorado Department of Public Health and Environment.

Cultural Resources

Cultural resources compliance for each farm will follow the procedures in the NRCS General Manual, Section 420.

Financing

The individual land users will be responsible for arranging their own personal financing for their portion of the cost to install the needed conservation practices.

Conditions for Providing Assistance

Technical and financial assistance furnished by the NRCS is contingent on the appropriation of funds by the United States Congress.

Operation, Maintenance, and Replacement

The participant is responsible for the annual operation and maintenance, as well as replacement of installed practices. These costs are estimated to be about $73,300 annually. The participants are responsible for all replacement costs. The expected useful life for the appurtenant structures is 15 years. All other enduring practices have an expected life of 25 years or more.

Table 1, Estimated Installation Cost
Limestone Graveyard Creeks Watershed, Colorado

Installation cost item	Unit	Amount	PL-566 Funds $ Dollars	Other Funds $ Dollars	Total $ Dollars
Management Practices					
Irrigation Water Management	AC	26,700		106,800	106,800
Nutrient Management	AC	26,700		53,400	53,400
Conservation Tillage	AC	5,800		58,100	58,100
Pest Management	AC	26,700		186,900	186,900
Polyacrylamide	AC	3,000	37,500	37,500	75,000
Subtotal (Management)			37,500	442,700	480,200
Enduring Practices					
Ditch Lining (concrete)	FT	149,610	598,400	598,400	1,196,800
Pipeline	FT	213,710	619,800	619,800	1,239,800
Land Leveling	AC	3,300	268,800	268,800	537,600
Water Control Structures	#	48	23,000	23,000	46,000
Appurtenant Structures	#	56	270,300	270,300	540,600
Mitigation					
Ponds	#	10	12,500	12,500	25,000
Wetland Development	AC	20	4,000	4,000	8,000
Subtotal (Enduring)			1,796,800	1,796,800	3,593,600
Technical Assistance			1,050,200		1,050,200
Administrative Costs			172,000	30,000	202,000
Total Project			3,056,500	2,269,500	5,326,000

1/ Price base 1996 9/96
2/ All on non-federal land

0586

0587

Table 4 Estimated Average Annual NED Costs
Limestone-Graveyard Creeks Watershed Colorado
(Dollars) 1

Evaluation Unit	---------Project Outlays---------- Amortization of Installation Cost	Maintenance Operation and Replacement Cost	Total
Land Treatment /Accelerated Irrigated Cropland	$488,300 2	$73,300	$561,600
Grand Total	$488,300	$73,300	$561,600

September 1996

1 Price Base 1996 discounted at 7 3/4 percent rate for 25 years.

2 Includes costs for technical assistance, project administration, and installation of land treatment practices.

Table 5a Estimated Average Annual Watershed Protection
Damage Reduction Benefits
Limestone-Graveyard Creeks Watershed Colorado
(Dollars) [1]

Item	--Damage Reduction Benefits-- Average Annual-Agricultural-related
Onsite Irr. Labor Reduction	$265,300
Water Quality	$215,400
Crop stand damage	$88,500
Subtotal	$569,200
Offsite Irr. Labor Reduction Ditch Cleanout	$17,300
Water Quality	$143,600
Subtotal	$160,900
Grand Total	$730,100

September 1996

1 Price Base 1996

0589

Table 6 Comparison of NED Benefits and Costs
Limestone-Graveyard Creek Watershed Colorado
(Dollars) [1]

Eval. Unit	Agricultural Related Onsite Damage reduction	Agricultural Offsite	Average Annual Benefits [2]	Average Annual Costs [3]	Benefit Cost Ratio
Accelerated Land Treatment 26,700 acres	$561,600	$160,900	$730,100	$561,600	1.3:1.0
Total	$561,600	$160,900	$730,100	$561,600	1.3:1.0

September 1996

1 Price Base 1996

2 From Table 5a

3 From Table 4

A Plan for the Development, Use and Conservation of the Resources of the Arkansas Basin in Colorado - Colorado Coordination Committee, Arkansas-White-Red Basins Inter-Agency committee, October 1953.

Abbott, P.O., "Description of Water-Systems Operations in the Arkansas River Basin, Colorado," U.S. Geological Survey Water-Resources Investigations Report 85-4092, 1985.

Analysis of Colorado Precipitation, by Kuo, M. and Cox, S.K., Colorado State University.

An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources. A Procedural Handbook. Published by U.S. Environmental Protection Agency (EPA) 600/8-80-012.

Annual Operating Plan, Frying Pan-Arkansas Project 1979-1980 USDI-W&PRS, April 1980.

Arkansas River Basin Cooperative Study Report, 1981 - Colorado Water Conservation Board, USDA Economic Research Service, Forest Service, and Natural Resources Conservation Service. (Formerly SCS)

Arkansas River and Tributaries - John Martin Dam, Colorado to Great Bend Kansas, December 1972. Report on Review Survey for Flood Control and Allied Purposes - U.S. Army Engineer District Corps of Engineers, Albuquerque, NM.

Arkansas River Tributaries, Las Animas, Colorado, and Vicinity - Letter from the Secretary of the Army July 2, 1943, 89th Congress, 1st Session House Document No. 165, May 11, 1965.

Arkansas Valley Water Management program by USDA Natural Resources Conservation Service.

Arkansas-White-Red Basins
Inter-Agency Committee Reports
Part II
Section 2 - Water Resources Project Data, Volume A, 1955
Section 5 - Drainage 1955
Section 6 - Irrigation and Reclamation 1955
Section 8 - Domestic and Industrial Water Supply 1955
Section 11- Agriculture 1955
Section 17- Availability USE, and Control of Water 1955

Basic Land Information Storage and Retrieval System. A Course Description and Set of Instructions. State and Private Forestry, Region 2, U.S. Forest Service, Coryell A. Alexander, 1979.

Bent County Colorado Soil Survey, Jan. 1971, USDA SCS and Colorado Agricultural Experiment Station.

"Bibliography of Published Reports on Sedimentation," March 1962. Arkansas-White-Red River Basins, Arkansas-White-Red Basins Inter Agency Committee.

Boesch, B., Irrigation Induced Erosion, August 1993. Report on the Second Irrigation Induced Erosion Meeting in Kimberty, Idaho.

Broner, I., Surge Irrigation Guide, Bulletin 543A, 1988 - Colorado State University Cooperative Extension.

Burns, A.W., Selected Hydrographs and Statistical Analysis Characterizing the Water Resources of the Arkansas River Basin Colorado - US Geological Survey, Water Resources Investigation Report 85-4264, 1985.

Cain, D., Relations of Specific Conductance to Streamflow and Selected Water Quality Characteristics of the Arkansas River Basin Colorado - Water Resources Investigations Report 87-4041, US Geological Survey, 1987. Prepared in cooperation with the Southeastern Colorado Water Conservancy District.

Carter, D.L., Berg R.D., Sanders, B.J., The Effect of Furrow Irrigation Erosion on Crop Productivity. 1985 Reprint from the Soil Science Society of America Journal, Volume 49 No.1.

Carter, D.L., Effects of Erosion on Soil Productivity, 1988 Draft.

Century II: A Plan for the Arkansas Valley Region of Colorado, October 1967, Colorado State Planning Office.

Climates of the States - Colorado by U.S. Department of Commerce Environmental Science Service Administration.

Colorado Agriculture Data (SRG-8) McGrail, March 1980 (Computer Printout).

Colorado Agriculture Statistics by Colorado Department of Agriculture.

Colorado Census of Agriculture by U.S. Department of Commerce - Bureau of Census.

Colorado Conservation Needs Inventory, December, 1969 - Colorado State Soil Conservation Board, Colorado Association of Conservation Districts, Soil Conservation Service of the U.S. Department of Agriculture.

Colorado Department of Agriculture, Colorado Agricultural Statistics, 1994, Colorado Department of Agriculture, Colorado Agriculture.

Colorado Department of Health, 1982, Classification and Numeric Standards for the entire Arkansas River Basin - Colorado Department of Health, Water Quality Control Commission.

Colorado Ground Water Basic Data Release No. 21 - Hydrogeologic Data for the Lower Arkansas Valley, Colorado by Thomas J. Major, R. Theodore Hurr and John E. Moore, USGS 1970.

Colorado Ground Water Basin Data Report No.3, El Paso, County - Fountain, Jimmy Camp and Black Squirrel Valleys by Edward D. Jenkins, USGS 1962.

Colorado Ground Water Basic Data Report No. 1, Prowers County by Paul T. Voegeli Sr., and Lloyd A. Hershey, USGS 1960.

Colorado Ground Water Basic Data Report No. 12, Big Sand Creek Valley in Lincoln, Cheyenne, and Kiowa Counties, Colorado by Donald L. Coffin, USGS 1962.

Colorado Ground Water Circular No. 10, Effects of Water Management on a Reach of the Arkansas Valley, La Junta to Las Animas, Colorado by E.A. Moulder, C.T. Jenkins, J.E. Moore and D.L. Coffin, USGS 1963.

Colorado Ground-Water Water Trends, Engineering Research Center, Colorado State University, (ER 72-73JAB32) by John A. Brookman.

Colorado Irrigation Guide, 1988 USDA Natural Resources Conservation Service (formerly SCS)

Colorado Water Resources Circular No. 27, Reservoir Release Routing Model for the Upper Arkansas River Basin of Colorado by Richard R. Luckey and Russell K. Livingston, USGS 1975.

Colorado Water Resources Circular No. 31, Artificial Recharge Experiments in the Alluvial Aquifer South of Fountain, El Paso County, Colorado by O. James Taylor, USGS 1975.

Comprehensive Listing and Categorization of Local Water and Sewer Needs, Colorado by Paula Herzmar, Executive Director Department of Local Affairs, Monte Pascoe, Executive Director Department of Natural Affairs, Dr. Frank Traylor, Executive Director Department of Health.

Conservation Technology Information Center, June 1993 - US Fertilizer Use Relatively Stalk.

Control of Water Pollution from Cropland Volume 1, November 1975, USDA Agricultural Research Service and EPA Office of Research and Development.
County and City Data Book, 1962, 1972, 1977, 1980 - U.S. Department of Commerce, Bureau of Census.

Donnelly, Kathleen, "The Early Days of the Santa Fe Trail," 1993, Southeast Colorado Travel Guide, Southeast Colorado Tourism Council, Inc.

Duce, J. T., "Geology of Parts of Las Animas, Otero, and Bent Counties, " Part III, Bulletin 27, Colorado Geological Survey, 1924.

Enterprise Budgets for Colorado Dare Information Report 1R:92-1 - Department of Agricultural and Resource Economics, Colorado State University Cooperative Extension.

Evaluation of Water Quality in the Arkansas River Basin of Colorado, October 1989 - US Geological Survey of Pueblo, Colorado Subdistrict Office.

Fenneman, N.M., Physiography of the Western United States, McGraw-Hill, New York, 1931.

Final Report on Land Ownership and Land Use-Present, Past and Future Irrigation, by Colorado Land Resources Subcommittee to State Coordinator for Colorado - Arkansas-White-Red Basins, July 21, 1952.

Gaydos, M.W., Summary of Water Quality Data for Selected Streams in Colorado - US Geological Survey, Water Resources Investigations Open File Report 80-682. Prepared in cooperation with the Colorado Department of Health Radiation and Hazardous Wastes Control Division.

Guide to the Geology of Colorado published by Geological Society of America, Rocky Mountain Association of Geologists, Colorado Scientific Society 1960.

Hanks, R.J. 1974. Model for Predicting Plant Yield as Influenced by Water Use. Agronomy Journal 66:660-665.

Hatten, H.J., Selenium in the Upper Cretaceous Niobrara Formation and Pierre Shale of South-Central Colorado in Abstracts for 1968 - Geological Society of America Special Paper 121, 1968, p. 606.

Houk, I., Irrigation Engineering, Volume II Projects, Conduits, and Structures.

Hurr, R.T. and Moore, J.E., "Hydrogeologic Characteristics of the Valley-Fill Aquifer in the Arkansas River Valley, Bent County, Colorado," US Geological Survey Hydrologic Investigations Atlas HA-461, 1972.

Irrigation Guide for Southeastern Colorado, Arkansas River Watershed below 7,000 feet, USDA-NRCS, August 1960.

Irrigation Water Requirements - Technical Release No.21 by USDA Soil Conservation Service, September 1970.

Irrigation Water Use and Management, June 1979, Interagency TaskForce Report, Department of the Interior, Department of Agriculture, Environmental Protection Agency.

Johnson, R.B., "Geologic Map of the Trinidad Quadrangle, South-Central, Colorado," US Geological Survey Miscellaneous Geologic Investigations Map I-558, 1969.

Jones, E., Schuff, S., Kick back next Summer, and let your Surge Value do the Irrigating, Colorado Rancher and Farmer, 1993.

Konikow, L.F., Person, M., Assessment of Longterm Salinity Changes in an Irrigated Stream Aquifer System - Water Resources Research, Volume 21 No.11.

Lower Arkansas River Basin Water Quality Study, Colorado, 1992, USDA Natural Resources Conservation Service.

Monthly Normals of Temperature, Precipitation, Heating and Cooling Degree Days 1941-70 by US Department of Commerce, National Oceanic and Atmospheric Administration.

Mueller, D.K., DeWeese, L.R., Garner, A.J., and Spruill, T.B., "Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in the Middle Arkansas River Basin, Colorado and Kansas, "US Geological Survey Water-Resources Investigations Report 91-4060, 1991.

National Range Handbook by USDA, Soil Conservation Service.

Nelson, G.A., Hurr, R.T., and Moore, J.E., "Hydrogeologic Characteristics of the Valley-Fill, Prowers County," US Geological Survey Open File Report 89-254, 1989.

Nelson, G.A., Hurr, R.T., and Moore, J.E., "Hydrogeologic Characteristics of the Valley-Fill, Crowley and Otero Counties, Colorado," US Geological Survey Open File Report 89-255, 1989.

Nelson, G.A., Hurr, R.T., and Moore, J.E., "Hydrogeologic Characteristics of the Valley-Fill, Pueblo County, Colorado," US Geological Survey Open File Report 89-256, 1989.

Patton, H.B., "Underground Water Possibilities for Stock and Domestic Purposes in the La Junta Area, Colorado," Part I, Bulletin 27, Colorado Geological Survey, 1924.

Physiography of Western United States, 1937 by Nevin M. Fenneman.

Predicting Rainfall Erosion Losses - Agriculture Handbook No. 537, December 1978 by USDA Science and Education Administration.

Preliminary Water and Sewer Facilities Study Working Paper No.5 - Lower Arkansas Valley Council of Governments.

Prowers County Colorado Soil Survey, April 1966, USDA Soil Conservation Service, Colorado Agricultural Experiment Station.

Public Domain Lands - Arkansas-White-Red River Basins - Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma and Texas, USDI-BLM 1961.

Public Water Supplies of Colorado 1959-60 by USGS in Cooperation with Colorado State University Agricultural Experiment Station - General Series 757, June 1961.

Report of the Hydrologic Subcommittee on Water Availability and Quality in the Arkansas-White-Red Basins, January 1951 by Arkansas-White-Red Basins Interagency Committee.

Report on Review Survey for Flood Control and Allied Purposes, Arkansas River and Tributaries Above John Martin Dam, Colorado. Volume 1 - Main Report, Appendix E, F, G and H by US Army Corps of Engineers.

Ritchie, J.T. 1973. Influence of Soil Water Status and Meterological Conditions On Evaporation from A Corn Canopy. Agron.J.65:893-897.

Salinity in the Arkansas Valley of Colorado by Donald L. Miles, Cooperative Extension Service, CSU, May 1977.

Sangre De Cristo, Plan of Action, USDA 1976, Resource Conservation and Development Project.

Scott, G.R., "Geologic and Structure Contour Map of the La Junta Quadrangle, Colorado and Kansas," US Geological Survey Miscellaneous Geologic Investigations Map I-560, 1968.

Scott, G.R., Taylor, R.B., Epis, R.C., and Wobus, R.A., "Geologic Map of the Pueblo 1 x 2 Quadrangle, South-Central Colorado, "US Geological Survey Miscellaneous Investigation Series Map I-560, 1968.

Schultz, L.G., Tourtelot, H.A., Gill, J.R., and Boerngen, J.G., Composition and Properties of the Pierre Shale and Equivalent Rocks, Northern Great Plains Region, US Geological Survey Professional Paper 1064-B, 1987.

Selenium in Agriculture and the Environment, SSSA Special Publication Number 23, American Soiciety of Agronmy, Inc., Soil Science Society of America, Inc., Madison, Wisconsin, USA, 1989.

Sharps, J.A., "Geologic Map of the Lamar 1 x 2 Quadrangle, Colorado and Kansas," US Geological Survey Miscellaneous Investigations Series Map I-994, 1976.

Snow Control with Road Design and Snow Fences. Outline of presentation at the Snow Removal and Ice Control Technical Institute, University of Wisconsin, October 13-14, 1981 by Ronald D. Tabler.

Soils of Colorado, Colorado State University Experiment Station, Fort Collins, Bulletin 566S in Cooperation with the Soil Conservation Service, USDA, R.D. Heil, D.S. Romine, D.C. Moreland, R.K.,Dansdill, R.H. Montgomery, J.E. Cipra, July 1977.

Soils of Colorado, Loss Factors and Erodibility and Hydrologic Groupings 1979 by USDA, Soil Conservation Service.

Special Flood Hazard Information, Arkansas River, Anderson and King Arrogos La Junta, Otero County, Colorado, 1977, Department of the Army, Albuquerque District, Corps of Engineers.

Specific Problem Analysis Summary Report 1975 Nation Assessment of Water and Related Land Resources, Prepared by Comprehensive Planning Committee, Arkansas-White-Red Basins Inter-Agency Committee, June 1977.

Southeastern Colorado Custom Rates Survey - Southeast Farm Business Association, Colorado State University Cooperative Extension.

Summary Appraisals of the Nation's Ground Water Resources - Arkansas-White-Red Region, Geological Survey professional paper 813-H, by Bedinger, M.S., Sniegocki, R.T., 1976.

Taylor, O.J., Luckey R.R., Water Management Studies of a Stream Aquifer System, Arkansas River Valley Colorado Groundwater, Volume 12, No.1, 1974.

Technical Guide, USDA Natural Resources Conservation Service.

Technical Note: Conservation Planning For Water Quality Concerns, Toxic Element, and Selenium, March 1993. Water Quality Series No. W1, WNTC - Quality Technology for Resources Decisions.

Ten Rivers in Americas Future - The Report of the President's Water Resources Policy Commission - Volume 2, 1950.

The Upstream-Downstream Controversy in the Arkansas-White-Red Basins Survey, 1960 by Irving K. Fox and Isabel Picken.

Thirty-Second Annual Report of the Upper Colorado River Commission.

Topelman, W.C., "Underground Water Resources of Parts of Crowley and Otero Counties," Part II, Bulletin 27, Colorado Geological Survey, 1924.

Turekian, K.K., Wedepohl, K.H., Distribution of the Elements in some Major Units of the Earth's Crust: Geological Society of America Bulletin, Vol. 72, February, 1961, pp. 175-192.

Universal Soil Loss Equation, Technical Note 50 (Revised January 1977), by USDA, Soil Conservation Service.

Voegeli, P.T., Sr. and Hershey, L.A., "Geology and Ground-Water Resources of Prowers County, Colorado," US Geological Survey Water-Supply Paper No. 1772, 1965.

Water for Tomorrow - Colorado State Water Plan - Phase 1 - Appraisal Report, Bureau of Reclamation in Cooperation with the State of Colorado, February 1974.

Water Legislation Investigations for the Arkansas River Basin in Colorado, Volume 1, Summary Report - W.W. Wheeler and Associates, Woodward-Clyde and Associates, Consulting Engineers, September 1968.

Water Management Studies of a Stream-Aquifer System, Arkansas River Valley, Colorado by O. James Taylor and Richard R. Luckey.

Water Resources Council Economic and Environmental Principles and Guidelines for Water and Related Land Rescurces Implementation Studies, Washington, D.C., US Government Printing Office, February 1983.

Water Resources Data - Colorado Water Year '93, Volume 1, 1994. Missouri River Basin Arkansas River Basin, Rio Grande Basin, US Geological Survey Water Data Report CO-93-1. Prepared in cooperation with the State of Colorado and with other agencies.

Water Quality Records in Colorado, 1964. US Department of the Interior Geological Survey, Prepared in cooperation with Colorado Water Conservation Board, Bureau of Reclamation, US Department of the Interior, Soil Conservation Service of the Department of Agriculture.

Water Quality Standards and Stream Classification, 1974 by the Water Quality Control Commission, Colorado Department of Health.

Water Quality Survey of Arkansas River, November 1971 through June 1972 by Gregory T. Misback, with Water Pollution Control Division.

Weeks, E.P. and Sorey, M.L., "Use of Finite-Difference Arrays of Observation Wells to Estimate Evapotranspiration from Ground Water in the Arkansas River Valley, Colorado," US Geological Survey Water-Supply Paper No. 2029-C, 1973.

