Fountain Creek Watershed Plan

Adopted by Pueblo Area Council of Governments October 2003
Adopted by Pikes Peak Area Council of Governments October 2003

This Plan was developed through a collaborative effort between:

City of Colorado Springs
Colorado Springs Utilities
El Paso County
City of Fountain
Town of Green Mountain Falls
City of Manitou Springs
Town of Monument
Town of Palmer Lake
City of Pueblo
Pueblo County
Teller County
City of Woodland Park

Published By:
Pikes Peak Area Council of Governments
Colorado Springs, Colorado
November 2003

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Pikes Peak Area Council of Governments
Colorado Springs, Colorado
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Acknowledgements

This Fountain Creek Watershed Plan was developed through a collaboration of local governments, State and Federal agencies, and a consultant. Team Members include:

Fountain Creek Watershed Plan Technical Advisory Committee

The Technical Advisory Committee is comprised of technical experts from agencies who provide input, public support and assist in interpretation of scientific data.

Central Colorado Soil Conservation District
Jay Frost
City of Colorado Springs
Bruce Thorson & Ken Sampley
City of Fountain
Dave Smedsrud & Gary King
City of Manitou Springs
Kirk Greasby & Todd Liming & Alan Tiefenbach
City of Pueblo
Jim Munch & Dennis Maroney
City of Woodland Park
David Buttery
Colorado Springs Utilities
Bill Van Derveer & Carol Baker
El Paso County
André Brackin & Joe Loop
Fort Carson
Gary Belew
Pikes Peak Area Council of Governments
Rich Muzzy, Fred Van Antwerp & Shannon O'Connell
Pueblo Area Council of Governments & Pueblo County
Kim Headley
Southeastern Colorado Water Conservancy District
Steve Arveschoug & Bob Hamilton
Teller County
Bill Johnston & Jean Garren
Town of Monument
Mike Wicklund & Glenn Burge
Turkey Creek Soil Conservation District
Bill Alt
United States Air Force Academy
Josh Kellar & Larry Reisinger
USDA Natural Resource Conservation Service
John Valentine

Fountain Creek Watershed Plan Project Management Team

The Project Management Team is comprised of technical and policy experts who are responsible for the coordination and development of the Watershed Plan.

City of Colorado Springs
Bruce Thorson
City of Pueblo
Dennis Maroney
City of Woodland Park
David Buttery
Colorado Springs Utilities
Carol Baker
Colorado State Soil Conservation Board
Rex Miller
El Paso County
André Brackin
Fountain Creek Watershed Program Coordinator
Brett Gracely (URS Corporation)
Pikes Peak Area Council of Governments
Rich Muzzy
Pueblo Area Council of Governments & Pueblo County
Kim Headley

Additional Contributors

Army Corps of Engineers
Kris Schaefer
Colorado Department of Public Health and Environment—Water Quality Control Division
Kathleen Reilly
Colorado Water Conservation Board
Rod Kuharich & Brian Hyde
United States Geological Survey
Pat Edelman

The Fountain Creek Watershed Plan was developed with financial assistance from the U.S. Environmental Protection Agency, Colorado State Soil Conservation Board and Colorado Water Conservation Board.

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EXECUTIVE SUMMARY

The *Fountain Creek Watershed Plan* was developed in 2000-01and updated in 2003 to address the need expressed by local governments, soil and water conservation districts, and private property owners for a more comprehensive understanding of the Fountain Creek Watershed. This *Plan* describes the existing conditions in the Fountain Creek Watershed and serves as a foundation to build upon in current and future planning efforts, including the Army Corps of Engineers Watershed Study. The *Plan* documents the problems and issues related to erosion, sedimentation and flooding within the watershed; establishes priorities upon which to focus in future work; and makes specific technical and policy implementation recommendations. The issues are addressed in the context of a watershed and, as such, recognize that problems must be solved collectively by the federal and state governments, local governments and private property owners.

Governance and Plan Development Process

The *Fountain Creek Watershed Plan* was developed under the auspices of the Pikes Peak Area and Pueblo Area Councils of Governments. The *Plan* draws from the experience and expertise of the member governments of these two organizations—the City of Colorado Springs, El Paso County, City of Fountain, Town of Green Mountain Falls, City of Manitou Springs, Town of Monument, Town of Palmer Lake, City of Pueblo, Pueblo County, Teller County, and City of Woodland Park—as well as Colorado Springs Utilities, state and federal agencies, soil conservation districts and military installations. Through regular monthly meetings, senior technical representatives provided information to be incorporated into the *Plan* specific to their jurisdictional entity.

Development of the *Plan* also included an extensive public education and outreach effort. To provide a status report and seek public input regarding development of the *Plan*, public outreach meetings were held in Pueblo, Colorado Springs, Woodland Park and Monument; quarterly newsletters were published; presentations were made to schools and organizations; press releases and articles were published in local papers; and a website (www.fountain-crk.org) was developed.

Vision

The vision of the *Plan* is to recognize the watershed as a regional asset supporting diverse interests and to promote the health of Fountain Creek and its tributaries. This vision has the support of the elected officials, urban planners, water resource managers, private property owners and stakeholders within the watershed. The recognition of this vision statement has already strengthened existing collaborative efforts, built collaboration where none had existed, and heightened awareness regarding the severity of flooding problems along Fountain and Monument Creeks.

The *Plan* recognizes that those who influence land use and water management decisions in the watershed can do the most to improve and maintain the condition of Fountain Creek. As such, the target audience for this *Plan* is landowners, businesses, military installations, government staff, elected

officials, urban planners, municipalities, water resource managers, and developers. The *Plan* recognizes that both public and political awareness are necessary to convey the understanding that permanent, not temporary, solutions are needed.

Scope

The *Fountain Creek Watershed Plan* consists of seven main sections:

1. Introduction
2. Background and Overview
3. Methodology
4. Characterization of Watershed Problems and Issues
5. Characterization and Evaluation of Channel Instability
6. Summary and Evaluation of Technical and Policy Management Strategies
7. Conclusions, Recommendations and Implementation Strategies

The key aspects and concerns addressed in this *Plan* are issues of highest priority in each of the four subwatersheds, including:

- existing and potential infrastructure problems along each stream reach:
- specific hydrologic, physical, erosion and sedimentation characteristics: and
- causes of channel instability and a stability class rating for each of the major stream reaches within the watershed.

The problems, issues, critical areas and regulatory programs identified within the *Plan* form the basis of a coordinated regional approach between the PPACG and PACOG Boards of Directors to resolve important issues regarding protection and restoration of the watershed.

Conclusions

The *Plan* identifies a wide range of problems, and issues and solutions to address the sources of problems and to mitigate existing damage. Specific policies must be implemented to address the occurrence and severity of erosion, sedimentation and flooding in the future, along with technical strategies to mitigate potential damage. The technical and policy strategies identified recognize that the Fountain Creek Watershed has diverse ecosystems, topography, climate, soils and land uses. Strategies found to be appropriate in one area can be inappropriate for other areas.

Many of the problems identified in this *Plan* are a result of population growth that has occurred in the watershed in the past fifteen to twenty years. The effects of population growth can be seen in the increase in impervious surface area, increase in wastewater treatment plant discharge, and an increase in importation of transbasin water. The problems have become magnified because most of the soils found in the Fountain Creek Watershed are easily erodable and have high to moderate runoff potential, which can contribute to increasing erosion and sedimentation damage in the watershed.

Recommendations

The recommendations described in the Conclusions, Recommendations and Implementation Strategies Section are based upon regional concerns and needs. For this *Plan* to be successful, implementation of the recommended strategies will require the support of all local governments and stakeholders. The Plan recognizes that diversity of the watershed makes certain implementation recommendations more appropriate for certain areas. Recommendation strategies are consistent with the vision and goals of the Fountain Creek Watershed Plan and are discussed in the following categories: Critical Area and Strategy Identification; GIS; Public Outreach and Education; Further Research and Evaluation; and Internal Coordination and Review. These recommendations include:

- Recommending solutions for each critical area to mitigate existing and/or avoid future damage that incorporate a geomorphic assessment and upstream/downstream impacts;
- Expanding the existing GIS database;
- Calculating the percentage of impervious surface area for the subwatersheds within the Fountain Creek Watershed;
- Establishing measurable criteria to determine if progress is being achieved as a result of implementing certain recommendations; and
- Developing a timely procedure to review work planned within the floodplain and significant wetland areas for comments and feedback to be given on potential consequences.

Army Corps of Engineers (ACOE) Watershed Study

The *Fountain Creek Watershed Plan* is a foundation to build upon for the Army Corps of Engineers (ACOE) Watershed Study. The ACOE Watershed Study, which began in April 2003, will evaluate the problems identified in the *Plan* and identify construction programs available from the ACOE to mitigate existing and prevent future damage. It will also provide guidance and direction to stakeholders for the development of watershed management tools, data and strategies. The formulation and analysis of alternative solutions to the problems identified in the ACOE Watershed Study will be conducted through separate projects that will require a sponsor, feasibility cost sharing agreement and intergovernmental agreement.

The findings of the ACOE Watershed Study and the technical and policy strategy recommendations contained in the *Plan* will allow each participating entity to implement appropriate strategies or make capital improvement decisions based on a comprehensive understanding of the watershed. The ACOE Watershed Study was developed and is being funded through an intergovernmental agreement between the ACOE and the City of Colorado Springs, El Paso County, City of Fountain, Town of Green Mountain Falls, City of Manitou Springs, Town of Monument, Town of Palmer Lake, City of Pueblo, Pueblo County, Teller County, and City of Woodland Park.

Funding and Consultant Assistance

The *Fountain Creek Watershed Plan* was developed with financial assistance from the U.S. Environmental Protection Agency and Colorado State Soil Conservation Board and the. Other financial assistance was provided by the Colorado Water Conservation Board. Consultant assistance was provided by URS Corporation.

1. Introduction

The Fountain Creek Watershed lies within the Arkansas River Basin in Southern Colorado and encompasses all or portions of eight municipalities – Colorado Springs, Pueblo, Green Mountain Falls, Fountain, Manitou Springs, Monument, Palmer Lake and Woodland Park – and three counties - El Paso, Pueblo and Teller. The watershed is bounded by Pikes Peak, the Rampart Range, and Ute Pass to the west; Monument Hill and the Palmer Divide to the north; and by a third, less recognizable divide between Fountain Creek and the Chico basin to the east. There are over 500,000 residents within these boundaries and 927 square miles of diverse terrain draining to a common point of discharge, the Fountain Creek mouth, located on the Arkansas River in Pueblo (the southern boundary of the watershed). Watershed elevations range from 14,100 feet at the summit of Pikes Peak to 4,600 feet in Pueblo. A regional reference map showing the watershed boundary, county boundaries, and the locations of cities and towns is shown in Figure 1-1.

Due to the regional extent and diverse characteristics of the watershed, a coordinated plan was needed to mitigate long-standing problems associated with flooding, sedimentation and erosion. These problems have caused washed out roads and bridges, eroded creek beds and banks, and even ruptured sewer lines. To diminish these problems in the future, stakeholders have recognized that sound planning is needed from a regional perspective.

The Fountain Creek Watershed Plan represents a critical step toward regional cooperation to find integrated solutions that address problems in the Watershed. For decades, public and private entities have independently developed storm water management, flood mitigation, erosion control, channel stabilization or other water resource projects, often without fully considering other potential impacts throughout the watershed. While State and Federal agencies have long conducted soil and water conservation programs and water resource management and investigation activities in and across jurisdictional boundaries, these efforts alone have not proven to be effective in controlling the regional problems of flooding, erosion and sedimentation. Stakeholders have realized that a ***coordinated plan*** is needed to mitigate against the problems associated with a watershed that can be considered both urban and continually urbanizing.

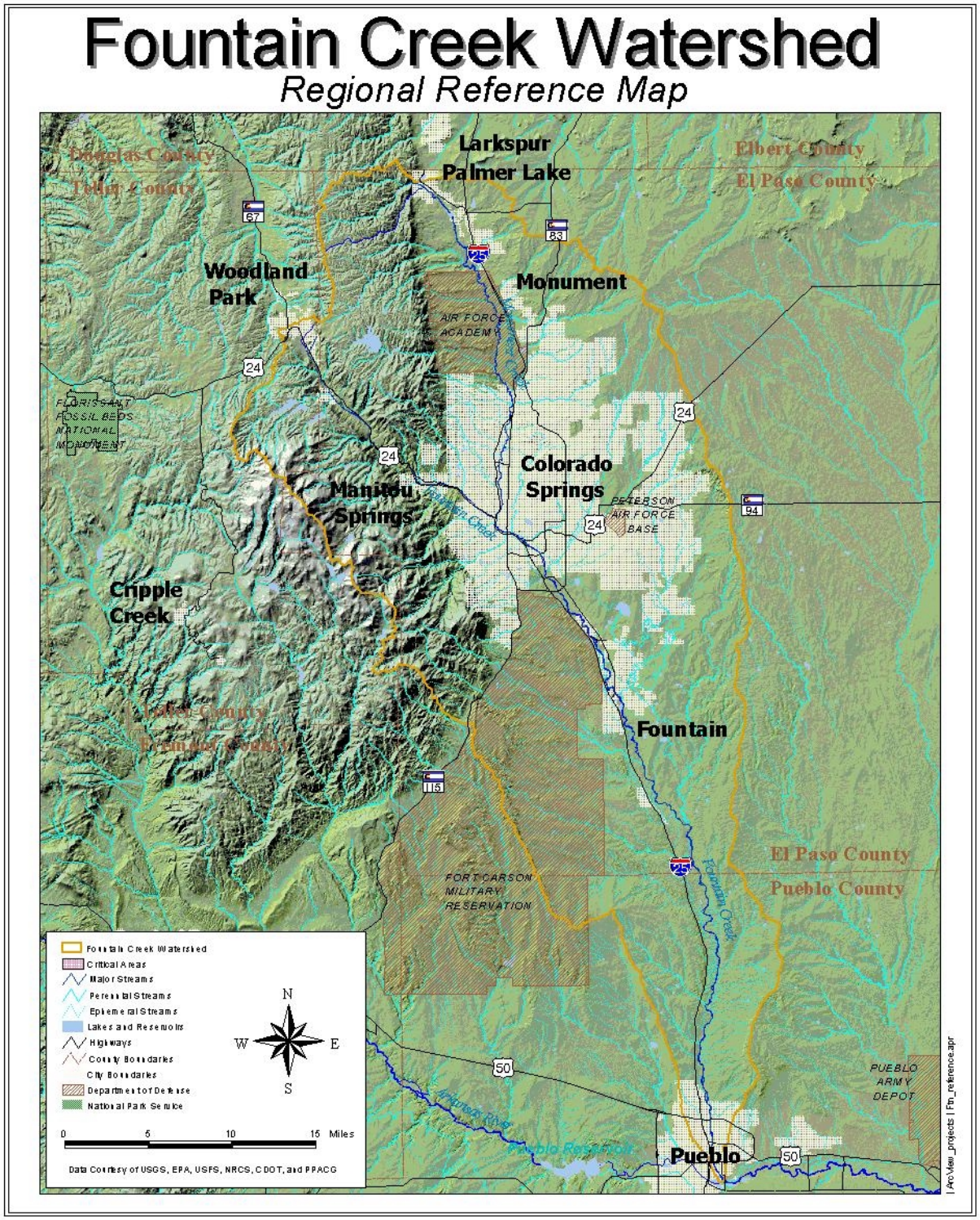

Figure 1-1: Fountain Creek Watershed Regional Reference Map

1.1 Plan Overview

This Plan was developed through a collaborative planning effort involving representatives from local municipalities and counties, State and Federal agencies, soil conservation districts and military installations. Public outreach meetings were held throughout the watershed to collect citizen input into the development of the Watershed Plan. Monthly meetings were held to develop consensus to ensure consistency with Plan goals and objectives, and to review milestones and drafts of the Plan. This regular meeting process maintained focus and developed a sense of ownership on the part of the participants.

This Plan is unique because it represents the first time where all stakeholders collaborated using a well defined and agreed upon set of common goals and objectives. This Plan will serve to document, inform and guide water resource related activities within the watershed as each participating entity selects policy and management strategy recommendations for implementation or makes capital investment decisions based on a comprehensive understanding of the watershed.

1.2 Vision and Purposes

1.2.1 Vision

The Fountain Creek Watershed Plan serves to recognize the watershed as a regional asset supporting diverse interests and promote the health of Fountain Creek and its tributaries.

1.2.2 Purposes

The Plan was developed to achieve the following purposes:

1) Identify and Prioritize Watershed Issues – Issues include erosion, sedimentation and flooding. These issues are described in Section 1.4.

2) Provide Integration with Other Projects in the Watershed – Information will provide integration with and help to support existing and future projects, and help determine possible data gaps and redundancies in projects.

3) Recommend Future Policy and Technical Strategies – Create a comprehensive list of management practices to mitigate against damage to infrastructure and residential, commercial and agricultural property caused by erosion, sedimentation and flooding. These practices can then be applied on a site-specific basis.

4) Provide Opportunities for Public Input – Public outreach and education is an integral component of this planning process. As a collaborative process, this planning effort is maximized through the coordinated efforts and communicated ideas of its stakeholders. Communication of Plan scope, activities and findings along with solicitation of input and feedback from the diverse stakeholder group is a major priority.

1.3 Goals and Objectives

A Goal is a "vision with a plan" and an Objective is a measurable step in that plan. The following goals and their respective objectives serve as the guiding principles for development and the means to achieve the purposes of the Fountain Creek Watershed Plan.

GOAL 1: Provide a regional, coordinated approach to resolve important issues regarding protection and restoration of the watershed while recognizing and respecting vested property interests and supporting diverse human activities.

OBJECTIVES:

- Actively solicit the participation of all major regional stakeholders in developing the Fountain Creek Watershed Plan.
- Provide a regional location to store, maintain and distribute information on mapping, problem areas, the geographic information system database, and materials describing critical watershed characteristics and features.

GOAL 2: Implement a regional, coordinated approach to identify critical areas of concern, make recommendations and develop mechanisms to effectively remedy problems.

OBJECTIVES:

- Develop methods to stabilize critical streambeds and banks, protect against flooding and flood damage, and restore and maintain stream health.
- Develop a long term implementation strategy to achieve the Fountain Creek Watershed Plan goals.
- Encourage landowners, homeowners, businesses and governments operating within the Watershed to adopt policies and operating practices consistent with developed mitigation methods and the principles contained in the Plan Vision and Purposes statements (Sections 1.2.1 and 1.2.2).

GOAL 3: Maintain communication, coordination, and collaboration among Plan stakeholders.

OBJECTIVES:

- Maintain regular communication and collaboration between the Project Management Team and the Technical Advisory Committee. The Project Management Team is composed of senior technical representatives of local governments within the watershed and is the primary contributor and reviewer of the Fountain Creek Watershed Plan. The Technical Advisory Committee. The Technical Advisory Committee includes representatives from local governments in the watershed and state and federal agencies, and has contributed scientific research and assisted in reviewing the Plan.
- Establish a Plan monitoring procedure in order to continue to receive public comment and input concerning Plan vision, goals, objectives and implementation.
- Communicate Plan outcomes and recommendations to all stakeholders.

GOAL 4: Develop a Geographic Information System (GIS) database to: 1) conduct watershed analysis; 2) serve as a decision-making and educational resource for communities within the watershed; and 3) serve as a guide to visually identify temporal and spatial changes and their corresponding effects on erosion and infrastructure due to flooding and other natural and/or anthropogenic events that have occurred in the watershed.

OBJECTIVES:

- Collect information during development of the Fountain Creek Watershed Plan for use with existing information to query and analyze data and produce maps.
- Build upon the existing GIS resources within the watershed.
- House and maintain the database through the Pikes Peak Area Council of Governments.

1.4 Watershed Issues

The primary driving factor that affects water quality and quantity activities in the Fountain Creek watershed is growing urbanization. The effects from urbanization are shown in the flowchart in Appendix I. Appendix I shows that population growth leads to increased water use, increased wastewater treatment plant (WWTP) discharge and increased baseflow. These factors, when coupled with a potential loss of natural cover and an increased impervious surface area, can lead to property damage, property loss, public safety hazards and contribute to water quality degradation. The three primary watershed processes that cause these problems are erosion, sedimentation and flooding.

1.5 Watershed Processes

Watershed processes have been divided into three separate categories: erosion, sedimentation and flooding. Due to the diversity of each of the four subwatersheds within the Fountain Creek Watershed (Fountain Creek Headwaters, Monument Creek, Colorado Springs Composite, and Lower Fountain Creek), each process will be prioritized later in the Plan based on the different characteristics of each subwatershed. A more detailed explanation of the subwatershed framework is provided in Section 3.

1.5.1 Erosion - Erosion is a natural watershed process occurring under low, average, and high flow regimes. Erosion and sedimentation may act concurrently in the same reach of a channel; however, erosion is more common in upland source areas and headwater stream channels where there may be erosion over large areas, channel downcutting or incising, or channel

head migration upslope. Erosion occurring in an uncontrolled or unmanaged system can result in exacerbated stream bank deterioration; channel instability; loss of agricultural, residential, industrial or private property; loss of infrastructure; and increased sediment loads to downstream reaches.

1.5.2 Sedimentation - Sedimentation or deposition is also a natural watershed process occurring under a variety of flow regimes. When these processes occur in an uncontrolled or unmanaged system, the results can include:

- loss of channel capacity, habitat, and fisheries;
- decreased channel stability;
- increased floodplain widths;
- more variable channel meander patterns;
- plugging of stormwater outlets;
- loss of agricultural, residential, industrial, or private property; and
- increased probabilities of flooding.

1.5.3 Flooding – Flooding of lands within floodplains and other lowland areas can be a natural response of a watershed system where increased flows resulting from precipitation events within the watershed exceed the low or normal flow channel. Flooding can also result from the failure of flood control structures; a reduction of channel hydraulic capacity due to sedimentation or construction within the floodplain; overburdened public and private infrastructure; increased impervious surface area (potentially increasing storm runoff); or from complete saturation of subsurface soil and rock. Flooding is an issue of major concern in portions of the Fountain Creek Watershed because the conveyance capacity for some creeks and streams is not able to meet demands. Loss of channel capacity due to sedimentation also contributes to flooding problems.

1.6 Economic Impacts - Economic loss can result from damaged or lost property and infrastructure, lost recreational or development opportunities, or reduced property or sales tax revenues. Furthermore, economic impacts from erosion, sedimentation and flooding often cross political, social or ownership boundaries, which can complicate the development of equitable solutions or mitigation alternatives.

1.7 Regulatory Programs - Several regulatory programs affect the activities occurring within the Fountain Creek Watershed. The activities these programs regulate have the potential to affect stream water quality, riparian zone habitat and wetlands, flood conveyance capacity, and sediment loading and transport. Some of these programs include:

1) FEMA Floodplain Regulations

2) Clean Water Act & National Pollutant Discharge Elimination System (NPDES)

   a. Municipal Wastewater NPDES Permits
   b. Industrial Wastewater NPDES Permits
   c. Municipal Stormwater NPDES Permits – Phase I (Colorado Springs), Phase II (Manitou Springs, Monument, Fountain, Pueblo, El Paso County, Pueblo County);
   d. Section 404 of Federal Clean Water Act

3) Endangered Species Act

4) Total Maximum Daily Load (TMDL)

5) Municipal & County Zoning Regulations

1.8 Watershed Activities

Appendix G contains the Fountain Creek Watershed Activity Matrix, which lists the goals, activities and status of all ongoing projects dealing with drainage, flood mitigation, planning, regulatory policies, transmountain diversions, public education, and modeling (GIS and remote sensing). This matrix has been used to determine integration between projects, possible gaps and redundancies in projects, where to find information and help in short and long term planning.

2. Background and Overview

2.1. Watershed History

2.1.1. Pre-Colonial Settlement

Water has played a role in the Fountain Creek Watershed since before European settlement. It is believed that as early as the thirteenth century, droughts forced the Mesa Verde peoples from their dwellings, and that some ventured as far north as the Pikes Peak Region in search of water and more hospitable climate. The Front Range corridor is also believed to be an early route for pre-historic peoples migrating from Asia across the Straits and into North America. For 12,000 years early hunters roamed the plains and followed the flanks of the Front Range, where wood and animal resources were most abundant.

Numerous Native American tribes lived throughout the watershed area prior to European settlement and exploration. The Ute, Comanche, Kiowa, Cheyenne, Arapahoe and Sioux all inhabited the area at various times. The "Ute Trail" was one of the principal passages that traversed the mountains into South Park. The cooler and higher elevation pastures supported abundant buffalo, deer and elk, and the mountain streams supported beaver and fish. Forests were frequently harvested for construction of tepees. Early settlers reported large deforested areas on Cheyenne Mountain south of Colorado Springs, where thousands of trees had apparently been cut for lodge poles.

2.1.2. Colonial Settlement and Westward Expansion

The watercourses of the Fountain Creek Watershed played a central role in the history of settlement of the area. Prior to roads and railways, the most practical travel routes were along rivers and streams where food, water, wood and grasses were most abundant. Present day Colorado Springs, located between the Platte and Arkansas rivers, was a natural destination for explorers, trappers, gold seekers and settlers who followed these rivers into the region. The existing "Ute Trail" along Fountain Creek's Ute Pass became a key route to the future gold fields of not only Cripple Creek and Victor to the west of Colorado Springs, but also to those well beyond South Park.

The age of settlement in the Fountain Creek Watershed began in earnest with the discovery of gold in Colorado. In 1858 gold was discovered along Cherry Creek (in what is now the City of Denver north of the Watershed) by a group of prospectors led by William Green Russell. Once news of this discovery traveled across country, migration to the Fountain Creek Watershed began.

While most of the early prospectors headed toward Denver, the passage of the Homestead Act of 1862 and a light snow year directed the economy of the Watershed toward farming and ranching. Fertile land along Fountain and Monument Creeks was converted to agriculture and produced good crops of wheat, oats and corn. Large snows during the winter of 1863-1864, however, caused severe flooding along these creeks and many lives were lost.

In the winter of 1869, Governor C.A. Hunt acquired a tract of land at the confluence of Monument and Fountain Creeks. In 1871, the town of Colorado Springs was established and the first train of the Denver and Rio Grande railroads arrived in October. Colorado Springs grew rapidly with the establishment of mining camps in the mountains and sheep and cattle ranching on the eastern plains. At the end of 1874, the city's population was 3,200 and there were 850 buildings. The second rail connection was established in 1888, linking Denver and Pueblo with a branch line to Manitou Junction. This opened access to the Black Forest, a principal source of lumber and ranch products. In 1891, the Colorado State Legislature created Monument Lake for the purposes of flood control and irrigation. In 1937, ownership of the lake was revisited by the State. The State retained the water rights, El Paso County was given the dam and the Town of Monument was given the lake bottom.

The booming tourist industry and discovery of gold at Cripple Creek in 1891 brought millions of dollars into the region. Thousands of families traveled to the region during the summer months, flocking to the medicinal springs, Pikes Peak, Garden of Gods and other scenic attractions. After World War I, the popularity of the automobile increased tourism in the Pikes Peak Region. New roads were built and existing ones were improved. A highway was established between Colorado Springs and Manitou Springs, and in 1916 a road was built that allowed automobile travel to the top of Pikes Peak.

The Colorado Springs area struggled through the Great Depression, although the region was not affected as severely as other cities throughout the country. An increase in gold production in the Cripple Creek mining district and in the price of gold helped significantly. The creation of the Civilian Conservation Corps during this time resulted in a number of local construction projects, including flood control dams in Ute Pass above Manitou Springs.

The tourism industry was affected greatly by the beginning of World War II. Gasoline rationing was established at the start of the war, and the influx of visitors during the summer months subsided. To some extent, government expenditures for the military offset the region's loss of tourist dollars.

2.1.3. Watershed Planning and Management History

The need for an organization geared toward protecting the Fountain Creek Watershed was first recognized by landowners who live and work along Fountain Creek between Colorado Springs and Pueblo. As early as the 1970s, Board Members of the El Paso County Soil Conservation District noted that the behavior of Fountain Creek was changing negatively in response to hydrologic modification.

The Fountain Creek Watershed Project was formed in 1995 to combat the many problems associated with streambank erosion, flooding and water quality occurring throughout the Watershed. The Project brought attention to the problems along Fountain Creek through newsletters, distribution of Best Management Practice pamphlets, videos, tours of the watershed, media interviews and other community outreach efforts. The project raised awareness among stakeholders and established a mailing list of over 350 individuals.

In 1998, the members of the Watershed Project created the Fountain Creek Watershed Forum in conjunction with Pikes Peak Area Council of Governments (PPACG). The Forum was an interim, tri-level regional structure formed to increase public awareness and education and to build long term solutions. It consisted of the:

- PPACG and Pueblo Area Council of Governments Boards of Directors (regional planning agencies governed by the elected officials of their member entities);

- Policy Development Committee (PDC) made up of elected officials; and
- Technical Advisory Committee (TAC) made up of technical representatives of the affected parties.

The PDC was vital to the initial development of the Fountain Creek Watershed Plan and was composed of Linda Barley, Duncan Bremer, Al Gurule, Nancy Hankin, John Klomp and LeNore Ralston. Meetings of the PDC were discontinued in 2001 and updates were made directly of the PPACG and PACOG Boards. The TAC included staff from PPACG and PACOG, representatives from Fort Carson, the U.S. Air Force Academy, the Natural Resource Conservation Service, the Southeastern Colorado Water Conservancy District and Soil Conservation Districts.

The TAC and a Project Management Team (PMT), which was composed of senior technical or management representatives from participating local public agencies, Colorado Springs Utilities and the Colorado State Soil Conservation Board comprised the structure used to develop the Fountain Creek Watershed Plan. The PMT provided direct oversight and guidance on the development of the Fountain Creek Watershed Plan and the TAC reviewed sections of the Plan and also provided input.

In 2001, an Intergovernmental Task Force composed of senior technical representatives from local governments within the watershed, was created to interface directly with the U.S. Army Corps of Engineers' program dealing specifically with issues related to the Army Corps of Engineers (ACOE) Watershed Study. The City of Colorado Springs, who is the lead local sponsor for the ACOE Watershed Study, coordinates these meetings. This group still meets on an as-needed basis. The Study is described in more detail in Section 2.1.9 and the Scope of Work is included in Appendix H.

2.1.4. Flooding History

Most of the stormflows in the Fountain Creek Watershed occur from May to August. During this period, masses of warm, moist air from the Gulf of Mexico combine over higher land with colder, drier air from the polar regions to create thunderstorm activity. The most severe storms often occur in the transitional periods of late spring and early fall, when polar air intrusions are most intense. Available records indicate that snowmelt has seldom contributed significantly to flood occurrences on Fountain Creek.

Based on available peak discharge data alone, the floods of 1864, 1886, 1935 and 1965 would be classified as "major" in terms of destructive capability. The 1935 flood was the highest and most destructive in the history of Colorado Springs, and serves as Fountain Creek's flood of record from Colorado Springs to Fountain. The flood resulted from excessive rainfall of short duration over an area of less than 100 square miles in the Monument Creek basin. In Colorado Springs, the storm total measured 7.19 inches at the Colorado College weather observatory. In June 1921, when Pueblo suffered the most destructive flood in its history, the observatory reported that the rainfall in Colorado Springs totaled only 4.54 inches for the entire month.

The 1965 flood exceeded all known floods below the confluence of Fountain and Monument Creeks to the El Paso County line. While it did not cause appreciable damage at Colorado Springs, it caused severe damage farther downstream. The flow at Jimmy Camp Creek was estimated to be 124,000 cubic feet per second (cfs) at a point 4.5 miles upstream from its confluence with Fountain Creek.

Millions of dollars of damage resulted from flooding that occurred during the last day of April and the first few days of May 1999, when flood flows peaked at 18,900 cfs at the Fountain Creek at Pueblo gage. This storm resulted in the declaration of federal flood disaster areas for several counties within and downstream of the Fountain Creek Watershed. Floodwaters washed out bridges, utility lines and agricultural lands. High flows caused wastewater system backups in Colorado Springs and sent floodwater down the main streets of cities and towns in the Lower Arkansas Basin east of Pueblo. These storms along with others that have occurred in the watershed are summarized in Table 2-1.

Table 2-1: Summary of five largest streamflow events on Fountain Creek at Pueblo, Colorado, and magnitude and general location of precipitation (USGS, 2000).

Date	Peak Instantaneous Streamflow [cfs]	Recurrence Interval Exceeded	Streamflow at Recurrence Interval [cfs]	General Storm Location within the Watershed	Reported Precipitation [inches]
6/17/1965	47,000	200yr	45,750	Northeast Colorado Springs	14
5/30/1935	35,000	50yr	30,060	Northeast Colorado Springs	18
6/4/1921	34,000	50yr	30,060	n/a	n/a
4/30/1999	18,900	10yr	15,750	Colorado Springs	10
7/10/1945	17,800	10yr	15,750	n/a	n/a
cfs: cubic feet per second					
n/a: not applicable					

2.1.5. Monument Creek Floodway Improvements

After the 1935 flood destroyed all of the bridges along Monument Creek and severely damaged Monument Valley Park, the Works Progress Administration (WPA) constructed the Monument Creek Floodway improvements between 1935 and 1940 through downtown Colorado Springs. Rockwork was constructed on the east and west banks of the creek to stabilize its channel that extended approximately 1 mile north and 2 miles south of the current Uintah Street bridge. The original Uintah Street bridge was replaced in 1940 to meet the new channel location and configuration.

2.1.6. Municipal Water Supply Development

2.1.6.1. Colorado Springs' Water Supply

Approximately 15 percent of Colorado Springs' water supply originates in the Fountain Creek Watershed, including tributary streams on Pikes Peak, while 85 percent is imported from out-of-basin sources. Up to 6 million gallons per day of domestic wastewater may also be reclaimed for landscape irrigation uses.

Local Water Supply

Development of water from Pikes Peak began in the 1890s. Through grants and purchases, Colorado Springs received title to the Seven Lakes: Lake Moraine in

1891, Boehmer in 1894, Bighorn and Wilson in 1896, Mason and McReynolds in 1905, and Big Tooth in 1929. The Seven Lakes are located on the south side of Pikes Peak, southwest of Colorado Springs. In 1908, the City took over ownership and management of its water supply.

The north and south slopes of Pikes Peak supply Colorado Springs with an average of 13,000 acre-feet of water per year, or about 15 percent of the total drinking water supply. The north slope has three reservoirs: Crystal, South Catamount and North Catamount.

Transbasin Diversions

The Blue River Project, the first trans-mountain diversion of water to Colorado Springs, was completed in the 1950s. During construction, water rights were acquired so that the project could be designed to eventually become Phase I of the Homestake Reservoir Project, which opened in 1967. This joint venture between Colorado Springs and the City of Aurora created a 5.5 mile tunnel beneath the Continental Divide.

In 1972, Colorado Springs purchased shares in the Twin Lakes Company near Leadville for $13.5 million and acquired water rights to an annual firm yield of 35,000 acre-feet. The Twin Lakes Company diverts water from the Roaring Fork River and its tributaries on the western side of the Continental Divide, and moves it through the Twin Lakes Tunnel into Lake Creek before its arrival at Twin Lakes Reservoir. Seventy-five percent of the water in the Twin Lakes system is trans-mountain water.

A majority interest in the water rights to the Colorado Canal, Lake Henry, and Lake Meredith in Crowley County was purchased in 1986, and is estimated to yield 13,700 acre-feet annually. This water is diverted into the Colorado Canal at the Arkansas River near Boone, Colorado. Water from Lake Meredith and Lake Henry can be returned to the Arkansas in exchange for water stored in reservoirs upstream.

Colorado Springs reuses its trans-mountain return flows by exchanging for water available upstream, significantly increasing the yields of existing and future trans-mountain water sources. Water may be available upstream from senior native

Arkansas flows or from reservoir storage. In addition to the Arkansas River Exchange, there are exchanges within the City's local systems that are tributary to Fountain Creek.

Southern Delivery System

Colorado Springs Utilities is proposing a major water delivery project, referred to as the Southern Delivery System, to provide additional water to Colorado Springs, Fountain and Security. The project would include a 43 mile, 66 inch diameter raw pipeline that would start at a point in Pueblo, then run north to Colorado Springs to a water treatment plant located near Jimmy Camp Creek. Several possible pipeline alignments are currently being evaluated. The target completion dates for the various components of the Southern Delivery System are:

- Complete environmental evaluation by 2004-2005
- Construct pipes, pump stations and water treatment plants by 2006-2007
- Construct proposed water storage reservoir site at either Jimmy Camp Creek site or William Creek site by 2015

Fryingpan-Arkansas Project

The Fryingpan-Arkansas Project is a multiple purpose reclamation project. It includes the collection and transmountain diversion of water from the Fryingpan and Roaring Fork Rivers in western Colorado to the Arkansas River in eastern Colorado. Since the late 1970's El Paso County and in particular the communities of Colorado Springs, Fountain, Security, Widefield and Stratmoor Hills have been participants in the project and have received water from the project diversion.

The project collects approximately 69,000 acre-feet of water each year from the Fryingpan River Basin on the western slope of the Continental Divide, and delivers it via the Arkansas River to the eastern slope. It includes 5 major dams and reservoirs, 17 smaller dams to divert water down shafts to 9 tunnels feeding the Arkansas River.

2.1.6.2. City of Pueblo and Pueblo County

Although Fountain Creek bisects the eastern portion of the City of Pueblo, the City does not divert drinking water from it, but rather from the Arkansas River through Pueblo Reservoir. Table 2-2 lists municipal water systems and their sources of water.

Table 2-2: Municipal Water Systems in the Fountain Creek Watershed

Municipality	Sources	
	Groundwater	**Surface Water**
Colorado Springs	Alluvial and bedrock aquifers	Fountain Creek; Arkansas, Blue, Eagle, Fryingpan and Roaring Fork Rivers
Pueblo	None	Arkansas, Eagle, Fryingpan and Roaring Fork Rivers
Manitou Springs	None	Fountain Creek and its tributaries
Fountain	Alluvial aquifers	Fountain Creek; Arkansas and Fryingpan Rivers
Security	Alluvial aquifers	Arkansas and Fryingpan Rivers
Widefield	Alluvial aquifers	Arkansas and Fryingpan Rivers
Woodland Park	Alluvial and bedrock aquifers	Arkansas, South Platte, Eagle and Roaring Fork Rivers
Green Mtn. Falls	None	Fountain Creek and Blue River

2.1.7. Agricultural Water Supply Development

Diversion of water for agricultural use began in the early to mid 1800s and continues today. Agricultural diversions exist in Fountain and Monument Creeks, as well as major tributaries including Bear Creek, West Monument Creek, Jimmy Camp Creek and Cheyenne Creek. The Fountain Mutual Ditch diverts water from Fountain Creek near the southern border of Colorado Springs. Historically, the Ditch delivered water for agriculture within in its service area. Now it serves primarily as a water rights augmentation company and has been developed as a stormwater collection and conveyance system.

2.1.8. Wastewater and Industrial Discharges

Today, the Fountain Creek Watershed has 12 wastewater treatment plants that discharge into Fountain Creek and its tributaries. A description of each of these treatment plants, service area population, capacities and discharge limitations can be found in the Water Quality Management 208 Plan (PPACG, 1999). These plants

with their discharge locations are provided in Table 2-3, which also shows the design/rated capacity of the treatment plant, which represents how much effluent the treatment plant was ultimately designed for and is currently permitted to treat. The existing load capacity of theses plants can also be found in the 208 Plan.

Table 2-3: Permitted Wastewater Treatment Plant Discharges in the Fountain Creek Watershed

Plant Name	Discharge Location	Design Flow Capacity (mgd)
Colorado Springs Utilities Las Vegas WWTP	Fountain Creek Segment 2a via Fountain Mutual Irrigation channel	65.00
Colorado Springs Utilities Garden of Gods (currently under construction)	Fountain Creek at Pikeview Reservoir	30.00
Garden Valley Water and Sanitation District	Fountain Creek at South Circle Drive bridge	0.11
Academy Water Sanitation District	Smith Creek at southern edge of treatment facility	0.12
Donala Water and Sanitation District, Forest Lakes and Triview Metropolitan Districts (Upper Monument Regional Facility)	Monument Creek at southwest corner of service area	0.88
Tri-Lakes Joint use WWTF (Monument, Palmer Lake and Woodmoor Water and/or Sanitation District)	Monument Creek at southern edge of Tri-Lakes Service Area	4.20
United States Air Force Academy	Academy's effluent recycle system and Monument Creek segment 6	1.40
Cherokee Metropolitan District	East fork of Sand Creek 300 yds. west of north entrance to Peterson Air Force Base	2.00
Fort Carson	Clover ditch about 1 mile upstream from Carson Blvd. bridge	3.00
Fountain Sanitation District	Fountain Creek, southern edge of treatment facility	1.56
Security Sanitation District	Fountain Creek, 1 mile upstream from Carson Blvd. bridge	2.40
Widefield Water and Sanitation District	Fountain Creek, .025 mile downstream from McGrath Ave. bridge	2.50

Colorado Springs Utilities (CSU) operates the largest watershed discharge facility, and has identified short and long term alternatives as part of a Wastewater Infrastructure Strategic Plan to meet requirements through the year 2040 (Montgomery-Watson, 2000). The preferred alternatives for expansion that are either in various stages of either being permitted, designed or constructed are development of the Garden of Gods Wastewater Treatment Plant, Jimmy Camp Creek Basin WWTP and Monument Creek

interceptor. More information about these alternatives can be founding the 208 Plan (PPACG, 1999).

2.1.9. U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (ACOE) has constructed several Flood Control Projects in the Arkansas River basin, including the John Martin Dam and Reservoir near Lamar, the Pinon Canyon Dam at Trinidad, and the Trinidad Reservoir Project on the Purgatoire River. Within the Fountain Creek Watershed, the Templeton Gap Floodway in northeast Colorado Springs was completed in 1948. The Pueblo Floodway Levee Extension and Fountain Creek Levees and Channelization projects, located on the mainstem of Fountain Creek within the city limits of Pueblo, were completed in 1952 and 1989 respectively. The ACOE has also performed numerous flooding and floodplain related investigations and studies in the Fountain Creek Watershed over the past several decades. Table 2-4 shows a chronology of completed reports.

Water resource planning studies have been conducted under the authority of the 1974 Water Resources Development Act (WRDA) legislation. Congress usually reauthorizes the WRDA every 2 years. General Investigations studies authorized by the WRDA occur in 2 phases: Phase I – Reconnaissance Study, and Phase II – Feasibility Study. In 2000, the ACOE completed a Phase I Study to establish federal interest in the areas of ACOE jurisdiction, namely, navigation, flood control and environmental restoration. It identified a local sponsor, and made a preliminary determination that there may be viable projects to address the problems or issues in the Study area. This phase was 100% federally funded and concluded with the development of a Scope of Work (Appendix H) to guide Phase II, a scope of work for development of the ACOE Watershed Study, signing of a feasibility Cost Sharing Agreement (FCSA) between the ACOE and the City of Colorado Springs and an intergovernmental agreement (IGA) between the City of Colorado Springs and the other ten participating local governments.

Table 2-4: Completed U.S. Army Corps of Engineers Reports (K. Schafer, personal communication, April 2001).

Date	Study Type	Title
May 1971	Flood Plain Information Report	Monument Creek, Colorado Springs, CO
Mar. 1973	Flood Plain Information Report	Fountain and Jimmy Camp Creeks, Colorado Springs, Fountain, & El Paso County, CO
Aug. 1985	Reconnaissance Study Report	Fountain Creek North Pueblo, CO. Upper Fountain Creek Reach from Headwaters near Woodland Park to US Hwy. 24 East of Manitou Springs
Aug. 1985	Reconnaissance Study Report	Fountain Creek North Pueblo, CO. Lower Fountain Creek Reach from Monument Creek Confluence to the Mouth at Pueblo, CO
Aug. 1985	Reconnaissance Study Report	Fountain Creek North Pueblo, CO. Central Fountain Creek Reach from US Hwy. 24 East of Manitou Springs to Monument Creek Confluence
Nov. 1989	Reconnaissance Study Report	Fountain Creek, Colorado Springs, CO from 33rd St to Monument Creek Confluence
Apr. 1994	Databook	Flow-Damage Data for Selected Locations in the Albuquerque District
Sep. 1999	Post Flood Assessment Report	Post Flood Assessment Report, Arkansas River, Southern Colorado

The ACOE Watershed Study will be completed by Fall 2006 and is funded through a 50/50 cost share between the federal government and state/local governments. The cost of the Study is about three million and $600,000 in grants was obtained from the Colorado Water Conservation Board (CWCB) and Department of Local Affairs (DOLA) towards the local cost share of the Study. The remaining $900,000 of State/local funding is being shared between the eleven participating governments in the watershed based on a formula using impervious surface area.

The ACOE Watershed Study began in April 2003. Its primary goal is to develop the Study from a regional perspective in which all local participating governments benefit by "spinning off" projects under other authorities to address flood control, erosion, sedimentation and environmental restoration problems. The planning process and key objectives of the Study include:

- Incorporating public input and involvement;
- Assessing watershed characteristics and conditions;
- Outlining watershed issues/concerns with erosion/sedimentation as a key component;

- Analyzing watershed issues/concerns (using GIS where practical and information available);
- Developing, evaluating and prioritizing conceptual alternatives including structural and non-structural measures;
- Spinning-off projects under other authorities as appropriate throughout the Study; and
- Completing the watershed plan and final report.

2.2. Physical Characteristics

2.2.1. Geology

The present Rocky Mountains were formed during a period of intense mountain building and faulting, known as the Laramide Orogeny, which began approximately 65 million years ago and involved the entire chain of mountains from Alaska to the southern end of South America. During this period, the Front Range, which forms the western boundary of the Fountain Creek Watershed, was uplifted. Precambrian rocks, composed of granite, gneiss and schist 1 to 1.75 billion years old, were thrust upward. Overlying younger sedimentary rocks were uplifted, stretched, and draped across the mountain cores. Twenty million years after the uplift ceased, the mountains began to erode; rivers and streams carried large amounts of sediment to the base. This sediment now comprises much of the surficial deposits through which the streams in the watershed flow.

In the northern portion of the watershed, a series of steeply tilted sedimentary rocks marks a transition from the higher elevations of the Front Range to the gently sloping sandstone and shale deposits of the Piedmont. The sandstone formations were deposited as ancient beaches, bars and coastal floodplains during the retreat of a shallow sea in the Cretaceous period. Underlying these sandstones is the older Pierre shale, a sedimentary rock that is present throughout much of the watershed and is made up of clay-sized minerals deposited in a shallow marine environment before the seas began to retreat from the area.

2.2.2. Soils

Soil types within the watershed are easily distinguished by their location and the geologic formations present at those locations. There are four dominant soil types located geographically: those formed from Pikes Peak to the west, the foothills to the north, the plains to the east, and the valley to the south. Table 2-5 shows the soil characteristics, description, erosion and runoff susceptibility, slope and average precipitation for each of these areas.

Table 2-5: Soil Characteristics Summary

	Pikes Peak-West	Foothills-North	Colorado Springs area and Plains to the East	Valley-South
Soil Characteristics	Shallow, gravelly soils derived from Pikes Peak Granite	Moderately deep, coarse sand derived from layers of sandstone	Deep sands deposited by wind	Shallow and moderately deep, derived from shale
Soil Description	Shallow and poorly developed	Moderately deep to sandstone bedrock with some areas exposed to the surface	Deep, well developed, existing on gentle slopes, high sand content combined with high wind (from plains) result in high wind erodibility	Clays in this area expand and contract with changes in moisture content, therefore shrink-swell is a major management concern
Erosion Susceptibility	High	Moderate	Low	Moderate – High
Runoff Susceptibility	Rapid	Medium	Slow	Moderate – Rapid
Elevation	7000-14000 feet	6800-7700 feet	6000-7000 feet	4600-6100 feet
Slope	25-90%	1-40%	1-20%	3-25%
Average Precipitation	22 inches	18 inches	15 inches	13 inches
Geographic Extent	Present in the quadrant extending from the confluence of Fountain Creek and Monument Creek north and west approximately along the Creek boundaries	Present in the quadrant extending from the confluence of Fountain Creek and Monument Creek north and east approximately along the Creek boundaries	Present in the quadrant extending from the confluence of Fountain Creek and Monument Creek south and east approximately along the Creek boundaries	Present in the quadrant extending from the confluence of Fountain Creek and Monument Creek south and west approximately along the Creek boundaries

Source: U.S. Department of Agriculture, Natural Resources Conservation Service, and El Paso County Service Center Staff

2.2.3. Fluvial Geomorphology in the Fountain Creek Watershed

The behavior of river channels is determined by interactions between the forces of moving water and the relative resistance of erodible materials in the channel. Gravity is the force that accelerates water down the channel and friction is the force that opposes this motion. When downstream forces exceed that of the resisting forces, the net result is erosion and transport of channel materials. Energy available for erosion is primarily dependent on the velocity of water moving through the channel. Velocity, in turn, is affected by discharge and gradient. At higher discharges, more water is moving through the channel and the correspondingly higher velocity tends to increase the potential for erosion. Because gravity moves water downstream, steeper gradients also mean greater velocities and increased potential for erosion.

The composition of the material water flows through also influences a stream's potential for erosion. Movement of individual particles depends on their size, shape and density. Natural cohesive forces tend to hold smaller, clay-sized particles together more tightly. Thus, sand-sized material in the streambanks and along the channel bottom will be more easily eroded than clay. The surficial deposits streams in the Fountain Creek Watershed travel through are primarily composed of sand-sized material, which is easily eroded at moderate to high discharges.

2.3. Climate and Precipitation

Climate within the watershed is broadly characterized as semiarid. It can vary from alpine arctic to semiarid depending on the elevation and proximity to the Front Range. The watershed has four precipitation stations – Ruxton Park, Colorado Springs, Fountain and Pueblo. According to a report by the USGS (Stogner, 2000), annual precipitation generally decreases with distance from the Fountain Creek and Monument Creek Headwaters as elevation decreases. The USGS pre-1977 and post-1976 analysis of trends in precipitation between each of the four stations showed that most of the storms are strong, isolated events that occur in the late afternoon during the early spring. The USGS reports that the Ruxton Park station consistently received the most precipitation annually, with a mean of 24.5 inches. The reporting station at the Pueblo station received the least rainfall annually, with a mean of 11.9 inches. Approximately 70 to 80 percent of daily precipitation that occurs in the region is less than or equal to 0.25 inches.

2.4 Streamflow

Streamflow in Fountain Creek and Monument Creek varies seasonally, but has three distinct types of flows: base flow, snowmelt and summer flow (Stogner, 2000).

- Base flow usually occurs from late September until mid-April (October 1st through April 15th) and flows are fairly constant, without much fluctuation.
- Snowmelt begins in mid-April and lasts until mid June (April 16th through June 15th) and flows are significantly higher and peak around mid-May, with April and May usually being the highest precipitation months.
- Summer flow begins in mid June and lasts until the end of September (June 16th through September 30th) and is usually highly variable due to afternoon and evening thunderstorms.

Graphs in Appendix A show temporal trends for each these three different flow regimes. A linear trend line is shown for the flow from Station 5500 for each of the three time periods. Each graph shows an increasing trend in flows from 1988 to 2001 for each of the three different flow regimes. The location of the monitoring stations is shown in Figure 2-1.

The considerable changes in channel morphology most often associated with large dramatic events that may cause sudden changes in channel shape usually occur from mid April to mid June. Research (Leopold and others, 1964) suggests that more common streamflow conditions associated with bankfull streamflow (1 to 2 year events) are considered the dominant force in development and maintenance of channel morphology.

2.5 Sediment Transport

From 1998 to 2001, the USGS measured sediment transport at sites located on Fountain Creek (sites 3700, 5500 and 5800), Monument Creek (site 3970) and Cottonwood Creek (sites 3977, 3985 and 3990). Results showed that on average, about 4.5 times more sediment was transported during stormflow than during normal flow (Edelmann, 2002). On average, stormflow caused about 10 times more tons/ft^3/s of sediment to be transported than would have occurred during normal flow for the 3 sites located in the Cottonwood Creek Basin. During normal flow, Fountain Creek downstream from Manitou Springs had the smallest suspended sediment concentrations and Cottonwood

Creek at the mouth had the largest. The second lowest suspended sediment concentrations were on Monument Creek upstream of Cottonwood Creek. This Study did not distinguish between in-stream erosion and sediment that was washed into the stream from other sources. The location of the monitoring stations is shown in Figure 2-1.

2.6 Potential Flood Hazards

Floodwaters are considered hazardous to life and property when flow depths of 3 feet or more combine with flow velocities of 3 feet per second or more (U.S. Army Corps of Engineers, 1973). The dynamic relationship between discharge, flow depth, flow width and velocity is influenced by numerous factors including storm precipitation, topography, and channel geometry. Flood hazards are created when channel width is encroached upon by inadequately designed structures, when fill or waste is placed within the active channel cross-section, or when debris creates flow restrictions. When flow velocities reach scour potential, stream banks can be destabilized or eroded and large amounts of sediment and debris can be transported downstream. Overbank flooding can be exacerbated in stream reaches where deposition or sedimentation has occurred and channel capabilities are reduced. In addition to potential damage to riparian natural resources, infrastructure at risk of damage or loss during flood events may include roads and bridges, utility crossings, residential and commercial structures, and flood control and drainage structures.

2.7 Land Use

The Cities of Colorado Springs and Pueblo are respectively the second and sixth largest metropolitan areas along the Front Range (Colorado Department of Local Affairs, 2001). The Fountain Creek Watershed reflects a variety of possible land uses: residential (high, medium and low density), commercial and office, industrial, parks and open space, schools and institutions, agricultural and undeveloped land. Most agricultural land is located along the lower portion of the mainstem of Fountain Creek.

Land use along the mainstem of Fountain Creek is predominately a mixture of agriculture and residential, with most of the agricultural land located in the unincorporated areas of El Paso, Pueblo and Teller Counties. The regional land use patterns along Monument Creek indicate a high percentage of vacant land. Due to rapid growth in the northern portions of El

Paso County, land use is expected to reflect an increasing percentage of residential and commercial/industrial use.

2.8. Impervious Surface Area

The USGS (Edelmann, 2002) has estimated total impervious area for 1964, 1992, 1997-2000 for four gauging stations based on the drainage area upstream of the USGS gauging stations. Monitoring station locations are shown in Figure 2-1, along with the percentage of impervious surface area within each drainage area. Changes in impervious surface area were estimated based on six different land use categories: commercial and industrial, residential, streets and easements, airports and military, agriculture and undeveloped. Different rates of permeability are associated with different types of land use. A 1964 land use map was scanned, geo-rectified and digitized (Edelmann, 2002) to provide estimates for 1964. Digital land use data from the National Land Cover dataset was used for 1992. Due to the scale of these maps it was not possible to get estimates for each land use type for 1964 and 1992. The City of Colorado Springs land use map was used to estimate impervious surface area for 1997 through 2000.

Table 2-6: Impervious Surface Area

Monitoring Station	Drainage Area (mi^2)	Impervious Surface Area							
		1964		1992		1998		2000	
		(mi^2)	%	(mi^2)	%	(mi^2)	%	(mi^2)	%
3700	103	16.6	16%	16.5	16%	22.2	22%	23.8	23%
3970	181	27.2	15%	31.4	17%	45.8	25%	45	25%
5500	392	62.7	16%	74.1	19%	105	27%	114	29%
5800	495	85.3	17%	111	22%	154	31%	166	34%

Note: Locations of monitoring stations are shown in Figure 2-1.

The largest total changes in the amount of impervious surface area were in drainage areas 5500 and 5800 (Edelmann, 2002):

- Site 5500 has increased from 62.7 mi^2 in 1964 to 114 mi^2 in 2000, which corresponds to a change in the amount of imperviousness from about 16% to 29%; and
- Site 5800 has increased from 85.3 mi^2 in 1964 to 166 mi^2 in 2000, which corresponds to a change in the amount of imperviousness from about 17% to 34%.

Studies (Schuler, 1994) have shown that stream degradation can occur at relatively low levels of imperviousness (10 – 20 %). Schuler reviewed scientific evidence that relates

"imperviousness to specific changes in the hydrology, habitat structure, water quality and biodiversity of aquatic systems".

2.9 Stream Gauge Monitoring Network

There are 22 active USGS monitoring stations located within the Fountain Creek Watershed, primarily on Fountain and Monument Creeks and major tributaries. Table 2-7 and Figure 2-1 show the location of these stations. These stations measure stream flow and different types of water quality parameters, such as biological, nutrients, organics, inorganics, physical properties, radiochemical and sediment. More information about the Fountain Creek Watershed stream monitoring network can be found at http://water.usgs.gov/cgi-bin/realsta.pl?select_type=point&point.x=185&point.y=153.

Table 2-7: Fountain Creek Watershed Stream Monitoring Network

Station Number	Location
7103700	Fountain Creek near Colorado Springs
7103703	Camp Creek at Garden of the Gods
7103785	Deadmens Creek above Deadmens Lake USAFA
7103780	Monument Creek above Northgate Boulevard near USAFA
7103797	West Monument Creek above Rampart Reservoir
7103970	Monument Creek above Woodmen Road
7103800	West Monument Creek at USAFA
7103930	West Monument Creek at Mouth of USAFA
7103940	Monument Creek at Southern boundary of USAFA
7103980	Cottonwood Creek at Woodmen Road near Colorado Springs
7103990	Cottonwood Creek at Mouth, at Pikeview
7099990	Upper Monument Creek, 0.25 mile before confluence
7105490	Cheyenne Creek at Evans Ave at Colorado Springs
7105000	Bear Creek near Colorado Springs
7105500	Fountain Creek at Colorado Springs
7105530	Fountain Creek at Janitell Road
7105800	Fountain Creek at Security
7105900	Jimmy Camp Creek at Fountain
7105945	Rock Creek above Fort Carson Reservoir
7106000	Fountain Creek near Fountain
7106300	Fountain Creek near Pinon
7106500	Fountain Creek at Pueblo

Note: Stream Stations are identified in Figure 2-1 by the last four digits of the Station Number shown on Table 2-7.