Weist, W.G., Jr., "Water in the Dakota and Purgatoire Formations in Otero County and the Southern Part of Crowlely, Colorado," US Geological Survey Water-Supply Paper No. 1669-P, 1963.

Weist, W.G., Jr., "Geology and Occurrence of Ground Water in Otero County and the Southern Part of Crowley County, Colorado," US Geological Survey Water-Supply Paper No. 1799, 1965.

Wiese, A.F., Vinger P.W., Irrigation and Dryland Farming and Limited Tillage: A Profitable Combination, 1983 - Journal of Soil and Water Conservation Volume 38, No.3.

Zielinski, R.A. and Asher-Bolinder, Sigrid, "Uraniferous Waters of Southeastern Colorado: A Function of Geology, Climate, and Land Use," U.S. Geological Survey [in Press], 1993.

208 Agriculture Assessment Report for Pueblo Area Council of Governments, May 1979 - Colorado SCB. Part No. Section 8, Domestic and Industrial Water Supply, 1955 - Arkansas-White-Red-River Basins Inter Agency Committee.

0599

LIST OF PREPARERS

This Draft Watershed Plan/EA was prepared by an interdisciplinary team composed of the following specialists, for NRCS as well as other specialists.

Name	Jim P. Thornton (Now Retired)
Job Title	Water Resources Planning Staff Leader
Assignment	Coordinated Staff Activities
Education	BS, Agricultural Engineering, 1960
Experience	NRCS engineer - 15 years Water Resources Planning Staff Leader - 16 years P.E. Colorado and New Mexico
Name	P. Stanley Mitchem
Job Title	State Geologist, Wyoming
Assignment	Principal investigator for geology
Education	BS, Geology, Oregon State, 1971 Wyoming PG Registration Oregon RPG Registration Hydrogeology, Wright State University, 1985
Experience	NRCS State Geologist - 9.2 years Planning Staff Geologist - 11.5 years Cartographic Tech - 1.2 years
Name	Harry L. Smith
Job Title	Planning Engineer/Cultural Resource Specialist
Assignment	Principal investigator for engineering designs
Education	BS, Agricultural Engineering, 1965
Experience	NRCS Engineer - 30 years
Name	Nyle L. Jordre
Job Title	Economist
Assignment	Principal investigator for economic evaluations and coordinated plan development and write-up.
Education	BS,MS, Agricultural Economics, 1967 NDSU
Experience	NRCS Economist - 28 years NRCS Soil Conservationist - 1 year
Name	Tim Sweeney
Job Title	Resource Conservationist/Water Quality Specialist
Assignment	Helped formulate alternatives, developed effects and developed public participants plan.
Education	BS, Natural Resource Management, 1974
Experience	NRCS Soil Conservationist - 13 years NRCS District Conservationist - 3 years Forestry Tech. (U.S. Army) - 3 years

0600

Name	Karen Conrad
Job Title	Resource Conservationist
Assignment	Gathered data, helped develop alternatives, and coordinated planning with sponsor and public.
Education	BS in Agronomy, 1986.
Experience	Resource Conservationist
Name	Frank Gipson
Job Title	Resource Conservationist
Assignment	Coordinate and plan with sponsors and publics.
Education	Agricultural Business Education
Experience	Coop student NRCS - 2 years Soil Conservationist - 3 years Resource Conservationist - 3 years
Name	P. Lorenz Sutherland
Job Title	Area Agronomist
Assignment	Develop agronomic inputs for alternatives, and also, coordinated water quality analysis with other agencies.
Education	BS Agronomy, MS and PHD in Soil Physics
Experience	USDA ARS - 2 years CSU - 6 years NRCS Agronomist - 7 years
Name	Miles Martin
Job Title	Soil Conservation Technician
Assignment	Data gathering as well as helped develop alternatives
Education	Conservation Technician, Trinidad State Junior College
Experience	Soil Conservation Technician - 17 years
Name	Terri Skadeland
Job Title	Biologist
Assignment	Coordinate Biology Activities
Education	BS, MS, in Fisheries and Wildlife Biology
Experience	District Conservationist - 9 years Biologist - 6 years
Name	Ronald Schierer
Job Title	Resource Conservationist/ Water Quality Specialist
Assignment	Review of water quality data
Education	BS, Agronomy, Kansas State University
Experience	Worked for NRCS in Kansas, Washington, and currently Colorado. Positions held: Soil Conservationist, District Conservationist, and Agricultural Agronomist.
Name	Stuart N. Simpson
Job Title	Assistant State Conservationist for Water Resources
Assignment	Review of overall document
Education	BS, Soils, Kansas State University
Experience	21 years of service with NRCS

0601

The draft watershed plan and environment assessment was reviewed and concurred in by state staff specialist having responsibility for engineering, soils, agronomy, biology, geology, and EIS.

0602

Draft Watershed Plan-Environmental Assessment
for
Limestone-Graveyard Creeks Watershed Project

Index page

GLOSSARY

CSSCB - Colorado State Soil Conservation Board

CDPH - Colorado Department of Public Health

NRCS - Natural Resources Conservation Service

CFSA - Consolidated Farm Services Agency

UCCES - University of Colorado Cooperative Extension Service

EPA - United States Environmental Protection Agency

Plan-EA - Watershed Plan Environmental Assessment

MCL - Maximum Concentration Level

MSL - Mean Sea Level

NRHP - National Register of Historical Places

USGS - United States Geological Survey

LTC - Long Term Contract

SHPO - State Historic Preservation Officer

FOTG - Field Office Technical Guide

IWM - Irrigation Water Management

Appendix A

Letters of Comments (or summary of letters and changes)

060

STATE OF COLORADO

Roy Romer, Governor
Pam Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80222-1530
Phone (303) 692-2000

Laboratory Building
4210 E. 11th Avenue
Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department
of Public Health
and Environment

July 31, 1995

Duane L. Johnson, State Conservationist
Natural Resources Conservation Service
655 Parfet Street, Room E200C
Lakewood, CO 80215-5517

RE: Limestone-Graveyard Creeks Watershed Plan/Environmental Assessment

Dear Duane:

I appreciate the opportunity to review the draft watershed plan/environmental assessment for the Limestone-Graveyard Creeks area on the lower Arkansas River. This area is one we consider a priority in the Nonpoint Source Management Program for Colorado, and we are pleased to see the pro-active stance of the local soil conservation districts.

In reviewing the plan, there are several issues I would like to address.

Several times in the plan the statement is made that wetlands should be enhanced due to improvements in the water quality. However, considering the amount of ditch lining and pipelines planned for installation, we would anticipate some negative impact to when seepage is reduced. We believe this is a part of the environmental assessment that needs further quantification.

The draft plan makes substantial claims to improve water quality (for example, reducing selenium levels in the Arkansas River by 17%; reducing nitrate loading by 32%; reducing uranium concentrations by 0.4 ug/l) but there is no monitoring plan to actually measure the validity of those projections and determine if the project is a success. We are available to work with your staff to design a monitoring plan that is appropriate for the goals of this project. Mr. Bob Owen would be the individual to contact at 692-3579.

On page 64 the draft plan states no land may be contracted with PL-566 funds if that land is under contract with another federal land treatment program. In the nonpoint source program we have tried to integrate the various cost-share programs to accomplish water quality objectives with the funds most appropriate for the practice. The draft plan, as written, would not allow us to participate in this watershed with additional funds, should the

opportunity arise. Conversations with your staff indicate the real intent is that a producer not be paid twice for installing an individual practice. This part of the plan should be clarified to accurately reflect the intent.

Finally, we noticed there are no cost-shares planned for the implementation of critical management practices. Our experience with water quality projects is that producers are very reluctant to try new management techniques with no immediate financial incentive, especially when the practices may present a risk to their slim profit margin -- and the management practices identified in the draft plan are crucial to the overall success of this project. We would support the addition of financial assistance to encourage the adoption of the management practices identified in the plan.

Again, I appreciate the opportunity to comment, and look forward to the implementation of this plan.

Sincerely,

Gregory A. Parsons

cc: Bob Owen, Nonpoint Source Unit, WQCD

United States Department of Agriculture
Natural Resources Conservation Service
655 Parfet Street
Room E200C
Lakewood, CO 80215

April 24, 1996

Greg Parsons, Non-Point Source Program Manager
Colorado Dept. of Health, WQD
4300 Cherry Creek Drive South
Denver, CO 80223-1530

Dear Mr. Parsons:

Thank you for your comments on the Draft Watershed Plan and Environmental Assessment for the Limestone-Graveyard Creeks Watershed Project, located in Prowers and Bent Counties, Colorado.

A revised draft plan is enclosed. Your specific comments are addressed as follows:

1. **Comment on the effects of practices on Wetlands.** Discussions under the Project Setting and the Formulation and Comparison of Alternative Sections were modified to address these concerns. Also, a mitigation component was included in the Recommended Plan Section as well as in the Contracting Section.

2. **Comment on Monitoring Plan.** Discussion on the monitoring plan for the project was included in the Formulation and Comparison of Alternatives Section.

3. **Page 64 - Comment on land contracted with PL-566 funds that have a contract with another federal land treatment program.** The Contracting Section has been modified. Add after "LTC will be approved." It is permissible to have two federally funded contracts on the same piece of land, however, these contracts cannot pay for the same conservation practices.

Delete sentence, "An LTC cannot be....treatment."

4. **Comment on Cost Sharing Management Practices.** Only new and innovative management practices can be cost-shared under PL-566. Therefore, only polyacrylmide as a management practice has been authorized for this plan. Farmers can consider other cost-sharing programs for management practices if they desire.

We appreciate that your agency took the time to comment on the draft plan. We have enclosed an amended draft plan for your review. We hope your comments have been properly addressed. However, any additional comments will be considered. Please return any additional comments to Duane Johnson by May 20, 1996.

Duane L. Johnson
for State Conservationist

Enclosure

0610

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
SOUTHERN COLORADO REGULATORY OFFICE
P.O. BOX 294
PUEBLO, COLORADO 81002-0294

REPLY TO ATTENTION OF:

August 2, 1995

Construction and Operations Division
Regulatory Branch

Mr. Duane L. Johnson
Natural Resources Conservation Service
655 Parfet Street, Room E200C
Lakewood, Colorado 80215-5517

Dear Mr. Johnson:

We have reviewed your Draft PL 83-566 Watershed Plan - Environmental Assessment for the Limestone Graveyard Creeks Project in Prowers and Bent Counties, Colorado (Action No. 1995 30322) which we received on July 27, 1995. The following comments are offered.

a. Page 60, "It is not anticipated that any federal permits ... will be needed to install the project...." - Practices to be installed for the project and which could require a Section 404 permit under the Clean Water Act from the Corps of Engineers (CE) if they occur in waters of the United States, including wetlands are: pipelines, land leveling, and seepage interceptors. Exemptions by law for agricultural activities are generally not available if the activity would convert a wetland to an upland. Nationwide permits may be available to authorize these projects; however, permit use requires that filling or excavating in waters of the United States must be minimized or avoided to the maximum extent practicable unless a compensation mitigation plan is approved. Nationwide permit use also requires that the adverse environmental effects for a project must be minimal. For example, although pipeline construction may be authorized by a nationwide permit, if the pipeline trench causes drainage of a wetland, we may condition the permit with requirements for special construction features such as cutoff collars to prevent wetland drainage. This could increase the costs of pipelines. Land leveling and seepage interceptors may also be authorized by a nationwide permit although compensatory mitigation may be required, again increasing the costs of the projects.

0611

b. Pages 15 and 34 - Statements are made that small scattered ephemeral wetlands occur within the project area, mostly along creek and drain bottoms and that since the project actions will occur within irrigated cropland, the actions will not affect the wetlands. We feel that this understates the extent of wetlands in the region and their location, especially small isolated wetlands which are located within existing fields. If National Wetland Inventory maps were used to determine the amount and typical locations of wetlands, you should be aware that the mapping in this region has a good potential for wetland omission because of the age, emulsion, scale, and dry year photography which the maps were based on. We are aware of at least two wetlands (1- to 2-acre-size) in the region which are not shown on the NWI maps. We do not know the extent of omission of such wetlands, but the Prowers and Bent County Soil Surveys shows that the project area is within the Rocky Ford-Nepesta-Numa, Las-Glendive, Las Apishapa-Bankard, and Rocky Ford-Numa soil associations and these associations include the map units which are listed as having hydric status in Natural Resources Conservation Service's (NRCS) 05/21/93 Comprehensive Hydric Soils List. This indicates to us that hydric soils and wetlands may be present throughout the project area and not just along streams. We recognize that the NRCS makes a distinction between natural wetlands and those termed artificial wetlands and that the CE does not. Without knowing the extent of wetlands in the project area, we cannot comment on the number of Section 404 permit actions which might be needed to implement the project.

c. Page 16, "Project effects on wetlands will be dealt with on a case by case basis." - Dealing with the loss of wetlands on a case by base basis does not allow the prospective project participant to know the full effort and cost for which they could be responsible. A Section 404 permit and any required mitigation could place additional planning efforts and construction costs onto participants. Some of this could be reduced with the use of mitigation banking or a regionally-located site which would be available for project mitigation. We would be willing to work with you to standardize permit mitigation for project actions or to identify acceptable mitigation sites.

0612

d. Page 34, Wetlands - We agree that reducing sediment and pollutants entering wetlands will benefit wetlands. The secondary and cumulative effects of reducing irrigation return flows to drains and streams also needs to be addressed. With greater water use efficiency, the overall amount of return water could be reduced and thereby reduce the overall amount of wetlands. With this unavoidable secondary adverse effect to wetlands, compensatory mitigation for direct wetland losses resulting from Section 404 regulated activities becomes more important.

Thank you for the opportunity to review and comment on the project. Should you have any questions please feel free to write or call Ms. Anita Culp at (719) 543-9459.

Sincerely,

James M. Townsend

James M. Townsend
Chief, Southern Colorado
Regulatory Office

United States Department of Agriculture
Natural Resources Conservation Service
655 Parfet Street
Room E200C
Lakewood, CO 80215

April 24, 1996

James M. Townsend 0613
Chief Southern Colorado Regulatory Office
Department of the Army Corps of Engineers
P.O. Box 294
Pueblo, CO 81002-0284

Dear Mr. Townsend:

Thank you for your comments on the Draft Watershed Plan and Environmental Assessment for the Limestone-Graveyard Creeks Watershed Project, located in Prowers and Bent Counties, Colorado.

A revised draft plan is enclosed. Your specific comments are addressed as follows:

Comment (a) page 60 - The Permits and Compliance section in the Recommended Plan has been modified. Also, a mitigation component was included in the recommended plan section. The contracts section has been modified to show that mitigation practices will be included in all contracts that have practices negatively affecting wetlands. Mitigation costs are now included in alternatives and tables.

Comment (b) Pages 15 and 34 - The Wetlands discussion is under the project setting and the Formulation and Comparison of Alternatives Sections were modified to address your concerns. A field review to ground truth the National Wetland Inventory was carried out by NRCS personnel.

Comment (c) page 16 - see a and b above.

Comment (d) page 34 - see a and b above.

Also attached is a model analysis which shows that although deep percolation will be reduced, the amount of water going back to the river will not be reduced. Also, a mitigation section has been included that states that any wetland values lost will be replaced. The landowner will be responsible to obtain any necessary permits.

We appreciate that your agency took the time to comment on the draft plan. We have enclosed an amended draft plan for your review. We hope your comments have been properly addressed. However, any additional comments will be considered. Please return any additional comments to Duane Johnson by May 20, 1996.

for Duane L. Johnson
State Conservationist

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

JUL 21 1995

0611

Ref: 8WM-EA

Mr. Duane L. Johnson
State Conservationist
USDA, Natural Resource Conservation Service
655 Parfet, Room E200C
Lakewood, Colorado 80215-5517

RE: Limestone-Graveyard Creeks
Watershed Draft
Environmental Assessment

Dear Mr. Johnson:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act (CAA), the Region VIII office of the Environmental Protection Agency has reviewed the subject document.

The proposed alternative should result in improved water use efficiency as well as improvements in erosion control and water quality. We offer the following comments.

Page 15 (and elsewhere) in the subject document indicates that the wildlife diversity of the area has been improved by the irrigated lands which "serves to break up the historically existing homogenous short-grass prairie habitat." Please furnish data in the final document to support this statement. The data could include the listing of the species and the numbers in both scenarios.

Page 16 indicates that project effects on wetlands will be addressed on a case by case basis. The document needs to indicate what will be done on a case by case basis. The two major impacts to wetlands likely to occur as a result of this project are direct loss as a result of filling the wetland as part of land leveling activities and reduced discharge to wetlands as a result of water management activities. Both of these activities could have significant adverse effects.

The document indicates that there should not be adverse wetlands impacts as a result of the project. Both EPA's and NRCS's long term experience with the Colorado River salinity program has indicated that the activities proposed will result in wetland losses. We request that you re-evaluate your conclusions on wetland impact to indicate how many acres of wetland loss will occur, what type of wetlands will be lost, the functions and

Printed on Recycled Paper

values to be lost, and the proposed mitigation for the losses.

On page 67, it is indicated that land leveling will occur on over 3,000 acres within the project area. This seems to be a high percentage of the project area and could result in major wetlands impacts. Please indicate how the land leveling and over 7,000 seepage interceptors proposed will impact wetlands. Also, should there be much need for seepage interceptors if the proposed water management practices are effective?

The document indicates that the potentially improved water quality may result in improved fisheries. The document should provide a water balance which indicates that the project induced flow reductions will not eliminate the available fish habitat.

EPA appreciates the opportunity to review the subject document and all the effort which went into the preparation of it. If you have any questions, please contact Carl Heskett of my staff, at (303) 293-1557.

Sincerely,

J. William Geise, Jr.
Acting Chief
Environmental Assessment Branch
Water Management Division

cc: Terri Skadeland, NRSC Colorado State Biologist, State Office

0616

United States Department of Agriculture | Natural Resources Conservation Service | 655 Parfet Street Room E200C Lakewood, CO 80215

April 24, 1996

J. William Geise, Jr., Acting Chief, EA Branch
Environmental Protection Agency, WMD
999 18th Street, Suite 500
Denver, CO 80202-2466

Dear Mr. Geise:

Thank you for your comments on the Draft Watershed Plan and Environmental Assessment for the Limestone-Graveyard Creeks Watershed Project, located in Prowers and Bent Counties, Colorado.

A revised draft plan is enclosed. Your specific comments are addressed as follows:

Page 15 (and elsewhere) - Statements on the subject of wildlife diversity of the area being improved by the irrigated lands is a statement of opinion. Since it has little bearing on the project, we have decided to delete the statement throughout the plan. We have included a list of Endangered and Threatened Animals and Plants.

Page 16 Effects on Wetlands - Discussions under the Project Setting and the Formulation and Comparison of Alternative Sections were modified to address these concerns. Also, a mitigation component was included in the Recommended Plan Section as well as in the Contracting Section.

Page 67 - Indicates how land leveling and seepage interceptors will affect the wetland. Seepage interceptors have been deleted from the plan. Discussions under the project setting and the Formulation and Comparison of Alternative Sections were modified to address these possible wetland effects due to project action. A Mitigation Section was inserted in the Recommended Plan Section, which will be used to address impacts. Mitigation costs were included for offsetting any loss of wetland values on a value for value basis. The mitigation strategy considered all practices to be implemented that could affect wetlands. No land leveling will be approved where wetlands would be negatively affected.

The document indicates that the improved water quality may improve fisheries and habitat. Various field scale models were used for on-farm water analysis (see Appendix C). All model runs associated with the recommended plan show reduced deep percolation but no reduction in water returning to the river. A summary is attached showing effects of the Recommended Plan on deep percolation and runoff.

0617

We appreciate that your agency took the time to comment on the draft plan. We have enclosed an amended draft plan for your review. We hope your comments have been properly addressed. However, any additional comments will be considered. Please return any additional comments to Duane Johnson by May 20, 1996.

George R. Christy

Duane L. Johnson
for State Conservationist

Enclosure

0618

STATE OF COLORADO

Colorado Water Conservation Board
Department of Natural Resources
721 State Centennial Building
1313 Sherman Street
Denver, Colorado 80203
Phone (303) 866-3441
FAX (303) 866-4474

Roy Romer
Governor

James S. Lochhead
Executive Director, DNR

Daries C. Lile, P.E.
Director, CWCB

August 3, 1995

Via Fax and Mail

Mr. Duane L. Johnson
State Conservationist
USDA, NRCS
655 Parfet, Room F200C
Lakewood, CO 80215-5517

RE: Arkansas River, Limestone-Gravey and Creeks Watershed Project

Dear Mr. Johnson:

We have reviewed the draft Watershed Plan-Environmental Assessment ("plan-EA") for the above referenced PL 83-566 project which you provided by your letter dated June 14, 1995. We appreciate the efforts of USDA and the Natural Resources Conservation Service (NRCS) in working with local producers to improve irrigation systems and regional water quality. We hope that the NRCS receives the Congressional appropriations necessary to provide the federal cost-sharing dollars that will allow this project to move ahead. The Colorado Water Conservation Board may be able to assist local producers in financing their share of project costs.

We have several specific concerns and/or comments that should be addressed by NRCS before finalizing the plan-EA and before the NRCS considers administrative approval of the project:

1. The discussion of the Arkansas River Compact found at the top of page 27 does not adequately explain the obligations and entitlements governed by the Compact, nor does it adequately reflect the significance of the ongoing litigation in the U. S. Supreme Court between the states of Kansas and Colorado. To the extent the proposed project alters historical water use patterns in the basin there are potential Compact issues which need to be better explained and considered in the report. We suggest the NRCS and the Colorado Soil Conservation Board work directly with Ms. Wendy Weiss of the Colorado Attorney General's Office in developing language which properly describes those Compact issues and is consistent with Colorado's Compact obligations.

2. On page 5 the NRCS suggests that there are no areas of controversy. We believe that unless the Compact issues are carefully analyzed and reconciled there is the potential for future controversy.

3. On page 5 the NRCS states that the "irrigation deficiency of 107,000 ac-ft will be reduced so that there will be a nearly adequate water supply." We do not find sufficient information in the plan-EA to fully understand how this is possible and suggest that NRCS summarize its analysis of water supply impacts/benefits in a concise water budget table. Generalizations such as the quoted language pose possible conflicts with the Arkansas River Compact.

4. We are unaware of any impacts to irrigation use of Arkansas River water due to selenium and/or uranium. The discussion at pages 22-25 appears to suggest otherwise. Please clarify this discussion and provide us with any additional information which explains agricultural damages from these contaminants. We have always assumed that the main concern as to agricultural water quality is TDS which the plan-EA tends to down play.

5. The discussion of sediment control on page 27 states pollutants from the project area "eventually end up in multi-purpose reservoirs downstream." We are unaware of any such reservoirs. The first mainstem reservoirs below the study area are in the Ponca City and Tulsa Oklahoma areas. Between Garden City and Dodge City, Kansas the river is effectively non-existent due to the excessive well pumping over-draft in Kansas impacting this reach. In light of these facts it is unclear what NRCS is referring to. A similar statement on page 46 as to "increased reservoir life" as a downstream benefit is questionable if not inaccurate.

Thank you for the opportunity to review the plan-EA. We hope our comments are constructive and useful, and lead to an improved final plan. We look forward to working with the NRCS, other state agencies, and the local irrigations in the implementation of this project.

Sincerely,

Daries C. Lile
Director

SM/DCL/lm

cc: Jim Lochhead
Dennis Montgomery
David Robbins
Hal Simpson
Steve Witte
Wendy Weiss
Dan Parker
Gene Jencsok

limesm2.ltr

0620

United States Department of Agriculture | Natural Resources Conservation Service | 655 Parfet Street Room E200C Lakewood, CO 80215

April 24, 1996

Daries C. Lile, Director
Colorado Water Conservation Board
Department of Natural Resources
721 State Centennial Building
1313 Sherman Street
Denver, CO 80203

Dear Mr. Lile:

Thank you for your comments on the Draft Watershed Plan and Environmental Assessment for the Limestone-Graveyard Creeks Watershed Project, located in Prowers and Bent Counties, Colorado.

A revised draft plan is enclosed. Your specific comments are addressed as follows:

1. **Discussion on Arkansas River Compact on Page 27.** The discussion on the Compact has been changed in the Water Quantity portion of the Problems and Opportunities Section to reflect input received from the Colorado Attorney General's Office.

The Formulation and Comparison of Alternatives Section was modified to state that no change in water diversions due to project action will occur at the point of diversion nor at the Canal, lateral or field ditch level.

2. **Comment on Page 5 on Areas of Controversy.** No areas of controversy arose during planning at public scoping and other public meetings. Concerns were included on page 5.

3. **Page 5 irrigation deficiency of 107,000 acre feet. Incorrect number was inserted in narrative.** Appendix C contains a discussion of methods and various field scale models for on-farm water analysis used for the Recommended Alternatives. All model runs associated with the recommended plan show reduced deep percolation but no reduction in water returning to the river. A summary is attached showing effects of the Recommended Plan on deep percolation and runoff.

4. **Page 22-25 Selenium/Uranium & TDS and irrigation use.** Add footnotes P. 22 after "...ground-water sites," and the complete citation after the third footnote at the end of the section. The water quality portion of the problems opportunity section include footnotes on the potential effects of selenium/uranium on agriculture.

[4/] Selenium in Agriculture, Agriculture Handbook No. 200, 1961 the draft plan.

[5/] Aquatic Cycling of Selenium; United State Department of the Interior, USFWS LEAFLET 12, 1987

[6/] Selenium in Agriculture and the Environment, Soil Science

Society of America, Special Publication #23, 1990.

0621

(Insert on P. 19 before the second paragraph)

Selenium is an element which is subject to bioaccumulation in the food chain. Selenium becomes concentrated in green plants as it takes up irrigation water. As drains within the irrigation system pick up water, selenium concentrations become very high. The water from these drains is reused for irrigation and livestock throughout the watershed.

We do agree that TDS is one of the main concerns. However, when developing a PL-566 project, any water quality objectives must meet State and EPA Standards. Since there are no TDS State Standards for Water Quality for Agriculture, we were not able to use TDS reduction as an objective. We do feel however, that the same practices will help improve water quality from reduced TDS.

5. **Page 27 and 46 - Pollutants from Project area eventually end up in multi-purpose reservoirs.** Statement has been deleted in both locations. NRCS feels that some pollutants will eventually reach the reservoirs downstream in Kansas during high runoff years. We do agree that it is not significant and therefore should be deleted.

We appreciate that your agency took the time to comment on the draft plan. We have enclosed an amended draft plan for your review. We hope your comments have been properly addressed. However, any additional comments will be considered. Please send any additional written comments to Duane Johnson by May 20, 1996. Thank You.

for Duane L. Johnson
State Conservationist

Enclosure

UNITED STATES DEPARTMENT OF AGRICULTURE
0622
NATURAL RESOURCES CONSERVATION SERVICE
655 PARFET STREET
ROOM E200C
LAKEWOOD, CO 80215-5517
(303) 236-2913

SUBJECT: Limestone Graveyard P.L.-566 Project DATE: 6 March 1995

TO: Lee Carlson
Colorado State Supervisor
U.S. Fish and Wildlife Service
730 Simms, Rm. 290
Golden, Colorado 80401

This letter is a request for information on endangered species found in the Limestone-Graveyard project area as per early, informal consultation under Section 7 of the Endangered Species Act.

The Natural Resources Conservation Service (NRCS) in Colorado is planning a P.L.-566 project in Eastern Bent and Western Prowers Counties in Southeast Colorado (see attached map). The watershed consists of 59,250 acres encompassing most of the land between the Fort Lyon Canal, the Arkansas River, the Prowers Arroyo, and the Pleasant Valley Drain. Land use in the watershed is 75% irrigated cropland. Our project will be confined to these acres.

The goals of our project are to improve water quality, to increase water quantity, and to reduce irrigation induced soil erosion in the watershed through installation of irrigation water management and improvement practices. A complete breakdown of the planned practices is listed in Table 1. The expected effects of practice installation include improving irrigation efficiency from the current 24% to 48%, reducing deep percolation by 25%, and reducing erosion by 88%. In addition, we expect increased stream flows and less leaching of salts because of more timely and efficient water application.

More specifically, we expect to benefit wildlife by increasing the amount of crop residue left on the soil surface over winter and by improving water quality (less salts and sediment) in the drainages leaving the watershed. A negative effect on wildlife will be loss of a small number of irrigation induced wetlands that result from leaking, unlined ditches. These wetlands consist of narrow, brushy and grassy corridors along the ditches and a few wet areas in the cropped fields. The negative effects of losing these wetlands will be offset through mitigation acceptable to state and federal fish and wildlife agencies.

If you need more information on this project, contact Terri Skadeland at 236-2913.

Duane Johnson
State Conservationist

0623

cc w/o attachments:
Lee E. Hill, ASTC-EQ, Lakewood

UB

0624

Data base is COLORADO, set is LIMEGRAVE

COMMON-NAME	SCI-NAME
BULLFROG	RANA-CATESBEIANA
FROG, LEOPARD, PLAINS	RANA-BLAIRI
TOAD, RED-SPOTTED	BUFO-PUNCTATUS
SPADEFOOT, PLAINS	SCAPHIOPUS-BOMBIFRONS
SALAMANDER, TIGER	AMBYSTOMA-TIGRINUM
TOAD, GREAT PLAINS	BUFO-COGNATUS
TOAD, WOODHOUSE'S	BUFO-WOODHOUSII
SPADEFOOT, NEW MEXICO	SCAPIOPUS-MULTIPLICATUS
COACHWHIP	MASTICOPHIS-FLAGELLUM
RACER, YELLOWBELLY	COLUBER-CONSTRICTOR
SNAKE, BLACKHEAD, PLAINS	TANTILLA-NIGRICEPS
SNAKE, CORN	ELAPHE-GUTTATA
SNAKE, GARTER, BLACKNECK	THAMNOPHIS-CYRTOPSIS
SNAKE, GARTER, PLAINS	THAMNOPHIS-RADIX
SNAKE, GARTER, TERRESTRIAL, WESTERN	THAMNOPHIS-ELEGANS
SNAKE, GLOSSY	ARIZONA-ELEGANS
SNAKE, GOPHER	PITUOPHIS-MELANOLEUCUS
SNAKE, GROUND	SONORA-SEMIANNULATA
SNAKE, HOGNOSE, WESTERN	HETERODON-NASICUS
SNAKE, LINED	TROPIDOCLONION-LINEATUM
SNAKE, LONGNOSE	RHINOCHEILUS-LECONTEI
SNAKE, MILK	LAMPROPELTIS-TRIANGULUM
SNAKE, NIGHT	HYPSIGLENA-TORQUATA
SNAKE, WATER, NORTHERN	NERODIA-SIPEDON
WHIPSNAKE, STRIPED	MASTICOPHIS-TAENIATUS
LIZARD, EARLESS, LESSER	HOLBROOKIA-MACULATA
WHIPTAIL, CHECKERED, COLORADO	CNEMIDOPHORUS-TESSELATUS
SKINK, GREAT PLAINS	EUMECES-OBSOLETUS
TURTLE, PAINTED	CHRYSEMYS-PICTA
TURTLE, BOX, ORNATE	TERRAPENE-ORNATA
TURTLE, MUD, YELLOW	KINOSTERNON-FLAVESCENS
SNAKE, RATTLER, WESTERN	CROTALUS-VIRIDIS
SOFTSHELL, SPINY, WESTERN	TRIONYX-SPINIFEROUS
RACERUNNER, PRAIRIE-LINED	CNEMIDOPHORUS-SEXLINEATUS
LIZARD, HORNED, TEXAS	PHRYNOSOMA-CORNUTUM
LIZARD, FENCE, EASTERN	SCELOPORUS-UNDULATUS
TURTLE, SNAPPING, COMMON	CHELYDRA-SERPENTINA
MASSASAUGA	SISTRURUS-CATENATUS
LIZARD, HORNED, SHORT	PHRYNOSOMA-DOUGLASSII
LIZARD, COLLARED, EASTERN	CROTAPHYTUS-COLLARIS *
SUNFISH, GREEN	LEPOMIS-CYANELLUS
PUMPKINSEED	LEPOMIS-GIBBOSUS
BASS, SMALLMOUTH	MICROPTERUS-DOLOMIEUI
CRAPPIE, WHITE	POMOXIS-ANNULARIS
BASS, LARGEMOUTH	MICROPTERUS-SALMOIDES
SUCKER, LONGNOSE	CATOSTOMUS-CATOSTOMUS
SUNFISH, ORANGESPOTTED	LEPOMIS-HUMILIS
CRAPPIE, BLACK	POMOXIS-NIGROMACULATUS
SUCKER, WHITE	CATOSTOMUS-COMMERSONI
STONEROLLER, CENTRAL	CAMPOSTOMA-ANOMALUM
CHUB, FLATHEAD	HYBOPSIS-GRACILIS
CARP, COMMON	CYPRINUS-CARPIO
MINNOW, SUCKERMOUTH	PHENACOBIUS-MIRABILIS
MINNOW, FATHEAD	PIMEPHALES-PROMELAS
CATFISH, CHANNEL	ICTALURUS-PUNCTATUS

DARTER, ARKANSAS	0625	ETHEOSTOMA-CRAGINI
BASS, WHITE		MORONE-CHRYSOPS
KILLIFISH, PLAINS		FUNDULUS-ZEBRINUS
PIKE, NORTHERN		ESOX-LUCIUS
PERCH, YELLOW		PERCA-FLAVESCENS
WALLEYE		STIZOSTEDION-VITREUM

Data base is COLORADO, set is LIMEGRAVE

COMMON-NAME	SCI-NAME
TROUT, CUTTHROAT, YELLOWSTONE	SALMO-CLARKI**
TROUT, RAINBOW	SALMO-GAIRDNERI
SHINER, SAND	NOTROPIS-STRAMINEUS
BULLHEAD, BLACK	ICTALURUS-MELAS
BULLHEAD, BROWN	ICTALURUS-NEBULOSUS
BAT, PALLID	ANTROZOUS-PALLIDUS
PIPISTRELLE, WESTERN	PIPISTRELLUS-HESPERUS
MYOTIS, SMALL-FOOTED	MYOTIS-LEIBII
MYOTIS, YUMA	MYOTIS-YUMANENSIS
OPOSSUM, VIRGINIA	DIDELPHIS-VIRGINIANA
BAT, BROWN, BIG	EPTESICUS-FUSCUS
WEASEL, LONG-TAILED	MUSTELA-FRENATA
FOX, RED	VULPES-VULPES
ERMINE	MUSTELA-ERMINEA
BOBCAT	FELIS-RUFUS
MINK	MUSTELA-VISON
BADGER	TAXIDAE-TAXUS
COYOTE	CANIS-LATRANS
FOX, GRAY	UROCYON-CINEREOARGENTEUS
SKUNK, STRIPED	MEPHITIS-MEPHITIS
FOX, SWIFT	VULPES-VELOX
MOUSE, POCKET, HISPID	PEROGNATHUS-HISPIDUS
SQUIRREL, GROUND, THIRTEEN-LINED	SPERMOPHILUS-TRIDECEMLINEATUS
GOPHER, POCKET, YELLOW-FACED	PAPPOGEDMYS-CASTANOPS
SQUIRREL, ROCK	SPERMOPHILUS-VARIESATUS
PRAIRIE DOG, BLACK-TAILED	CYNOMYS-LUDOVICIANUS
RAT, KANGAROO, ORD'S	DIPODOMYS-ORD11
GOPHER, POCKET, PLAINS	GEOMYS-BURSARIUS
SQUIRREL, FOX	SCIURUS-SCIURUS NIGER
BEAVER	CASTOR-CANADENIS
MOUSE, POCKET, PLAINS	PEROGNATHUS-FLAVESCENS
MOUSE, POCKET, SILKY	PEROGNATHUS-FLAVUS
SQUIRREL, GROUND, SPOTTED	SPERMOPHILUS-SPILOSOMA
MUSKRAT	ONDATRA-ZIBETHICUS
MOUSE, GRASSHOPPER, NORTHERN	ONYCHOMYS-LEUCOGASTER
RAT, NORWAY	RATTUS-NORVEGICUS
MOUSE, HARVEST, WESTERN	REITHRODONTOMYS-MEGALOTIS
MOUSE, PINYON	PEROMYSCUS-TRUEI
MOUSE, HARVEST, PLAINS	REITHRODONTOMYS-MONTANUS
MOUSE, HOUSE	MUS-MUSCULUS
RAT, COTTON, HISPID	SIGMODON-HISPIDUS
WOODRAT, WHITE-THROATED	NEOTOMA-ALBIGULA
MOUSE, WHITE-FOOTED	PEROMYSCUS-LEVCOPUS
WOODRAT, SOUTHERN PLAINS	NEOTOMA-MICROPUS
MOUSE, DEER	PEROMYSCUS-MANICULATUS
MOUSE, BRUSH	PEROMYSCUS-BOYLII
WOODRAT, EASTERN	NEOTOMA-FLORIDANA
JACKRABBIT, BLACK-TAILED	LEPUS-CALIFORNICUS
COTTONTAIL, DESERT	SYLVILAGUS-AUDUBONII
COTTONTAIL, EASTERN	SYLVILAGUS-FLORIDANUS
JACKRABBIT, WHITE-TAILED	LEPUS-TOWNSENPII
DEER, MULE	ODOCOILEUS-HEMIONUS
PRONGHORN	ANTILOCAPRA-AMERICANA
DEER, WHITE-TAILED	ODOCOILEUS-VIRGINIANUS
HERON, BLUE, LITTLE	EGRETTA-CAERULEA

GREBE, EARED	PODICIPEDS-NIGRICOLLIS
GREBE, RED-NECKED	PODICEPS-GRISEGENA
GREBE, PIED-BILLED	PODILYMBUS-PODICEPS
GREBE, HORNED	PODICEPS-AURITUS
EGRET, CATTLE	BUBULCUS-IBIS
BITTERN, AMERICAN	BOTAURUS-LENTIGINOSUS

0627

Data base is COLORADO, set is LIMEGRAVE

COMMON-NAME	SCI-NAME
HERON, NIGHT, BLACK-CROWNED	NYCTICORAX-NYCTICORAX
PELICAN, WHITE, AMERICAN	PELECANUS-ERYTHRORHYNCHOS
CORMORANT, DOUBLE-CRESTED	PHALACROCORAX-AURITUS
EGRET, SNOWY	EGRETTA-THULA
GREBE, WESTERN	AECHMOPHORUS-OCCIDENTALIS
BITTERN, LEAST	IXOBRYCHUS-EXILIS
HERON, BLUE, GREAT	ARDEA-HERODIAS
HERON, GREEN-BACKED	BUTORIDES-STRIATUS
IBIS, WHITE-FACED	PLEGADIS-CHIHI
PINTAIL, NORTHERN	ANAS-ACUTA
GOOSE, WHITE-FRONTED, GREATER	ANSER-ALBIFRONS
GOOSE, CANADA	BRANTA-CANADENSIS
GOLDENEYE, COMMON	BUCEPHALA-CLANGULA
TEAL, GREEN-WINGED	ANAS-CRECCA
GOOSE, SNOW	CHEN-CAERULESLENS
REDHEAD	AYTHYA-AMERICANA
SCAUP, LESSER	AYTHYA-AFFINIS
MERGANSER, COMMON	MERGUS-MERGANSER
BUFFLEHEAD	BUCEPHALA-ALBEOLA
DUCK, RUDDY	OXYURA-JAMAICENSIS
MALLARD	ANAS-PLATYRHYNCHOS
TEAL, BLUE-WINGED	ANAS-DISCORS
GADWALL	ANAS-STREPERA
TEAL, CINNAMON	ANAS-CYANOPTERA
PIGEON, AMERICAN	ANAS-AMERICANA
SHOVELER, NORTHERN	ANAS-CLYPEATA
MERGANSER, HOODED	LOPHODYTES-CUCULLATUS
HAWK, SWAINSON'S	BUTEO-SWAINSONI
EAGLE, GOLDEN	AQUILA-CHRYSAETOS
FALCON, PRAIRIE	FALCO-MEXICANUS
HAWK, FERRUGINOUS	BUTEO-REGALIS
HARRIER, NORTHERN	CIRCUS-CYANEUS
VULTURE, TURKEY	CATHARTES-AURA
KITE, MISSISSIPPI	ICTINIA-MISSISSIPPIENSIS
HAWK, RED-TAILED	BUTEO
EAGLE, BALD	HALIAEETUS-LEUCOCEPHALUS
HAWK, ROUGH-LEGGED	BUTEO-LAGOPUS
KESTREL, AMERICAN	FALCO-SPARVERIUS
CURLEW, LONG BILLED	NUMENIUS-AMERICANUS
SANDPIPER, SPOTTED	ACTITIS-MACULARIA
SANDPIPER, UPLAND	BARTRAMIA-LONGICAUDA
PHALAROPE, WILSON'S	PHALAROPUS-TRICOLOR
SNIPE, COMMON	GALLINAGO-GALLINAGO
BOBWHITE, NORTHERN	COLINUS-VIRGINIANUS
AVOCET, AMERICAN	RECURVIROSTRA-AMERICANA
PLOVER, MOUNTAIN	CHARADRIUS-MONTAUS
KILLDEER	CHARADRIUS-VOCIFERUS
QUAIL, SCALED	CALLIPEPLA-SQUMATA
CRANE, WHOOPING	GRUS-AMERICANA
PRAIRIE-CHICKEN, LESSER	TYMPANUCHUS-PALLIDICINCTUS
PHEASANT, RING-NECKED	PHASIANUS-COLCHICUS
COOT, AMERICAN	FULICA-AMERICANA
MOORHEN, COMMON	GALLINULA-CHLOROPUS
RAIL, VIRGINIA	RALLUS-LIMICOLA
TURKEY, WILD	MELEAGRIS-GALLOPAVO