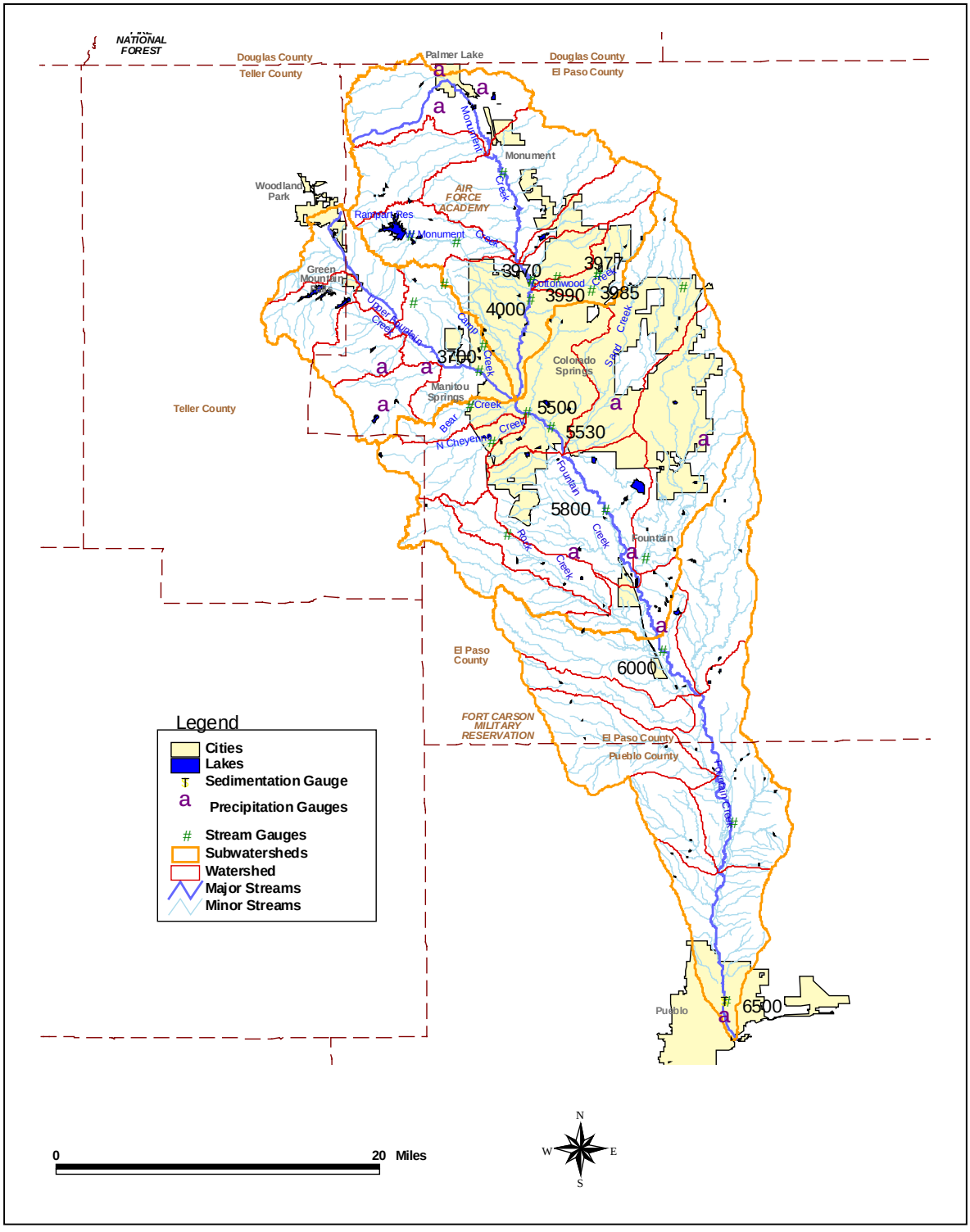

Figure 2-1: Fountain Creek Watershed Stream Monitoring Network

2.10 Population and Socioeconomic Characteristics

Anticipated growth in the region reinforces the importance both of understanding the correlation between population growth and watershed health and also of formulating a plan to minimize the effects of future growth. Many critical issues, from transbasin diversion rates to impervious cover and resulting stormwater runoff rates, are a reflection of regional population dynamics. Population projections serve as the basis for determining the amount of water necessary to meet the forecasted demand for 20 to 40 years. Table 2-8 shows the historic and most recent population for each local government within the Fountain Creek Watershed. For the municipalities and counties that straddle the boundaries of the watershed, the population has been adjusted to reflect only those residents in the watershed.

Although most of the growth between 1990 and 2000 that occurred in El Paso County was in Colorado Springs, the future forecasts suggest that more growth is expected in the unincorporated areas of El Paso County. By 2010 or 2011, El Paso County's population is expected to exceed 583,000 residents and become the largest populated county in Colorado; Teller County's growth rate between 1990 and 2000 was among the fastest in the State.

Table 2-8: Summary of Fountain Creek Watershed Population Estimates

Entity	Population 1990	Population 2000	Percent Change 1990-2000
Colorado Springs	208,430	360,890	28.7%
Fountain	10,754	15,197	41.3%
Green Mtn. Falls	663	773	16.6%
Manitou Springs	4,535	4,980	9.8%
Monument	1,020	1,971	93.2%
Palmer Lake	1,480	2,179	47.2%
Pueblo	23,190	24,033	3.5%
Woodland Park	1,360	2,316	41.3%
Unincorp. El Paso County	69,870	100,100	30.2%
Unincorp. Teller County	1,235	1,900	64.9%
Unincorp. Pueblo County	1,020	1,200	15.0%
Total	**395,557**	**515,539**	**23.0%**

Source: U.S. Census Bureau

3. Methodology: The Watershed Approach

The Fountain Creek Watershed Plan relies on the diversity of its concerned stakeholders and their expertise to find comprehensive upstream and downstream solutions for watershed problems.

3.1 Organization and Structure of the Plan

Characterization of the Fountain Creek Watershed and analysis of critical issues and areas uses the U.S. Geological Survey (USGS) Hydrologic Unit Code (HUC) Framework. This framework is a nationwide system of watershed delineation and is used to catalog major drainage basins. It recognizes that a watershed is a composite of multiple smaller systems, and that each system has individual concerns and issues that must be recognized.

Using this framework, the Fountain Creek Watershed (HUC 11020003) has been divided into four smaller drainage basins or subwatersheds: Fountain Creek Headwaters (HUC 1102000301), Monument Creek (HUC 1102000302), Colorado Springs Composite (HUC 1102000303), and Lower Fountain Creek (HUC 1102000304). These four subwatersheds are further subdivided into subwatershed basins. Each level of subdivision is based primarily on hydrographic and topographic boundaries corresponding to natural stream and drainage features on the landscape. Tables 3-1 lists the subwatersheds and subwatershed basins for the Fountain Creek Watershed by name, respective HUCs, and approximate drainage area in square miles. This HUC framework is illustrated graphically in Figure 3-1.

A Drainage Basin Planning Study (DBPS) process is used to define major stormwater improvement needs. Each DBPS identifies needed improvements, environmental impacts and estimated costs. Depending upon the location of these improvements they are either the responsibility of the municipality or developer. The Drainage Bain Boundaries for the City of Colorado Springs and El Paso County do not overlap directly with the USGS subwatershed boundaries, as described above. A subwatershed may have one or more DBPSs completed within it depending on the nature of past and proposed development. Appendix D and the References Section of the Plan has a list of the DBPSs.

Table 3-1: Tabulation of the HUC Framework for the Fountain Creek Watershed

Watershed, Subwatershed, and Subwatershed Basin Names	HUC4 [1] (watershed)	HUC5 [1] (subwatershed)	HUC6 [1] (subwatershed basin)	Sq. Miles
Fountain Creek	***11020003***			***927***
Fountain Creek Headwaters		**1102000301**		**118**
Upper Fountain Composite			110200030101	26
Reservoirs Composite			110200030102	18
Manitou Reservoir Composite			110200030103	18
Garden of the Gods Composite			110200030104	39
Ruxton Creek			110200030106	18
Monument Creek		**1102000302**		**228**
North Monument Creek			110200030201	43
Beaver Creek			110200030202	27
Monument Creek Headwaters			110200030203	56
West Monument Creek			110200030204	24
Kettle Creek			110200030205	17
Lower Monument Composite			110200030206	44
Cottonwood Creek			110200030207	18
Colorado Springs Composite		**1102000303**		**324**
Cheyenne Creek			110200030301	25
Colorado Springs Composite			110200030302	45
Upper Little Fountain Creek			110200030303	27
Rock Creek			110200030304	20
Cheyenne Mountain Composite			110200030305	62
Sand Creek			110200030306	59
Jimmy Camp Creek			110200030307	69
Little Fountain Bottom Composite			110200030308	17
Lower Fountain Creek		**1102000304**		**257**
Racetrack Composite			110200030401	41
Sand Creek			110200030402	17
Young Hollow			110200030403	38
Williams Creek			110200030404	50
Pinon Composite			110200030405	53
Steele Hollow			110200030406	18
Bragdon Composite			110200030407	40

[1]HUC4, HUC5, and HUC6 represent the 8, 10, and 12 digit Hydrologic Unit Codes for the subwatersheds within the Fountain Creek Watershed (USGS, 1987).

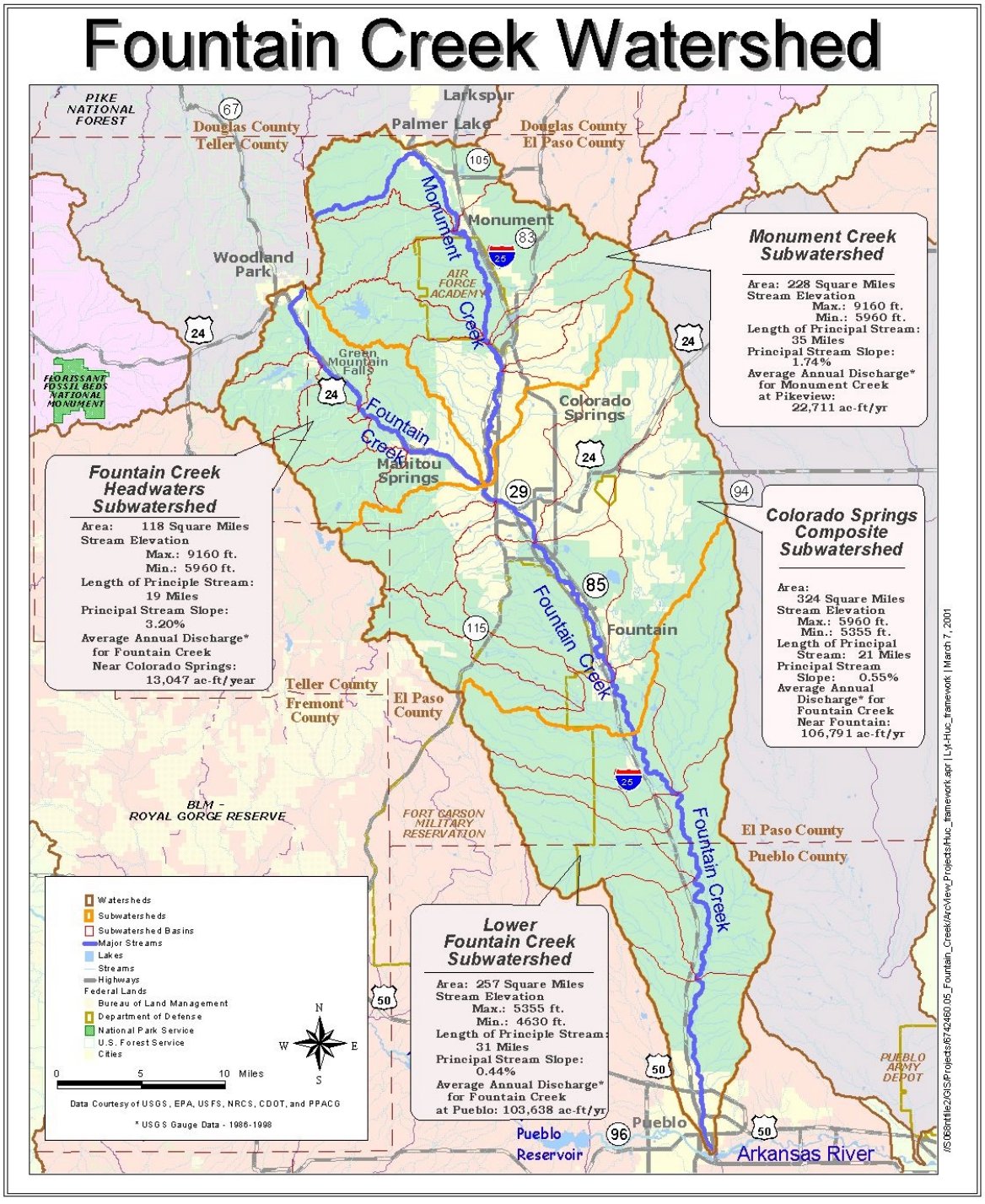

Figure 3-1: Map of the HUC Framework for the Fountain Creek Watershed

3.1.1. Fountain Creek Headwaters

Ute Pass and the north slope of Pikes Peak dominate the Fountain Creek Headwaters subwatershed. This subwatershed extends from the confluence of upper Fountain Creek and Monument Creek in Colorado Springs to its headwater streams in Teller County. The upper segment of Fountain Creek begins in a small catchment west of Woodland Park on the north side of Highway 24. The Towns of Crystola, Green Mountain Falls, Cascade, the City of Manitou Springs, and portions of the Cities of Colorado Springs and Woodland Park lie within this subwatershed.

Fast Facts	
Drainage Area	118 Sq. Miles
Principal Stream Length	19 Miles
Principal Stream Slope	3.2%
Principal Stream Elevation Range	9160 – 5960 ft
Avg. Annual Discharge at Fntn. Crk. Near Colo. Spgs Gage	13,047 ac-ft/yr
1960 – 1999 Avg. Annual Precipitation (Ruxton Park)	24.5 inches

The Pikes Peak Highway and three water supply reservoirs (Crystal, South Catamount and North Catamount) on the north slope of Pikes Peak are also in this subwatershed. Principal tributary streams in this primarily forested subwatershed include Crystal, Catamount, French and Ruxton Creeks. A more detailed characterization of this subwatershed follows in Section 4.1.

3.1.2 Monument Creek

The Monument Creek subwatershed extends from the confluence of Monument Creek and upper Fountain Creek in Colorado Springs to its headwater streams in northern El Paso County at the Palmer Divide. The Towns of Palmer Lake and Monument

Fast Facts	
Drainage Area	228 Sq. Miles
Principal Stream Length	35 Miles
Principal Stream Slope	1.7%
Principal Stream Elevation Range	9160 – 5960 ft
Avg. Annual Discharge at Mnmt. Crk. At Pikeview Gage	22,711 ac-ft/yr
1949 – 1999 Avg. Annual Precipitation (Colo. Spgs. Weather Service Office)	16.4 inches
1966 – 1972, 1976, 1979 – 1981 Avg. Annual Precipitation (Colo. Climate Center)	20.3 in

and a portion of the City of Colorado Springs are in this subwatershed, as are the U.S. Air Force Academy (USAFA) and a portion of Black Forest. Principal tributary streams include Cottonwood, Kettle, Beaver, and West Monument Creeks. Rampart Reservoir and associated water treatment plants are located in the West Monument Creek subwatershed basin. Western and northeastern portions are forested. A more detailed characterization of this subwatershed follows in Section 4.2.

3.1.3 Colorado Springs Composite

The Colorado Springs Composite subwatershed is dominated by the urban area of the City of Colorado Springs. This subwatershed is termed a "composite watershed" because it is composed of a number of smaller urban watersheds that can not be grouped together strictly on topographic or hydrographic bases, but in aggregate represent an area of similar size to the other three subwatersheds.

Fast Facts	
Drainage Area	324 Sq. Miles
Principal Stream Length	21 Miles
Principal Stream Slope	0.55%
Principal Stream Elevation Range	5960 – 5355 ft
Avg. Annual Discharge at Fntn. Crk. Near Fountain Gage	106,791 ac-ft/yr
1949 – 1999 Avg. Annual Precipitation (Colo. Spgs. Weather Service Office)	16.4 inches

The northern boundary of the Colorado Springs Composite subwatershed is made up of the southern boundary of the Ruxton Creek subwatershed basin to the west and the southern boundary of the Cottonwood Creek subwatershed basin to the east. The southern boundary of the Colorado Springs Composite is comprised of the southern boundary of the Little Fountain Creek subwatershed basin to the west and the southern boundary of the Jimmy Camp Creek subwatershed basin to the east. In addition to a significant portion of the City of Colorado Springs, the City of Fountain and the communities of Secuity, Widefield, and Stratmoor Hills are within this subwatershed. While much of this subwatershed is urbanized, the western portion at higher elevations is forested and portions of the eastern and southern areas are used for agricultural purposes. A more detailed characterization of this subwatershed follows in Section 4.3.

3.1.4 Lower Fountain Creek

The Lower Fountain Creek subwatershed extends from its shared northern boundary with the Colorado Springs Composite subwatershed to the mouth of Fountain Creek on the Arkansas River east of Pueblo. The majority of this subwatershed area is used for agricultural purposes including cattle and horse ranching and irrigated feed crops. Principal tributary streams include Sand, Pinon and Williams Creeks. The lower portion of this subwatershed bisects northern and central parts of the City of Pueblo roughly parallel to the Interstate 25 and railway corridors. There are numerous stock tanks and reservoirs in this subwatershed. Calhan Reservoir (on a small tributary to Williams Creek) is the only reservoir of significant size in the basin. A more detailed characterization of this subwatershed follows in Section 4.4.

Fast Facts	
Drainage Area	257 Sq. Miles
Principal Stream Length	31 Miles
Principal Stream Slope	0.44%
Principal Stream Elevation Range	5355 – 4630 ft
Avg. Annual Discharge at Fntn. Crk. At Pueblo Gage	103,638 ac-ft/yr
1955 – 1999 Avg. Annual Precipitation (Pueblo Weather Service Office - Airport)	11.9 inches

3.2 Methodology

Evaluation of the Fountain Creek Watershed has been done for each of the subwatersheds described above and focuses on the following:

- Identification and characterization of watershed problems and issues;
- Characterization and evaluation of channel instability; and
- Evaluation of technical and policy management strategies that can be developed to alleviate or mitigate identified problems and issues.

Channel and watershed characteristics, streambank erosion and deposition, stream channel alignment, infrastructure damage, urbanized development, and agriculture are dealt with separately for each subwatershed, as are evaluation and characterization of stream channel instability, definition and causes of such instability and recommended stabilization

methods. Erosion, sedimentation and flooding issues are prioritized for each subwatershed using the information developed in the characterization and evaluation described above.

4. Characterization of Watershed Problems and Issues

This section summarizes existing data and identifies strategic data gaps in channel and watershed characteristics for the Fountain Creek Watershed. Information on erosion and sedimentation characteristics and on channel stability and alignment is provided in subsections 4.1, 4.2, 4.3, and 4.4. Characterizations in this section are based on Colorado Springs and El Paso County Drainage Basin Planning Studies (DBPS), Federal Emergency Management Agency (FEMA) Flood Insurance Studies, Army Corps of Engineers (ACOE) Floodplain Information Reports, U.S. Geological Survey (USGS) reports and internet data sources, Natural Resource Conservation Service (NRCS) reports, and academic publications. Some fundamental hydrologic features for the Fountain Creek Watershed are provided on Figure 4-1 along with the watershed and subwatershed boundaries.

4.1. Fountain Creek Headwaters Subwatershed

The Fountain Creek Headwaters subwatershed originates in eastern Teller County and extends southeast through Manitou Springs to the confluence of Monument Creek and upper Fountain Creek in Colorado Springs. Some fundamental hydrologic characteristics are provided on Figure 4-2 along with the watershed and subwatershed boundaries. More detailed information about this subwatershed can be obtained from the following Drainage Basin studies:

1. Fountain Creek Drainage Basin Planning Study
2. City of Woodland Park Stormwater Master Plan
3. Camp Creek Drainage Basin Planning Study

4.1.1. Channel and Watershed Characteristics

This subsection describes channel characteristics for the creeks within the Fountain Creek Headwaters subwatershed, including hydrologic, physical, and erosion and sedimentation characteristics.

4.1.1.1. Hydrologic Characteristics

The mainstem of the upper portion of Fountain Creek is perennial through much of the subwatershed, but localized reaches are intermittent in character where transmission losses to sandy streambed sediments exceed low flow rates. Snowmelt,

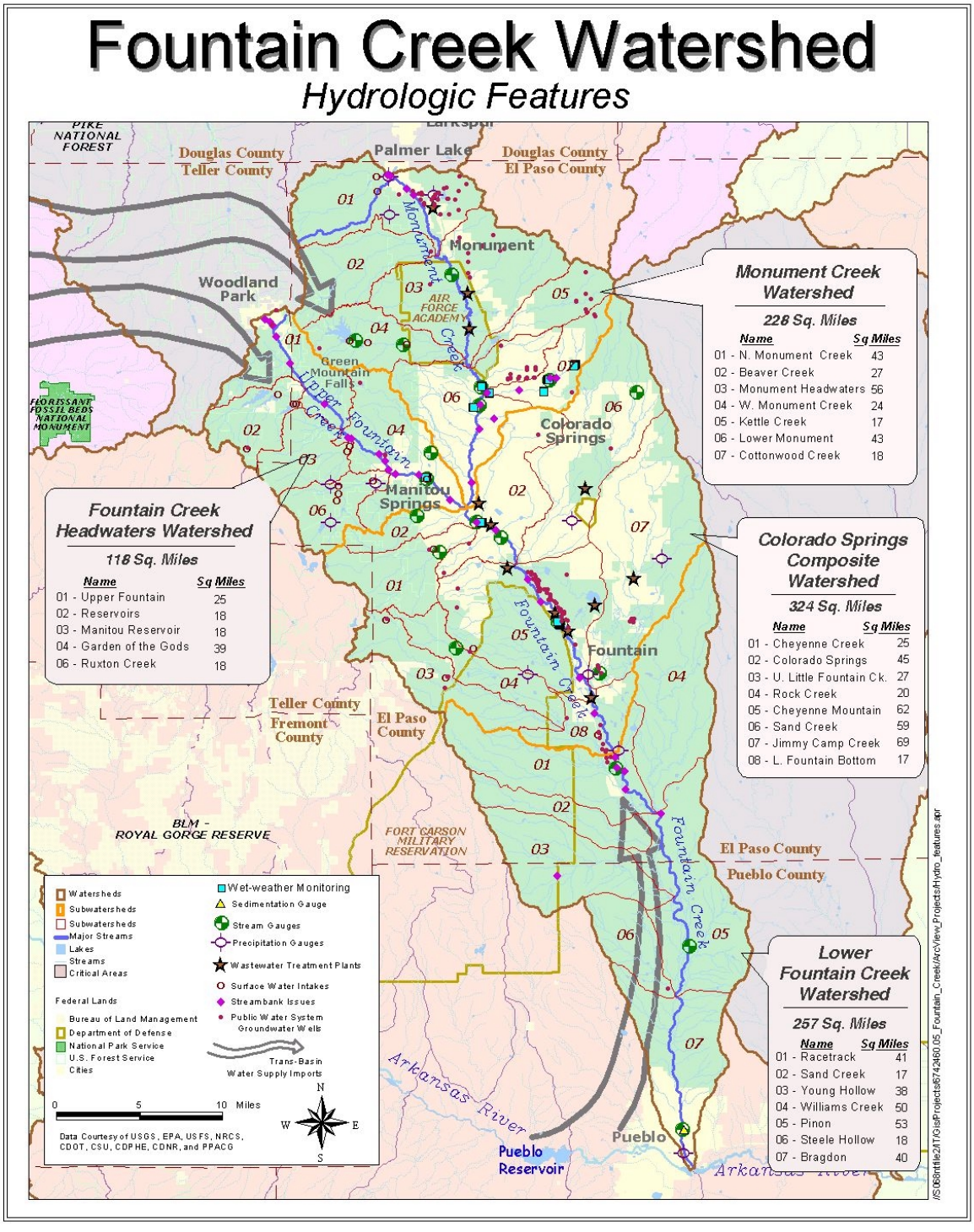

Figure 4-1: Fountain Creek Watershed Hydrologic Features

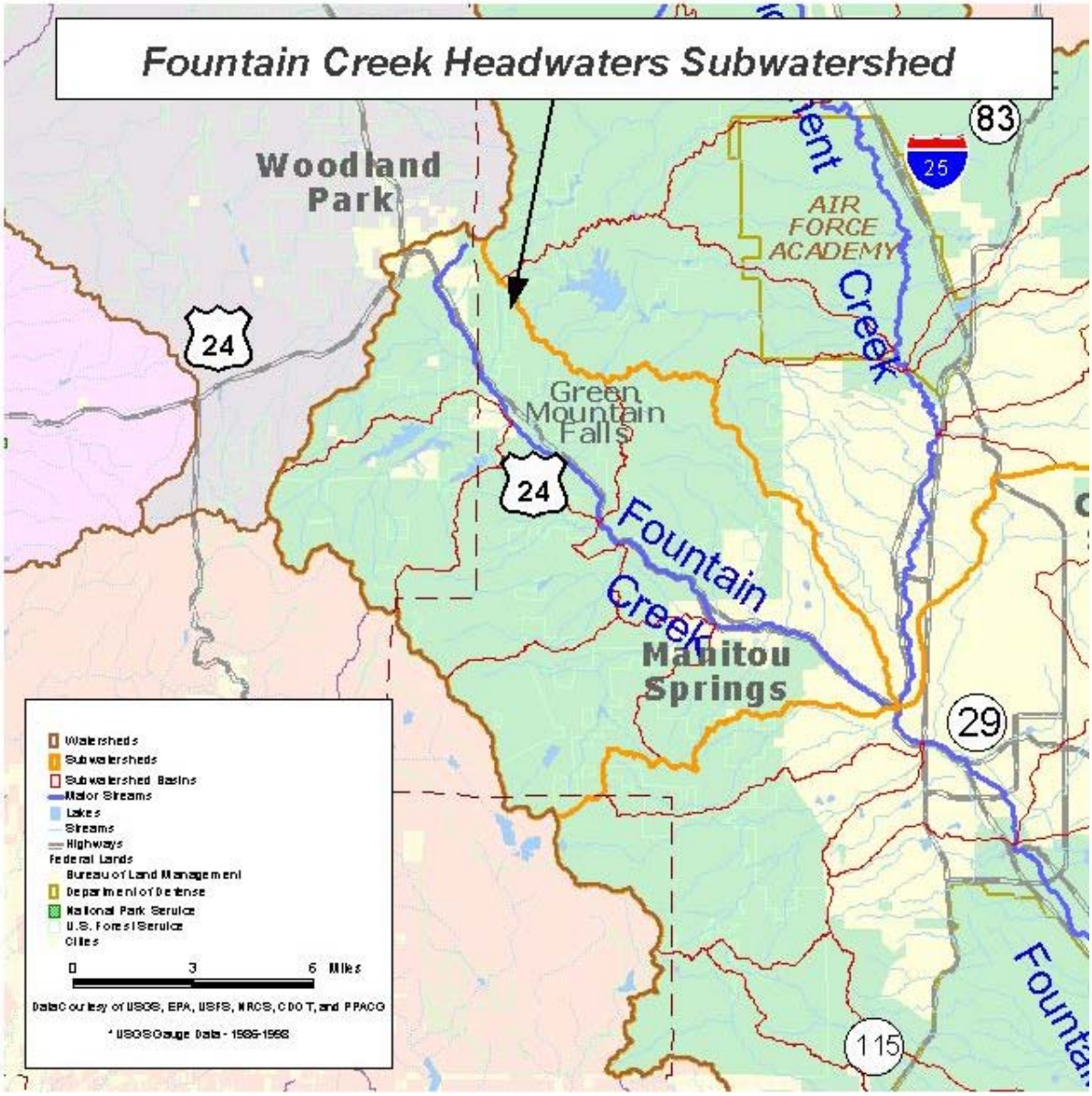

Figure 4-2: Fountain Creek Headwaters Subwatershed

rainfall and springs feed the headwaters. Thunderstorms tend to form and stall on the mountain front where the creek arises, which creates the potential for intense and relatively long lasting, localized storms to settle over the subwatershed. Flash floods may result when these conditions occur in the spring and summer months. Debris flows occur in the steep areas of the subwatershed and may contribute large amounts of sediment in short periods of time. Stream gauge data are summarized in Appendix A.

4.1.1.2. Physical Characteristics

The Fountain Creek Headwaters subwatershed occupies the steep, mountainous valley separating Pikes Peak from the Rampart Range to the north. The Rampart Range is a small range extending southward from the Front Range. Slopes are steep and rocky, with granular soils derived from granite dominating the upper subwatershed area. Gently sloping mesas and ridges are found in the lower subwatershed between the mountain front and the plains to the east. These transitional areas are mantled with colluvial and debris flow deposits with bedrock outcrops protruding through as hogbacks. Elevations range from 14,110 feet at Pikes Peak to 5,960 feet at the confluence with Monument Creek. The stream course follows in a southeastern direction in a narrow, fault-controlled bedrock canyon before exiting the mountain front. The valley widens downstream of Manitou Springs. Forested slopes dominate the upper subwatershed and gradually give way to shrub and grassland areas at lower elevations. Figure 4-3 shows a profile of upper Fountain Creek.