STILT, BLACK-NECKED		HIMANTOPUS-MEXICANUS
SORA	0020	PORZANA-CAROLINA
GULL, CALIFORNIA		LARUS-CALIFORNICUS
GULL, HERRING		LARUS-ARGENTATUS
TERN, BLACK		CHLIDONIAS-NIGER
GULL, GLAUCOUS		LARUS-HYPERBOREUS

Data base is COLORADO, set is LIMEGRAVE

COMMON-NAME	SCI-NAME
GULL, RING-BILLED	LARUS-DELAWARENSIS
ERN, LEAST	STERNA-ALBIFRONS
ERN, FORSTER'S	STERNA-FORSTERI
CUCKOO, YELLOW-BILLED	COCCYZUS-AMERICANUS
WL, SHORT-EARED	ASIO-FLAMMEUS
WL, SCREECH, COMMON	OTUS-ASIO
OWL, GREAT-HORNED	BUBO-VIRGINIANUS
OVE, ROCK	COLUMBA-LIVIA
WL, BARN, COMMON	TYTO-ALBA
CUCKOO, BLACK-BILLED	COCCYZUS-ERYTHROPTHALMUS
OWL, BURROWING	ATHENE-CUNICULARIA
WL, LONG-EARED	ASIO-OTUS
OADRUNNER, GREATER	GEOCOCCYX-CALIFORNIANUS
WOODPECKER, HAIRY	PICOIDES-VILLOSUS
IGHTHAWK, COMMON	CHORDEILES-MINOR
WIFT, CHIMNEY	CHAETURA-PELAGICA
WOODPECKER, DOWNY	PICOIDES-PUBESCENS
WOODPECKER, RED-BELLIED	MELANERPES-CAROLINUS
OODPECKER, LADDER-BACKED	PICOIDES-SCALARIS
LICKER, NORTHERN	COLAPTES-AURATUS
HUMMINGBIRD, BROAD-TAILED	SELASPHORUS-PLATYCERCUS
OODPECKER, RED-HEADED	MELANERPES-ERYTHROCEPHALUS
UMMINGBIRD, BLACK-CHINNED	ARCHILOCHUS-ALEXANDRI
KINGFISHER, BELTED	CERYLE-ALCYON
OODPECKER, LEWIS'	MELANERPES-LEWIS
WALLOW, BANK	RIPARIA-RIPARIA
SWALLOW, BARN	HIRUNDO-RUSTICA
LARK, HORNED	EREMOPHILA-ALPESTRIS
WALLOW, CLIFF	HIRUNDO-PYRRHONOTA
SWALLOW, ROUGH-WINGED, NORTHERN	STELGIDOPTERYX-SERRIPENNIS
NUTHATCH, WHITE-BREASTED	SITTA-CAROLINENSIS
HRASHER, CURVE-BILLED	TOXOSTOMA-CURVIROSTRE
REN, BEWICK'S	THRYOMANES-BEWICKII
CHICKADEE, BLACK-CAPPED	PARUS-ATRICAPILLUS
REN, CANYON	CATHERPES-MEXICANUS
REN, HOUSE	TROGLODYTES-AEDON
THRASHER, BROWN	TOXOSTOMA-RUFUM
CATBIRD, GRAY	DUMETELLA-CAROLINENSIS
OCKINGBIRD	MIMUS-POLYGLOTTOS
WREN, MARSH	CISTOTHORUS-PALUSTRIS
WREN, ROCK	SALPINCTES-OBSOLETUS
IREO, WARBLING	VIREO-GILVUS
STARLING, EUROPEAN	STURNUS-VULGARIS
VIREO, BELL'S	VIREO-BELLII
SHRIKE, LOGGERHEAD	LANIUS-LUDOVICIANUS
IREO, RED-EYED	VIREO-OLIVACEOUS
GROSBEAK, EVENING	COCCOTHRAUSTES-VESPERTINUS
SPARROW, HOUSE	PASSER-DOMESTICUS
OWBIRD, BROWN-HEADED	MOLOTHRUS-ATER
GOLDFINCH, AMERICAN	CARDUELIS-TRISTIS
BLACKBIRD, BREWER'S	EUPHAGUS-CYANOCEPHALUS
RACKLE, COMMON	QUISCALUS-QUISCULA
SISKIN, PINE	CARDUELIS-PINUS
FINCH, HOUSE	CARPODACUS-MEXICANUS
RAVEN, CHIHUAHUAN	CORVUS-CRYPTOLEUCUS

BLUEBIRD, MOUNTAIN	0631	SIALIA-CURRUCOIDES
CROW, AMERICAN		CORVUS-BRACHYRHYNCHOS
MAGPIE, BLACK-BILLED		PICA-PICA
JAY, PINYON		GYMNORHINUS-CYANOCEPHALUS
JAY, BLUE		CYANOCITTA-CRISTATA
RAVEN, NORTHERN		CORVUS-CORAX

Data base is COLORADO, set is LIMEGRAVE

COMMON-NAME	SCI-NAME
GNATCATCHER, BLUE-GRAY	POLIOPTILA-CAERULEA
BLUEBIRD, EASTERN	SIALIA-SIALIS
ROBIN, AMERICAN	TURDAS-MIGRATORIUS
SPARROW, LARK	CHONDESTES-GRAMMACUS
LONGSPUR, MCCOWN'S	CALCARIUS-MCCOWANII
SPARROW, GRASSHOPPER	AMMODRAMUS-SAVANNARUM
SPARROW, SAGE	AMPHISPIZA-BELLI
BLACKBIRD, RED-WINGED	AGELAIUS-PHOENICEUS
SPARROW, RUFOUS-CROWNED	AIMOPHILA-RUFICEPS
LONGSPUR, LAPL ND	CALCARIUS-LAPPONICUS
SPARROW, CASSI S	AIMOPHILA-CASINII
CARDINAL, NORTHERN	CARDINALIS-CARDINALIS
WARBLER, YELLOW	DENDROICA-PETECHIA
SPARROW, SAVANNAH	PASSERCULUS-SANDWICHENSIS
ORIOLE, NORTHERN	ICTERUS-GALBULA
SPARROW, LINCOLN'S	MELOSPIZA-LINCOLNII
SPARROW, FOX	PASSERELLA-ILIACA
TOWHEE, RUFOUS-SIDED	PIPILO-ERYTHROPHTHALMUS
TOWHEE, BROWN	PIPILO-FUSCUS
SPARROW, FIELD	SPIZELLA-PUSILLA
SPARROW, WHITE-CROWNED	ZONOTRICHIA-LEUCOPHRYS
BLACKBIRD, YELLOW-HEADED	XANTHOCEPHALUS-XANTHOCEPHALUS
MEADOWLARK, WESTERN	STURNELLA-NEGLECTA
SPARROW, VESPER	POOECETES-GRAMINEA
SPARROW, CLAY-COLORED	SPIZELLA-PALLIDA
SPARROW, AMERICAN TREE	SPIZELLA-ARBOREA
DICKCISSEL	SPIZA-AMERICANA
SPARROW, WHITE-THROATED	ZONOTRICHIA-ALBICOLLIS
DOVE, MOURNING	ZENAIDA-MACROURA
YELLOWTHROAT, COMMON	GEOTHLYPIS-TRICHAS

United States Department of Agriculture | Natural Resources Conservation Service | 655 Parfet Street Room E200C Lakewood, CO 80215

April 26, 1996

Perry D. Olson, Director
Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216

Dear Perry:

Enclosed is a copy of the revised draft Watershed Plan-Environmental Assessment (plan-EA) for Limestone-Graveyard Creeks Watershed, Colorado, prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 10 (2) (c) of the National Environmental Policy Act of 1969 (Public Law 91-190). The final plan-EA may be approved administratively.

We are requesting that comments be received by Duane Johnson, State Conservationist, on or before May 20, 1996.

George R. Christy
for Duane L. Johnson
State Conservationist

Enclosure

STATE OF COLORADO
Roy Romer, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
AN EQUAL OPPORTUNITY EMPLOYER

John W. Mumma, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192

063

REFER TO

For Wildlife – For People

5-10-96

Bruce Goforth
Colorado Division of Wildlife
2126 N. Weber
Colorado Springs, CO 80907

Mr. Duane L. Johnson
State Conservationist
Natural Resources Conservation Service
655 Parfet Street, Room E200C
Lakewood, CO 80215

RE: Revised Draft of Watershed Plan-Environmental Assessment for Limestone-Graveyard Creeks Watershed, Colorado

Dear Mr. Johnson:

The Colorado Division of Wildlife (CDOW) is in receipt of the above referenced plan and offers the following comments:

* This plan may have water quality benefits for the Arkansas River through increased return flows, and higher water quality via reduced salinity, heavy metals, etc. However, it appears that small wetlands throughout the project will be lost in providing these benefits. CDOW would like to see a quantification of these anticipated wetland losses.

* Individually, wetland losses may be small and their conversion made possible without mitigation via the use of a US Army Corps of Engineer, Nationwide Permit. However, on a cumulative basis (throughout the project), the wetland losses/impacts may be substantial, requiring an Individual 404 Permit. An analysis quantifying total anticipated wetland losses should be provided. In addition to this quantification, a proposal for mitigating wetland losses should be provided.

* Wetland/riparian habitat is the richest habitat type in Colorado, providing important life cycle functions for at least 80 % of Colorado's wildlife species. With this in mind, it is difficult for CDOW to understand how wildlife benefits will be increased through the implementation of this project. If water quality benefits are projected to increase wildlife or fishery values, such benefits should be identified and compared to anticipated wildlife/fishery losses.

DEPARTMENT OF NATURAL RESOURCES, James S. Lochhead, Executive Director
WILDLIFE COMMISSION, Arnold Salazar, Chairman • Rebecca L. Frank, Vice Chair • Mark LeValley, Secretary
Louis F. Swift, Member • Jesse Langston Boyd, Jr., Member
William R. Hegberg, Member • John Stulp, Member • James R. Long, Member

* Water rights issues regarding potential impacts to existing water rights and/or obligations/restraints or benefits in consideration of the Arkansas River Compact (Colorado-Kansas conflicts) should be discussed.

With the forgoing points of concern in mind, CDOW suggests that the project, as described to date, is incomplete. Until such time as a more thorough analysis of wetland, wildlife, and water rights/quality project effects can be provided to determine the net benefits or impacts to wildlife, CDOW must withhold support for this project.

CDOW appreciates the opportunity to provide comments on this project. If you have questions about these comments or wish to further discuss CDOW's concerns for wildlife and water issues, please call me at 719-473-2945, ext. 224.

Sincerely,

Bruce Goforth
Sr. Wildlife Biologist

cc. Bob Towry
Ron Desilet
Mel De Pra
Doug Krieger

0636 USDA

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

655 Parfet Street
Room E200C
Lakewood, CO
80215-5517

303 236-2886
303 236-2896 - FAX

July 2, 1996

TO: Bruce Goforth
Colorado Division of Wildlife
2126 N. Weber
Colorado Springs, CO 80907

RE: Revised Draft of Watershed Plan-Environmental Assessment for Limestone-Graveyard Creeks Watershed, Colorado

This is to respond to your concerns that you expresses to NRCS involving our Environmental Assessment and Plan for the Limestone-Graveyard Watershed. Please review and let me know by July 12, 1996 if you have and disagreements with our responses to your concerns.

DOW COMMENT 1

This plan may have water quality benefits for the Arkansas River through increased return flows, and higher water quality via reduced salinity, heavy metals, etc. However, it appears that small wetlands throughout the project will be lost in providing these benefits. CDOW would like to see a quantification of these anticipated wetland losses.

NRCS RESPONSE

It is not possible to quantify potential wetland losses because it is not known where practices will be implemented at this time. As stated on page 41 of the plan, mitigation will be carried out on a case by case basis as needed for all wetland losses. Also refer to pages twelve and thirty-one of the plan for wetland inventory information and potential effected wetlands.

DOW COMMENT 2

Individually, some wetland losses may be small and their conversion made possible without mitigation via the use of a US Army Corps of Engineer, Nationwide Permit. However, on a cumulative basis (throughout the project), the wetland losses/impacts may be substantial, requiring an Individual 404 Permit. An analysis quantifying total anticipated wetland losses should be provided. In addition to this quantification, a proposal for mitigating wetland losses should be provided.

NRCS RESPONSE

As stated in the response to your first comment, refer to page 41 of the plan, all wetland effects will be mitigated for. This mitigation will be part of the contracting agreement before funds can be approved. This plan has been reviewed by the Army Corps of Engineers and all their concerns have been addressed to their satisfaction in this plan. Also note table 1 quantifies anticipated mitigation efforts.

DOW COMMENT 3

Wetland/riparian habitat is the richest habitat type in Colorado, providing important life cycle functions for at least 80% of Colorado's wildlife species. With this in mind, it is difficult of CDOW to understand how wildlife benefits will be increased through the implementation of this project. If water quality benefits are projected to increase wildlife of fishery values, such benefits should be identified and compared to anticipated wildlife/fishery losses.

NRCS RESPONSE

Paragraph 4 on page 18 and paragraph 5 on page 30 will be removed from the final document in response to your concern, however concentrations of sediment and selenium in the Arkansas River will be reduced as a result of project action.

DOW COMMENT 4

Water rights issues regarding potential impacts to existing water rights and/or obligations/restraints or benefits in consideration of the Arkansas River Compact (Colorado-Kansas conflicts) should be discussed.

NRCS RESPONSE

Please note that pages 17, 30 and Appendix C all refer to issues related to the Arkansas River Compact and potential effects from this project. Additionally, we are working closely with other DNR agencies to insure that the project does not adversely affect the compact.

Natural Resources Conservation Service appreciates you taking the time to review this draft plan and I hope these responses address your concerns.

Sincerely,

Duane L. Johnson

DUANE L. JOHNSON
State Conservationist

Appendix B

UC33

HYDROGEOLOGIC CROSS SECTION

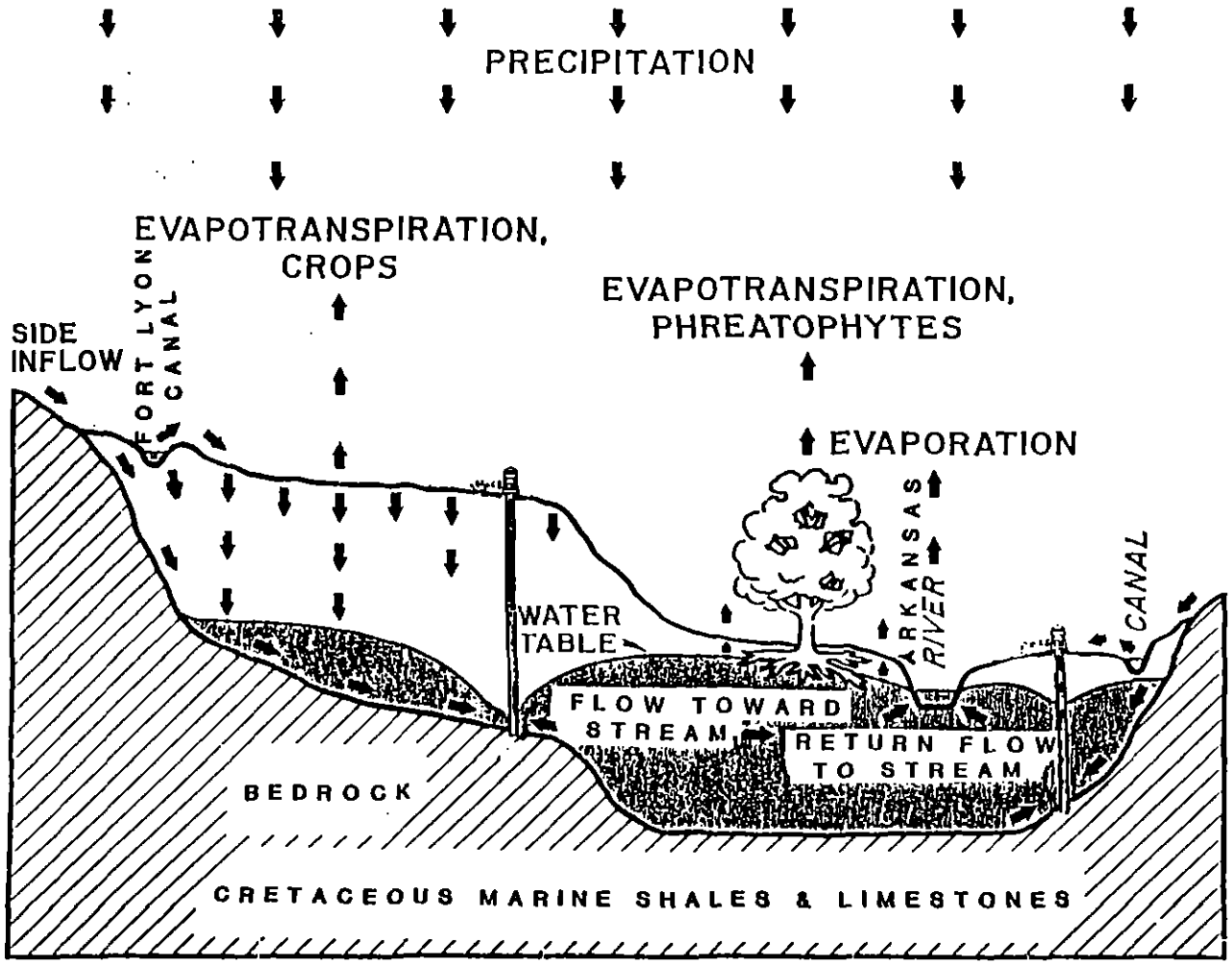


Figure B-1

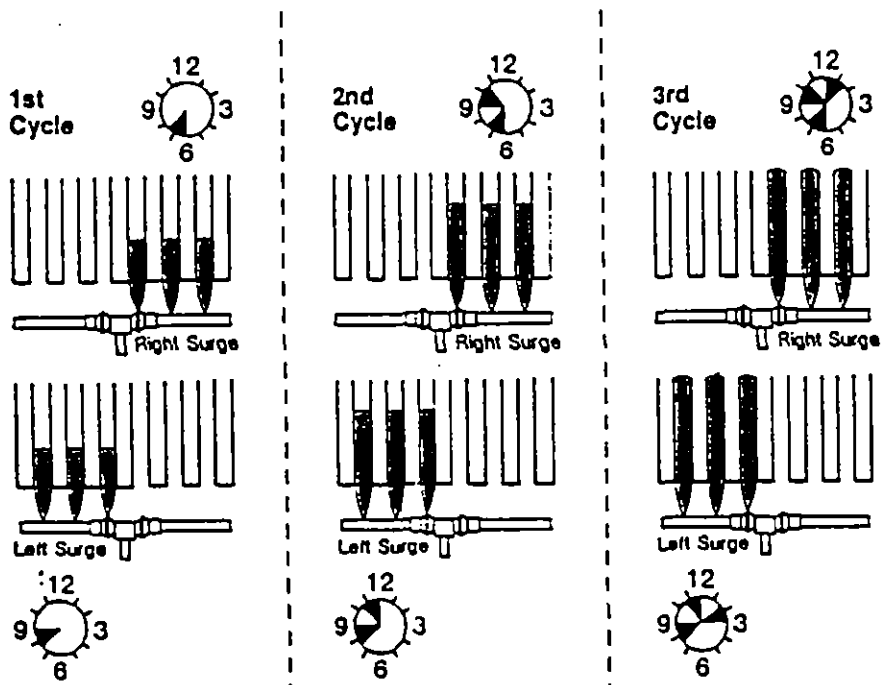
0640

SURGE IRRIGATION GUIDE

Bulletin 543A
Colorado State - University Cooperative Extension

Surge irrigation can be applied manually by alternating water between two sets of furrows. However, labor is prohibitive in most cases because usually more than a few surges are needed. In today's typical installation, surge irrigation is applied through the use of an automatic "surge valve" located between two sets of gated pipes. Water is alternated between the right and left sides of the surge valve. Therefore, for each set of furrows, a series of on and off time periods is created. For example, a furrow on one side of the surge valve receives water for 40 minutes and then water is shut off for 40 minutes. This furrow will receive the second surge of water after one hour and 20 minutes (80 minutes). The second surge duration can again be 40 minutes or longer according to the particular program used. This process continues until the advance is complete.

Surge cycles and water advance.



Cut back for the soaking phase in surge irrigation can be done in two ways. The first way is to divide the flow between the two sets, which reduces the stream size by 50 percent. The second way is to continue to alternate the water between the two sets of furrows on a short time interval, which cuts back time and the average stream size.

Figure B-2

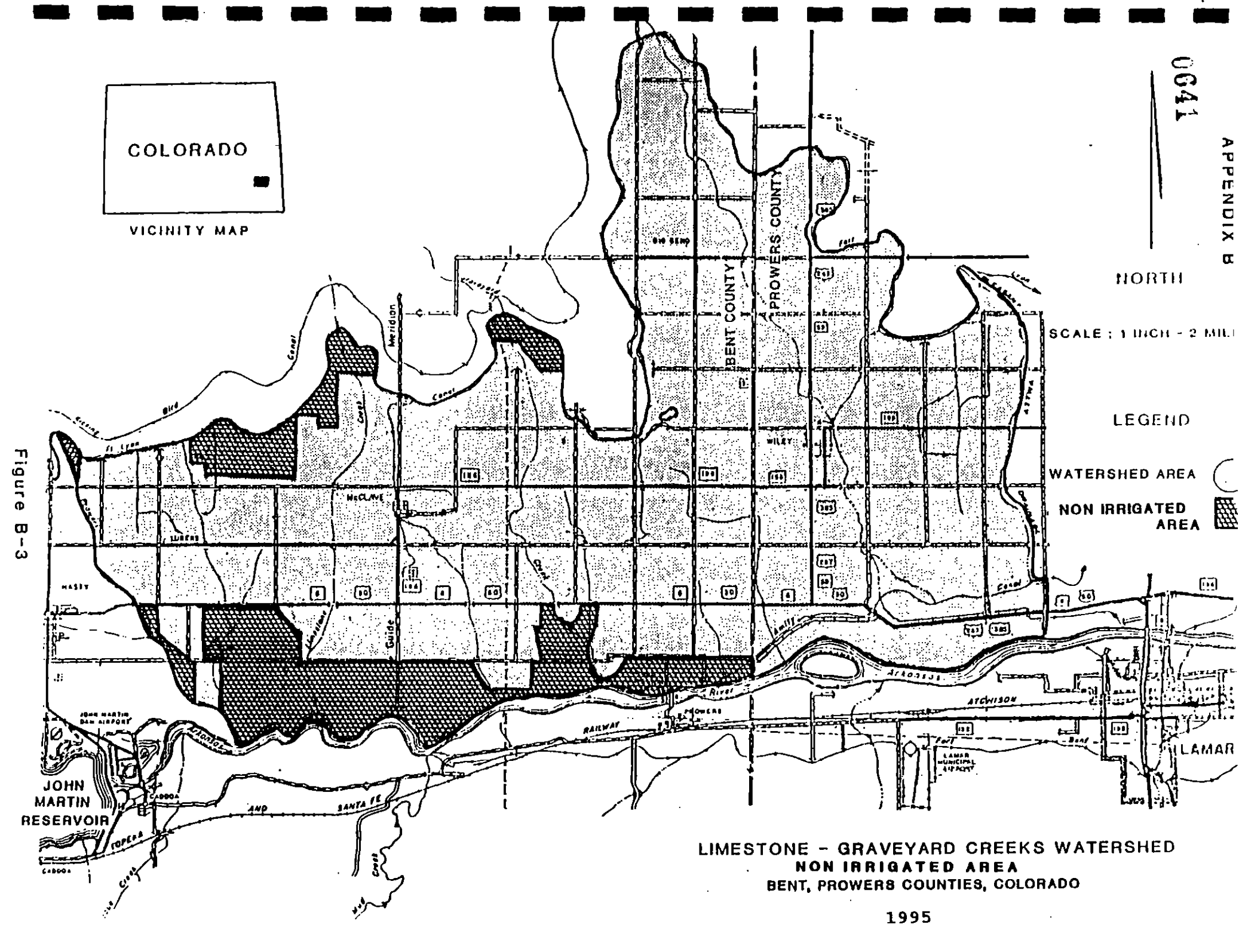
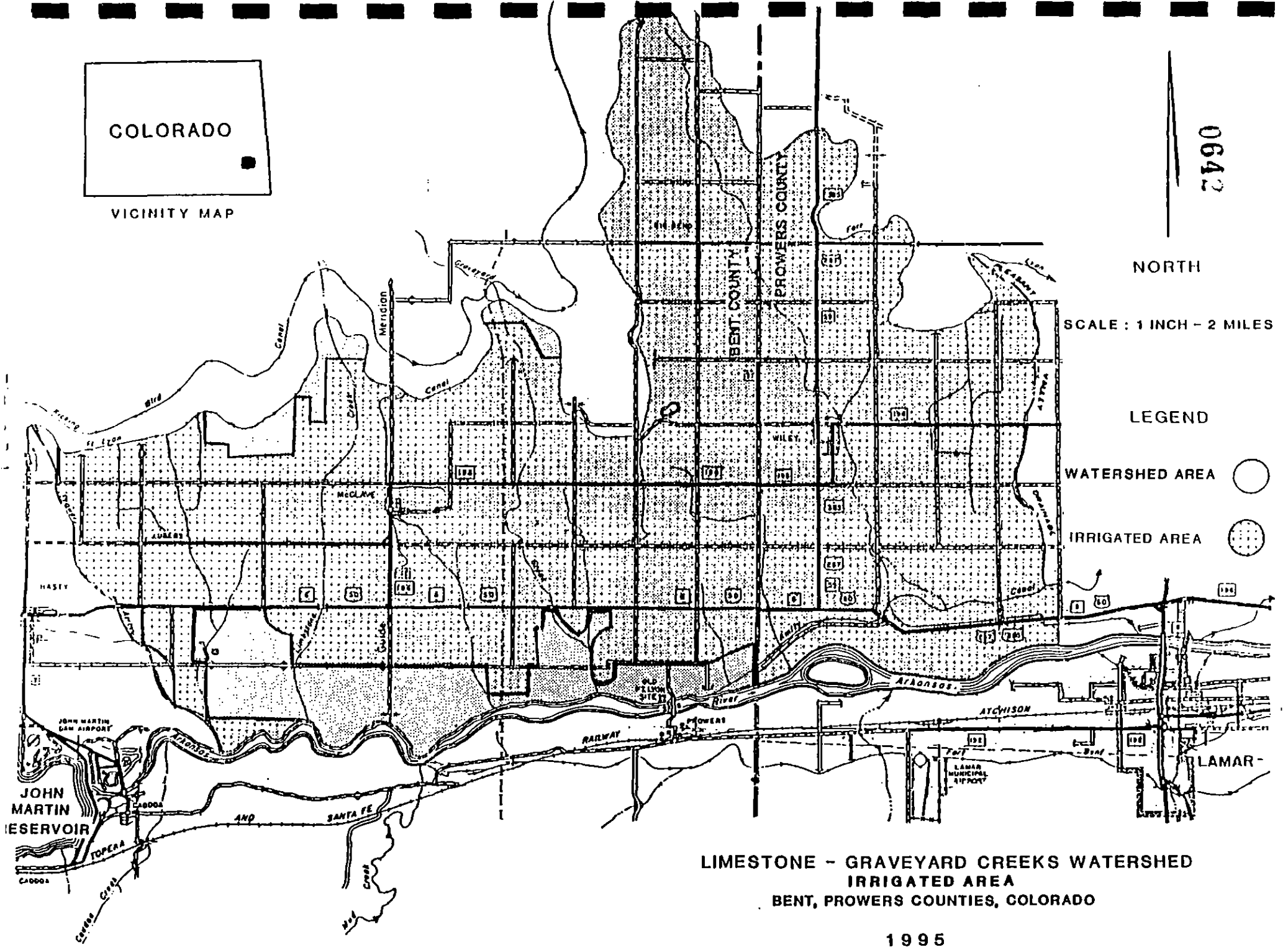


Figure B-3

LIMESTONE - GRAVEYARD CREEKS WATERSHED
NON IRRIGATED AREA
BENT, PROWERS COUNTIES, COLORADO

1995



LIMESTONE - GRAVEYARD CREEKS WATERSHED
IRRIGATED AREA
BENT, PROWERS COUNTIES, COLORADO

1995

United States Department of Agriculture

Natural Resources Conservation Service

West National Technical Center
101 S.W. Main St., Suite 1700
Portland, Oregon 97204-3225

0643

January 24, 1995

WEST NTC BULLETIN NO. W450-5-3

SUBJECT: TCH - RELEASE OF WNTC INTERIM CONSERVATION PRACTICE STANDARD 201

Purpose. To transmit WNTC Interim Conservation Practice Standard 201, *IRRIGATION EROSION CONTROL (POLYACRYLAMIDE - PAM)* for use by the western states.

Expiration Date. February 1, 1996.

Enclosed is the WNTC Interim Conservation Practice Standard 201, *IRRIGATION EROSION CONTROL (POLYACRYLAMIDE - PAM)* for use in the western states along with supporting rationale for reference at the state office level. The standard is effective until February 1, 1998, or until superseded by an applicable national standard.

The following information shall be recorded and reported, per field, annually to the Technical Center or office with standards responsibility:

- Location applied, legal or other description of the field.
- Size of field or treatment area.
- Predominate soil series and texture.
- Method dispersed into the irrigation water and form of PAM used (i.e., solute, powder, block, etc.)
- Number of seasonal PAM applications.
- Number of soils disturbance operations during the irrigation season.
- Total amount of PAM applied to the field or treatment area.
- Effectiveness of controlling irrigation induced erosion.
- Distance off field to potential receiving waterbody and type of body, noting any apparent aquatic effects.

For further information or assistance, contact Larry Dawson, WNTC Irrigation Engineer, at (503) 414-3014.

Mike Sonnville, acting
ROGER L. BENSEY
Acting Director

Enclosure

DIST:
S (West and Pacific Basin)
T
N

The Natural Resources Conservation Service, formerly Soil Conservation Service, is an agency of the United States Department of Agriculture

To be issued w/ Tech Guide Notice 3/95

0644

NATIONAL RESOURCES CONSERVATION SERVICE
WEST NATIONAL TECHNICAL CENTER
INTERIM CONSERVATION PRACTICE STANDARD

IRRIGATION EROSION CONTROL (POLYACRYLAMIDE)

(acre)
WNTC 201-I

DEFINITION

The addition of polyacrylamide to irrigation water.

PURPOSE

To minimize or control irrigation-induced soil erosion.

CONDITIONS WHERE PRACTICE APPLIES

On corrugation or furrow irrigated lands susceptible to irrigation-induced erosion. This practice does not apply to peat soils or where irrigation waters exceed a sodium adsorption ratio (SAR) of 15.

CRITERIA

The polyacrylamide (PAM) will be of the anionic type meeting EPA and FDA acrylamide monomer limits, and shall be applied according to the labeling of the product for this use. Use shall conform to all federal, state, and local laws, rules, and regulations.

PAM will be used during the first irrigation after soil disturbance (pre-irrigation is considered irrigation).

PAM will be added to irrigation water only during the advance phase of an irrigation. The advance phase will be considered to be from the time irrigation starts until water has advanced to the end of the furrows or corrugations.

The concentration of PAM in irrigation water applied shall not exceed 10 ppm. Premixed stock solutions are encouraged. Mixing of and/or application of materials shall be in accordance with the manufacturers recommendations.

CONSIDERATIONS

Other conservation treatments such as land leveling, irrigation water management, reduced tillage, crop rotations, etc. should be used in conjunction with this practice to control irrigation-induce erosion.

Adjustment of the concentrations downward from 10 ppm may be used so long as no visible erosion occurs.

Secondary applications on untilled furrows may be needed but may not require as high a rate as the first application.

Where reasonably possible, the tailwater containing PAM should be used on other fields (or stored for a future irrigation).

PAM is a flocculating agent which can cause deposition in canals, laterals, head ditches, pipelines, furrows, or other locations where it comes in contact with sediment ladened waters. Down stream deposition from the use of PAM may require frequent cleaning to maintain normal functions.

The advance rate can vary greatly between hard rows (wheel packed) and soft rows. Both PAM application and irrigation water management would benefit from treating these differences appropriately.

Consider the impacts of increases in infiltration of up to approximately 15% when PAM is applied.

SAFETY AND HEALTH

Consider proper health and safety precautions according to the label and industry guidelines. If inhaled in large quantities, PAM dust can cause choking and difficult breathing. A dust

mask of a type recommended by the manufacturer should be used by persons handling and mixing PAM. PAM solutions can cause surfaces, tools, etc. to become very slippery when wet.

PLANS AND SPECIFICATIONS

Specifications will be developed site specifically for each application. Specifications for this practice will be prepared for each field or treatment unit according to the criteria, considerations, and operation and maintenance described in this standard. Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Irrigations will be monitored and the PAM applications to irrigation waters will be discontinued when the advance phase has been completed.

All equipment will be operated and maintained to provide the uniform application rates as listed in Criteria. Rinse all equipment used to mix and apply PAM thoroughly with water to avoid formation of intractable PAM residues.

0646

INTERIM STANDARD WNTC 201 - RATIONALE IRRIGATION EROSION CONTROL (POLYACRYLAMIDE - PAM)

AUTHORS

The interim standard and supporting rationale were assembled by Larry Dawson, Irrigation Engineer, Ken Pfeiffer, Agronomist, and Tom Spofford, Agricultural Engineer of the WNTC and incorporates comments received from industry and NRCS western states during an extensive review process. Extensive input and comments were received from Robert E. Sojka and Richard D. Lenz with the USDA-ARS, Soil & Water Management Research Unit at Kimberly, Idaho.

PURPOSE

Irrigation-induced erosion has occurred for centuries and continues today at alarming rates. Erosion and sediment yield into streams and waterbodies is a significant issue in ecosystem based activities.

Research of PAM use (4 years) in surface irrigation waters of southern Idaho (ARS - Kimberly) and other locations, has shown a significant reduction in field erosion and sediment yield. Reductions of 80-99% sediment yield are the norm when using 10 ppm PAM concentration in the advance phase of furrow irrigation (0 ppm the balance of the irrigation).

A preliminary estimate of cost of applying PAM is in the neighborhood of $4.00 (1994 costs) per acre per application. Probably 2 applications will be needed annually as a minimum and more would be needed on crops with frequent tillage operations.

CRITERIA

Numerous studies have documented that the highest sediment yields occur during the first irrigation on disturbed soil surfaces and in the first few hours of a given irrigation. Research (ARS - Kimberly) has documented that introduction of PAM during irrigation on disturbed surfaces, 'ties' the surface soil particles together, holding them in place and shape. Research and field experience have shown residual effect of PAM until the soil has been disturbed again. This residual effect diminishes with time.

Based on applications ranging from 0 to 20 ppm, optimal concentration appears to be 10 ppm. Kimberly research with various application methods indicates that stock solutions provided the most consistent and uniform concentrations. Dry applications require more vigorous mixing and also resulted in higher amounts of PAM transport off the field in tailwater. This effect is lessened when dry PAM is added in turbulent water.

There are potentials for automating the advance phase application. Once the approximate advance phase for an irrigation has been established, timers could be used for additional applications versus having an individual present to shut the PAM off at the end of the advance phase.

CONCERNS

PAM has an extensive history of use in the food processing industry, food packaging industry, off shore oil drilling, and municipal drinking water and sewer facilities as a flocculent. The anionic form is required in this standard versus the use of cation PAM

which can accumulate in fish gills. Both forms of PAM are commonly available and meet FDA and EPA requirements for specified uses.

There are various unresolved questions as to resource impacts of PAM material that leaves with tailwater. Applications only during the advance phase resulted in minimum runoff of PAM. Until resource issues are resolved, known technology should be used to minimize PAM movement off field as much as is practical.

Possible effects offsite an the various aspects of the water, animal, and plant resources need to be assessed and evaluated as appropriate before this interim standard becomes a national standard. The effects of PAM on aquatic habitat and waterways needs to be better understood with the help of outside agency aquatic biologists as partners in this effort. These effects should not be judged as separate effects, but as a comparison to the effects of 50 tons sediment per acre per year entering into streams and waterbodies, carrying with it nutrients, pesticides, and organics. Intuitively this practice needs to be established, but other specialists need to become fully aware of the practice to gain the fullest acceptance and use of it.

References: *Copies of the following references are on file at the WNTC.*

Polyacrylamide (PAM), A new Weapon in the Fight Against Irrigation Induced Erosion by R. E. Sojka and R. D. Lentz, USDA-ARS Kimberly, ID, Station Note #01-94, 1994.

Guide to Polyacrylamide (PAM) Use for Erosion Control by Tim D. Stieber, University of Idaho - Extension Educator, Unpublished 1994.

Field Results Using Polyacrylamide to Manage Furrow Erosion and Infiltration by R. E. Sojka and R. D. Lentz, USDA-ARS Kimberly, ID, Soil Science, Vol. 158, No. 4, 10/94.

Potential Water Column Toxicity of Polyacrylamides to Ceriodaphnia dubia and Pimephales promelas by Jeanne Chilcott, Agricultural Unit, Central Valley Region Water Quality Control Board, CA, Unpublished Draft 1994.

Preventing Irrigation Furrow Erosion with Small Applications of Polymers by R. D. Lentz, I. Shainberg, R. E. Sojka and D. L. Carter, USDA-ARS Kimberly, ID, Soil Science Society of America Journal, Vol. 56, No. 6, 11/92.

Interactions of Polyacrylamides with Certain Soil Pseudomnads by Mary M. Grula and May-lin Huang, Oklahoma State University, Unpublished Chapter 38, Department of Energy Contract DE-AT19-78BC-30201.

Acute Toxicity of Wastewater Treatment Polymers to Daphnia Pulex and the Fathead Minnow (Pimephales promelas) and the effects of humic acid on polymer toxicity by W. Scott Hall and Richard J. Mirenda, Research Journal WPCF, Vol. 63, No. 6, Sept/Oct 1991.

Desorption of Polyacrylamide and Polysaccharide Polymers from Soil Materials by A. Nadler, M. Malik, and J. Letey, Soil Technology, Vol. 5, pg 91-95, Cremlingen (Germany) 1992.

Toxicologic Investigations of Polyacrylamides by D. D. McCollister, C. L. Hake, S. E. Sadek, and V. K. Rowe, Journal of Toxicology and Applied Pharmacology, pp. 639-651, 9/65.

Time for Yet Another Look at Soil Conditioners, by R. E. Sojka and R. D. Lentz, USDA-ARS Kimberly, ID, Soil Science, pg. 233-234, Vol. 158, No. 4, October 1994.

Polyacrylamide Characteristics Related to Soil Applications by Frank W. Barvenik, Soil Science, pg. 235-243, Vol. 158, No. 4, October 1994.

Adsorption and Desorption of Polymers on Soil by J. Letey, Soil Science, pg. 244-248, Vol. 158, No. 4, October 1994.

PAM Application Techniques and Mobility in Soil by Arie Nadler, Mordeckai Magaritz, and Lea Leib, Soil Science, pg. 249-254, Vol. 158, No. 4, October 1994.

Predicting Key Polymer Properties to Reduce Erosion in Irrigated Soil by Jozef Bicerano, Soil Science, pg. 255-266, Vol. 158, No. 4, October 1994.

Organic Polymers and Soil Sealing in Cultivated Soils by I. Shainberg and G. J. Levy, Soil Science, pg. 267-273, Vol. 158, No. 4, October 1994.

Field Results Using Polyacrylamide to Manage furrow Erosion and Infiltration by R. D. Lentz and R. E. Sojka, Soil Science, pg. 274-282, Vol. 158, No. 4, October 1994.

Runoff, Erosion, and Polymer Application in Moving-Sprinkler Irrigation by M. Ben-Hur, Soil Science, pg. 283-290, Vol. 158, No. 4, October 1994.

Interactions of Certain Polyacrylamides with Soil Bacteria by Mary M. Grula, May-Lin Huang, and Guy Sewell, Soil Science, pg. 291-300, Vol. 158, No. 4, October 1994.

Project Formulation

Water quality and quantity problems in and along the Arkansas River have long existed. Various state and federal agencies have collected data for many years. Local groups recently have begun looking for possible ways to address the problems.

A project was initiated by the Bent and Prowers SCDs. Their request for assistance was directed to the NRCS field offices in Lamar and Las Animas.

The purpose to be served by the project are agricultural water management and watershed protection. This project is being formulated to improve water quality, both surface and groundwater, reduce irrigation induced erosion to acceptable levels, and more effectively conserve and use available water supplies by improving irrigation efficiency.

There is a concern that the geology of this area, along with current land use practices are adversely affecting the water quality of the surface and ground water. This concern over heavy metals in the irrigation drainages and Arkansas River and its potentially harmful effects on human health, fish and wildlife has been studied by scientists from the U.S. Geological Survey, the U.S. Fish and Wildlife Service and the U.S. Bureau of Reclamation.

Land use in the project area consists of rangeland and irrigated crop land. Most of the problems that surfaced were on the irrigated cropland. To conduct an inventory which would be representative of the area, NRCS personnel decided to collect data on the majority of the irrigated operators. Farm interviews and investigations were used to collect the data on a field by field basis.

The data collected consisted of: Cropping pattern, present irrigation systems and needs, soils, crop rotation and inputs, irrigation efficiencies, resource conditions, passable measures to be considered, and the extent of these measures needed to address the sponsors' concerns. The magnitude of the needs were derived by extrapolation of the inventoried data.