4.1.2. Channel and Watershed Erosion and Sedimentation Characteristics

4.1.2.1 Woodland Park and Teller County

Located high in the subwatershed near the Fountain Creek drainage divide, Woodland Park and Teller County do not have severe flooding problems with the creek. The primary problems are erosion and sedimentation. The erosion problems in the main channel through town were recently solved with channel improvements and installation of hard erosion control measures, including a system of two-tiered boulder structures. Sediment inflows come from tributaries entering the main channel just east of Woodland Park.

Sedimentation problems are evident behind the Safeway grocery store just downstream of Woodland Park. A drop structure just downstream of the Safeway appears to be controlling base level on this reach. Photo 4-1 shows sediment aggradation behind the concrete drop in the channel at this location.

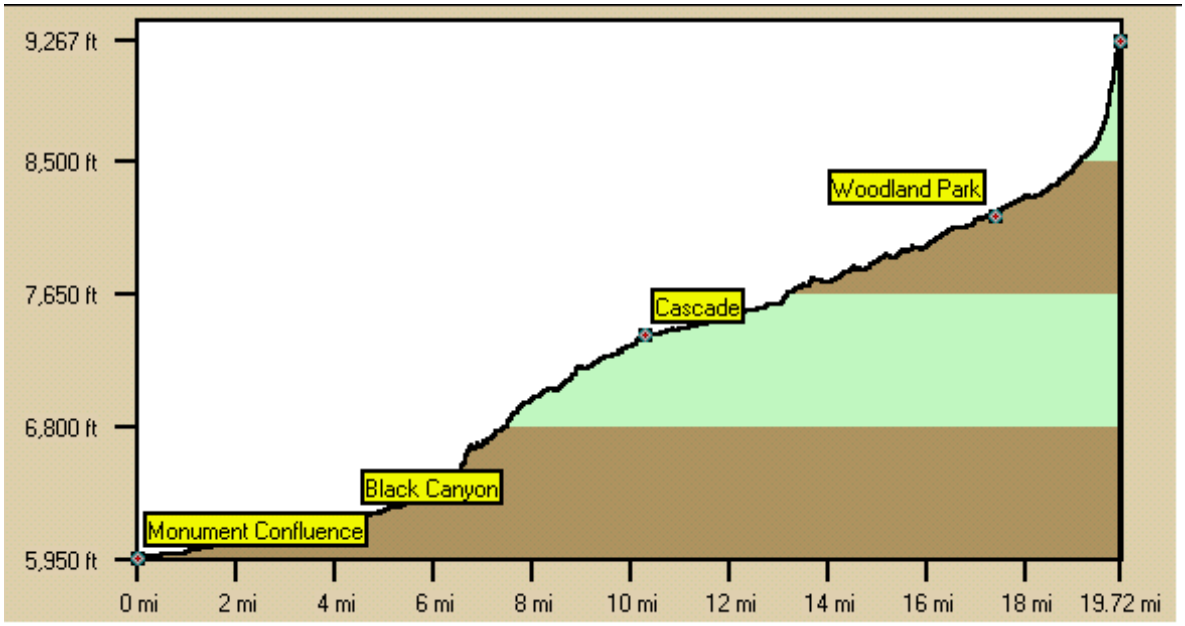

Figure 4-3: Upper Fountain Creek displays a compound channel profile (concave up in the lower area, convex up in mid-reaches from Manitou Springs to Cascade, and concave up again in the headwaters area) indicating a more complex erosional development history of the subwatershed.

Photo 4-1: Sediment in the upper Fountain Creek channel in Woodland Park.

Erosion problems are evident in the stream banks upstream of the Old Crystola Road. This may be the result of confining the channel to the southwest side of the valley and straightening the channel to make more use of the valley floor for a now defunct wastewater treatment plant. Sediment is again a problem further downstream at the Old Crystola Road Bridge where the channel is filled with sediment.

Soils in the region are predominantly decomposed granite. Steep slopes, intense storms and cohesionless soils generate sediment from roadsides and other unprotected areas, as well as in portions of the upper Fountain Creek channel. Photos 4-2, 4-3 and 4-4 show a view of the channel downstream of the Old Crystola Road Bridge.

4.1.2.2. Green Mountain Falls and Teller County

Loss of channel conveyance capacity due to sedimentation appears to be a problem in Teller County, in the stream reaches immediately downstream of Woodland Park as seen in Photo 4-4. After the stream becomes confined in bedrock a few miles downstream and passes through small on-stream reservoirs, sediment problems are not evident until reaching Manitou Springs. Minor problems are occasionally experienced in this reach.

4.1.2.3. Manitou Springs

Problems with Fountain Creek in Manitou Springs are mostly chronic in nature and generally related to the limited conveyance of the narrowly confined channel. Sediment and flooding are the main problems, most recently occurring in 1999 and 2000. Photo 4-5 shows a view during the 1999 flood.

Although vegetation generally provides a measure of bank stability, some of this flooding is probably a result of trees and vegetation gradually encroaching on the Fountain Creek channel to a point where conveyance capacity of the main channel is decreased. High waters have flooded some property bordering the creek in the past. High stream flows are responsible for gradual undercutting of some bank areas in town, and a few wall structures associated with buildings have also been undercut by eroding stream banks. The channel is concrete lined on the west end of town. Sedimentation and the reduction of channel capacity have been a problem in this reach.

Photo 4-2: Realignment of upper Fountain Creek channel has pushed the channel to the southwest side of the valley, causing bank erosion downstream of Woodland Park.

Photo 4-3: Bank erosion caused by channel manipulation downstream of Woodland Park.

Photo 4-4: Channel sediment aggrading in the channel below the bridge connecting to the Old Crystola Road downstream of Woodland Park.

Photo 4-5: Flooding of Manitou Springs streets during the floods of 1999.

Williams Canyon contributes a high amount of sediment to Fountain Creek because it is underlain by granitic bedrock that weathers to a grussic or granular texture, which is easily eroded. Whether sediment from Williams Canyon is natural or is being exacerbated by development activities that disturb easily eroded soils is unknown at this time.

4.1.2.4. Colorado Springs

The gradient of Fountain Creek flattens below Manitou Springs. For the most part, development along this reach is fairly old and the channel grade is relatively stable. One exception is the crossing under 21st Street, where recent channel improvements (Photo 4-6) were necessary to stabilize the grade and repair severe damage that resulted from the 1999 flood.

Photo 4-6: Fountain Creek improvements near 21st Street.

Further downstream near the confluence, the channel passes near the tailing deposits of a former gold milling site, and the channel is constrained between the tailings site and Highway 24. Some bank erosion and instability are evident along this reach (Photo 4-7). The channel gradient is fairly low between this point and the confluence. The Highway 24 road embankment and other development constrains the floodplain. The mobile home park located in the floodplain has

experienced numerous flooding events, including the 1999 flood**.** Improvements are planned for the near future.

Observations suggest that, while showing clear examples of high sediment contributions to the system, the Fountain Creek headwaters generally display considerably less bedload sediment transport than the Monument Creek portion of the watershed.

Photo 4-7: Erosion in the bank of Fountain Creek upstream of the Monument Creek confluence.

4.1.3. Stream Channel Alignment

Channel alignment along most of upper Fountain Creek has not changed greatly in the recent past because most of the channel is formed in bedrock. As the channel gradient flattens and the valley widens below Manitou Springs, manipulation of the channel has historically occurred over much of the reach down to the confluence with Monument Creek. Remains of past mining practices and road construction are two of the main causes for channel realignment east of Manitou Springs.

In the reach from Woodland Park to Cascade, channelization has confined the headwaters portion of the creek as it flows through Woodland Park. Downstream of Woodland Park near the connecting bridge to Old Crystola Road, the channel has been rerouted to the

southwest margin of the valley to allow use of the floodplain, thus causing bank erosion as discussed above.

In the reach from Cascade to Manitou Springs, upper Fountain Creek is confined to a channel between the two lanes of Highway 24. Although this course approximates the original channel, the road embankments and riprap now constrain the channel to a narrower width. In the City of Manitou Springs, channelization and structures in the floodplain have straightened and confined the channel.

4.1.4. Infrastructure

Water, wastewater, gas and electric facilities cross the stream corridor along with roads and bridges in the floodplain. There are more than 30 jurisdictional dams within the upper subwatershed (Muller, 1994). A jurisdictional dam is a dam that creates a reservoir with a capacity of more than 100 acre-feet or a reservoir with a surface area in excess of 20 acres at the high-water line.

4.1.5. Urban Development

Urban development continues to occur within the subwatershed, but much of the urbanization of the areas adjacent to Fountain Creek is well established. Some buildings and homes may be adjacent to or encroach upon the 100-year floodplain in the eastern portion of the subwatershed, but most have been in these locations for many years. The primary concern with respect to urbanization is the constriction of channel conveyance capacities as vegetation matures and blocks the floodway. Additionally, urbanization increases the amount of impervious surface area. Proper management strategies must be utilized to mitigate those effects.

4.1.6. Agriculture

Agriculture is not a primary land use in this part of the subwatershed. Minor agricultural areas are found in streamside areas in the upper half of the subwatershed. Generally, these areas are not adversely impacted by Fountain Creek, but there are several point locations where significant erosion has occurred.

4.1.7. Ranking and Prioritization of Watershed Problems and Issues

The following prioritization is based upon the judgment and opinions of stakeholders and representatives of public agencies within the subwatershed. In the upper subwatershed

(the Ute Pass area) the issues may be ranked as 1) erosion, 2) sedimentation and 3) flooding. Further downstream, but still in the upper subwatershed, the ranking changes to 1) sedimentation, 2) erosion and 3) flooding. At the base (the lower subwatershed through Manitou Springs and the west side of Colorado Springs) the issues may be ranked as 1) flooding, 2) erosion and 3) sedimentation.

The individual stream segments within this subwatershed that have been identified as currently or potentially having problems are shown in Table 4-1. Each of these stream reach segments will be investigated as part of the Army Corps of Engineers Watershed Study. The modeling analysis that is conducted will be determined based on the priority assigned (1 being the highest) and the Problems/Issues identified. This list will also be used to determine the priority for doing additional critical reach analysis. The priority assigned to the reaches in Table 4-1 was based on a review of the problems/issues, potential infrastructure problems, stability class rating and other Reports. Specific infrastructure problems/issues along with a stability class rating have also been identified for Monument and Fountain Creeks and are listed in Appendix E.

Table 4.1: Fountain Creek Headwaters Subwatershed Stream Segments

Priority	Reach	From	To	Length (miles)	Problems/Issues
Fountain Creek Headwaters					
2	W Fountain	Woodland Park - Sheridan Ave	Crystola	2.7	localized areas of erosion and sedimentation
3	W Fountain	Crystola	Manitou U/S	2.0	constrained channel
2	W Fountain	Manitou U/S	Manitou D/S	2.5	Flooding; constrained and inadequate conveyance capacity
2	W Fountain	Manitou D/S	Monument Confl	4.0	Erosion and flooding potential; constrained and inadequate conveyance capacity (channel & bridges); sediment conveyance from U/S areas
1	Sutherland Creek/Subtrib. to Crystal Park	Fountain Confl	U/S of Crystal Park	3.8	Erosion and sedimentation
2	Camp Crk	Chambers Way	Fountain Confl	1.4	Flooding

4.2 Monument Creek Subwatershed

The Monument Creek subwatershed originates along the northern border of El Paso County and continues south through the Tri-Lakes and northern Colorado Springs areas to the confluence of Monument Creek and upper Fountain Creek in Colorado Springs. Fundamental hydrologic features are provided on Figure 4-4, along with the watershed and subwatershed boundaries. More detailed information about this subwatershed can be obtained from the following Drainage Basin Planning Studies:

1. Black Squirrel Creek Drainage Basin Planning Studies
2. Black Forest Drainage Basin Planning Studies
3. Middle Tributary Drainage Basin Planning Studies
4. Monument Creek Drainage Basin Planning Studies (Vol. I of III)
5. Monument Branch Drainage Basin Planning Studies
6. Cottonwood Creek Drainage Basin Planning Study
7. Fountain Creek Drainage Basin Planning Study
8. Pine Creek Drainage Basin Planning Study
9. Douglas Creek Drainage Basin Planning Study
10. Dry Creek Drainage Basin Planning Study
11. Smith Creek Drainage Basin Planning Study

4.2.1 Channel and Watershed Characteristics

This subsection describes channel characteristics for Monument Creek and its major tributaries within the Monument Creek subwatershed. This includes hydrologic, physical, and erosion and sedimentation characteristics.

4.2.1.1. Hydrologic Characteristics

Monument Creek is a perennial stream originating in the Rampart Range, which forms the foothills of the main crest of the Rockies to the west of Colorado Springs. It flows eastward into the Piedmont area and then turns southward and flows along the valley bordering the east side of the Rockies until it joins Fountain Creek on the southern side of Colorado Springs.

Several of the main tributaries are perennial, including Kettle Creek and Cottonwood Creek. Conversations with local residents revealed that in the past, Kettle Creek used to dry up during the drier months of the year; it now flows year-round. Cottonwood

Creek also flows year-round, but with the substantial urbanization of the basin it is reasonable to assume that return flows bolster the baseflow rates above what existed naturally in this drainage. It is slightly smaller in drainage area than the Kettle Creek basin and it is possible that Cottonwood Creek also used to stop flowing during drier months. Stream gauge data are summarized in Appendix A.

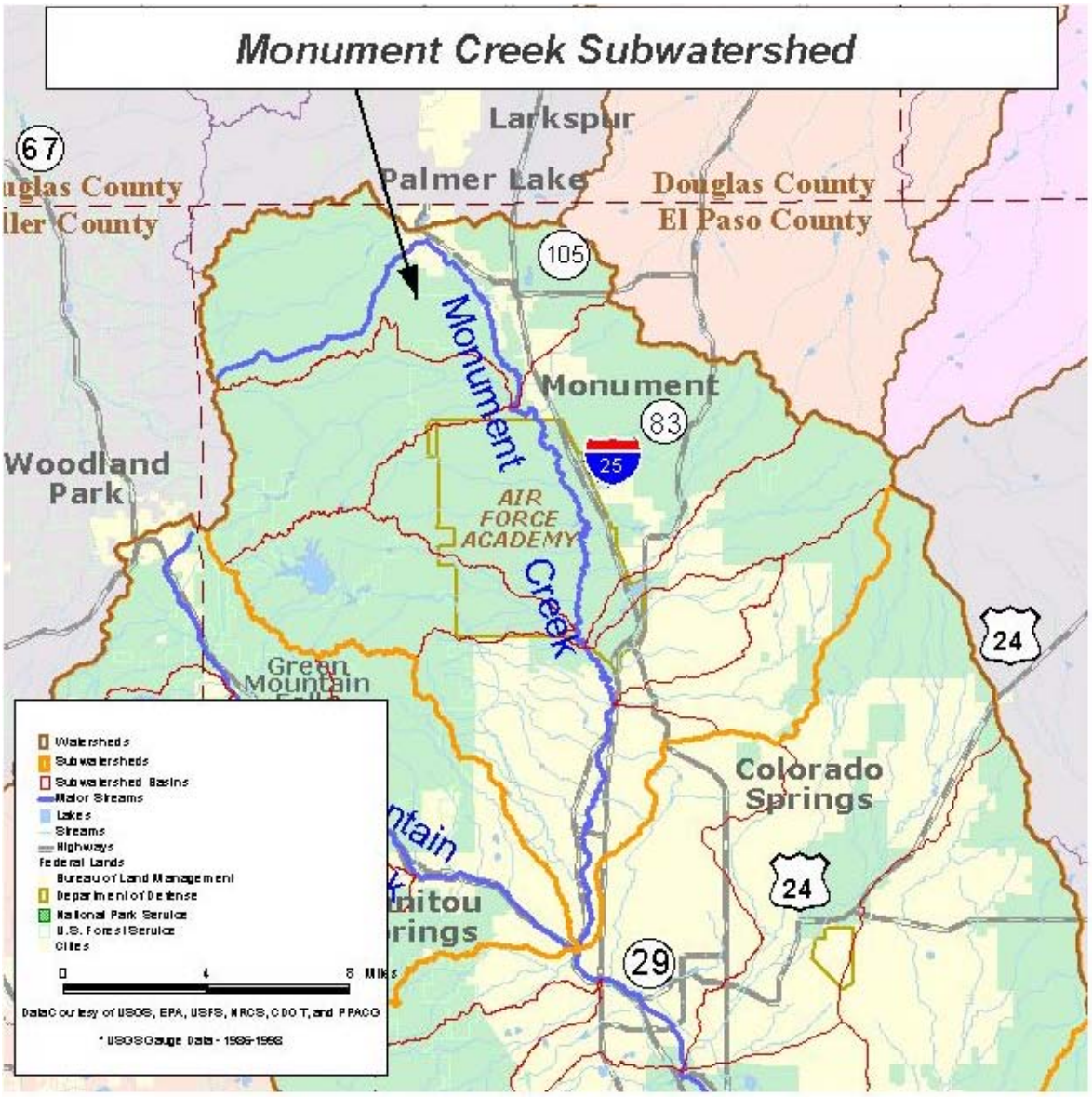

Figure 4-4: Monument Creek Subwatershed

4.2.1.2. Physical Characteristics

The Monument Creek subwatershed is bounded on the west by the Rampart Range and to the north and east by Palmer Ridge. Most of the subwatershed is located in the Piedmont valley bordering the east side of the Rockies. While slopes on the mountain front are quite steep, the majority of the basin is comprised of moderately sloping hills. Pine forests cover the mountain hillslopes and the higher elevations of the northeastern parts of the basin in the Black Forest area. Soils in the watershed have moderately low runoff potential (52% Group B soils) that corresponds with the granular soils formed on granite in the mountains and upland soils formed on sandy, tertiary alluvial deposits. High runoff potential soils (32% Group D soils) are the other major type and correspond with soils formed on Pierre Shale and rock outcrops. Figures 4-5 and 4-6 show profiles of Monument and Cottonwood Creeks.

4.2.2 Channel and Watershed Erosion and Sedimentation Characteristics

The Monument Creek channel upstream of Woodmen Road is relatively undisturbed. The channel meanders in a well-formed floodplain for much of the mainstem length below Monument Reservoir. Pool and riffle sequences are common in the upper reaches of Monument Creek. Some short reaches near the Town of Monument are plugged with beaver dams, creating a chain of small lakes and wetlands in the upper half of the main channel (Photo 4-8). Erosion problems are generally limited to bank cutting around beaver dams, as seen in the Photo 4-8.

Flooding in 1999 caused some problems in the area of Monument Lake, some of which have been repaired. The most prominent erosion problems after the 1999 flood include bank and sewer line erosion and damage at the wastewater treatment plant and spillway damage at Monument Lake. Flooding damage also occurred at Palmer Lake. Overall, problems with the stream channel in the reaches above the Air Force Academy are generally minor and the channel retains a somewhat undeveloped and natural appearance. Between the Air Force Academy and Woodmen Road the channel is still fairly natural; however, some development and encroachment into the floodway fringe continues to occur.

Encroaching development may create future problems in this area. For example, Photo 4-9 shows Monument Creek passing a new motel development. The floodplain is being filled to provide parking lot space. Such encroachment restricts floodway fringe areas and increases the 100-year base flood elevation within acceptable limits. The floodway fringe includes the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than one foot at any point (Federal Emergency Management Agency, 1986; Flood Insurance Study, El Paso County, CO). However, it should also be noted that development in the floodway fringe is allowed subject to approval of a floodplain permit. The fill appears to be encroaching on the floodway and could possibly create backwater pooling effects upstream, thus raising the 100-year flood level.

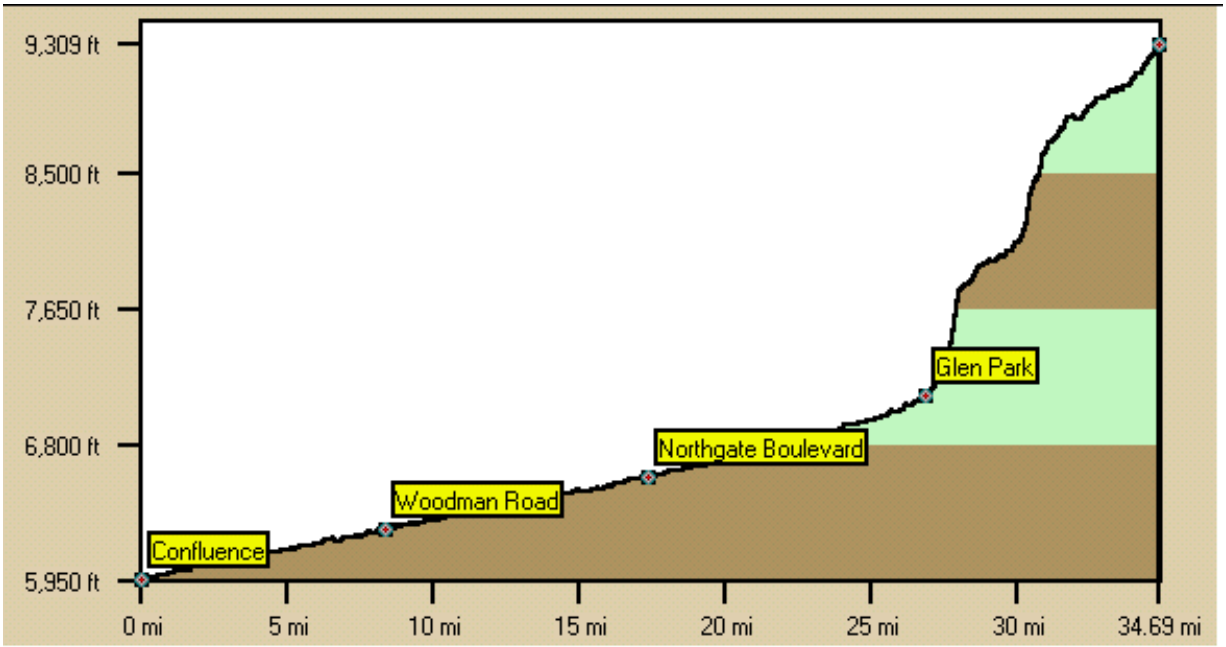

Figure 4-5: The Monument Creek channel profile shows a nearly uniform slope until reaching the foothills area near Glen Park, where it becomes complex in geometry.

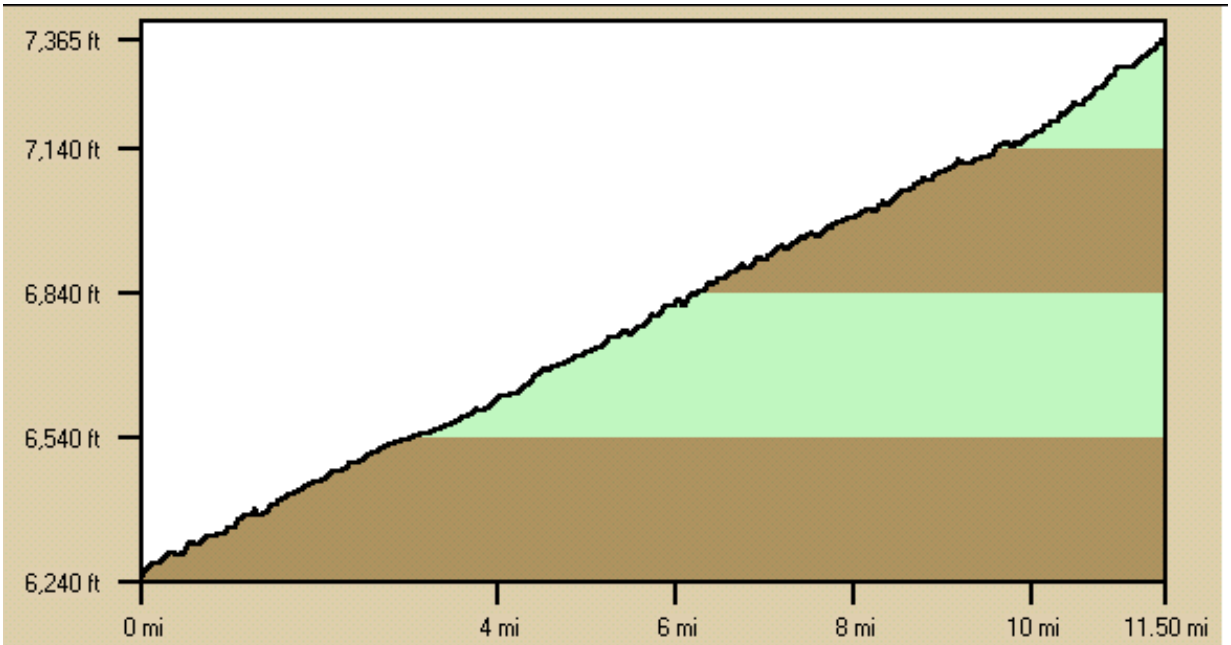

Figure 4-6: The Cottonwood Creek channel profile is somewhat unusual. Although the profile covers the full length of the subwatershed basin, it displays very little indication of convexity or concavity. The steep overall slope of the channel is indicative of the erosion potential that exists in this area.

Photo 4-8: Beaver dams are common on upper Monument Creek near Monument. The channel and riparian areas appear to be in good condition.

The channel of Monument Creek has been altered considerably downstream of Woodmen Road. The floodplain is constrained in numerous reaches by fill, dikes and structures built to maximize the development of floodplain space. Concrete, rock bed and bank controls have been installed at numerous locations to retard erosion as well. Trapezoidal channel cross-sections are located throughout the reach below Woodmen Road (Photo 4-10). Locations of structural controls include:

- A bridge and concrete channel lining constructed at Woodmen Road Crossing;
- Numerous concrete check structures below Woodmen Road down to the confluence with Fountain Creek (see Photo 4-11); and
- Reservoir/Pond located downstream of Woodmen Road.

Photo 4-9: Fill placement in the Monument Creek floodplain at a new motel development in north Colorado Springs restricts channel flow capacity.

Photo 4-10: Concrete channel lining at the Woodmen Road Bridge provides bank protection and restricts the floodplain width.

Over the past several years several significant drainage and erosion problems have occurred in several reaches along Cottonwood Creek. The channel is degrading and there are bank erosion problems in the lower half of the subwatershed. Storms in the summer of 2001 eroded the banks of Cottonwood Creek at the Epernay Apartments just upstream of Union Boulevard (Photo 4-12). At this location, the channel is constrained as a result of placement of earth fill and construction of a dike when the apartments were constructed. Flooding has also damaged a drop structure and caused channel degradation just downstream of Academy Boulevard where concrete and riprap channel lining and abutment protection have been placed. (Photo 4-13). New drop structures in the form of grouted riprap have been installed downstream of Union Boulevard (Photo 4-14).

Photo 4-11: Old concrete check structures in the lower Monument Creek channel are ineffective and have been damaged as a result of channel changes and flooding. Newer grouted riffle drop structures seen in Photo 4 – 14 have replaced the concrete check structures.

Photo 4-12: An intense thunderstorm during the summer of 2001 caused bank erosion damage on Cottonwood Creek at the Epernay Apartments.

Photo 4-13: Channel bed degradation on Cottonwood Creek downstream of Academy Boulevard. Riprap has been placed in attempts to control erosion.

4.2.3. Stream Channel Alignment

The Monument Creek channel alignment generally follows the original course above Woodmen Road. The majority of the floodplain is unconstrained and natural, except where the Monument Reservoir and dam occupy the channel near the Town of Monument. Below Woodmen Road, the channel has been altered greatly with structural controls, and the floodplain is constrained and very limited in its capacity to convey and attenuate floodwaters.

Eight new drop or riffle structures were installed in 2001 on the lowest reach between Fontanero and Cimarron Streets (Photo 4-15). These drop structures do not address all of the stream channel problems on Monument Creek in Colorado Springs, and represent the first of three phases that will implement portions of the Monument Creek Drainage Basin Planning Study. An additional series of eight drop structures are planned for construction between the Bijou Street and Woodmen Road bridges.

Photo 4-14: A new boulder drop structure to control channel degradation on Cottonwood Creek downstream of Union Boulevard.

Photo 4-15: One of the boulder drop structures recently constructed on lower Monument Creek in Colorado Springs.

4.2.3.1 Critical Reach Analysis

Monument Critical Reach

The Monument Creek critical reach that was investigated is located between Palmer Lake and Monument Lake. The area immediately adjacent to the channel has experienced substantial development over the last several decades, and there is concern about how this might affect the stability of the stream reach.

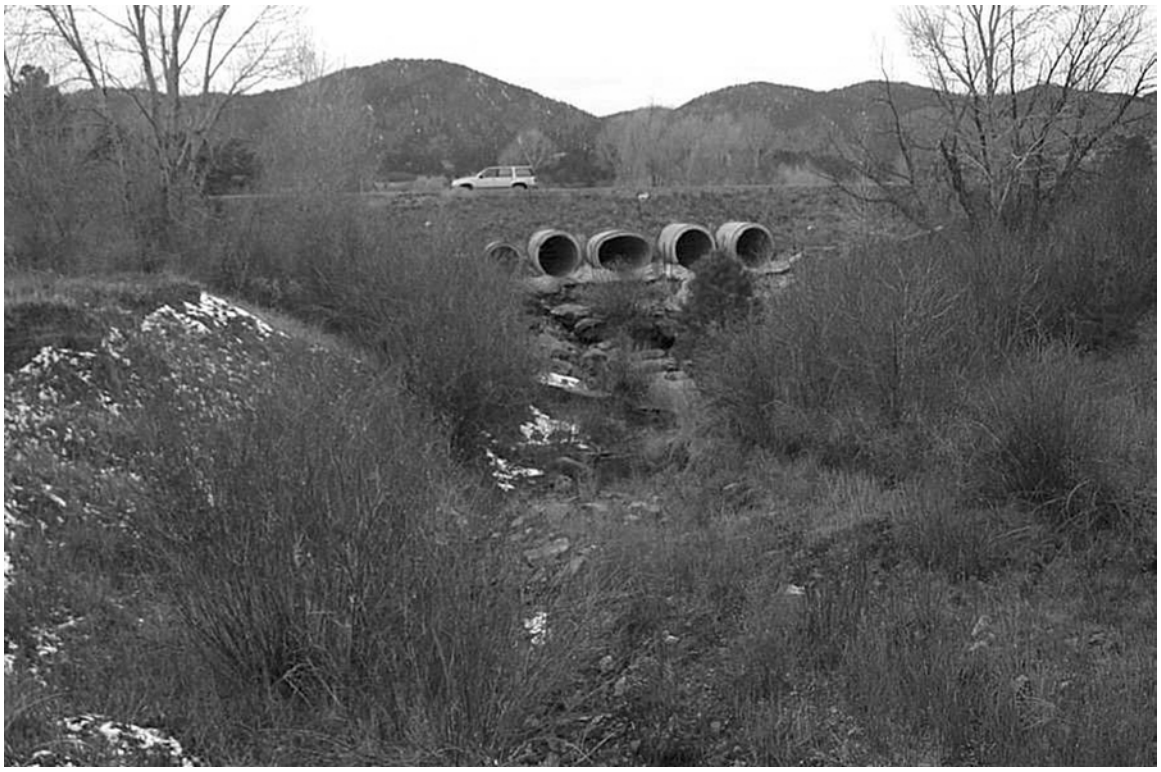

Photo 4-16 An upstream view of Red Rock Ranch Drive and the Monument Creek channel immediately downstream of the stream underpass. The channel has degraded 15 to 20 feet below the original rechannelized grade.

The channel morphology has changed considerably from 1955 to the present. In 1955, the critical reach was a sandy braided stream with a relatively wide meander belt, but it is now mostly a gravel-bed stream with the channel confined to a narrower width by deep incision or artificial channelization. This has greatly reduced the width of the meander belt. Most of the changes in the critical reach are due to land use changes and manipulation of the channel by construction activities. In the lower half of the critical reach, problems from sediment aggradation have occurred as recently as 1999, and are

caused by sediment pulses from the upstream incision that have progressed down the channel. There is considerable sediment accumulation, beginning at Monument Lake and extending in a 3,000 foot wedge upstream. Other problem areas along this critical reach that were identified and should be monitored include upstream of Oxbridge Road, at Oxbridge Road, and downstream of Red Rocks Ranch Drive.

Black Forest Tributary

The Black Forest tributary is a small tributary to Monument Creek. Development upstream of this critical reach has occurred over the past 10 years and there is concern about how this might affect the geomorphologic changes of the reach. The Black Forest channel is narrow and the active floodplain is mostly confined to areas immediately adjacent to the active channel. The channel is confined to a small valley; therefore, a meander belt is difficult to distinguish. Also, the map scale and the resolution limitations of aerial photography preclude the delineation of active channel margins for GIS mapping. Temporal differences were extremely difficult to distinguish using GIS.

Photo 4-17: Channel degradation in the upper middle portion of the Black Forest reach. The channel appears to be healing and is relatively stable. Downcutting may be due to sustained stream flow in the channel, which was originally ephemeral. Stream flow comes from seepage from the upstream reservoir.

Analysis indicated that in 1955 the stream was ephemeral, but presently there is a low rate of constant stream flow, which has resulted in increased riparian vegetation. Most of the channel changes have been associated with construction of stock ponds and small reservoirs. Several of these stock ponds have breached, causing sediment to fill in behind the pond dams, which has created local instability in the channel segment downstream of the dams. There has also been a substantial increase in roads, houses and parking lots along this reach between 1955 and 1999.

Cottonwood Creek

The Cottonwood Creek critical reach extends from the Union Boulevard bridge downstream to the I-25 bridge. This reach used to be an ephemeral sand bed channel contained within low banks, but it is now a perennial stream channel that has incised in many places as much as 25 feet and is now down to bedrock.

A comparison of the aerial photos show that the watershed was generally undeveloped in 1955, but is now at maximum development in areas adjacent to the critical reach. This has caused changes in the watershed hydrology. Sediment is now transported at base flow and engineered check structures have been built to control the base level of the channel.

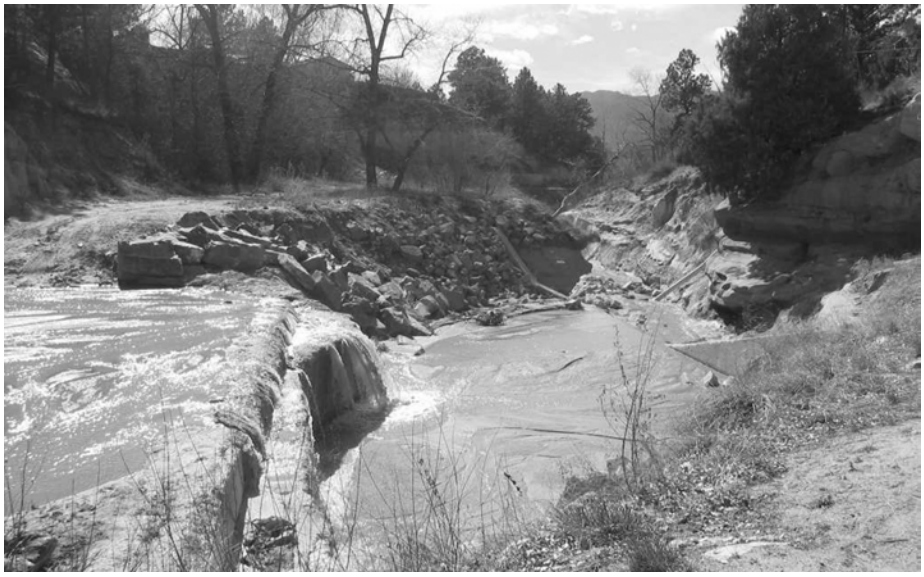

Photo 4-18: Two relatively old drop structures control channel degradation on Cottonwood Creek midway between Academy Boulevard and I-25. The concrete drop in the foreground encases a pipeline. Both drops show signs of undercutting of the bedrock on which they are founded. Enhancement of these structures may be needed to prevent failure and massive erosion of the upstream channel.

GIS analysis showed that the channel length has not changed greatly over the years, which reflects the vertical rather than horizontal movement that has prevented the channel from meandering. As such, sinuosity has remained constant in Cottonwood Creek since 1955. In contrast, the measure of unstable banks and the active channel area categories have changed considerably. Unstable banks are difficult to define from aerial photographs, but the trend toward less incision in 2001 reflects that much of the channel is now incised in bedrock and excessive erosion is reduced in these areas. The active channel area was much larger in 1955 because the stream used to be wide and sandy, and infrequent floods would spread over a wide area. Because the channel has incised down to bedrock, the amount of incision and scour has been reduced.

4.2.4. Infrastructure

Infrastructure in the Monument Creek subwatershed, as with the Fountain Creek Headwaters, includes numerous water, wastewater, gas, electric and transportation facilities crossing the stream corridor. This includes:

- Massive erosion of the creek bed and over topping of Greeley and Monument Creek banks.
- Erosion of road side ditches and over topping of Epworth Highway, Shady Lane and Douglas surfaces.
- Flooding along several side streets, including Hwy 2015.
- Rupture of a sewer line near Palmer Lake.

In the 1990s, the State dam inspector declared the Monument Lake dam unfit and required the dam to be repaired or breached. In addition, Monument Lake dam spillway was overtopped by 5 feet during the 1999 flood. In 2000, the State Legislature gave possession of the lake parts to the Town of Monument. El Paso County agreed to give the dam to the town and financial assistance with repairs. El Paso County and the Town of Monument have made the necessary repairs to the dam and the Town of Monument is now in possession of the lake.

4.2.5. Urban Development

Urban development is proceeding at a rapid pace in the northern Colorado Springs area. The Floodplain Administrator of the Pikes Peak Regional Building Department reviews urban encroachment; however, numerous conflicts still exist. The most recent flooding on Cottonwood Creek in July 2001 caused severe erosion at an apartment complex immediately upstream of Union Boulevard. Construction of the apartment complex further constricted the Cottonwood Creek floodplain. Flood flows took out several hundred feet of riprap bank protection, several trees, water lines, backed up storm culverts and eroded the bank up to the apartment complex parking lot.

4.2.6. Agriculture

Agricultural land uses (primarily cattle ranching and horse grazing) are common in the Monument Creek subwatershed. These land uses are not affected to a great extent by erosion, sedimentation or flooding in the Monument Creek channel, except for some small, localized areas. Suburban residential development is supplanting agricultural uses in many areas.

4.2.7. Ranking and Prioritization of Watershed Problems and Issues

The following prioritization is based upon the judgment and opinions of stakeholders and representatives of public agencies within the subwatershed. In the upper subwatershed through the Tri-Lakes area and the reach through the Air Force Academy property, the issues may be ranked as 1) erosion, 2) sedimentation and 3) flooding. Further downstream through the northern and central Colorado Springs reach, the ranking changes to 1) erosion, 2) flooding and 3) sedimentation.

The individual stream segments within this subwatershed that have been identified as having current or potential problems are shown in Table 4-2. Each of these stream reach segments will be investigated as part of the Army Corps of Engineers Watershed Study. Modeling analysis will be determined based on the priority assigned (1 being the highest) and the problems and issues identified. This list will also be used to determine the priority for additional critical reach analysis. The priority assigned to the reaches in Table 4-2 is based on a review of the problems and issues, potential infrastructure problems, stability class rating (Appendix E) and other reports.

Table 4-2: Monument Creek Headwaters Stream Segments

Priority	Reach	From	To	Length (miles)	Problems/Issues
	Monument Creek Headwaters				
2	Monument Crk	Palmer Lake U/S	USAFA N. boundary	7.3	Erosion and flooding potential; sediment conveyance from U/S areas
2	Monument Crk	USAFA S. boundary	Fountain Confl	10.2	Erosion and flooding potential; constrained and inadequate conveyance capacity; sediment conveyance from U/S areas
1	Cottonwood Crk-mainstem	Black Forest Road	Monument Confl	8.0	Erosion and sedimentation; apparent significant sediment load; detailed cross section monitoring available
3	Dry Crk (El Paso Co)	Carlson Dr	Monument Confl	0.0	Hydrology only
3	N. Douglas Crk	Centennial Dr	Monument Confl	0.0	Hydrology only
2	S. Douglas Crk	Centennial Blvd	Monument Confl	1.4	Flooding, erosion and channel stability
3	Templeton Gap	Austin Bluffs	Monument Confl	0.0	Perched water table/saturated flood control channel
2	Dirty Woman Crk	I-25	Monument Confl	1.1	Erosion and flooding potential in urbanizing area
1	Teachout Crk	Higby Rd	Monument Confl	2.1	Erosion and sedimentation in urbanizing area
1	Jackson Crk	Jackson Crk Parkway	Monument Confl	1.4	Erosion and sedimentation in urbanizing area
1	Black Forest Tributary	Gleneagle Detention Pond	Monument Confl	1.2	Erosion and sedimentation in urbanizing area
1	Smith Crk	Northgate Rd	Monument Confl	1.0	Erosion and sedimentation in urbanizing area
1	Monument Branch	S. trib./S. branch	Monument Confl	3.4	Erosion and sedimentation in urbanizing area
1	Middle Tributary	S. trib./N. branch	Monument Confl	2.4	Erosion and sedimentation in urbanizing area
1	Black Squirrel Crk	3200' U/S of Hwy 83	Monument Confl	4.6	Erosion and sedimentation in urbanizing area
1	Elkhorn (Ford Fairlane Tech. Park)	USAFA E boundary	Monument Confl	1.2	Erosion and sedimentation from U/S urbanizing area
2	Pine Crk	Academy Blvd	Monument Confl	1.3	Erosion and channel stability

4.3 Colorado Springs Composite Subwatershed

The Colorado Springs Composite subwatershed is comprised of natural tributary streams and several urbanized drainages in and around the incorporated Colorado Springs city limits. Its principal drainage is the mainstem of Fountain Creek, which originates at the confluence of Monument Creek and upper Fountain Creek. Fundamental hydrologic features are provided on Figure 4-7, along with the watershed and subwatershed boundaries. More detailed information about this subwatershed can be obtained from the following Drainage Basin Planning Studies:

1. Bear Creek Drainage Basin Planning Study
2. Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study
3. Fishers Canyon Drainage Basin Planning Study
4. Windmill Gulch Drainage Basin Planning Study
5. Engineering Study and Revision of the North Shooks Run Templeton Gap Drainage Basin Planning Study
6. Fountain Creek Drainage Basin Planning Study
7. Shooks Run Drainage Basin Planning Study (Vol. I-III)
8. Sand Creek Drainage Basin Planning Study
9. Peterson Field Drainage Basin Master Plan Update
10. Jimmy Camp Creek Master Drainage Planning Study

4.3.1 Channel and Watershed Characteristics

This subsection describes channel characteristics for Fountain Creek and its major tributaries within the Colorado Springs Composite subwatershed. This includes hydrologic, physical, and erosion and sedimentation characteristics.

4.3.1.1 Hydrologic Characteristics

Fountain Creek is perennial with average flow rates in recent years approaching 95 cfs at the Security gauging station. Baseflow is currently made up of discharge water from upstream treatment plants, return flow from lawn watering and other urban uses, and the slow release of water from detention facilities in upstream communities. Aerial photographs from 1955 show areas of the stream channel were dry during July of that year. Local residents' experience suggests this was once a common

occurrence, but recent stream flow records indicate the flow is typically continuous and greater than 100 cfs. Stream gauge data are summarized in Appendix A.

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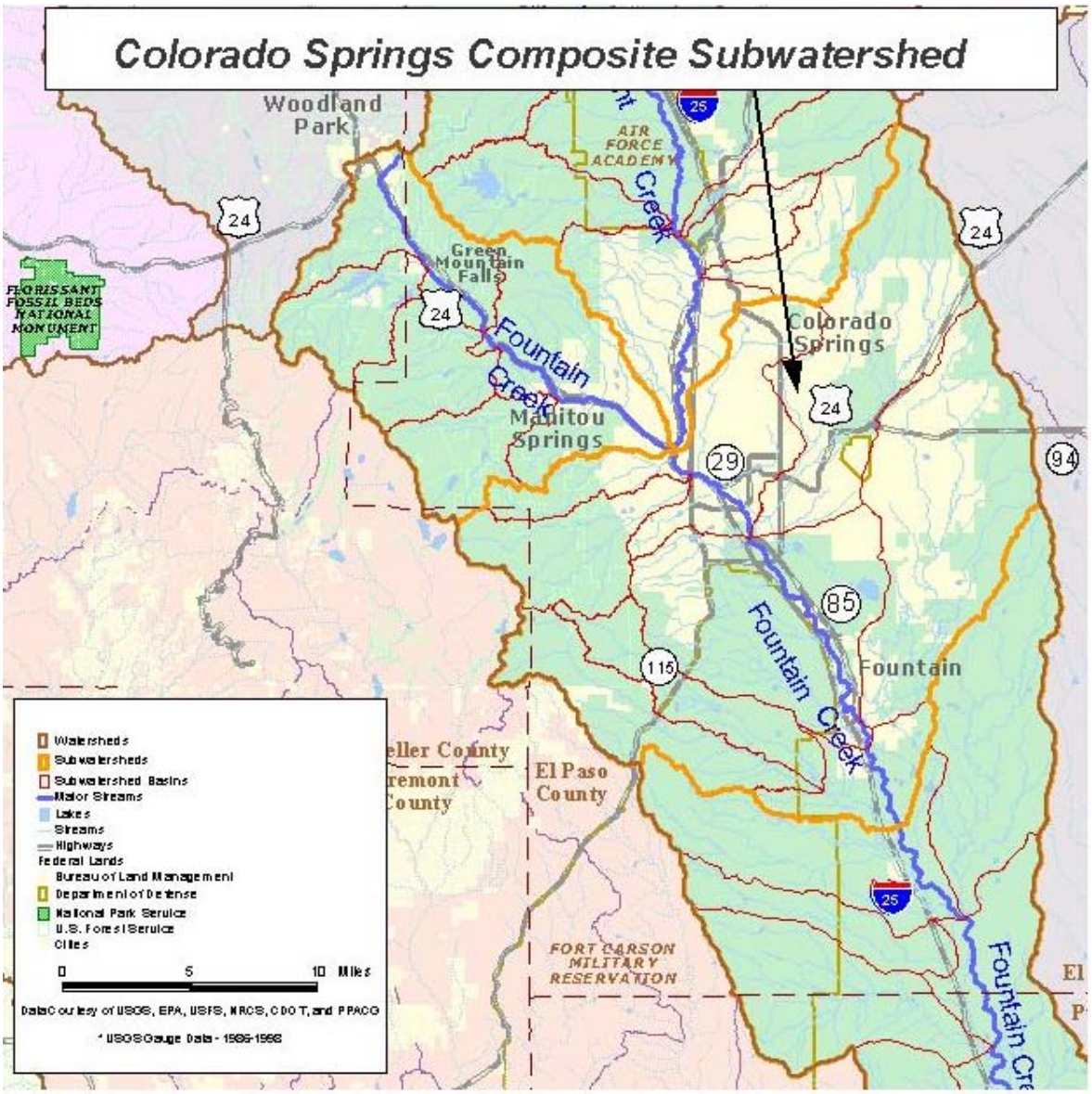


Figure 4-7. Colorado Springs Composite Subwatershed

4.3.1.2 Physical Characteristics

Streams in this area of the subwatershed drain the foothills and steep terrain surrounding Cheyenne Mountain to the west, and the low rolling Piedmont hills on the east and west side of Fountain Creek. Monument Creek and Fountain Creek join at the upstream end of this subwatershed. The stream is sand and gravel bedded with a wide meandering channel below the confluence to the downstream end of the subwatershed.

The upper portion of the original Shooks Run tributary basin flows into the Templeton Gap Floodway; therefore, it is diverted into Monument Creek subwatershed. (For simplicity it is not delineated separately on watershed maps for this project). The Templeton Gap Floodway (Photo 4-19) was constructed to relieve flooding in the older Colorado Springs neighborhoods located in the lower part of Shooks Run. Further development since the construction of the Floodway has again exacerbated drainage problems in the lower part of this drainage basin. Figures 4-8 and 4-9 show profiles of Fountain and Jimmy Camp Creeks through this subwatershed.

Photo 4-19: The Templeton Gap Floodway diverts storm runoff from the upper Shooks Run drainage to Monument Creek to relieve flooding problems.

4.3.2 Channel and Watershed Erosion and Sedimentation Characteristics

Stream bank erosion and channel degradation are the primary problems in the metropolitan Colorado Springs area. Active channel problems in the subwatershed are numerous on Sand Creek and Shooks Run. Erosion damage occurs on a chronic and acute basis that requires continual repair and maintenance. Additionally, funds are not available to address all of the problems associated with storm and flood runoff in the Fountain Creek Watershed system. Sediment is produced in large quantities from several tributaries to Monument Creek, but the sediment is generally transported downstream without causing problems in this subwatershed.

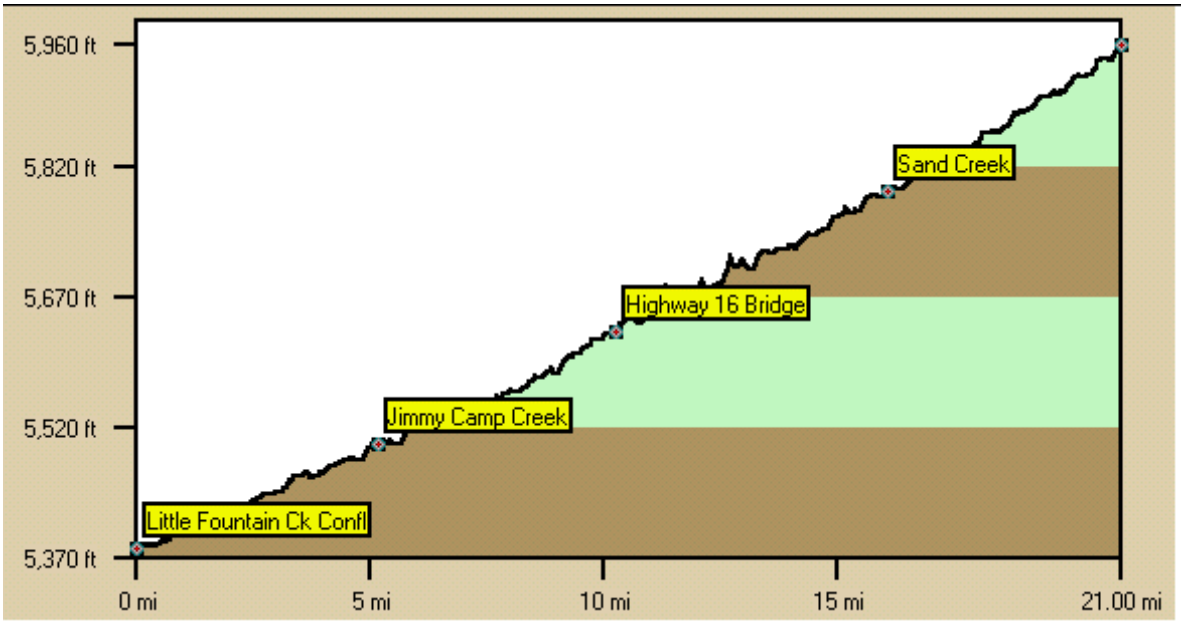


Figure 4-8: The channel profile of Fountain Creek through the Colorado Springs Composite subwatershed is somewhat irregular, but it shows the overall constant slope with slight convex upward concavity as one moves upstream.

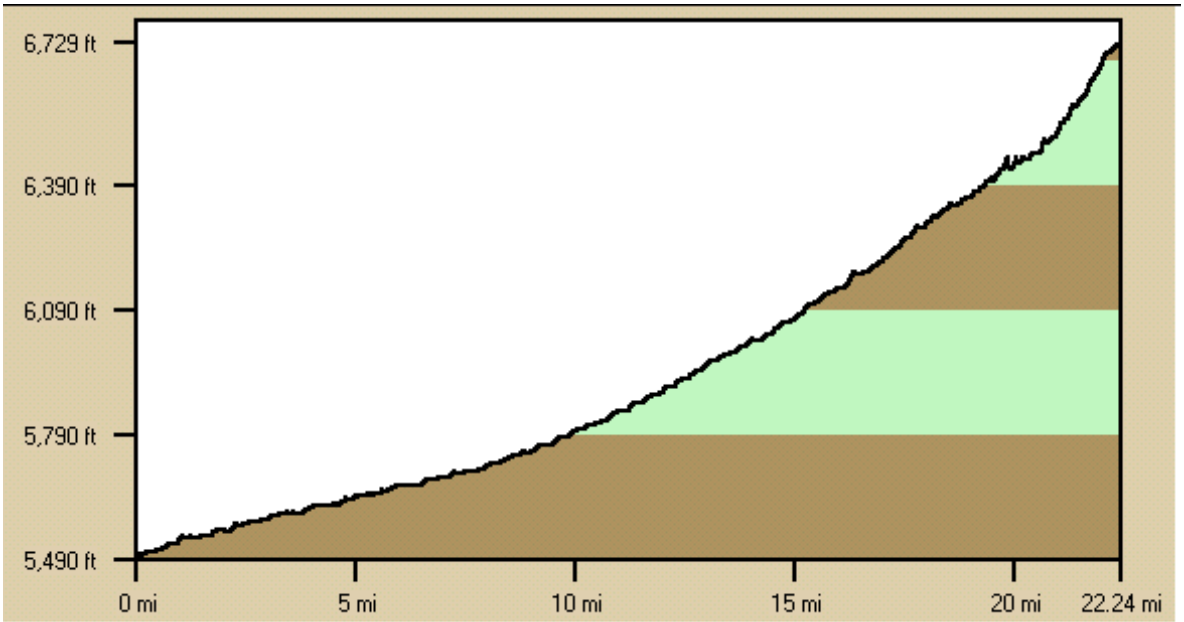


Figure 4-9: The channel profile of Jimmy Camp Creek shows the prominent concave upward geometry that is expected in small drainage basins formed in softer sedimentary bedrock.

Problems on Fountain Creek include the degradation of channel grade. Control and bank protection structures are impacted by downstream channel degradation. In this subwatershed erosion is causing many bridge abutments and infrastructure crossings in this subwatershed to be at risk. Sand Creek has several ongoing problems, mostly involving erosion. Colorado Springs Utilities (CSU) has multiple projects in progress or planned to remedy problems on Sand Creek and Shooks Run.

The City of Colorado Springs is monitoring a series of cross-sections on various streams, which provide a record of temporal change in erosion and sedimentation for each of these locations. Figure 4-10 shows an example of how stormflow has caused considerable erosion at a representative cross-section on Fountain Creek. Figure 4-11 shows the location of the cross-section survey locations. The cross-section data show that degradation of the channel bed is the general trend of sand bed streams in the Colorado Springs area. The channel bed has been stabilized with grade control, which has slowed or stopped channel degradation in some locations; other locations will require additional stabilization projects to remedy existing and developing problems. Further analysis of the cross-section data, as well as a re-survey of cross-sections originally established on Fountain Creek by the USGS in 1985 (Guerard, 1985) could establish long term trends in channel bed change.

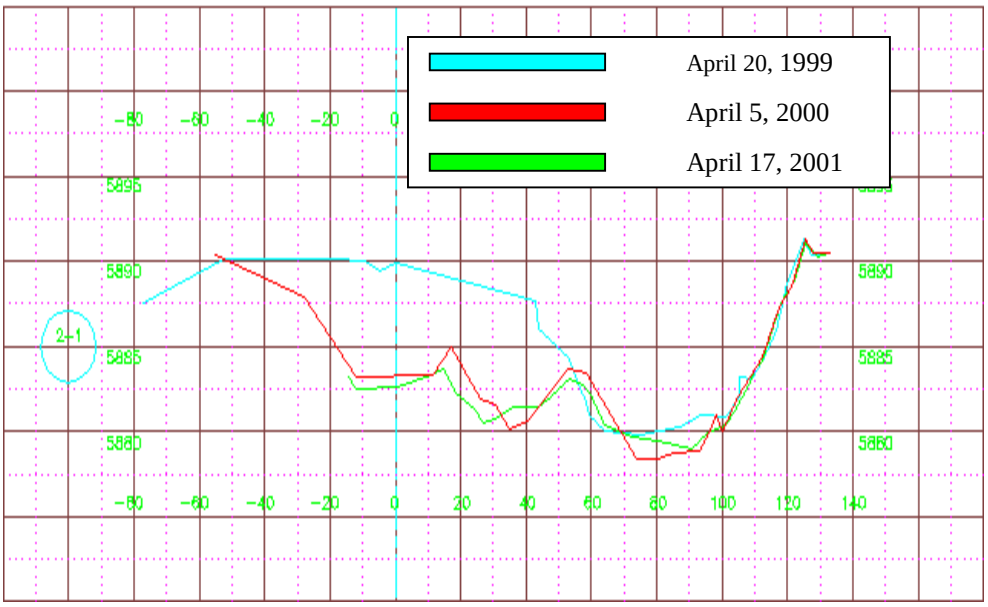


Figure 4-10: A representative cross-section at the Fountain Creek at Nevada site for April 1999, April 2000, and April 2001. The 2001 and 2002 lines show how the creek dropped by about 8 feet (5890 to 5882) in sections due to erosion that resulted from the 1999 flood.

Problems associated with Fountain Creek downstream of the City of Colorado Springs mostly involve stream bank erosion. Several of the main problems include:

- Bank erosion at the KOA campground (Photo 4-20)
- Bank erosion causing major loss of ranch land upstream of Old Pueblo Road (Photo 4-21)
- Bank erosion near the City of Fountain causing loss of land
- Bank erosion in the City of Fountain threatening structures (Photo 4-22)
- Bank erosion at the Frost Ranch causing major loss of land
- Bank erosion at the Clear Spring Ranch (formerly known as Hanna Ranch) causing major loss of land and threatening structures

Table 4-1 shows the average cut and fill values for the survey stations shown in Figure 4-11 at different cross-sections from 1998 to 2000.

Table 4-3: Average cut and fill values for various survey stations at different cross-sections from 1998 to 2000.