Various field scale models were used to analyze the effects of alternatives. These models include FIRI (an irrigation evaluation program, developed by the Natural Resource Conservation Service Technical Center in Portland, Oregon); FURCAL (a furrow irrigation evaluation program); SIRMOD (a irrigation evalualtion program developed by Utah State University in Logan, Utah); and FUSED (a program developed

by the Natural Resource Conservation Service Technical Center in Portland, Oregon to quantify sediment movement under furrow irrigation.

Some assumptions were made for the purpose of analysis. The Arkansas river is a gaining stream. The project watershed is not in a sink. There is a direct link between leaching and selenium concentration in the ground water. Deep percolation occurs from the top of a field to the bottom during irrigation (based on field data). The root zone is not allowed to be depleted below 50 percent of its holding capacity between irrigations. Consumptive use is static from the top of a field to the bottom when soil moisture is maintained at 50 percent or above of a given soils holding capacity.

A detailed water quantity and quality data collection began for the Lower Arkansas River Basin Water Quality Study of which this watershed is a part of. This study completed in 1992 along with additional data that has since been published helped formulate the problems and needs.

Based on the needs, alternative treatments were developed. Since the irrigated land was similar in soils and problems, the entire watershed was used as a treatment unit. Various levels of treatment were used as alternative plans. The effects of each alternative related to the sponsors' concerns were developed. Estimates of the effects of each practice within an alternative were made. These effects were extrapolated in the same fashion as the inventoried needs. The overall effect of an alternative was derived from these estimates as well as including an expected application factor. The draft watershed plan and environmental assessment was reviewed by state staff specialists having responsibility for engineering, soils, agronomy, range conservation, biology, forestry, economics, and geology. The sponsors selected an alternative which is the recommended plan.

Environmental Considerations

Field inventories of the irrigated land were carried out on approximately 80 percent of the project area. These inventories included a field investigation specifically targeted at wetlands. After they were completed, an Environmental Assessment was made for each viable alternative. Based on these evaluations, it was determined that an Environmental Impact Statement was not needed.

Engineering

The analysis of on-farm irrigation efficiencies was conducted by using the computer program FIRS for the future without and future with project conditions. The future with and without project factor values were determined by adjusting present condition for the estimated changes to take place. The expected changes were determined by the NRCS staffs at Las Animas, Lamar, La Junta, along with the Water Resources Planning Staff. The judgement estimates were made considering present irrigation methods and future changes in the irrigation systems.

Irrigation water management will be improved by installing ditch lining and underground pipe and surge valves.

Assistance to farmers will be an increased effort to install designed irrigation systems and adjust set times and lengths of run such that irrigation water will be applied at optimum efficiency, thereby reduce deep percolation and runoff.

Geology

The geologic information for the project was obtained from special reports.

(1) "Uraniferous Waters of Southeastern Colorado - A Function of Geology, Climate and Land Use, 1993."

(2) "Technical Note - Conservation Planning for Water Quality Concerns Toxic Element - Selenium. - Water Quality Series No. W1, March, 1993.

(3) Reconnaissance Investigation of Water Quality Bottom Sediment and Biota associated with Irrigation Drainage in the Middle Arkansas River Basin, Colorado and Kansas, 1988, 89. USGS Water Resources Investigations Report 91-4060, prepared in cooperation with USFS and USBR, Denver, CO, 1991.

(4) Limestone-Graveyard Creeks and Highline Breaks Watersheds on-site Investigation and Trip Report - Pueblo, Otero, Bent and Prowers Counties, Colorado, February 1995, Mitchem, P.S., PG.

Economics

The procedure used to analyze this project was to develop a Future -Without- Project condition from the information gathered from the field. This was used as the basis to compare alternatives that would meet the sponsors objectives. Damage investigations and evaluation methods described in the NRCS Economics Handbook Part II, were followed to evaluate damages. The National Watersheds Manual was also used to develop incremental analysis. It was found that improvement of the present onfarm irrigation systems was a viable alternative as EPA standards for selenium levels and sediment reduction could be met. Enduring and management practices, including surge irrigation systems was the only viable method to meet the EPA and state water quality standard for selenium. This thus became the only candidate plan that met the 4 aspects of completeness, effectiveness, efficiency and acceptability.

Partial budgets were developed from the inventory data to show the change in net income due to yield changes from irrigation efficiencies and more available water, fertilizer usage, irrigation labor cost changes that occur with the installation of the more irrigation efficient irrigation systems, and reduced operation and maintenance costs to on farm ditches. Irrigation water management, nutrient and pest management are very important practices in meeting EPA standards.

A combination of practices were used for each increment for improved surface and groundwater, water quality and quantity, irrigation induced erosion reduction that met the test of completeness, effectiveness, efficiency and acceptability. To determine benefits versus cost, using incremental analysis, emphasis was placed on achieving the greatest net return for planned actions. It was on this basis that an alternative was selected as the National Economic Development (NED) plan and which is the recommended plan.

Summary of incremental analysis for evaluation units.
Average Annual Dollars 1/

Increment	Incremental Benefits	Total Benefits	Incremental Costs	Total Costs	Net benefits
Management Practices 2/	$157,800	$157,800	$67,600	$67,600	$90,200
Management & Enduring Practices 3/	$572,300	$730,100	$491,400	$559,000	$171,100

1/Practices were amortized over a 25-year period at 7 3/4 percent. Operation, maintenance, and replacement costs as well as technical assistance and project administration costs were included.

2/Practices included: Irrigation water management, nutrient management, conservation tillage, pest management - these are all non-cost shareable.

3/Practices included: Practices in footnote 2 plus ditch lining pipelines, tailwater systems land leveling, water control structures, seepage intercepters, and appurtenant structures.

Prices

Current prices were used for project installation, operation, maintenance and replacement costs. Field office ACP, LTA and Great Plains practice costs were used where possible and applicable. Engineering costs estimates were developed for the enduring practices by the planning, area and field office staffs. Cost data was also obtained from local companies in the area. Fertilizer and other crop inputs and costs were obtained from the local suppliers and producer interviews. Current normalized prices were used for agricultural commodities.

Period of Evaluation

A period of 25 years was used as being the expected useful life of the project. The interest rate for converting benefits, replacement costs as well as federal and other costs, to a common time base and in discontinuing future benefits was 7 3/4%.

Civil Rights

This program or activities conducted under this agreement will be in compliance with the nondiscrimination provision as contained in Titles VI and VII of the Civil Rights Act of 1964, as amended, the Civil Rights Restoration Act of 1987 (Public Law 100-259), and other nondiscrimination statutes, namely, Section 504 of the Rehabilitation Act of 1972, and the Age Discrimination Act of 1975. They will also be in accordance with regulation of the Secretary of Agriculture (7 CFR15, Subparts A & B), which provide that no person in the United States shall, on the grounds of race, color, national origin, age, sex, religion, marital status, or handicap, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving federal financial assistance from the Department of Agriculture or any agency thereof.

Water Quality & Water Quantity

Water quality analysis of the Arkansas River Basin area began in the late 1930's by checking for salinity. These water quality analysis have been continued by various groups and agencies, as they have analysised the surface and ground water for their special interests (chemicals - sodium, magnesium, chloride, arsenic, lithium, strontium, iron, nitrates, boron, sulfate's, selenium, uranium, etc. and sediments). In the mid 1980's, a program to identify the nature and extent of irrigation induced water quality problems was started. From this program, there was an increased concern over the potential harmful effects of the heavy metals in irrigation drainages and the Arkansas River to the fish, wildlife, livestock, and domestic water users.

The Colorado Department of Health has standards on most chemicals that are in the water. These standards are exceeded in the Arkansas River Basin, based on analysis for these chemical elements. Salt is an element that does not have a standard in this portion of Colorado.

Most chemical elements that effect water quality in the Arkansas River are found in the soil parent material of the marine shales. These chemical elements move into solution as irrigation water is applied. It then moves downward toward the aquifer through deep percolation. Its' element concentration increasing as the irrigation water moves down through the soil profile.

Most of the irrigated acres are furrow irrigated. Water is applied at a high rate and the furrows are steep and have no residue to prevent erosion of the soils. Significant sedimentation problems exist due to these factors.

Computer analysis using; Farm Irrigation Rating System (FIRS), Surface Irrigation Simulation Model (SIRMOD) , and Furrow Sediment/ Erosion Program (FUSED) shows that improving irrigation water management reduces leaching from the marine shales, as well as reducing erosion.

In the use of the SIRMOD program some assumptions were made. These assumptions include: 1. The crop to be irrigated would be alfalfa. 2. The soil used was "Rocky Ford", which has a available water holding capacity of 10.2 inches.
3. Irrigation begins in March with a furrow irrigation head of 25 gpm. 4. As water becomes short in the delivery canals the irrigation furrow flows are reduced proportionately.
5. When soil moisture depletion remains less than or equal to 50% the consumptive use of the crop remains static.
6. The consumptive use information provided by the United States Geological Survey was adequate for use in this analysis.

0657

The comparative analysis done through SIRMOD revealed that the soil moisture depletion rarely exceeded 50% for the alternatives studied. Deep percolation was least when a surge irrigation system was used and greatest under the current conditions. Changing the irrigation set time to reflect the crops need reduces field water loss. In the months of September, October, and November there is inadequate water to irrigate the fields under current conditions. Reducing the furrow length to 660 feet would make it possible to achieve a more complete irrigation.

The analysis shows several things. Deep percolation of irrigation water can be reduced significatly without increasing crop consumptive use. Changes in water management can reduce deep percolation, but changes in management and methods facilitates the greatest reduction.

United States Department of Agriculture
Natural Resources Conservation Service
318 Lacey
La Junta, CO 81050-2039

0652

(719) 384-5408 (COM)
(719) 384-7869 (FAX)

November 29, 1995

SUBJECT: TCH-Responses for Limestone-Graveyard PL-566 Project

TO: Nyle Jordre
Agricultural Economist
Lakewood, CO

Tim Sweeney
Resource Conservationist
Lakewood, CO

Please find attached the results of a number of "water budget" simulation runs for on-field irrigation system evaluations for Limestone-Graveyard. These were developed to address the concerns of the State Water Conservation Board.

P. Lorenz Sutherland, PhD
Conservation Agronomist

cc. John A. Knapp, AC, La Junta
Stu Simpson, ASTC, Lakewood

LIMESTONE-GRAVEYARD PL-566 PROJECT-COLORADO STATE WATER CONSERVATION BOARD RESPONSE

We agree that a water budget for the Limestone reach of the Fort Lyon Canal would be beneficial. We've considered the development of a water budget on a number of ocassions. For two reasons we have elected not to pursue a water budget. First because of the complexity of the Fort Lyon canal and lack of basic hydrologic information, we have received counsel from technical specialists including our own and those from the Department of Interior-USGS that any analysis would result into a strictly academic exercise.

Secondly, assuming our *science-based* water budget data was accurate, we do not want to add to the conflict surrounding the Colorado-Kansas lawsuit. As a technical agency, we are in full accord with the proposed rules, ***"Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin, Colorado"***. Please be assured that we appreciate the challenges that the State of Colorado is faced regarding resolution of the Colorado-Kansas water conflict. It is our recognition of the specific responsibilities of the state and division engineers for determining stream depletions and authority within the scope of the proposed rules.

Any data associated with a water budget that could be taken and used by other entities to calculate their own stream depletions for furthering argument is not in Colorado's best interest in our opinion. We feel that it would interfere with the efforts of the state engineer, both technically, and in negotiating the *non science-based* values of "presumptive stream depletions" between the Colorado "out-of-priority depletions" (well-users) and the Colorado senior surface water right holders. We are particularly sensitive to this issue at this time; as you should be well aware, the proposed rules are being considered by the water court.

To address your concerns we have included an irrigation system evaluation at the field level. This evaluation describes a typical benchmark system (existing condition) and several alternatives with varying levels of conservation treatment. The results show the effects of these levels of treatment. We chose a system using grain sorghum with the following typical boundary conditions:

Slopes:	a) 0.015 ft/ft	b) 0.01 ft/ft
Furrow Flow Rates:	a) 30 gpm	b) 25 gpm
Field Delivery:	a) 5 cfs	
Length of Run:	a) 1320 ft	
Time of Sets:	a) 12.0 hours	

Climate Data Set:	a) 71-yr running record-Lamar (CO4770)
Fort Lyon Canal Salinity Data Set:	a) USGS, 1965-1974
Selected Return Flow Drain Salinity Data Set:	a) SCS, 1983-1985

The irrigation evaluation was performed using standard Saint-Venant (Conservation of Mass and Momentum) numerical solutions including kinematic wave, zero inertia, and hydrodynamic approaches to furrow flow. Evapotranspiration was calculated using the Modified Blaney-Criddle method which includes corrections for elevation.

Figure 1 summarizes the crop evapotranspiration, average precipitation, and seasonal effective rainfall. The seasonal effective rainfall was calculated for three probabilities representing wet, normal, and dry years.

Since there's a concern regarding additional consumptive use within the Arkansas basin, the alternatives were developed where the field water supply and crop consumptive use (ET) were

0660 kept constant. This adheres to the principle that for conservation planning efforts the step-wise linear model is used, where a crop's ET remains at or near maximum over a given range of soil moisture depletion (water availability) as illustrated in Figure 2. Any water "savings" are allowed to pass by the field.

The Kostiakov-Lewis function was chosen to describe soil water infiltration. For review the function is described as follows:

$$Z = kt^a + F_o t$$

where Z is the cumulative infiltration at time, t, k and a are constants. and F_o is the basic intake rate. Taking the first derivative, the equation becomes:

$$dZ/dt = i = akt^{a-1} + F_o$$

where i is the soil infiltration rate.

Since the application of surge irrigation techniques is a proposed conservation practice, the furrow intake was calculated using the steady-state (basic) intake rates for both surge (intermittent furrow wetting) and continuous flow as illustrated in Figure 3.

The vadose zone salt distributions were estimated using volume weighted linear crop water uptake functions. The relationship between specific conductance (electrical conductivity, EC) and salt concentration is not constant within the Arkansas River basin. The relation is dependent upon landscape position and river flow. Figure 4 shows the electrical conductivity/salt concentration relation for the Limestone-Graveyard project landscape position as taken from Department of Interior-USGS long-term data. Note that the salt loads of the selected irrigation return flow drains within the Limestone-Graveyard Project range from 2.5 to 3.5 times the salt load of the water supply.

The salt concentration of irrigation water applied to a field does not change as it moves through the furrow. Therefore, any degradation of water quality occurs from ditch/canal seepage and soil profile vadose zone leaching (deep percolation). Adhering to the conservation of mass and momentum, low salt concentrations of the drainage waters at the bottom of the root zone indicate severe leaching (deep percolation); that is the soils are being continually leached resulting in high salt concentrations in the irrigation return flow drains. Conversely, higher salt concentrations of the soil water at the bottom of the root zone show less deep percolation occurring. This results in lower salt concentrations in the irrigation return flow drains. The goal, then is to develop alternatives that decrease deep percolation resulting in a higher, but crop tolerant salt concentration in the root zone. Another way to visualize the physics of the system is as the leaching fraction increases, the salt concentration of the soil water (drainage water) at the bottom of the root zone decreases. and conversely, as the leaching fraction decreases, the salt concentration of the soil water at the bottom increases.

A benchmark condition and six(6) alternative (desired future condition) levels of treatment within three(3) groups were evaluated:

Benchmark Condition (BMRK)-

> Field has a slope of 0.015 ft/ft and a furrow flow rate of 30 gpm. Seventy-four(74) rows are irrigated per set. The water velocity in the furrows is 0.90 ft/sec which exceeds the critical velocity of 0.8 ft/sec and erosion is occurring at the top of the field. Completing the field irrigation requires 3.5 days (84 hours).

Alternative Group 1 (DFC-1, DFC-2)-

A surge system is installed on field and managed at two levels of farmer management. All other variables are the same as the benchmark.

Alternative Group 2 (DFC-3, DFC-4)-

In addition to the two levels of farmer management of the surge system, the field is land leveled (0.01 ft/ft) and the furrow flow rate is decreased to 25 gpm by increasing the number of rows per set from 74 to 89 rows per set. The resulting water velocity in the furrow is reduced to an acceptable rate (0.74 ft/sec) so that furrow erosion is not occurring at the top end of the field. The time to irrigate this field is reduced from 3.5 days (84 hours) to 2.9 days (70 hours).

Alternative Group 3 (DFC-5, DFC-6)-

Same conditions as DFC-3 and DFC-4 except a deficit irrigation strategy is employed. The net application rate is set at about 82 percent of the required. This management scenario also would represent the condition where water uptake is restricted to shallower soil depths.

Figure 5 summarizes the results of the evaluation. There are several responses of the evaluation that are note worthy. First, it should be noted that irrigation efficiency remains nearly constant. Secondly, there is a shift in the partitioning of the inefficiency. There is a reduction in the deep percolation which is shifted to field runoff which goes back into watershed system. The result is a decrease in the risk of contamination from soluable salts, soluable heavy metals and nitrates.

Thirdly, as the deep percolation is decreased larger amounts of salts are being kept in the soil profile at planned levels that do not exceed the crop tolerance. Therefore, the quality of the drain water has the potential of being managed appropriately.

Fourth, the furrow water velocities are changed to address the soil erosion/off field sediment concern.

The salt concentration of the soil water at the bottom of the root zone in DFC-2 is probably lower than predicted, as shown. Because of high levels of bicarbonate, calcium, and sulfate and low levels of carbonate, precipitation of gypsum is expected to occur. Without data regarding the partial pressure of CO_2 in the system the precipitation of the calcium and sulfate as gypsum would be difficult to determine.

The time savings of 14 hours allows more timely water application to other fields resulting in yield improvement potential, particularly at critical reproductive crop growth stages.

Regarding the issue of heavy metals and other contaminants, the potential risk of nitrates, selenium and uranium as contaminants from irrigation return flows is well documented:

Mueller, D.K., L.R. DeWeese, A.J. Garner, and T.B. Sprull. 1991. *Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage in the Middle Arkansas River Basin, Colorado and Kansas. 1988-89.* WRIR 91-4060. USGS. Denver, Colorado.

Zielinski, R.A., S. Asher-Bolinder, and A.L. Meier. 1995. Uraniferous waters of the Arkansas River valley, Colorado, U.S.A.: a function of geology and land use. Applied Geochemistry 10:133-134.

Seiler, R.L. 1995. Prediction of areas where drainage may induce selenium contamination of water. J. Environ. Qual. 24:973-979.

Johnson, C.A., R.A. Zielinski, and S. Asher-Bolinder. 1995. *Nitrogen Isotopes in Nitrate from Surface Water and Shallow Groundwater at Sixmile Creek, Southeastern Colorado*. OFR 95-536, USGS. Denver, Colorado.

Although there hasn't been any reported biota effects of selenium or uranium, the existing and potential resource problems to be addressed through a watershed project were identified through the formal scoping process. The scoping process involved the stakeholders, which, in the case of Limestone-Graveyard, included the participation of the State Water Conservation Board. Heavy metals, specifically selenium and uranium, were identified as a potential resource problem that needed attention. We feel that conservation treatment levels that address other irrigation issues will affect the future risk of these other contaminants. In the case of uranium, USGS has shown a direct proportional relation between salinity and uranium. The goal, as is with the soluable salts, is to keep the heavy metals in the root zone, rather then transporting them with excessive deep percolation.

I. Specific Consumptive Use/Effective Rainfall Data for Grain Sorghum Based on 71-71 Climate Record

0663

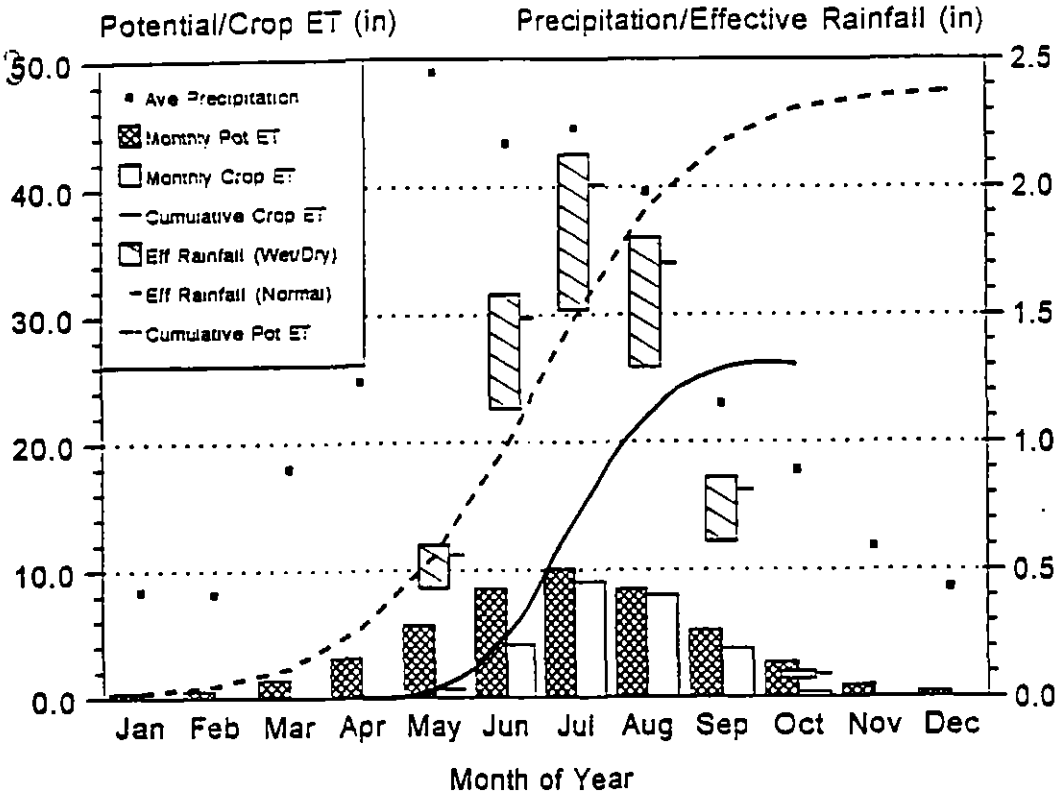
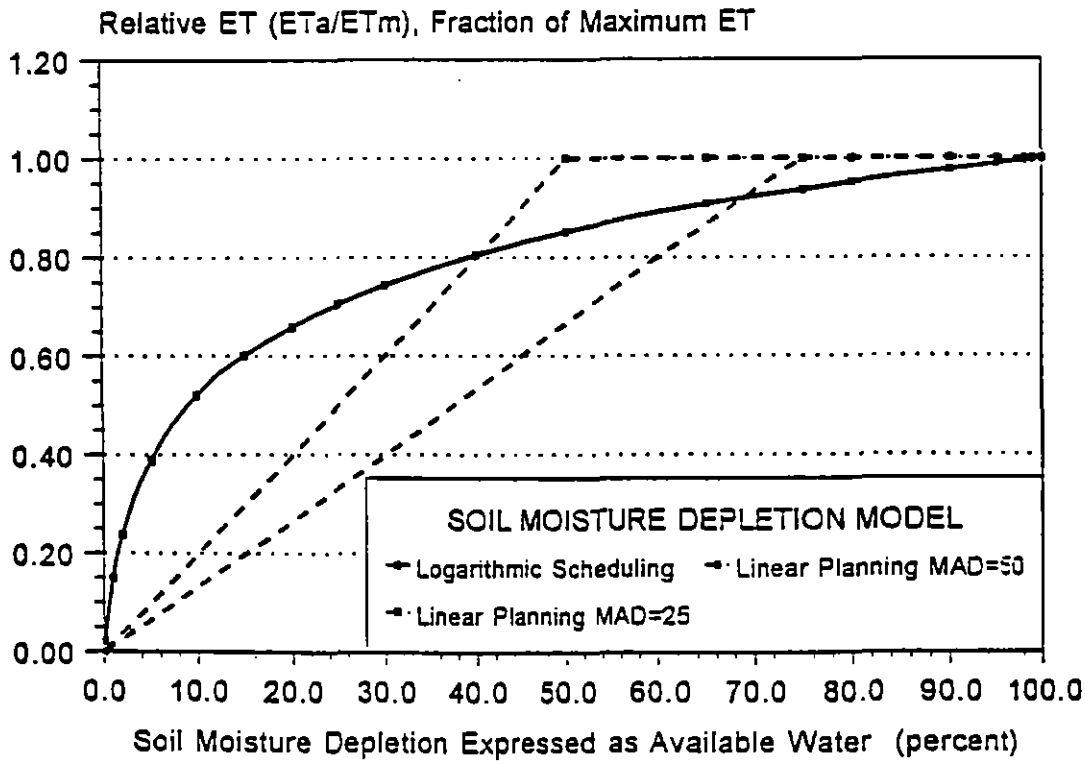


FIGURE 2. CROP EVAPOTRANSPIRATION RELATIONS for LIMESTONE-GRAVEYARD PL-566 PROJECT
II. Soil Moisture Depletion (Available Water) Correction to Maximum Crop ET



MAD-Moisture Allowed Depletion expressed as a percent.

0661

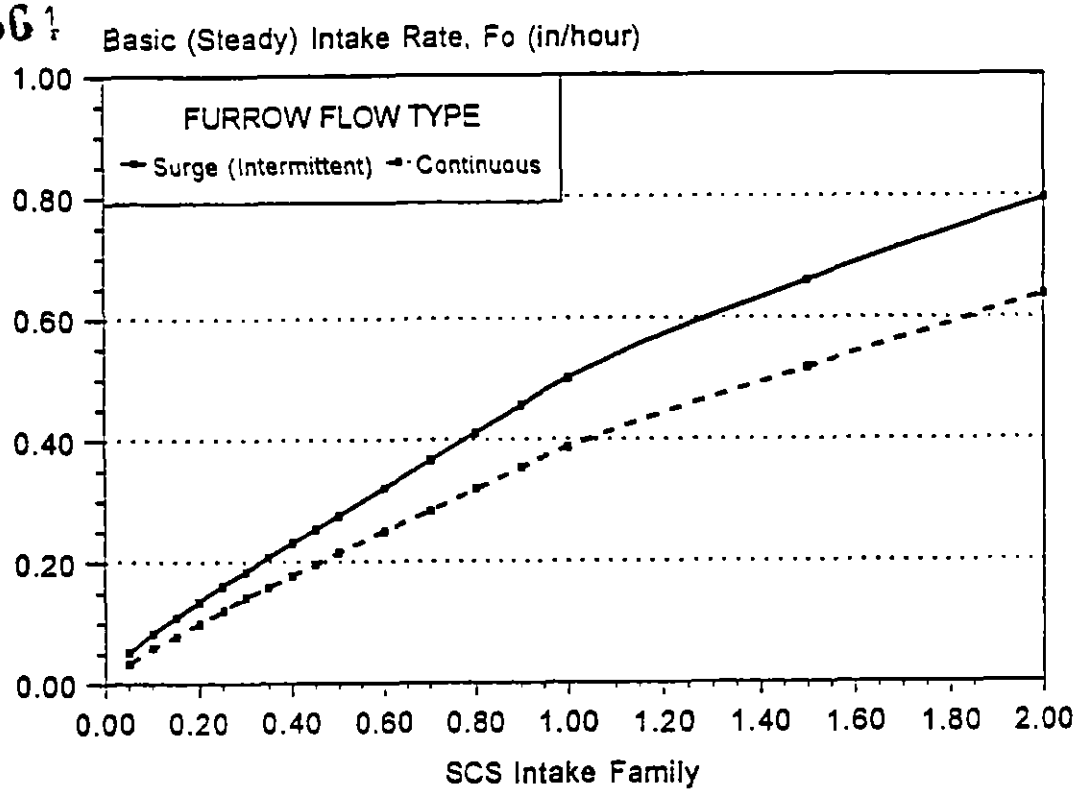
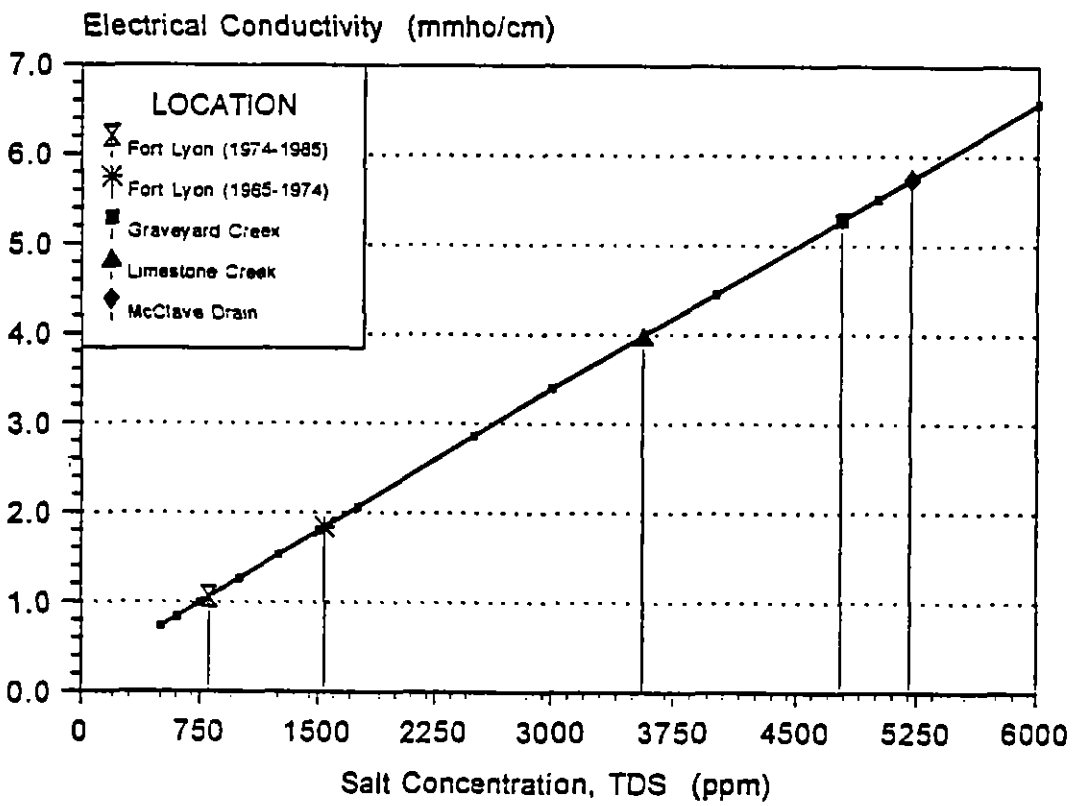
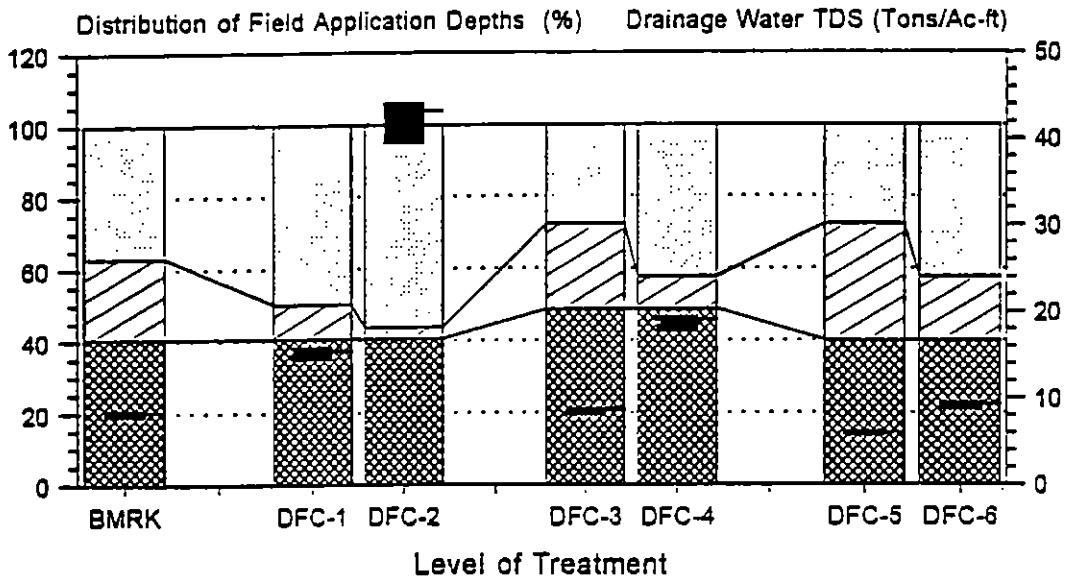


FIGURE 4. LIMESTONE-GRAVEYARD RELATIONS OF ELECTRICAL CONDUCTIVITY TO SALT CONCENTRATIONS
Fort Lyon Canal Water Supply and Selected Irrigation Return Flow Drains

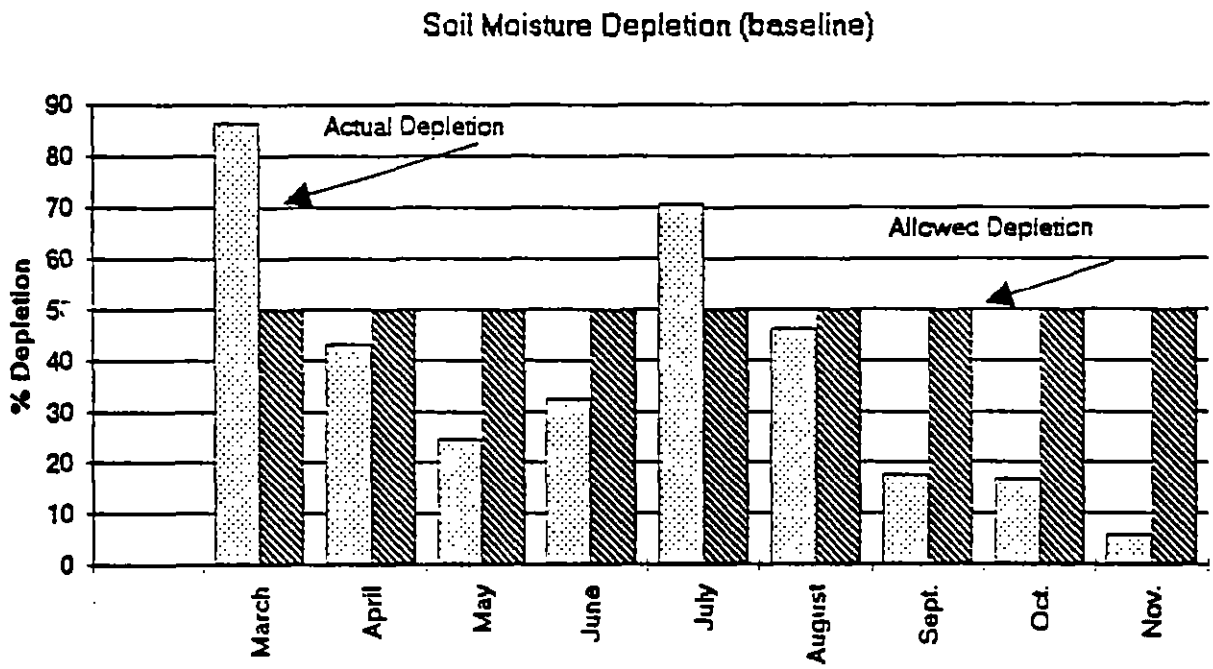


0665

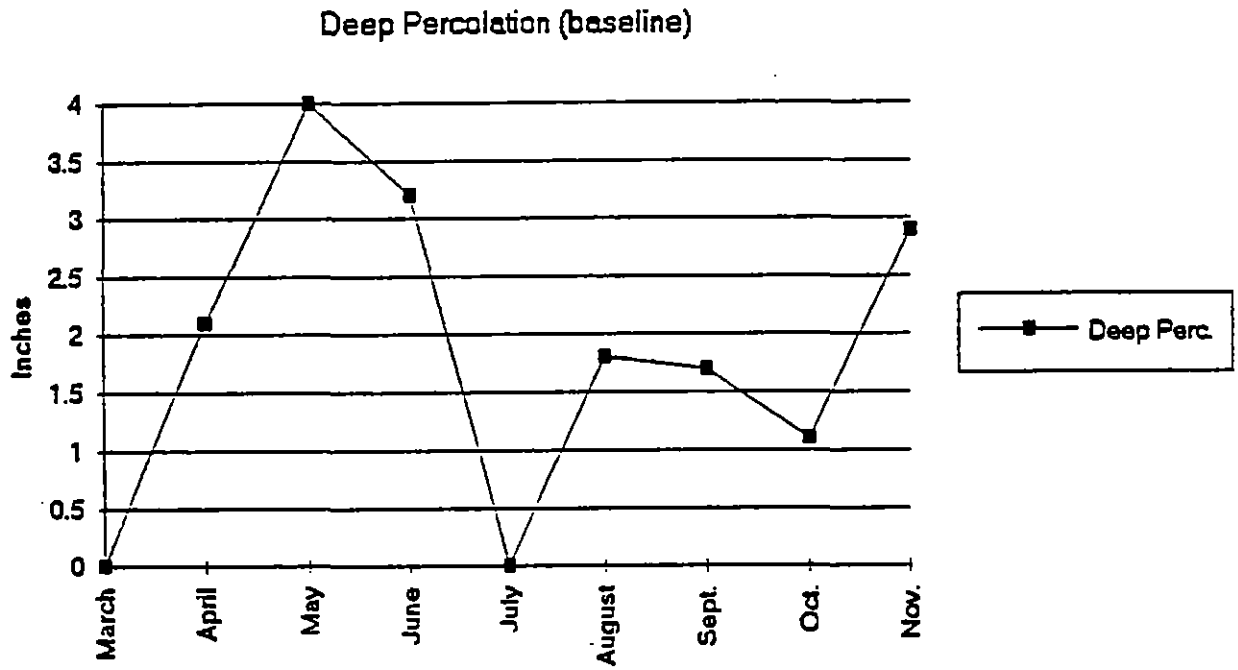


BMRK, Benchmark Condition (Existing Condition); DFC-x, Desired Future Condition
Field Water Delivery and Consumptive Use (ET) Remain Constant

0000

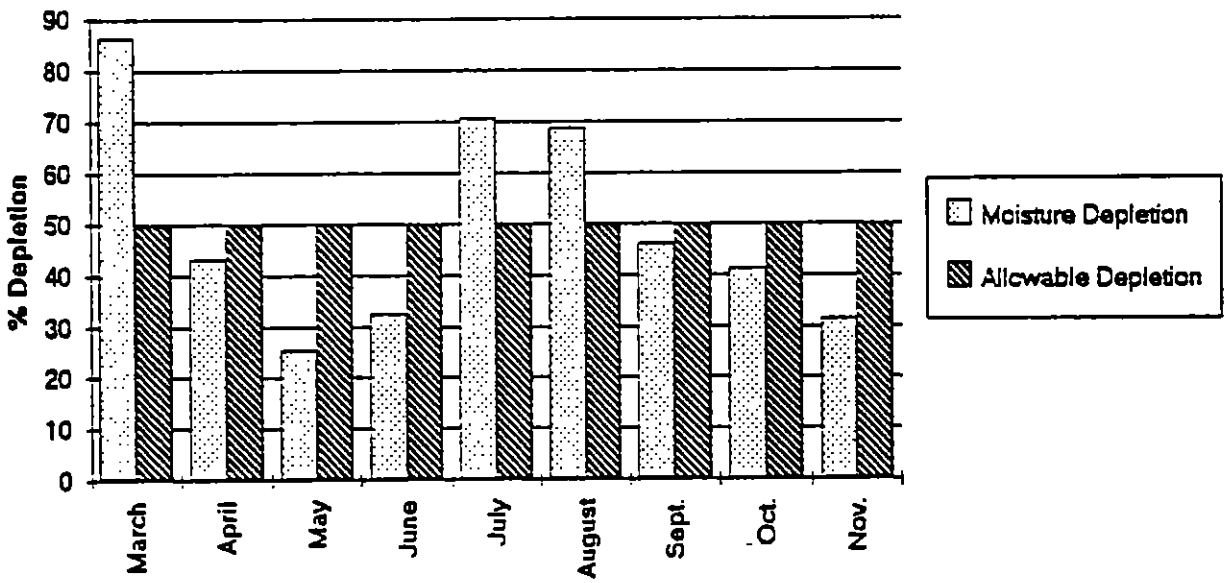

Soil Moisture Depletion (baseline)
% Depletion
90
80
70
60
50
40
30
20
10
0
Actual Depletion
Allowed Depletion
March
April
May
June
July
August
Sept.
Oct.
Nov.