STATION	AVG. CUT (sq. ft.)	AVG. FILL (sq. ft.)
Cottonwood Creek at North Cowpoke	6.21	4.60
Cottonwood Creek at Rangewood	11.26	13.74
Cottonwood Creek at South Cowpoke	4.11	1.98
Cottonwood Creek at Mouth at Vincent	9.41	6.96
Cottonwood Creek at Woodmen	10.65	8.13
North Rockrimmon at Delmonico	5.23	4.24
Fountain Creek at Security	49.59	23.84
Fountain Creek at 33rd Street	5.14	5.15
Fountain Creek at Nevada	70.71	22.59
Monument Creek at Woodmen	10.97	7.52

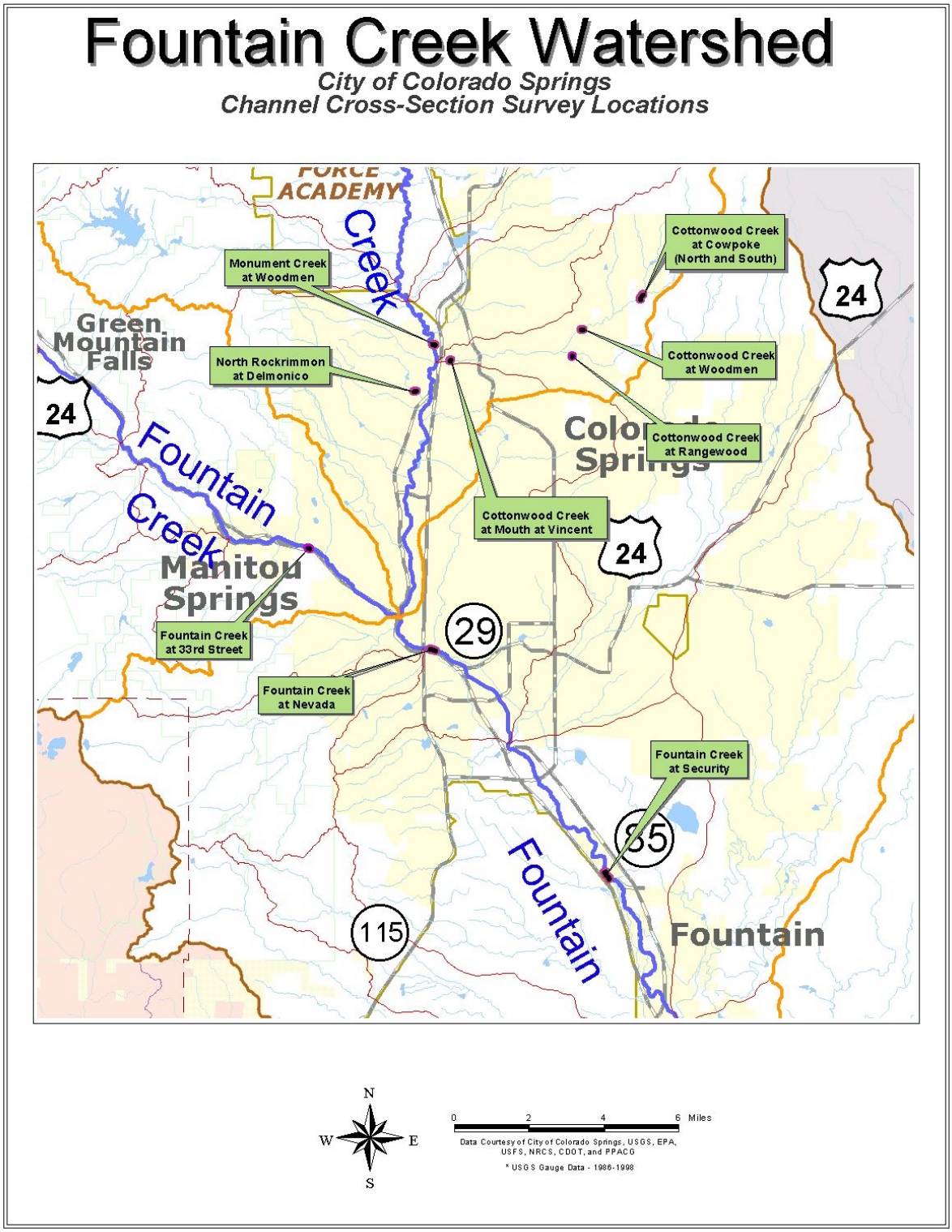


Figure 4-11: City of Colorado Springs Cross-Section Survey Sites.

Photo 4-20: Erosion of the Fountain Creek bank during the flood of 1999 adjacent to the KOA campground.

Photo 4-21: Meander migration and erosion of the outside stream bank of Fountain Creek upstream of the Old Pueblo Highway Bridge is causing loss of agricultural land.

Photo 4-22: Streambank erosion encroaching on homes on the banks of Fountain Creek in the City of Fountain.

4.3.3 Stream Channel Alignment

Hard drop controls and erosion protection structures have been constructed to control the stream channel alignment through the City of Colorado Springs below the confluence of Fountain and Monument Creeks. In many areas the floodplain is constrained by filling and dikes that are used to protect buildings and structures in the floodplain. While the channel is conveying extensive sediment, erosion and down-cutting in the main channel are the major problems.

The channel is mostly unconstrained and the floodplain is largely intact below the intersection of Highway 24 and I-25. Some down-cutting of the channel probably reduces the effectiveness of the floodplain, and more flood flow is conveyed within the main channel.

4.3.3.1 Critical Reach Analysis

Jimmy Camp Creek

The Jimmy Camp Creek critical reach begins at Fontaine Boulevard and continues downstream for about 1.7 miles. Residential development is occurring in the watershed, but at present, most of the land is still rural and dominated by agriculture. Further

development will increase base flows and could cause channel and bank stability problems.

Photo 4-23: A view looking downstream on Jimmy Camp Creek at the pedestrian bridge where the upper end of berms confine stream flow in Jimmy Camp Creek to a narrow corridor, leaving the floodplain mostly cut off from the channel.

The Jimmy Camp Creek critical reach has not changed dramatically since 1955 in comparison with other tributaries to Fountain Creek in the Colorado Springs area. A major meander cutoff and some minor channel changes have caused channel shortening and minor changes in sinuosity. A reduction in the unstable and eroding banks and active channel area can be attributed to channel shortening and increased stream corridor vegetation.

Channel corridor vegetation density has increased since 1955, but the reason for the change is not clear. Control of prairie fire and increases in shallow groundwater levels

due to upland irrigation may be factors in increasing vegetation. Otherwise, channel geomorphology does not show dramatic changes in regard to human influences, other than channelization in certain sections. Study results indicate several locations where the channel is outside of the 100-year floodplain. This shows that the regulatory floodplain does not always accurately reflect the geomorphic changes in the creek.

4.3.4 Infrastructure

Infrastructure in the Colorado Springs Composite subwatershed, like the Fountain and Monument Creek Headwaters subwatersheds, includes numerous water, wastewater, gas, electric and transportation facilities crossing the stream corridor. During the 1999 flood non-potable irrigation water lines, the foundations of power poles, and the banks abutting road and railways were eroded. Appendix E provides a listing of the major infrastructure locations.

4.3.5 Urban Development

Some of the older parts of Colorado Springs (such as the lower part of Shooks Run) were developed early in the City's history. Recent development has caused renewed drainage problems in some of these older areas, while drainages such as Sand Creek are locations of completely new development. New development has created a new set of drainage issues in Sand Creek similar to those issues discussed for Cottonwood Creek in the Monument Creek subwatershed. The City of Fountain and Security and Widefield are also experiencing significant suburban growth; some of which is considered in the DBPSs listed in Section 4.3.

4.3.6 Agriculture

Agriculture is not a primary land use in most of this subwatershed. Some landowners near the City of Fountain and in areas bordering Jimmy Camp Creek have experienced flooding and the loss of land due to bank erosion.

4.3.7 Ranking and Prioritization of Watershed Problems and Issues

The following prioritization is based upon the judgment and opinions of stakeholders and representatives of public agencies within the subwatershed. Throughout the subwatershed, both in the urbanized Colorado Springs and Fountain reaches as well as through rural, southern El Paso County, the issues may be ranked as 1) erosion, 2) flooding and 3) sedimentation.

The individual stream segments within this subwatershed that have been identified as currently or potentially having problems are shown in Table 4-4. Each of these stream reach segments will be investigated as part of the Army Corps of Engineers Watershed Study. The modeling analysis that is conducted will be determined based on the priority assigned (1 being the highest) and the problems and issues identified. This list will also be used to determine the priority for additional critical reach analysis. The priority assigned to the reaches in Table 4-3 as based on a review of the problems and issues, potential infrastructure problems, stability class rating and other reports. Specific infrastructure problems and issues along with a stability class rating have also been identified for Monument and Fountain Creeks and are listed in Appendix E.

Table 4.4: Colorado Springs Composite Stream Segments

Priority	Reach	From	To	Length (miles)	Problems/Issues
	Colorado Springs Composite				
2	Fountain	Monument Confl	Sand Crk Confl	4.7	Flooding and erosion; channel stability/ migration
2	Fountain	Sand Crk	Jimmy Camp Confl	8.8	Flooding and erosion; channel stability/ migration
2	Shooks Run	LaSalle St./RR tracks	Fountain Confl	4.2	Flooding in old urban area
1	Sand Crk (C.Spgs)- mainstem	Headwaters (U/S CSU map.)	Fountain Confl	15.3	Erosion and sedimentation
1	E Fork Sand Crk - mainstem	Headwaters (U/S CSU map.)	Sand Crk Confl	13.2	Erosion and sedimentation in urban area
1	Jimmy Camp Creek - mainstem	near Fontaine Blvd.	Fountain Confl	8.5	Erosion, sediment and flooding in urban area; City of Fountain beginning basin study
3	Cheyenne Crk	City Limits	Fountain Confl	0.0	Deleted due to Section 205
3	Little Fountain	SW of Butts airfield at Ft. Carson	Fountain Confl near Near Nixon Plant	0.0	Erosion and sedimentation contribution from Ft. Carson to downstream. No detailed sediment analysis; use normal sediment modeling analysis
2	Peterson Field	Hancock Expressway	Sand Crk Confl	2.2	Erosion and sedimentation

4.4 Lower Fountain Creek Subwatershed

The Lower Fountain Creek subwatershed is comprised of natural tributary streams and several composite drainages in southern El Paso County and Pueblo County. Its principle drainage is the mainstem of Fountain Creek originating at the northern confluence of Monument Creek and upper Fountain Creek in Colorado Springs. Fundamental hydrologic characteristics are provided on Figure 4-12 along with the watershed and subwatershed boundaries. More detailed information about this watershed can be obtained from the Little Johnson/Security Creek Drainage Basin study.

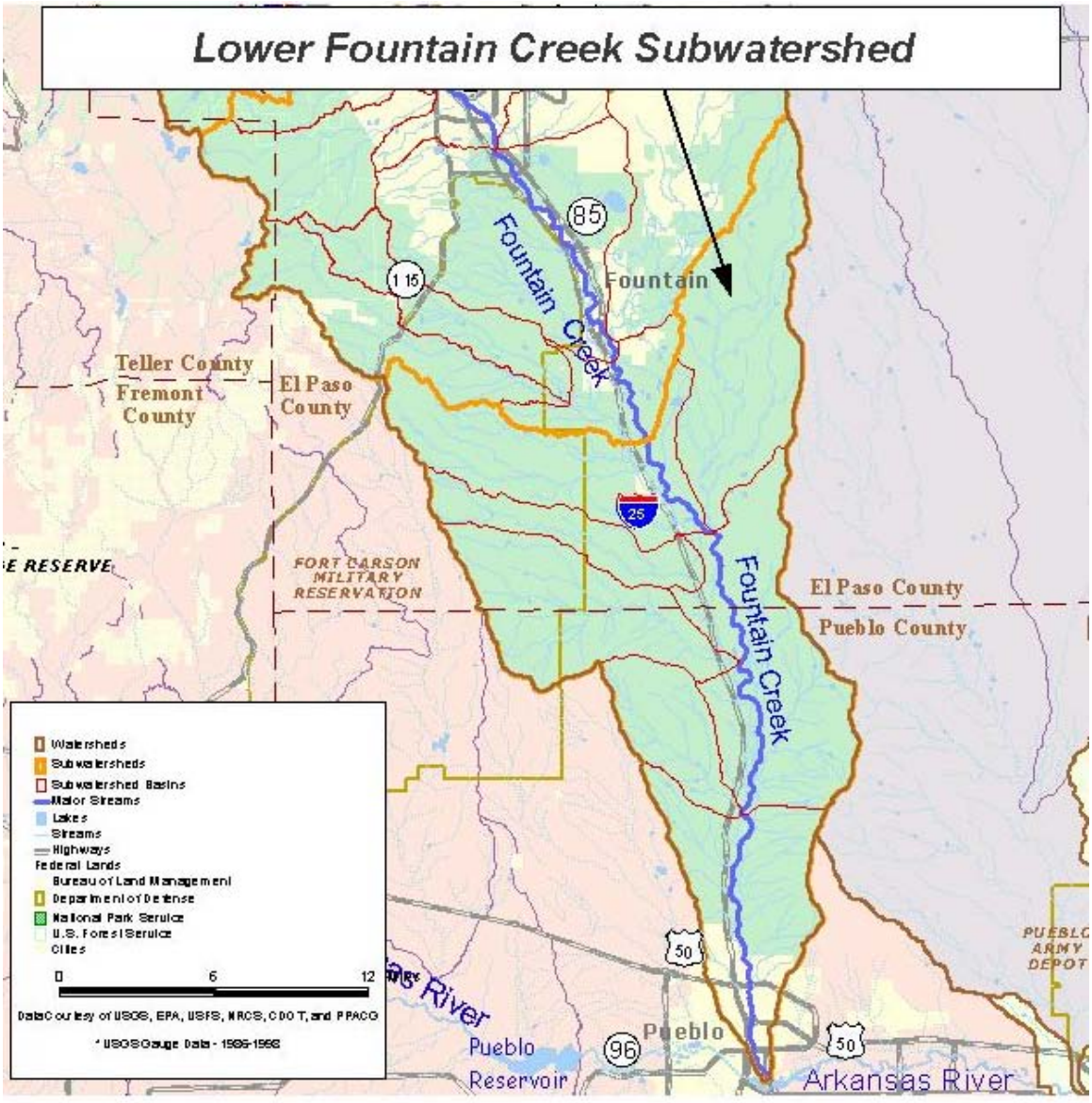


Figure 4-12: Lower Fountain Creek Subwatershed

4.4.1 Channel and Watershed Characteristics

This subsection describes channel characteristics for Fountain Creek and its major tributaries within the Lower Fountain Creek subwatershed. This includes hydrologic, physical, and erosion and sedimentation characteristics.

4.4.1.1 Hydrologic Characteristics

Fountain Creek is perennial with annual average flow rates in recent years in excess of 200 cfs at the Pueblo gauging station. Baseflow is currently made up of upstream treatment plant discharges, return flow from upstream lawn and farm irrigation and other sources. Aerial photographs from 1955 show that areas of the Fountain Creek stream channel were dry in this part of the watershed during July of that year. Apparently, this was once a common occurrence; stream baseflow is now continuous. Stream gauge data are summarized in Appendix A.

4.4.1.2 Physical Characteristics

The subwatershed is dominated by low rolling hills, and most of the tributaries to Fountain Creek are ephemeral. Numerous small stock water reservoirs dot the countryside, but there are no large reservoir storage facilities within the subwatershed boundaries. Figures 4-13 and 4-14 show profiles of Fountain and Williams Creeks in this subwatershed.

4.4.2 Channel and Watershed Erosion and Sedimentation Characteristics

The Lower Fountain Creek subwatershed displays the widest array of problems associated with the creek and the most dramatic examples of erosion and sedimentation. This reach includes rural and agricultural communities as well as near-bank areas with dense urban development. Fountain Creek is experiencing aggradation of sediments from the confluence with the Arkansas River in south Pueblo approximately to the Highway 50 bridge. Sediment is transported from the subwatershed uplands to the Fountain Creek mouth at a greater rate than the system can handle.

Above the Highway 50 bridge to the upstream boundary of the subwatershed unit, erosion of stream banks associated with meander migration is the most noteworthy condition

affecting streamside landowners and infrastructure. In several locations meander bends on Fountain Creek have migrated or elongated their bed lengths to compensate for changing channel and hydrologic conditions, and/or structural creek bank controls. In a few of these instances meanders are widening the active floodplain by cutting into bedrock at its margin. This process is normally a natural part of alluvial valley evolution, but it appears to be quickening due to the changes occurring in the geomorphic system, namely increasing baseflow and density of floodplain vegetation.

4.4.2.1 City of Pueblo

The City of Pueblo is located near the confluence of the Arkansas River and Fountain Creek. The segment of Fountain Creek through the City of Pueblo has had flooding and severe erosion problems as well as sedimentation and riverbed aggradation problems in the past. All floods occurring in the subwatershed must flow through the City of Pueblo because it is located at the most downstream point. The Army Corps of Engineers built a flood control system along the banks of Fountain Creek in 1989 that includes a series of levees, some of which are armored with masonry, soil cement or riprap. The levee system starts near 13th Street and continues downstream on both banks of Fountain Creek to a point about ¼ mile above the confluence with the Arkansas River. In the 1999 flood event, flooding and rapid bank erosion were problems within the city limits of Pueblo and in the stream reaches passing through agricultural lands upstream of Pueblo.

The most pronounced problem in this area is sediment delivery from Fountain Creek has gradually increased as baseflow on the mainstem has become strong and steady and storm events erode upper subwatershed areas. Historically, Fountain Creek would dry up during summer months of the year. Now that the stream flows continually, sediment is constantly moving on the bottom of the sandbed channel to the confluence with the Arkansas River. Current sediment delivery rates are probably much greater than 50 years ago.

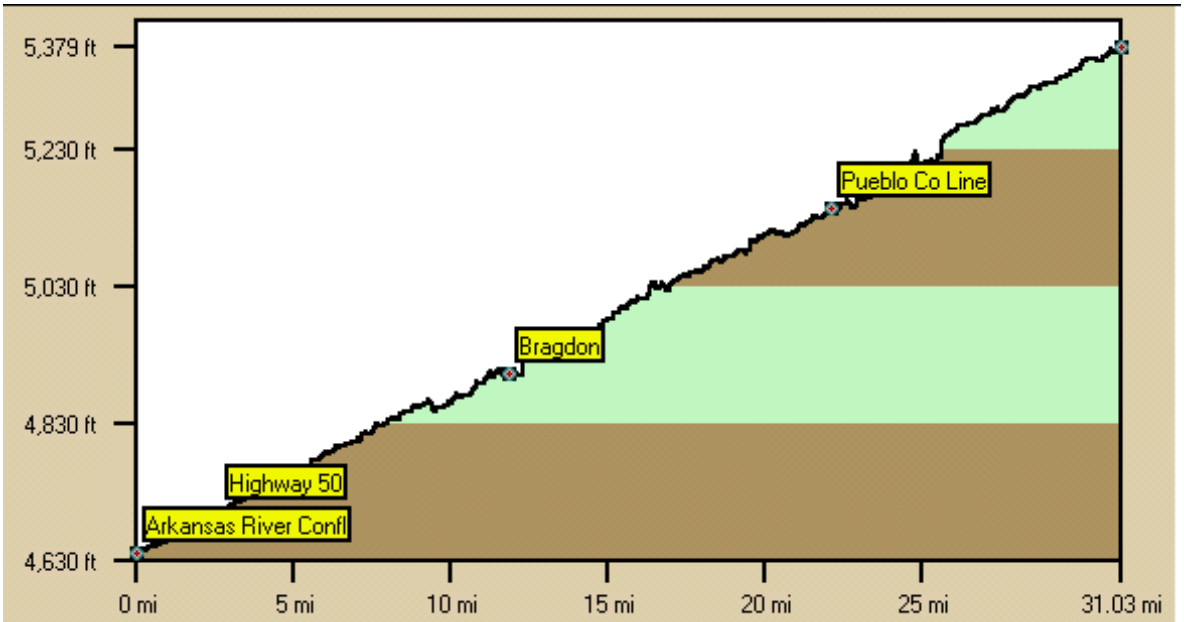


Figure 4-13: The channel profile of lower Fountain Creek shows a consistent slope throughout most of the reach.

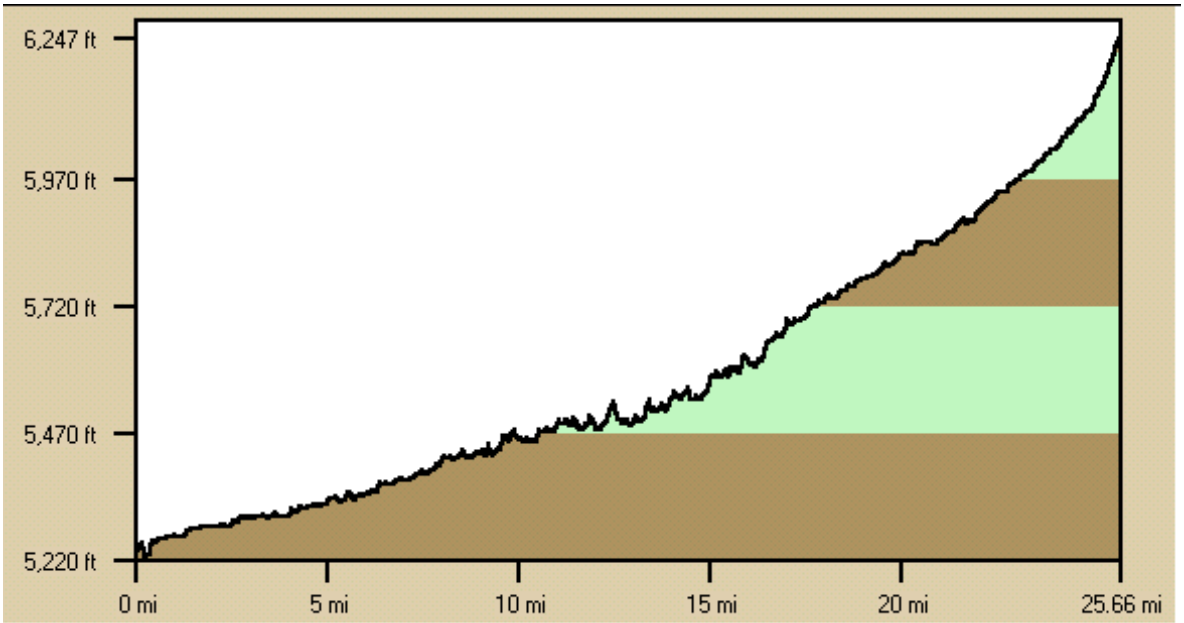


Figure 4-14: The channel profile of Williams Creek shows the typical concave upward geometry like that of the Jimmy Camp Creek subwatershed.

In addition, since the Pueblo Reservoir was built, the Arkansas no longer produces flash stormflow at the confluence with Fountain Creek; therefore, sediment is not regularly flushed downstream. This lack of seasonal flushing is another reason why sediment aggrades at the mouth of Fountain Creek. An alluvial fan is building on

Fountain Creek at this location, with sediments reported to be 4 to 5 feet deeper that they were 5 to 8 years ago at this location. In addition, the alluvial fan building into the Arkansas River restricts the river to a narrow corridor on the south side of the river bed at the Fountain Creek mouth, a fraction of the channel that was normally maintained (Photos 4-24 and 4-25). Occasionally, larger flows in the Arkansas will clear some of the sediment from the river path, allowing semi-restricted flow of the river; but generally a large slow water pool exists on the Arkansas upstream of the alluvial fan.

In general, sediment aggradation has become a major problem in the last 7 or 8 years. A grade control structure that crosses Fountain Creek approximately 600 feet upstream of the confluence used to serve as protection for a 108" sanitary sewer trunk line in the stream, and water flowed uniformly over the top much as it does over a weir. The City of Colorado Springs selected this location to monitor water flow due to the uniform flow condition and installed an automated flow gauging station. Several years ago the location became completely silted-in; it is now covered with sediment, and the location no longer provides the ideal flow measurement conditions. During the 1999 flood, park facilities, including picnic tables (Photo 4-26), walks and fire grates were buried by several feet of sediment.

Specific problems associated with sediment aggradation include:

- Loss of channel capacity below Highway 50 due to the buildup of sediment in the floodplain. It is likely that FEMA floodplain delineation is obsolete and that another study would show the predicted 100-year flood extends beyond current limits. Some businesses and community infrastructure might be at risk because 100-year flooding areas could be inadequately delineated. The conveyance capacity between the dike systems may become inadequate to control the 100-year flood event if channel aggradation continues. A cross-section monitoring system should be installed to document the progression of this problem.

Photo 4-24: View of the confluence of Fountain Creek with the Arkansas River showing a sediment fan built into the Arkansas River and constraining flow to the right.

Photo 4-25: View looking upstream on the Arkansas River showing sediment prograding into the river from Fountain Creek and the pool formed in the river due to flow constriction at this point.

Photo 4-26: Several feet of sediment covered the park area near the mouth of Fountain Creek during the 1999 flood as is shown by this picnic table, the top of which now appears to be only a few inches off the ground surface.

- Pedestrian walkways in the greenway area are gradually being covered by sediment. Continual maintenance is necessary to retain usage of remaining park facilities.
- Storm drainage outlets to Fountain Creek are impacted by sediment at some downtown locations bordering the creek as the river base level rises, especially at 4th Street and 5th Street (Photo 4-27).
- Sediment from Fountain Creek is building up on the Arkansas River downstream of the confluence and, as a result, the outfall from the wastewater treatment plant does not flow as it was originally designed, particularly after significant storm events.

Erosion has occurred at numerous places along Fountain Creek within the city limits of Pueblo. Localized erosion problems have periodically occurred, but numerous serious problems occurred during the 1999 flood. Erosion at the Target Store (Photo 4-28) exposed existing foundations and required extensive repairs and channel modifications.

Photo 4-27: Storms drains emptying into Fountain Creek at this location are now several feet under the typical creek level due to aggradation of the channel bed with sediment creating a maintenance problem for the City of Pueblo (note flood control dike at left in photo).

Photo 4-28: View of the embankment adjacent to the Target Store that had to be closed due to heavy flooding. Flooding caused heavy bank erosion, destruction of the gabion protection, and eventually exposed the foundation.

4.4.2.2. North Pueblo County

Fountain Creek is largely a meandering, sand bed river from the boundary of the subwatershed to the Highway 50 bridge. The major problems on this reach generally involve bank erosion resulting from shifting or expanding meander bends. The following are problem locations from upstream to downstream:

- Pinon Bridge washout in 1999 flood, ongoing concerns (Photo 4-29)
- Bank erosion, bridge damage and road loss at Overton location (Photo 4-30)
- Loss of agricultural land due to meander migration
- Bank erosion at Creek Side Subdivision in north Pueblo (Photo 4-31)

Photo 4-29: View from Pinon Bridge showing Fountain Creek flow directed toward the bridge abutment, thus suggesting that erosion and stability will be a continued problem in future floods.

Photo 4-30: Bank erosion and bridge damage after the 1999 flood, which continues today at the Overton Road site.

Photo 4-31: Severe bank erosion was a problem at this site near the Creek Side Subdivision in north Pueblo. Spur dikes have been constructed at this location to control erosion in the future.

4.4.3 Stream Channel Alignment

Fountain Creek alignment has changed significantly over the last 50 years. Some channel changes are the result of natural river adjustment, while others may be attributed to changes in watershed hydrology, the invasion of non-native riparian vegetation, increased vegetation density, and structural controls on the riverbanks. The discussion presented in Section 4.3.3 also applies to this section. Figure 4-15 shows the Hanna-Frost reach and the channel centerline and channel margins for 1955, 1961, and 1999. Such channel migration has occurred on many of the rural reaches of lower Fountain Creek.

4.4.3.1 Critical Reach Analysis

Hanna Frost and North Pueblo

Two critical reaches were chosen for detailed channel analysis on lower Fountain Creek. The Hanna-Frost reach near the Old Pueblo Highway Bridge and the north Pueblo reach in the northern portion of the City of Pueblo were chosen because of the severe erosion problems. These two reaches contrast the concerns of agricultural versus urban priorities. The results of the analysis also emphasize the differences in channel alignment and channel bank problems between rural and urban settings. This work is described in Appendix C. Figure 4-15 shows the Hanna-Frost reach and the channel centerline and channel margins for 1955, 1961, and 1999.

A railroad and the Old Pueblo Highway Bridge crossing, which have been in place since before 1955, bisect the Hanna-Frost reach. Channel problems have arisen in recent years because bridge abutments prevent the creek from adjusting its course. Consequently, it is detached from its floodplain by the railroad embankment. The meander bend upstream of the bridge crossings is prevented from adjusting eastward due to the riprap-covered railroad embankment. Energy that would normally be dissipated by the lengthening of the upstream meander is transferred downstream to the next meander in the river. The river is now eroding large portions of the agricultural property and may eventually threaten railroad infrastructure. The concrete bridge abutments also prevent river adjustment.

Although the river is changing course upstream, any adjustment at this point is not possible due to the hard controls. Downstream of the crossing, the river is eroding the agricultural property immediately downstream of the bridge. This is partly a result of the

water being channeled on a direct path from the upstream meander through the bridge abutments and into the downstream left bank. Changing river hydrology is likely a contributing factor in erosion problems on this reach.

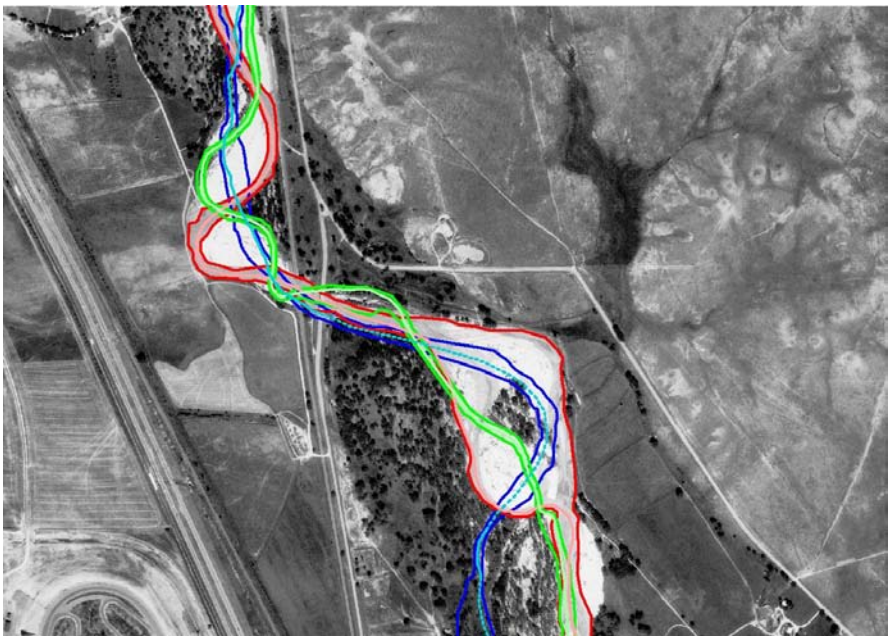


Figure 4-15: The Frost-Hanna critical reach on Fountain Creek shows how the main channel has changed over the years (Blue delineation = 1955, Green delineation = 1961, Red delineation = 1999)

In the City of Pueblo critical reach, explosive urban growth in the southern portions of the reach have channelized and straightened the creek. This decreases the floodplain and increases flow velocities, which increase the transport of sediment downstream. Consequently, there is a tendency for more destructive floods, and with them an increase in property losses. One example is the Target store (Photo 4-28) property near the southern boundary of the critical area. During the 1999 flood, the creek caused extensive damage and nearly led to the store falling into the creek. As long as urbanization continues in this area without taking into consideration the meander belt of Fountain Creek, problems such as these will probably become typical.

In the Pueblo critical reach transportation increased from 12.0 miles in 1955 to 17.7 miles in 1999, while urbanization over the same period exploded from just 5.8 square miles to 533.6 square miles. In 1955, the meander belt in the far southern portion of the critical area was quite expansive at just over 0.5 miles wide. However, in 1999 the meander belt had narrowed to roughly 0.2 miles (a reduction of 60%) as a result of channelization.

Furthermore, the damaged Target stores, and many properties directly to its north and south, lie squarely within the 1955 meander belt and on the border of the 1999 meander belt. Obviously, increased development pressures due to the construction of Highway 47 spurred growth north of Pueblo, but at the cost of building within Fountain Creek's historic meander belt. Consequently, it appeared Fountain Creek was trying to reclaim some of its meander belt during the 1999 flood.

4.4.4 Infrastructure

Storm drainage has become suppressed at some downtown Pueblo locations (especially at 4th Street and 5th Street near the creek) due to the rise in river base level and sediment accumulation. Flap gates on several stormwater outfalls that discharge into Fountain Creek are prevented from opening because sediment has been filling in behind the flaps, and chronic drainage problems are becoming a concern as gravity flow to the stream is prevented. The City of Pueblo has to remove sediment from behind the gates at frequent intervals to insure proper function of the gates, which has resulted in increased maintenance requirements.

Sediment from Fountain Creek is building up on the Arkansas River downstream of the confluence, and as a result, the outfall from the wastewater treatment plant does not discharge properly. The pipe discharges to the river at an elevation near the previously normal river level. Sediment clogging the stream has caused stream flow levels to rise to the point that plant outflow is impeded from discharging at adequate rates. Sediment deposits following storm events cause increased discharge depths, causing secondary channels to be developed by the wastewater discharges.

Severe erosion during floods has also been a problem in the Pueblo reach in the vicinity of Highway 50 since before the 1999 flood, which caused dramatic changes in the Fountain Creek channel and caused major erosion at some locations. Heavy tree growth, debris and buildup have altered flow patterns and caused significant changes in channel locations during flood events. Some of the more serious problems included:

- Target store and parking lot
- Creek Side Subdivision (Chinook Avenue Road)

- Sewer line (27-inch) washout upstream of Creek Side

- Erosion Levee Armor within the ACOE project area at West 2nd Street and West 13th Street along the west bank of Fountain Creek

These are locations that may experience erosion problems in the future when another major event occurs. Bank protection measures that have been installed should provide stability during less severe events, but have not yet been tested during a larger flow event. Problems may occur in area such as the reach bordered by the Target store parking lot because the floodplain has been severely constrained. The City of Pueblo has stabilized the southeast locations though the installation of bank stabilization techniques, the realignment of the Fountain Creek channel, and the removal of floodway vegetation and debris to improve floodway flow capacity.

4.4.5 Urban Development

There is little urbanization in the northern portion of this subwatershed extending from approximately the El Paso – Pueblo County line south to 47th Street at the north end of the City of Pueblo. The southern portion of this subwatershed narrows to the mouth of Fountain Creek on the Arkansas River and is densely urbanized through the majority of the lower reach. This lower reach includes major road and rail corridors, large shopping and commercial areas, light and heavy industrial complexes and numerous residential communities.

4.4.6 Agriculture

Agriculture in the Lower Fountain Creek subwatershed consists primarily of alfalfa and grass hay, wheat and corn. Approximately 2,000 acres are irrigated through the Bannister, Sutherland, Lincoln, Benesch, J.W. Drawfield, McElroy, Olin, Greenview, Hobson, Cactus and Chillicott agricultural ditches located between the Pueblo County line and the northern extent of the City of Pueblo. The hay crops and pasture grasslands also support cattle and horse ranching.

4.4.7 Ranking and Prioritization of Watershed Problems and Issues

The following prioritization is based upon the judgment and opinions of stakeholders and representatives of public agencies within the subwatershed. The prioritization within the

Lower Fountain Creek subwatershed is conveniently divided at the Highway 50 crossing. Upstream of the crossing, the issues may be ranked as 1) erosion, 2) flooding and 3) sedimentation; while downstream they may be ranked as 1) sedimentation, 2) flooding and 3) erosion.

The individual stream segments within this subwatershed that have been identified as currently or potentially having problems are shown in Table 4-4. Each of these stream reach segments will be investigated as part of the Army Corps of Engineers Watershed Study. The modeling analysis that is conducted will be determined based on the priority assigned (1 being the highest) and the problems and issues identified. This list will also be used to determine the priority for additional critical reach analysis. The priority assigned to the reaches in Table 4-5 as based on a review of the problems and issues, potential infrastructure problems, stability class rating and other reports. Specific infrastructure problems and issues along with a stability class rating have also been identified for Monument and Fountain Creeks and are listed in Appendix E.

Table 4-5: Fountain Creek Headwaters Stream Segments

Priority	Reach	From	To	Length (miles)	Problems/Issues
Lower Fountain Creek					
2	Fountain	Jimmy Camp Crk	Young Hollow Confl	15.1	Erosion and channel stability/migration
1	Fountain	Young Hollow Confl	Porter Crk Confl	10.0	Erosion and channel instability
1	Fountain	Porter Crk Confl	Arkansas Confl	9.0	Significant sedimentation problem; reduction of conveyance capacity; interference with stormwater systems; significant infrastructure elements; channel stability issues associated with debris movement in floods and interference with bridges; stormwater systems; significant infrastructure elements; channel stability issues associated with debris movement in floods; interference with bridges
1	Arkansas River	Fountain Confl	Baxter Rd.	6.5	

5. Characterization and Evaluation of Channel Instability

Increasing urbanization of the Fountain Creek Watershed has led to problems and issues associated with the main streams draining the basin. Erosion, sedimentation and flooding problems have highlighted the need to understand the consequences of development activities in the watershed. A qualitative characterization and evaluation of channel stability problems in the main stream reaches has been conducted.

To better understand current and potential consequences of activity in the watershed, the Rosgen Classification method was used to broadly classify the main streams of the subwatersheds (Rosgen, 1996). Classification is largely based on observed channel patterns, topographic map data, limited stream geometry data, and limited sediment data. Confirmation and refinement of the stream classification will be completed when a comprehensive watershed dataset is developed.

5.1. Defining Stream Instability

Erosion and deposition in Fountain and Monument Creeks and their respective tributaries are the result of a balance of physical relationships presented in an illustration by Lane (1955) shown in Figure 5-1. A change in the relationships that make up the balance, such as a significant increase in sediment supply, will instigate geomorphologic change that attempts to reestablish equilibrium in the fluvial mechanics of the system. The following are the basic parameters that most affect channel changes and controlling erosion and sedimentation problems in the Fountain Creek Watershed, all of which are interrelated:

- Increased baseflow discharge
- Increased sediment supply
- Increased sediment transport
- Floodplain encroachment
- Floodplain and woodland expansion
- Channel realignment
- Channel bank protection and grade control

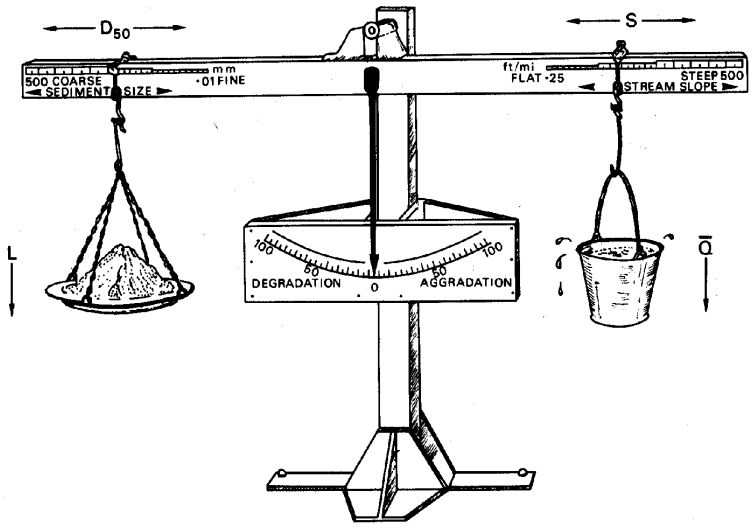


Figure 5-1: Lane's relationship for qualitative analysis of channel stability (Lane, 1955)

The stability class column in Appendix E designates a general rating of stream stability for each reach measured for this table, which is based on limited data and observations. A rating from 1 to 5 was given to each reach based on the available information. The class ratings are defined as follows:

5 = Maximum stability, no anthropogenic effects on channel morphology evident, channel in apparent equilibrium with watershed conditions, no recent dramatic hydrologic events have perturbed the system, structures in the stream corridor.

4 = Mostly stable, anthropogenic effects on channel morphology may be evident, channel mostly in apparent equilibrium with watershed conditions, some recent dramatic hydrologic events may have perturbed the system slightly, watershed has some developmental that may affect storm hydrology, there are scattered structures in the stream corridor.

3 = Stable reaches dominate with some unstable bank or channel areas, some anthropogenic effects on channel morphology are evident, channel appears mostly in good condition and is in equilibrium with watershed conditions, development or agricultural activities may affect bank areas locally, recent dramatic hydrologic events may have perturbed the system slightly, watershed has significant development that probably affects storm hydrology, structures may be common in the stream corridor.

2 = Unstable reaches dominate with some stable areas, anthropogenic effects on

channel morphology are evident, channel banks are eroding on numerous reaches, channel bed may be degrading or aggrading to a degree above the natural state, some reaches are stable with engineered controls or are obtaining equilibrium after disturbance, dramatic hydrologic events may perturb the system, watershed has significant development that probably affects storm hydrology, structures may be common in the stream corridor.

1 = Mostly unstable, unstable reaches dominate, anthropogenic effects on channel morphology are evident, channel banks are eroding on numerous reaches, channel bed may be chronically degrading or aggrading, few reaches appear in equilibrium with watershed conditions and there is a lack of engineered channel and bank controls, dramatic hydrologic events will perturbed the channel system, watershed has significant development that probably affects storm hydrology, structures may be common in the stream corridor.

Interviews with various government personnel did not reveal any existing stability rating systems currently being used by officials within the watershed. The stream stability assigned to each reach was based on a cursory analysis of available data and as discussed in the Conclusions and Recommendations Section. A more definitive, quantitative based stability rating system should be developed in the future. General ratings were applied to each main stream segment according to the Rosgen Stream Type Classification in Table 5-1.

The primary causes for stream instability are watershed-wide problems, but each of the four subwatershed areas has particular geomorphic factors that are more applicable to the individual areas. The main factors controlling stream stability are discussed in Section 5.2.

5.2. Stream Channel Classification

Table 5-1 shows the Rosgen Classification scheme, which provides a detailed scheme for organizing stream channel types (Rosgen, 1996). The classification of stream segments within the watershed provides a baseline record from which changes in stream geomorphology arising from stream instability and channel change can be documented. Channel types also give an indication of the condition of the stream when considered in the context of upstream and downstream comparisons. Geomorphic parameters that are not in the range for a particular stream type can indicate problem areas or processes. In the last several years,

Rosgen's Classification has become the most commonly used classification in the western United States, and it provides the most accurate way to communicate the classification of streams. Channel reaches are designated with a letter (A-G) that refers to the type of stream and a number subscript (1-6) that refers to the dominant channel bed material. Texture classification for all streams will be finalized when sediment grain size distributions are available.

Stream classification for the stream segments being discussed is possible at Level 1, geomorphic characterization, of the Rosgen Classification. Level 2, morphological description, is provided in some cases below, but final classification requires detailed survey, mapping and topographic data. Stream classifications presented below are based the channel alignment displayed on 1961 USGS Topographic DEM Quadrangles and aerial photography as described in Appendix C. As such, channel slopes and other channel geometry may not accurately depict current conditions. Grain size data is lacking within the watershed; therefore the probable classification range as affected by sediment texture is estimated and provided in Appendix E.

Table 5-1: Summary of Delineative Criteria for Broad-Level (Level 1 and 2) Classification (Rosgen, 1994)

Stream Type	Entrench-ment Ratio	Width/ Depth Ratio	Sinuosity	Slope	Meander Belt/ Bankfull Width	Dominant Bed Material*
Aa+	<1.4	<12	1.0 - 1.1	> 0.10	1.0 - 3.0	1,2,3,4,5,6
A	<1.4	<12	1.0 - 1.2	0.04 - 0.10	1.0 - 3.0	1,2,3,4,5,6
B	1.4 - 2.2	>12	>1.2	0.02 - 0.039	2.0 - 8.0	1,2,3,4,5,6
C	>2.2	>12	>1.4	< 0.02	4.0 - 20	1,2,3,4,5,6
D	n/a	>40	n/a	< 0.04	1.0 - 2.0	3,4,5,6
DA	>4.0	<40	variable	< 0.005	n/a	4,5,6
E	>2.2	<12	>1.5	< 0.02	20 - 40	3,4,5,6
F	<1.4	>12	>1.4	< 0.02	2.0 - 10	1,2,3,4,5,6
G	<1.4	<12	>1.4	0.02 - 0.039	2.0 - 8.0	1,2,3,4,5,6
*** Dominant Bed Material: 1 – Bedrock, 2 – Boulder, 3 – Cobble, 4 – Gravel, 5 – Sand, 6 - Silt/Clay**						

5.2.1. Fountain Creek Headwaters

Upper Fountain Creek is primarily a Type B channel down through the City of Manitou Springs. A short reach of Type C4 channel is located in the area of reduced channel slope and high sediment transport directly below the City of Woodland Park. Below the City of Manitou Springs, a Type C channel dominates intermittently. Type A channels are found in the headwaters of the drainage basin.

5.2.2. Monument Creek

The uppermost reaches of the subwatershed above and through the Town of Palmer Lake are Type A and Type B channels. The mainstem of Monument Creek from Monument Lake down to the confluence with Fountain Creek is a Type C4 or C5 channel.

5.2.3. Colorado Springs Composite

Type C channels dominate the upper end of Monument Creek and Fountain Creek in this subwatershed; however much of the urban area channels have been altered either by realignment or erosion protection. Some reaches in Monument Creek have had problems with erosion to the extent that the channel has become incised.

5.2.4. Lower Fountain Creek

Mainstem channels of Fountain Creek are in the Type C4 or C5 range, with localized reaches of Type D4 or D5. This mixed classification may reflect the gradual change from more braided type streams to a more meandering channel. Most channels in the 1955 photos would be classified as Type D4 or D5 streams. Jimmy Camp Creek also displays these conditions, except in the most headward areas where Type A and B type channels are found. Changes in channel conditions are reflected in the channel classification comparison between the 1955 and 1999 aerial photographs.

5.3. Causes of Channel Instability

5.3.1. Drainage Basin Hydrology

The USGS analyzed trends in precipitation, streamflow and morphologic changes in Fountain Creek. Low streamflow statistics indicate that the low streamflow has increased significantly throughout most of the watershed, particularly since the early

1980s. The increase can be attributed to the modes of water management occurring in the basin, including 1) increases in wastewater effluent, 2) management of the Fountain Creek transbasin return flow decree, and 3) return flow from lawn watering and crop irrigation. Likewise, statistical analysis shows there have been minor increases in instantaneous peak flow of high return frequency-flow events. Increased flow peaks are likely the result of basin development and greater impermeable surface area in the watershed (USGS, 2000).

The increase in low streamflow may be a primary factor influencing channel morphology change, particularly in the mainstem of Fountain Creek and possibly in several of its larger tributaries. Water availability effects sediment movement and vegetation establishment, which in turn effect stream channel stability and geomorphology. Originally, the interaction of climate, geology and topography in the basin caused many streams to be ephemeral or intermittent sand bedded streams. Potential transmission losses in coarse sands are high, and in the dry periods of the year basin streams used to dry up completely. Now that low flows have increased, lower Fountain Creek, Cottonwood Creek and Kettle Creek flow continuously, whereas they previously dried up seasonally.

5.3.2. Sediment Transport

Sediment movement in the main channels of the Fountain Creek Watershed was previously intermittent in nature, similar to the intermittent nature of stream flow that used to exist in the tributaries. The sands composing the channel bed are now continually transported downstream due to channel discharge that is now perennial in many watershed stream reaches. If the sediment in the channel was composed of significant amounts of cohesive clays, or if coarse material such as gravel or cobbles dominated the channel, sediment transport during low flow conditions would be much lower. Sediment movement and production from the watershed today is likely much greater than it was in the past. The degradation of channel beds in the Colorado Springs area and the aggradation of sediment at the mouth of Fountain Creek in Pueblo are conditions that reflect the increased transport of sediment.

One study by the USGS (1989) indicated that the bedload part of sediment transport in Fountain Creek makes up 16 to 90 percent of the total sediment load during snowmelt

events, whereas storm runoff events contribute only 6 to 30 percent. This conclusion is indicative of the fact that bedload accounts for most of the sediment moving during baseflow periods when water is mostly clear and free of suspended sediment but is still moving on the bottom of the stream in the form of rolling or saltating grains of sand.

Table 5-2 shows a qualitative accounting of the physical factors influencing sediment transport within a watershed (Williams, 1991). It will be used as a general guide to help explain the factors that contribute to the increased sediment transport in the Fountain Creek Watershed. A "plus" (+) indicates that a factor increases sediment transport and a "minus" (-) indicates that a factor decreases sediment transport. The number of plusses and minuses indicates the severity of that factor. Three of the twelve factors shown in Table 5-2 will be discussed in detail in this section.

Table 5-2: Factors Affecting Sediment Transport

Relative Effect	Factors of Sediment Transport (Relative to pre-1980s)	Explanation
+++	Increased baseflow (main channel)	Continuous flow, more channel forming events
+	Increased Highflow	Increased discharge in high flow events due to development
-	Increased Paving/Structures	Surface protection
+	Increasing Construction	Disturbed ground (short term)
-	More Reservoirs	Effective sediment traps
-	Increased Floodplain Vegetation Density	Tamarisk, Russian live invasive species, more water availability with increased baseflow
++	Increased Bank Erosion	Due to increasing sinuosity
+	Increased Bed Erosion	Due to reduced effective channel width
-	Decreased Grazing, Farming	Decreased acreage
++	Increased Baseflow in Tributaries	Kettle Creek, Cottonwood Creek, Sand Creek development
-	More Channel Stabilization Structures	Hard structures in urban corridor
+	Floodplain Encroachment	Development, encroachment in urban areas
+11 – 5 = +6	**Increased Sediment Production**	

Sediment yield from the drainage basin hillslopes may be similar to or even less than it was historically. Increased urban development creates larger areas of paved and protected surfaces, thereby reducing the amount of sediment available for transport while increasing developed run-off. Detention structures provide settling basins for entrained sediment, which also reduces sediment movement in the system.

5.3.2.1 Floodplain Encroachment

Urban expansion in all of the communities located near the main stream corridors of the Fountain Creek Watershed has caused floodplain areas to be developed. Fill has been placed to allow the use and development of areas that originally provided zones for natural floodwater storage and conveyance. As a result, channel floodway zones have become constrained. Flood passage through these areas results in higher than normal flow velocities and a shortage of flood attenuation potential. Therefore, flood waves may progress downstream faster and flood peaks may be higher than normal in some reaches. In other reaches, encroachment may impede the downstream progression of the floodwave such that backwater effects may cause high local flood levels.

Encroachment of floodplain areas may also be caused by vegetation or large trees that have been protected to enhance landscape and urban riparian zones. In some cases, dense stands of trees in the urban stream corridor are not the natural condition of the floodplain, as may be the case in Manitou Springs. Another important aspect of encroachment by vegetation is discussed in the following section.

5.3.2.2 Increased Floodplain Vegetation Density

Floodplain vegetation on Fountain Creek has changed dramatically in the last 50 years, due in part to changes in the Fountain Creek flow regime. A comparison of aerial photographs between 1955 and 1999 shows that vegetation density increased dramatically in that time period. The USGS (2000) has suggested that vegetation in the floodplain is mainly governed by the frequency of flooding, in that floods cause scouring and denuding of the floodplain. This process obviously occurs on Fountain Creek, but it is apparent from the limited work with aerial photographs that the density of floodplain vegetation has increased over the years. Conversation with local

residents and officials confirm that this observation is correct (Alt, B., 2001, personal communication).

Water flowing in the drainage network year round due to return flow of irrigation and treatment plant discharges has increased the water availability to riparian vegetation. This results in a more continuous supply of shallow alluvial and surface water supply to vegetation near Fountain Creek and its tributaries.

The fact that invasive species now cover much of the riparian corridor is related to the increase in vegetation density. Tamarisk (also known as salt cedar) and Russian olive now compose a larger part of the riparian vegetation in 1999 compared to 1955. Tamarisk was brought from Asia in the late 1800s to aid in erosion control. Tamarisk is a phreatophyte that may tap water with long roots at depth, but thrives in riparian areas (Graf, 1978). Photographs taken in the late 1800s in southwestern streams compared to modern photos taken at similar places show how completely this plant can invade streamside areas. Such is also the case on the lower half of Fountain Creek. Tamarisk thrives in the understory of the larger cottonwood and elm trees that serve as canopy cover for floodplain vegetation. Tamarisk and Russian olive can act as sieves for floating debris when flood flow attempts to spread over the floodplain from the main channel. There were numerous accounts during the 1999 flood of log jams during the high flow events.

Riparian vegetation density in 1999 provides considerably more floodplain stabilization to overbank areas than it did in 1955. Dense vegetation effectively narrows an active channel by stabilizing the sandy bank. Flood flows are less likely to spread evenly over the floodplain with dense vegetation blocking the path of overbank flood flows.

In 1955, the floodplains in lower Fountain Creek mostly had sparse vegetation. Scour is evident over much of the width of the floodplain in the 1955 photos. The stream appears to have been more braided than meandering, and it probably frequently left the main channel zone during higher flow periods. With the lack of dense floodplain vegetation in 1955, overbank flows were not impeded from crosscutting the flat floodplain, which was the most direct path downslope. In this setting, the capacity of the floodplain areas to carry flood waters or even minor out-of-bank seasonal flows,

was greatly enhanced due to lack of flow resistance relative to present day conditions where large trees and dense bushes occupy most parts of the floodplain.

The changes taking place on lower Fountain Creek are somewhat similar to those that have occurred on the Platte River east of Denver. As the discharge regime of the Platte River has become less flashy due to upstream reservoirs and increased low flow from stream inputs from the City of Denver, the channel character has changed from a wide, flat, sandy bed with sparse vegetation to a meandering channel with dense floodplain vegetation. The river is much less dynamic than it was in the 1800s, partly due to woodland/floodplain expansion (Naldler, C.T. and S.A. Schumm, 1981).

5.3.2.3 Increased Bank Erosion

In the lower end of the Colorado Springs Composite subwatershed and most of the Lower Fountain Creek subwatershed, the realignment of Fountain Creek from 1955 to 1999 is evident. Changes in watershed conditions are causing the channel to adjust to the new influencing factors. Most notably are an increase in channel sinuosity and an increase in the length of channel banks that are actively cutting into previously un-eroded bedrock. This increased activity in channel bank cutting likely provides additional sediment for transport through the basin.

5.3.3. Channel Bank Protection and Grade Control

In some cases, the construction of channel bank protection constrains the floodplain and floodway, thus reducing the storage available for out-of-bank flows and promoting the quick passage of stream flow downstream. Bank protection causes other problems in areas outside of the urban environment. Bridge abutments create permanent cross sections where streams must pass. Channel adjustments upstream and downstream may create a need for the river to naturally adjust to maintain equilibrium. If the stream cannot naturally adjust, the energy requiring adjustment will be transferred to another location upstream or downstream and channel changes (such as erosion or widening of the stream cross-section) will result, causing problems to transfer from one location to another.

Such is the case at Pinon, where the channel was naturally shifting a meander downstream. The migrating meander adjusted as far as possible until the road

embankment stopped the downstream progression. The result was initially the loss of road embankment to stream erosion, and eventually the loss of a bridge span when the flow was directed into the bridge support system instead of in a downstream path as was originally intended. In another case, a highway bridge and a railroad bridge cross Fountain Creek at the Old Pueblo Road crossing downstream from the City Fountain. The railroad encroaches on the floodplain approximately one-quarter mile upstream. The stream is constrained at these two points, and its natural tendency to adjust over the full width of the floodplain is prevented by hard controls. The energy directed at the railroad embankment is transferred downstream to the next bend, where a very large meander is developing and eroding agricultural land. Other problems are occurring downstream of the bridge, where agricultural land is being lost to erosion and local channel widening as the stream dissipates energy.

Bank protection and channel grade controls line much of the main channel of Fountain and Monument Creeks as they wind through the developed areas of Colorado Springs. Stream reaches in the older areas of the city were altered many years earlier and these channel areas are mostly stable. The occasional flood may reveal or revive erosion in problem areas. Similar well-established bed and bank protection may be found in other older parts of communities within the watershed, such as the levee system in downtown Pueblo and hard bank erosion control measures in Manitou Springs. In general, the effects of the construction of the older, well-established structures have long since occurred and some sort of equilibrium within the fluvial system has been attained.

6. Summary and Evaluation of Policy and Technical Management Strategies

This section summarizes policy and technical management strategies relevant to the Fountain Creek Watershed.

- Section 6.1 outlines federal and state regulatory programs that affect activities within the watershed.
- Section 6.2 contains a comprehensive summary of local (county and municipal) regulatory programs. A matrix summarizing local regulatory programs is included as Appendix F.
- Section 6.3 identifies a broad range of potential management practices that protect and restore watershed health.
- Section 6.4 contains general channel stabilization methods for problems in the Fountain Creek Watershed.

6.1 Summary of Current Federal and State Regulatory Programs

Federal and state regulatory programs affecting activities within the watershed are divided into seven specific categories:

- Floodplain;
- Riparian and Wetland Habitat;
- Stormwater and Urban Runoff;
- Construction Discharge Permits;
- Water Quality;
- Water Resource Development; and
- Wastewater Treatment Plant and Industrial Discharge Permits.

Information regarding guidance documents for some of the categories is also discussed.

6.1.1 Floodplain

The Federal Emergency Management Agency (FEMA), pursuant to Title 44 CFR Parts 65, 70, and 72 (February 6, 1997), addresses issues including:

- Identification and Mapping of Special Flood Hazard Areas;
- Procedures for Map Correction;

- Procedures and Fees for Processing Map Changes;
- Final Rule and Fee Schedule for Processing Requests for Map Changes; and
- Flood Insurance Study Backup Data.