0667

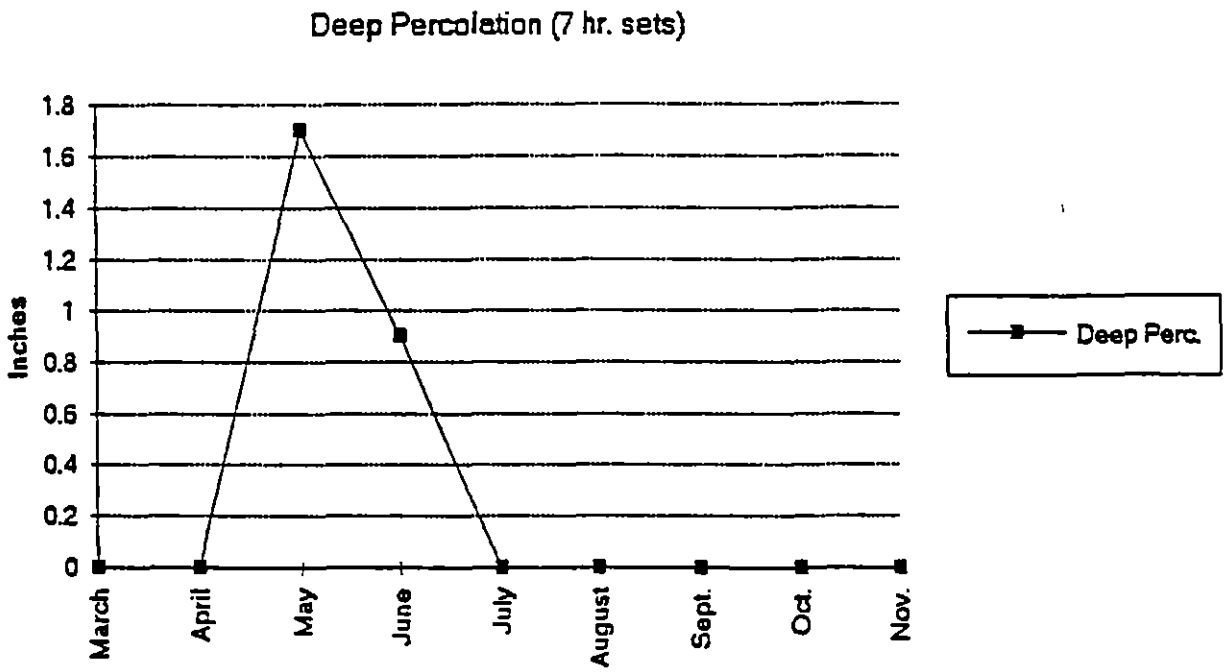

Deep Percolation (baseline)
Inches
4
3.5
3
2.5
2
1.5
1
0.5
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Deep Perc.

0663

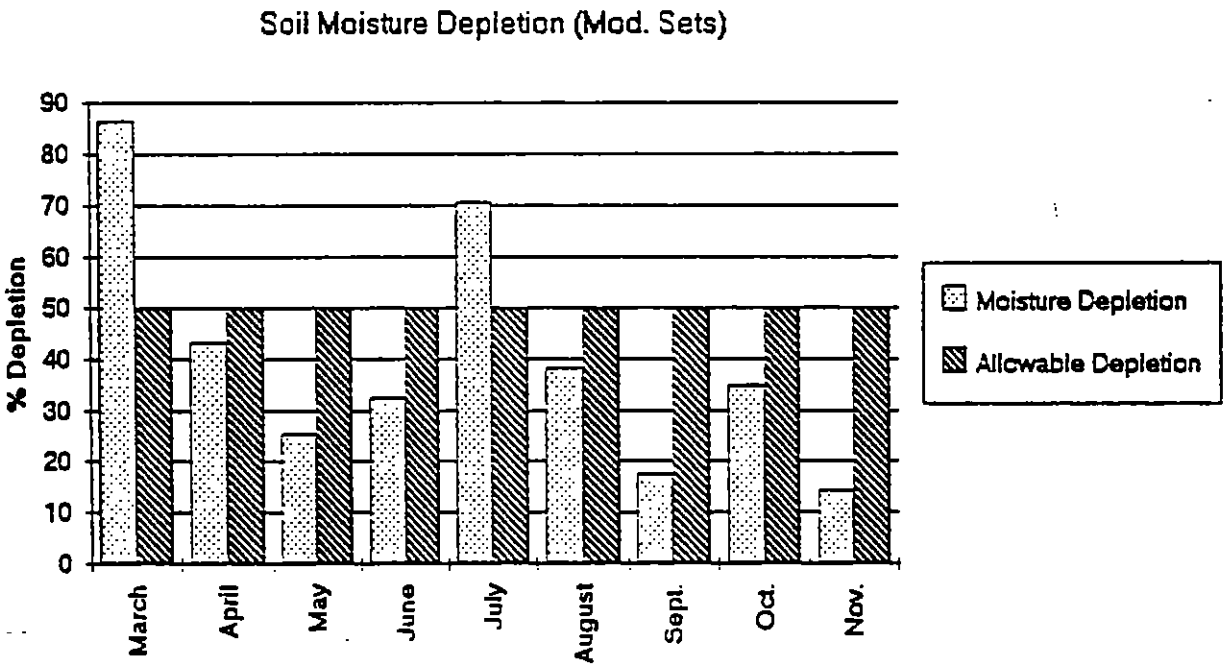
Soil Moisture Depletion (7hr. sets)



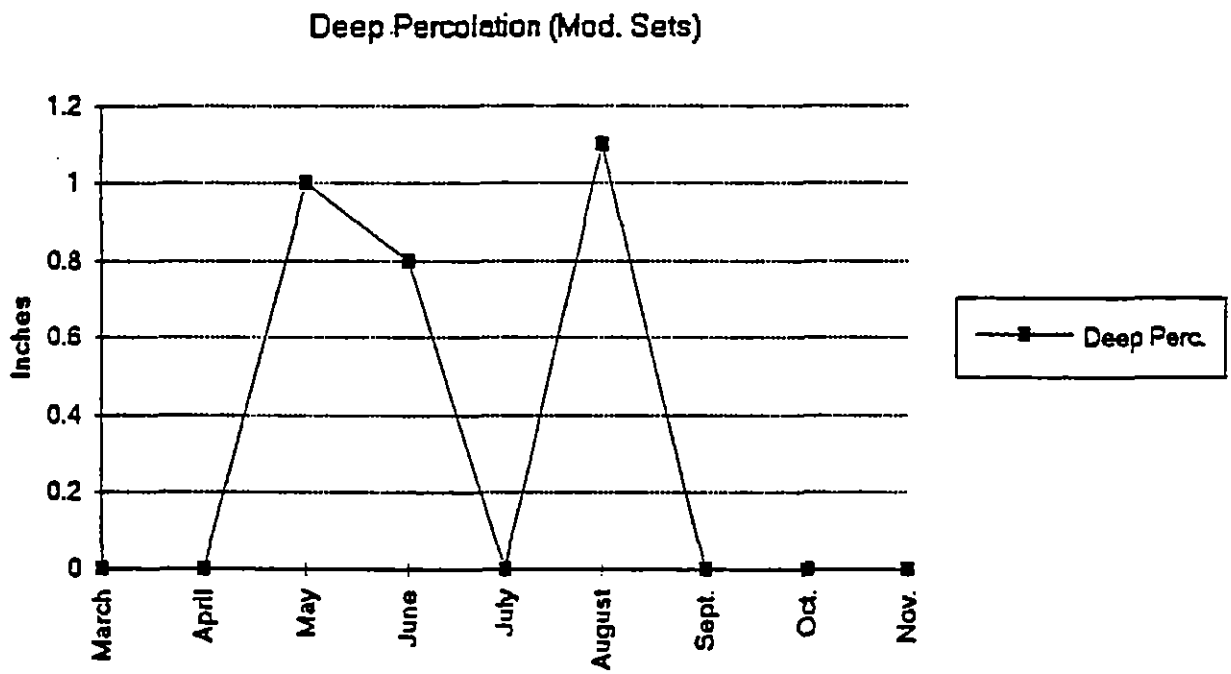
0669


Deep Percolation (7 hr. sets)
Inches
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Deep Perc.

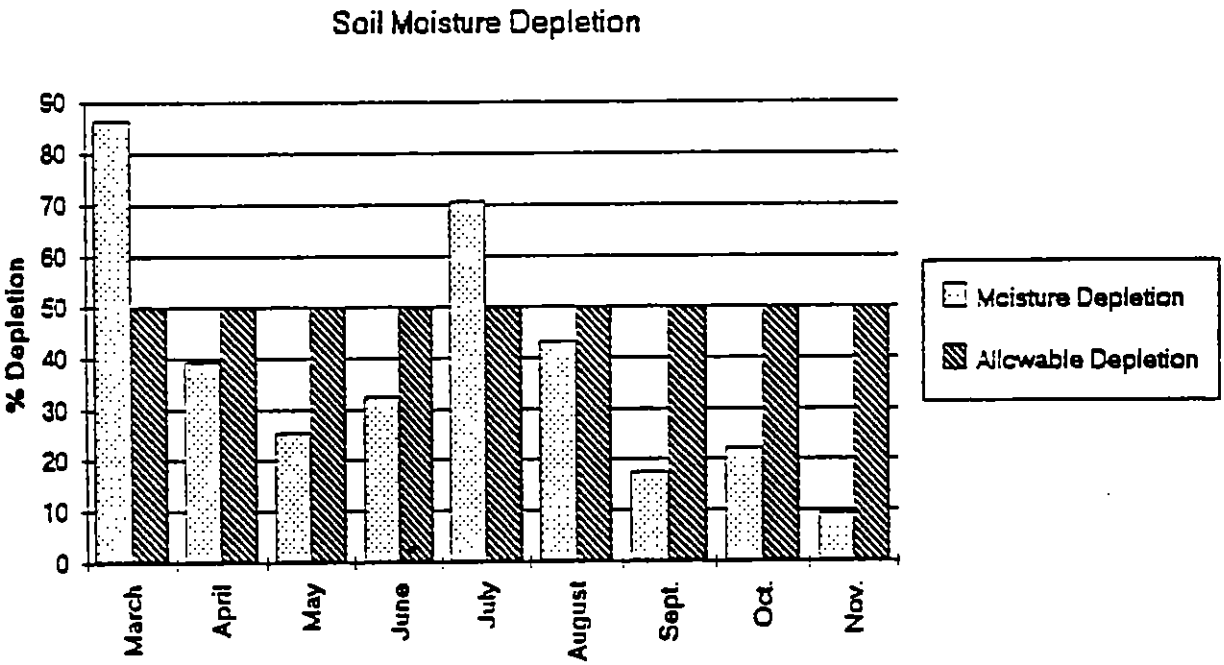
0670


Soil Moisture Depletion (Mod. Sets)
% Depletion
90
80
70
60
50
40
30
20
10
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Moisture Depletion
Allowable Depletion

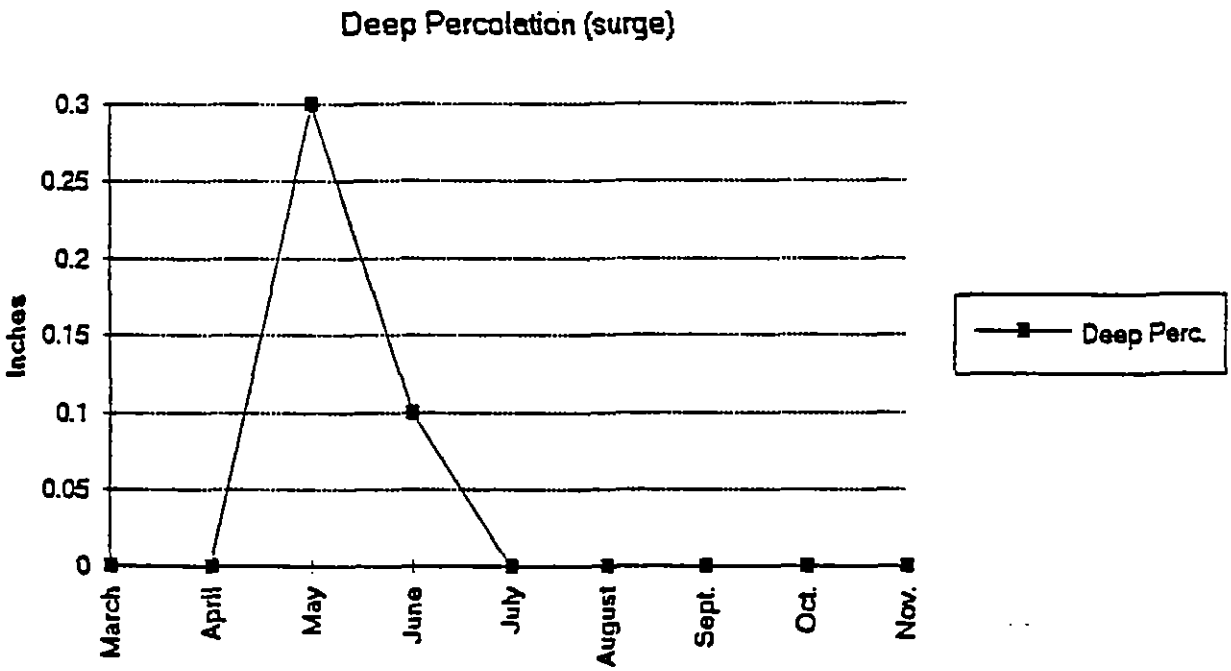
0671

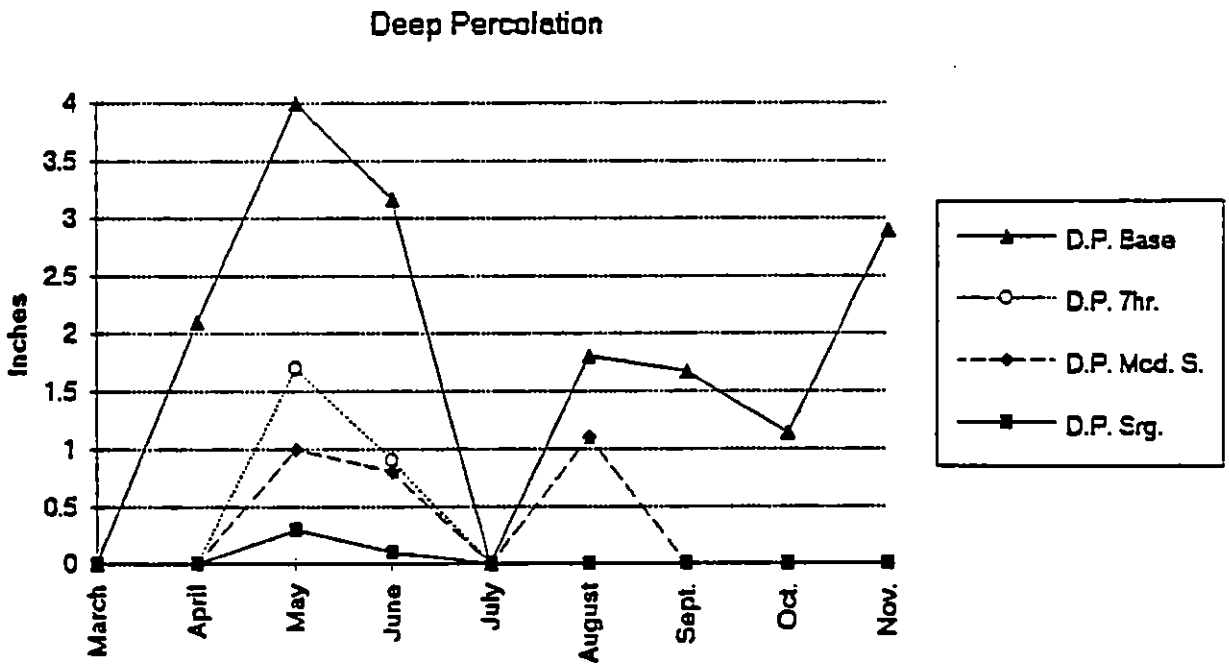

Deep Percolation (Mod. Sets)
Inches
1.2
1
0.8
0.6
0.4
0.2
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Deep Perc.

0672


Soil Moisture Depletion
% Depletion
90
80
70
60
50
40
30
20
10
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Moisture Depletion
Allowable Depletion

0673


Deep Percolation (surge)
Inches
0.3
0.25
0.2
0.15
0.1
0.05
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
Deep Perc.


Deep Percolation
Inches
4
3.5
3
2.5
2
1.5
1
0.5
0
March
April
May
June
July
August
Sept.
Oct.
Nov.
D.P. Base
D.P. 7hr.
D.P. Mcd. S.
D.P. Srg.

Effects of the Recommended Plan on Resources of National Recognition

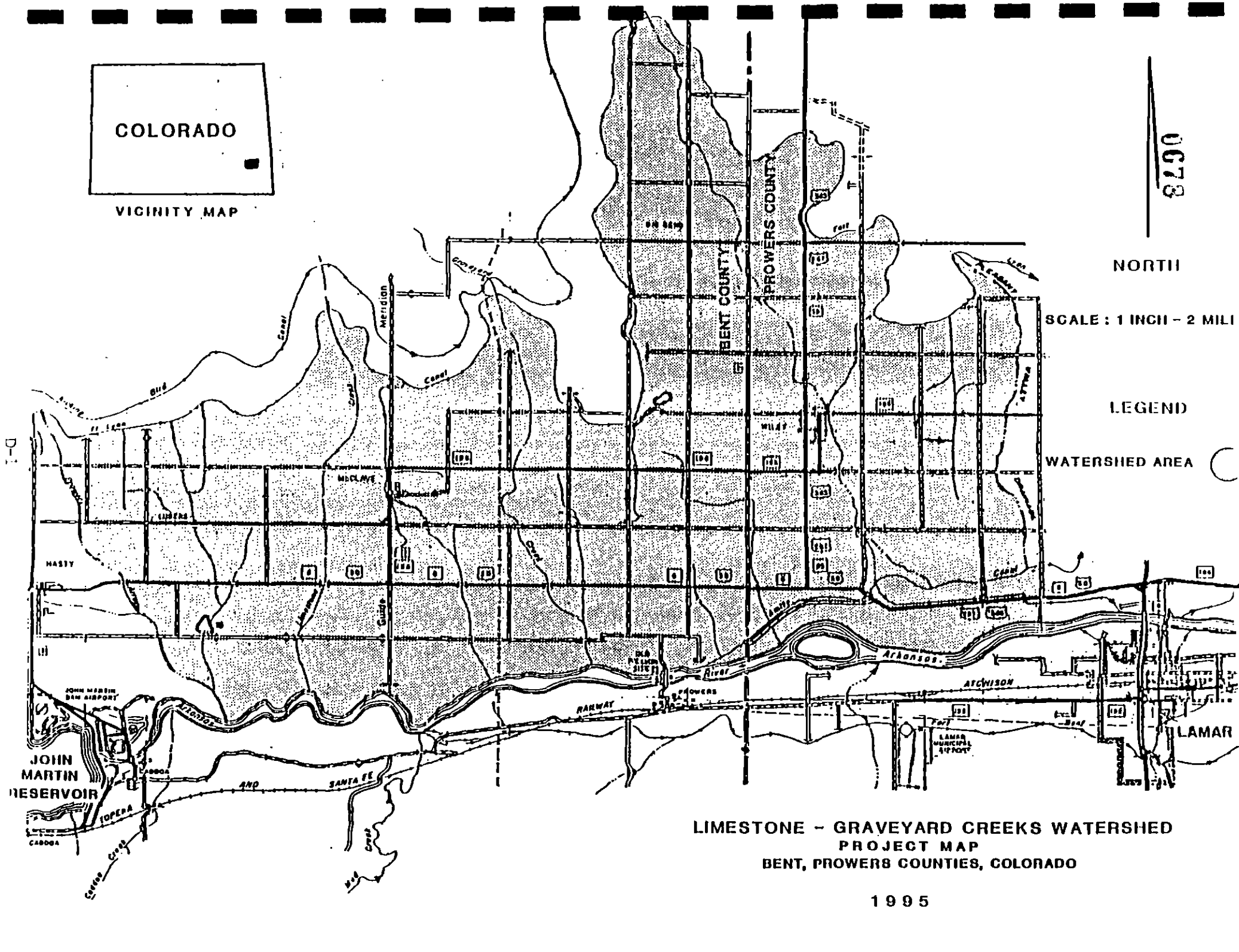
Types of resources	Principal sources of National recognition	Measurement of effects
Air quality	Clean Air Act, as amended (42 U.S.C. 7401 et seq.)	NO EFFECT
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Not present in planning area.
Endangered/threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	The habitat will be enhanced, but there will not be any changes in the quantity of Endangered or threatened species habitat.
Fish/wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	The habitat will be enhanced, but there will be no change in the acres of habitat.
Flood plains	Executive Order 11988, Flood Plain Management	NO EFFECT
Historic & Cultural properties	National Historic Preservation Act of 1966, as amended (16.U.S.C. Sec. 470 et seq.)	NO EFFECT
Prime & unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act, Farmland Protection Policy Act of 1981.	NO EFFECT

0673

Effects of the Recommended Plan on Resources of National Recognition

Types of resources	Principal sources of National recognition	Measurement of effects
Air quality	Clean Air Act, as amended (42 U.S.C. 7401 et seq.)	NO EFFECT
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Not present in planning area.
Endangered/threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	The habitat will be enhanced, but there will not be any changes in the quantity of Endangered or threatened species habitat.
Fish/wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	The habitat will be enhanced, but there will be no change in the acres of habitat.
Flood plains	Executive Order 11988, Flood Plain Management	NO EFFECT
Historic & Cultural properties	National Historic Preservation Act of 1966, as amended (16.U.S.C. Sec. 470 et seq.)	NO EFFECT
Prime & unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act, Farmland Protection Policy Act of 1981.	NO EFFECT

0610



LIMESTONE - GRAVEYARD CREEKS WATERSHED
PROJECT MAP
BENT, PROWERS COUNTIES, COLORADO

1995