The Colorado Water Conservation Board (CWCB) administers Colorado's Flood Protection Program. The Flood Protection Program is directed in Section 37-60-106(1) C.R.S. (1990) to prevent flood damages; review and approve floodplain designations prior to adoption by local government entities; and provide local jurisdictions with technical assistance and floodplain information. In addition, an August 1, 1977 Executive Order requires the CWCB and Land Use Commission, which has since been dissolved[1], to assists entities in meeting the requirements of the National Flood Insurance Program. Additional information can be obtained from the CWCB Flood Protection Program website at: http://cwcb.state.co.us/Flood_Program.htm.

6.1.1.1 FEMA National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is a federally established insurance program available to communities that participate voluntarily and agree to develop and enforce floodplain management ordinances in accordance with NFIP requirements. The NFIP was established by the National Flood Insurance Act of 1968 and was updated and modified in 1973 and 1994. Floodplain management ordinances are administered in El Paso County and its municipalities by the floodplain administrator under the Pikes Peak Regional Building Department; in Pueblo County by the Director of the Department of Planning and Development; in Teller County by the County Planning Director; and in the City of Pueblo by the Stormwater Coordinator.

6.1.2 Riparian and Wetland Habitat

6.1.2.1 Clean Water Act, Section 404 Regulations

Section 404 of the Clean Water Act regulates the discharge or placement of dredged or fill material into waters and wetlands of the United States. Activities that may be regulated

[1] The Colorado Land Use Commission has been dissolved, but as there is no official record of it being dissolved in the CRS, the duties and requirements of the Commission are still contained in the CRS. There is also no record of any changes to the CRS that would supersede the formation of the Commission or its requirements.

under Section 404 include infrastructure development, draining or filling of wetlands, channel and waterway modification, maintenance and repairs, and construction of dams or levees for water resource development. The program is administered by the U.S. Army Corps of Engineers (ACOE) with review by other federal agencies.

Pursuant to Section 404(e) of the Clean Water Act, the ACOE has the authority to issue general permits on a nationwide basis for any category of activity involving discharges of dredged or fill material if the activities in that category are similar in nature and have minimal adverse environmental effects, individually or cumulatively. Nationwide permits (NWPs) are a type of general permit issued by the ACOE and are designed to authorize, with little or no delay or paperwork, certain activities having minimal individual or cumulative adverse effects on the environment (see 33 CFR 330.1 for policies concerning NWPs).

6.1.2.2 Colorado Natural Heritage Program

The Colorado Natural Heritage Program (CNHP) provides services that include online access to data, mapped locations of imperiled species and areas of statewide significance, conservation plans, species and site inventories, expert scientific consultation services, and species habitat and ecological modeling.

6.1.2.3 Colorado Division of Wildlife (State Guidance and Enforcement)

The Colorado Division of Wildlife (CDOW) provides access to and information regarding the Natural Diversity Information Source (NDIS). The mission of the NDIS is to provide data and analysis needed to enhance decisions on land use affecting Colorado's animals, plants and natural communities. This mission is accomplished by bringing together information from a variety of sources, including the CDOW, the CNHP, Colorado State University, local governments and other conservation partners.

6.1.2.4 U.S. Fish and Wildlife Service

Some of the permits commonly requested from the U. S. Fish and Wildlife Service (USFWS) that apply to activities occurring in the Fountain Creek Watershed include:

- Habitat Conservation Plans and Incidental Take Permitting Process;

- Special Use Permits for Authorization for Research and Study of Cultural Resources; and
- Land Use Permits

The USFWS and the National Marine Fisheries Service have adopted a policy to address the conservation needs of species that are listed or are proposed to be listed under the Endangered Species Act (ESA) of 1973 as amended, while providing for the continuation and enhancement of recreational fisheries. This policy identifies measures to ensure consistency in the administration of the ESA between and within the two agencies; promote collaboration with other federal, state and tribal fisheries managers; and improve and increase efforts to inform nonfederal entities of the requirements of the ESA while enhancing recreational fisheries. This policy meets the requirements set forth in Section 4 of Executive Order 12962, Recreational Fisheries.

6.1.2.5 Endangered Species Act (61 FR 27978, June 3, 1996)

The fundamental purpose of the Endangered Species Act (ESA) is to conserve and recover species in danger of extinction, and to conserve the habitats and ecosystems these species depend upon. The ESA does this by listing a species as either endangered or threatened. "Endangered" means the species is presently in danger of becoming extinct without conservation and recovery effort, and "threatened" means the species is at risk of entering endangered status. In Colorado there are 14 fish, 1 amphibian, 9 bird, 8 mammal and 13 species of plants listed as threatened or endangered. In the Fountain Creek Watershed, listed species include the Preble's Meadow Jumping Mouse, the Greenback Cutthroat Trout, the Piping Plover, the Ute Ladies' Tresses Orchid, the Arkansas Darter, the Mexican Spotted Owl and the Least Term Burrowing Owl.

6.1.3 Stormwater and Urban Runoff

6.1.3.1 National Pollutant Discharge Elimination System Phase I and II

The Clean Water Act as amended provides for the National Pollutant Discharge Elimination System (NPDES) to regulate the discharge of pollutants to waters of the United States. This permit program was established (and in some states is administered by) the U.S. Environmental Protection Agency (EPA). In other states including

Colorado, authority is granted for permits to be administered by an appropriate state agency. Colorado's Department of Public Health and Environment (CDPHE) administers the state's NPDES permitting program, while the EPA administers the NPDES program for federal facilities within Colorado such as Fort Carson and the U.S. Air Force Academy.

The NPDES program initially focused on point source dischargers and all were required to have a permit. Amendments to the Clean Water Act in 1987 initiated the process of controlling stormwater pollution and required the EPA to develop a phased strategy for implementing the NPDES Stormwater Program. The goal of the stormwater permits program is to reduce the amount of pollutants entering streams, lakes and rivers as a result of runoff from residential, commercial and industrial areas

The Phase I regulations were implemented in 1993 and requires cities with a population greater than 100,000 to obtain a permit. The City of Colorado Springs was the first city in the Fountain Creek Watershed to be affected by the NPDES Phase I regulations. Information regarding the City of Colorado Springs Phase I permit can be found at www.springsgov.com/Page.asp?NavID=139.

In December 1999, the EPA promulgated the final Phase II NPDES stormwater regulation affecting cities/counties with a population between 10,000 and 100,000. Initially, Phase II will impact El Paso County, the City of Fountain, the City of Manitou Springs, the Town of Monument and the City and County of Pueblo; Teller County may be affected in the future. These communities are required to develop and implement six stormwater management programs or minimum measures:

1. Public Education/Outreach
2. Public involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Management
6. Pollution Prevention/Good Housekeeping for Municipal Operations

A permit application outlining programs that fulfill the permitting requirements was

submitted for each of these communities in March 2003. The programs established by the permits must be implemented by March 9, 2008.

6.1.4. Construction Discharge Permits

A construction discharge general permit is required under NPDES Phase II for stormwater discharges from construction activities that result in a total land disturbance of equal to or greater than one acre where those discharges enter surface waters of the United States or a municipal storm sewer system leading to surface waters of the United States. The permit also authorizes stormwater discharges from any other construction activity designated by EPA as having the potential to contribute to a water quality standard or for significant contribution of pollutants to surface water.

The EPA is developing Effluent Limitation Guidelines and New Source Performance Standards for the Construction & Development Point Source Category. When finalized, this regulation will establish technology-based standards for wastewater discharges to navigable waters from construction sites regulated by the NPDES permitting program and also standards for post-construction best management practices (BMPs).

6.1.5 Water Resource Development

The use of water in Colorado is governed by the office of the State Engineer, Division of Water Resources, and also by state law. The Colorado Constitution states that the right to appropriate the unappropriated water of the state "shall never be denied." Water rights in Colorado are governed by the doctrine of prior appropriation. In essence, this means that while no person can literally own the water in a stream, all people, municipalities and corporations have the right to use the water for beneficial purposes.

Water is then allocated by what has come to be known as the "first in time, first in right" maxim. The first person to appropriate water (to take water physically from a stream or underground aquifer) and apply it to beneficial use is known as a "senior appropriator." A senior appropriator has the right to have his or her water needs met before a junior appropriator. "Beneficial use" is recognized by the Colorado Constitution as a preference of water uses in this order: domestic, agricultural and industrial.

Water rights are granted by a special Water Court, and Colorado recognizes both

"absolute" and "conditional" water rights. An absolute water right is defined as an appropriation that has been completed by the diversion and beneficial use of the water by the appropriator. However, most projects take a number of years to plan, construct and complete; therefore, the appropriator can obtain a conditional water right from the Water Court to protect his or her priority before completing the actual appropriation of the water to assure that water that was available at the beginning of the project will still be available when it is completed. The project must proceed with "reasonable diligence" and demonstrate such diligence every 6 years.

There are two general types of water rights in Colorado: direct flow and storage. A direct flow right is usually measured in terms of a rate of flow rather than a total volume of water. The appropriator may take water at the approved rate as long as the water is physically available in priority and it is applied to a beneficial use. Direct flow rights also operate with a "duty" (amount of water necessary for the stated use) that functions as a limit on the amount of water that can be diverted under a priority and is designed to prevent waste. For example, an appropriator with a direct flow right of 10 cubic feet per second (cfs) to irrigate a 100-acre field cannot divert more water than is needed to irrigate that 100-acre field at the rate of 10 cfs.

The second type of water right is a storage water right, which is measured in terms of volume. The appropriator might have the right to store a prescribed amount of water in a vessel such as a reservoir each year for beneficial use at a later time. Storage rates are usually permitted for one filling of a vessel per year.

6.1.6 Water Quality

6.1.6.1 Clean Water Act, Section 303(d) Regulations

The CWA section 303(d) requires states to identify waters that are not expected to meet the national goal of being "fishable and swimmable" and to develop Total Maximum Daily Loads (TMDLs) for these waters with oversight from the EPA. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards.

Section 303(d) of the Clean Water Act requires states to prepare and submit biennially a list of waters to the EPA that do not or may not meet water quality standards. This is used to set pollution abatement program priorities in areawide management programs and must be done for stream segments where technology based controls for both point and non-point sources are not able to meet the standards.

The 303(d) list identifies priority waters requiring a TMDL process, which allocates pollutant loads or potential pollutant loads among all identified sources in a manner such that the combined discharges do not cause the water quality standards for a given water body to be exceeded under existing and future conditions. To control the pollutant levels, NPDES permits are issued and administered by the CDPHE through its Water Quality Control Division (WQCD). TMDLs are pollutant-based for individual creek sections. In the 2002 303(d) Monitoring and Evaluation (M&E) List, sections Segments 1 and 3 of Fountain Creek were listed for sediment.

6.1.7 Wastewater Treatment Plant and Industrial Discharge Permits

The goal of the NPDES program for wastewater dischargers is to ensure that every publicly owned treatment works facility treats their wastewater in a manner than protects public health and aquatic life. The permitting program establishes pollution limits and specifies monitoring and reporting requirements to meet this goal. The EPA has also developed a NPDES watershed strategy that is consistent with its larger watershed approach to address the following six focus areas:

- Statewide coordination;
- Streamlining of the permitting process within a watershed;
- Monitoring and assessment;
- Programmatic measures and environmental indicators;
- Public participation; and
- Enforcement.

As a component of the influent wastewater stream, industrial wastes that may contain toxic pollutants represent a significant risk to the effective operation of wastewater treatment operations and to the goal of achieving fishable and swimmable water quality in receiving waters. Therefore, operators of publicly owned treatment works must establish a pretreatment program to prevent the release of potentially toxic pollutants to the influent wastewater stream to their treatment plants.

Under NPDES, the CDPHE established 6 general permit categories that cover over 27,000 permittees to date:

- Light industry;
- Construction;
- Auto recycling;
- Heavy industry;
- Sand and gravel mining; and
- Metal mining.

6.2 Summary of Current Local Regulatory Programs

This section reviews local regulatory programs and ordinances and discusses local strategies. A summary of local regulatory in included in the Policy Matrix (Appendix F). Zoning ordinances, regulations and drainage criteria were reviewed from the eleven local governments within the Fountain Creek Watershed: El Paso County, Pueblo County, Teller County, the City of Colorado Springs, the City of Fountain, the City of Manitou Springs, the City of Pueblo, the City of Woodland Park, the Town of Green Mountain Falls, the Town of Monument and the Town of Palmer Lake.

Documents from each local government were evaluated to provide a common, consistent baseline for decision making. In order to protect and restore the Fountain Creek Watershed, regulations and policies must address the non-point source origins of problems in the watershed and recognize specific issues related to watershed health, particularly erosion, sedimentation and

flooding. It is important to determine how progress can be achieved to ensure that each of the eleven local governments implement regulations that consider the regional and cumulative effects of their programs and activities within the Fountain Creek Watershed.

This is particularly important because municipal and county zoning regulations are designed to provide a systematic process for the development and use of lands within their own jurisdictions. By regulating the location and height of structures, the amount and location of parks and open space, the development and structure of subdivisions (including lot sizes and spacing) and allowable activities, zoning regulations have the potential to dramatically influence the state of the land surface, the effect on precipitation and run-off, and ultimately the state of the watershed.

6.2.1 Regulatory Program Review and Summary

Local regulations and ordinances that affect stormwater management, erosion control, and floodplain restrictions in the counties and municipalities within the Fountain Creek Watershed are shown in the Policy Matrix (Appendix F). The Policy Matrix allows for regulatory categories that are common in each jurisdiction in the watershed to be compared. The matrix also identifies categories where documents or policies do not exist or are not comprehensive. A more detailed discussion in the following sections indicates both the common points and differences in policies and ordinances throughout the watershed.

The Policy Matrix is divided into regulatory categories that include:

- Drainage Planning Policies
- Stormwater Utility
- Stormwater Design Criteria
- Financial Responsibility
- Development Near Channels, Irrigation Ditches, and Drainageways
- Stormwater Runoff Detention
- Stormwater Runoff

- Quality of Stormwater Runoff
- Channelization
- Erosion and Sediment Control
- Erosion, Sediment Control and Stormwater Quality (combined)
- Floodplain Standards
- Streamside Approach/Prudent Line
- Drainage Basin Fees
- Grading
- Easements
- Required Improvements
- Street Design
- Construction
- Miscellaneous

6.2.2 Review and Comparison of Policies and Ordinances

Policies and ordinances of local governments within the Fountain Creek Watershed were reviewed, compared and identified as being either common to all communities or unique to a particular community.

6.2.2.1 Policies and Regulations Common to All Communities in the Watershed

There are several ordinances and policies with similar objectives that are shared among individual communities, including:

- **Floodplain Restrictions.** All land use control documents require residential development to be located at a minimum elevation equal to or above the base

(100-year) flood elevation. Other development inside the floodplain must be floodproof and waterproof below the base flood elevation. Proper anchoring and hydrostatic resistance must also be in place. Floodplain development standards are required by the Federal National Flood Insurance Act in order for counties to qualify for federal flood insurance. Municipalities must have the legal authority to implement land use and control measures that comply with federal requirements in order to qualify for federal flood insurance.

The Colorado Land Use Act allows local governments to identify, designate and regulate development within flood hazard areas through a permitting process. Colorado Revised Statutes (CRS) allow local units of government to develop planning and zoning regulations addressing, in part, development within the 100-year floodplain. Please see the Floodplain category in the Policy Matrix (Appendix F).

- **Development Planning.** All local governments within the watershed require a complete drainage plan for new developments. The requirements of each drainage plan differ, and although there are no state requirements (CRS do authorize municipalities and counties to consider such requirements), most drainage plans consider on and off-site drainage improvements, assume full development of any proposed development upstream upstream, and place all costs of improvements upon the developer.

  In some municipalities and counties the costs are offset for the developer only if regional facilities are constructed as part of the development. Jurisdictional drainage planning for new development is authorized under CRS, pertaining to county and municipal planning and zoning. NPDES Phase I and Phase II Stormwater regulations (refer to Section 6.1.3) require local governments of a certain population to address stormwater runoff from new developments through an NPDES permit from the State. Please see the Drainage Planning Policies category in the Policy Matrix (Appendix F).

- **Erosion Control Plan.** All governments require an erosion control plan that outlines methods for reducing soil erosion during construction and grading of land. All governments have some policy addressing erosion control, but the

level of requirements varies across the watershed. General requirements include an erosion control plan to be approved prior to the commencement of construction. More specific policies address requirements for temporary and permanent sediment control facilities, protection of land cover for long construction periods, and security required until construction is completed and inspected.

Erosion control plans are required components of Stormwater Management Plans for construction activities, which are required under NPDES Phase II for stormwater discharges from construction activities resulting in a total land disturbance of equal to or greater than one acre where those discharges enter surface waters of the United States or a municipal storm sewer system leading to surface waters of the United States. A regulation that has been proposed by the EPA (Effluent Limitation Guidelines and New Source Performance Standards for the Construction and Development Category; FR Vol. 67, No. 200, June 2002) would establish performance standards and/or effluent limitation guidelines for construction sites on a nationwide basis. A decision regarding this has not been rendered. Please see the Erosion and Sediment Control category in the Policy Matrix (Appendix F).

Industrial facilities including most manufacturers, mining, transportation facilities, power plants, landfills, wastewater treatment plants and recyclers that discharge water must be covered by a state stormwater discharge permit.

- **Detention.** Local governments within the watershed recognize the importance of detention when increasing the impervious area within the basin. While not all communities have specific criteria regarding detention, its importance is mentioned in their planning policies. There are no specific federal or state laws or regulations mandating stormwater detention. However, state statutes require counties to adopt subdivision regulations requiring developers to submit maps and plans (where applicable) for facilities to control stormwater in excess of historic runoff levels. Counties are also required by state statute to include provisions governing standards and technical procedures applicable to storm drainage systems and detention facilities in their subdivision regulations.

Similar requirements do not extend to municipalities. Please see the Stormwater Runoff Detention category in the Policy Matrix (Appendix F).

- **Design Requirements.** Detailed design criteria for structures such as roads, culverts, channel linings, detention, storm sewer systems and others are provided across the watershed. Municipalities without specific criteria adopt county guidance. While detailed design criteria are not contained in federal or state laws and regulations, state statutes require that standards and technical procedures for stormwater drainage and sanitary sewer service be established in subdivision regulations for unincorporated county areas. Some stormwater drainage design requirements for county road systems (and municipal streets to a lesser extent) are contained in the state statutes, the detailed requirements of which are the responsibility of counties and municipalities to determine.

  Under the Colorado Land Use Act (CRS 24-65-105), the Colorado Land Use Commission[2] is required to develop model resolutions to serve as guidelines for county planning commissions in developing subdivision regulations. These resolutions shall include provisions for criteria, standards, technical processes, and operational procedures. These resolutions must also address development of land use and construction controls within designated floodways. Beyond this, however, there are no model ordinances or standards promulgated within the state statutes addressing any structures or land use features. Please see the various categories in the Policy Matrix (Appendix F).

6.2.2.2 Communities With Ordinances or Policies Unique to the Watershed

Some communities within the Fountain Creek Watershed have unique policies or ordinances related to stormwater issues within the basin, including:

- **Stormwater Utilities.** One ordinance that is unique to the Cities of Manitou Springs and Pueblo is the creation of stormwater utilities that generate revenue for building and maintaining drainage facilities. Currently, Manitou Springs generates revenue by charging each water customer three dollars per month on

[2] The Colorado Land Use Commission has been dissolved, but as there is no official record of it being dissolved in the CRS, the duties and requirements of the Commission are still contained in the CRS. There is also no record of any changes to the CRS that would supersede the formation of the Commission or its requirements.

their utility bill. The City of Pueblo adopted a stormwater utility ordinance that became effective on June 1, 2003, which was created to meet the need of improving the quality of streams and creeks and prevent flooding. All properties within the City of Pueblo pay a stormwater service charge based on impervious area of individual ownerships. While no state or federal laws or regulations mandate the establishment of stormwater utilities, several state statutes do grant the authority to establish local improvement districts, and give direction to local governments seeking to create stormwater utilities. Please see the Stormwater Utility category in the Matrix (Appendix F).

- **Drainage Basin Fees.** Some jurisdictions in the watershed impose drainage basin fees for new developments or substantial improvements, including the City of Colorado Springs, Town of Monument, Town of Palmer Lake, City of Woodland Park and El Paso County. Fees are based on a developed acreage algorithm. El Paso County adopted detailed regulations outlining specific measures with respect to drainage basin fees, which address various scenarios, such as drainage facility construction cost and lot size that might allow for fee reduction or reimbursement of fees. Under the City of Colorado Springs drainage basin fee system, public drainage facility costs in excess of the drainage basin fees are reimbursed to the developer as other drainage basin fees become available in the respective basin. While drainage basin fees are not mandated by either state or federal laws or regulations, procedures are contained in the state statutes that require counties to establish subdivision regulations and related development standards, and criteria for establishing payment of drainage fees. Please see the Drainage Basin Fees category in the Policy Matrix (Appendix F).

- **Channel Stabilization.** In Colorado Springs and El Paso County, channels must be adequately stabilized to prevent erosion in excess of historic flows. The City of Woodland Park has a similar ordinance indicating that stream and watercourse banks and channels downstream from any land disturbing activity shall be protected from increased degradation by accelerated erosion resulting from high velocity runoff. While there are no state or federal laws or regulations mandating the stabilization of natural channels for erosion control, state statutes give local governments the authority to remove obstructions to flood channels

(which may include eroded materials). Authorities granted by the state to local governments concerning new subdivisions allow counties and municipalities to require developers to submit maps and plans (where applicable) for facilities to control stormwater in excess of historic runoff from areas undergoing development. Please see the Channelization category in the Policy Matrix (Appendix F).

- **Erosion Control Buffer Zone.** The City of Pueblo requires an erosion buffer zone to be delineated near highly erodible channels to allow for future natural widening of the channel and to provide for protection of the stream corridor. Submittal must show this zone on the plat. El Paso County incorporates a similar policy in their Prudent Line Setback. While no state or federal mandates for erosion buffer zones exist, state statutes do allow local governments to identify highly erodible areas through their master planning process and adopt measures to guide development within these areas. Please see the Streamside Approach/Prudent Line category in the Policy Matrix (Appendix F).

- **NPDES Stormwater Requirements.** The City of Colorado Springs recently adopted an additional drainage criteria manual that specifically addresses its NPDES Phase I requirements including BMPs and stormwater quality. It is expected that El Paso County will adopt similar measures for compliance under NPDES Phase II requirements. The other communities in the watershed designated to comply with NPDES Phase II requirements are the City and County of Pueblo, the City of Fountain, the City of Manitou Springs and the Town of Monument.

- **Streamside Ordinance.** The City of Colorado Springs recently adopted a new Streamside Ordinance with the purpose of guiding the development and maintenance of property adjacent to stream corridors. Development is to be compatible with the environmental conditions, constraints and characteristics of these areas. The ordinance is specific in requiring design review, development standards, allowable impervious area, streamside buffers, and land uses within the streamside zone. This policy is unique in that it has the most detailed coverage regarding development near streams.

While no federal or state laws or regulations mandate this type of ordinance, floodplain development standards are required by the Federal National Flood Insurance Act in order for counties to be eligible for federal flood insurance. The Colorado Land Use Act allows counties to designate flood hazard zones as areas of state interest where regulations may be implemented. CRS allow local governments to develop planning and zoning regulations addressing, in part, development within the 100-year floodplain. For areas outside of the 100-year floodplain, state statutes allow local governments to identify appropriate land uses and development densities within areas of special jurisdictional interest, including stream corridors; however, specific criteria are not mandated. Please see the Streamside Approach/Prudent Line category in the Policy Matrix (Appendix F).

- **Downstream Impacts.** The City of Pueblo has the most provisions requiring that new development does not increase the water management problems of downstream entities. Several ordinances require analysis showing that downstream impacts to property are negligible due to the development. Other than the National Environmental Policy Act (applicable to actions taken or funded by federal agencies), no other federal or state laws or regulations directly require the assessment of downstream impacts generated by upstream development. However, counties are required by state statutes to specify design and drainage standards for development under subdivision regulations. These standards must address the impact of the new development on existing flood control and storm drainage facilities in the area. The assessment of downstream impacts may be required by jurisdictions under this statutory provision. Please see various categories in the Policy Matrix (Appendix F).

6.2.3 Policy Strategies

6.2.3.1 Watershed Concerns Not Addressed in Existing Documents

- **Volume Increase.** Most jurisdictions in the watershed require detention in order for peak flows to be attenuated, and although this controls flooding during storm events, the total volume of flow is not reduced. Increased impervious areas throughout the watershed cause increased runoff volume that results in

prolonged shear stress to channels during flood events and more baseflow during other periods. Irrigation return flows also contribute to increased volume. Further, transbasin water imported for water supply results in higher sanitary and storm sewer flows, ultimately discharging and adding non-historical flow into Fountain Creek.

The EPA's stormwater permit program under the Clean Water Act, implemented at the state level through NPDES permits, recommends that permittees select BMPs designed to maintain pre-development runoff conditions at sites where new or re-development is planned. The state, in its guidance to Phase II stormwater permittees, does require permittees to develop design criteria and standards for BMPs and identifies stormwater quantity detention and infiltration practices as among those to be included. These requirements only address the issue of stormwater volume increase within the areas of permit coverage.

Outside of permitted areas, no other federal or state laws or regulations directly address this issue. If stormwater volume increases and/or transbasin diversions contribute to stream channel erosion and sedimentation and causes water quality impairments to a stream, the Clean Water Act may require the state to develop a TMDL for sediment, which would lead to enforceable requirements aimed at the sediment sources.

- **Clear Water Scour and Sediment Transport.** Currently there is not an ordinance among the watershed jurisdictions related specifically to clear water scour and sediment transport. A common problem across the watershed is the settlement of sediment in detention facilities, which can result in increased clearwater scour downstream. While no state or federal laws or regulations address this issue directly, the Federal Clean Water Act and the state laws that implement it indirectly address sources of sediment to state waters where those sources result in the stream being listed as water quality-impaired due to sediment.

- **Flow Bulking**. There are no current ordinances specifically related to flow bulking, which refers to the quantity and size of sediment and may affect the

hydrologic analysis of the drainage basin. Bulking transported by storm runoff may significantly increase the volume of flow, affect flow characteristics and can be a major characteristic in the hydraulic design of drainage structures. Bulking factors are typically used in determining design for facilities located within mountainous regions that are subject to fire and subsequent soil erosion.

- **Channel Improvement Impacts.** Existing design criteria do not sufficiently address system impacts that can occur from the construction of channel improvements. A more holistic design approach should be considered to address both upstream and downstream changes that may result from in-channel projects, particularly in the mainstem of Fountain Creek where meander migration is most pronounced. While no state or federal laws or regulations address this issue directly, the Federal Clean Water Act and the state laws that implement it indirectly address sources of sediment to state waters where those sources result in the stream being listed as water quality-impaired due to sediment.

- **Enforcement and Maintenance.** Maintenance of stormwater facilities and enforcement of ordinances are also an issue in the watershed, especially in new facilities that were not properly installed, do not functioning properly, or have failed entirely. The City of Woodland Park has the only ordinance requiring financial accountability for facilities that are not properly installed. Enforcement will become even more important as the NPDES Phase II stormwater rules go into effect for the larger jurisdictions in the watershed. The federal NPDES Phase I and Phase II stormwater regulations mandate ordinance enforcement and BMP maintenance requirements. Local jurisdictions required to obtain a NPDES Phase II permit must:

    - Adopt minimum control measures designed to reduce the introduction of pollutants to their municipal separate storm sewer system (MS4) to the maximum extent practicable;

    - Demonstrate long-term operation and maintenance of appropriate BMPs; and

    - Adopt and enforce stormwater ordinances.

No federal or state requirements exist that specifically address these issues outside of areas covered by these permits. A proposed EPA regulation (Effluent Limitation Guidelines and New Source Performance Standards for the Construction and Development Category; FR Vol. 67, No. 200, June 2002) would establish performance standards and/or effluent limitation guidelines for construction sites on a nationwide basis, but would not address post-construction stormwater management.

6.2.3.2 Implementation of New Policies

Effective maintenance and enforcement practices for stormwater and erosion control should be implemented across the watershed. New policies and regulatory controls should be adopted and developed to provide a basis for conducting inspections, issuing violation notices, imposing fines, and issuing stop work orders for violations during construction. An effective program would ensure that compliance and inspection is consistent throughout the watershed. This could be accomplished by clearly identifying tiers of violations and associated metrics in order for property owners and contractors to understand the implications of their actions. The most important aspect of the success of this type of program is regular construction inspections and strict compliance with regulations, which would mandate a larger labor force (Burrell, 2002).

6.3 Other Watershed Policies

There are several national organizations that provide helpful links and information pertinent to the future development in the watershed including ordinances and policies in place in other communities. This includes several watershed organizations located within Colorado and associated with the Colorado Watershed Assembly, such as the North Fork River Improvement Association, which recently won an award for building a watershed partnership on the North Fork of the Gunnison River that resulted in significant restoration and improved aquatic riparian habitat.

Table 6-1 provides a summary of useful watershed organizations relevant to the Fountain Creek Watershed.

Table 6-1. Relevant Watershed Organizations

Watershed/ Organization Name	Mission Statement and/or Relevance to Fountain Creek Watershed	Location	Contact Information
Watershed Management Council	A non-profit educational organization dedicated to the advancement of the art and science of watershed management.	National, based in California	www.watershed.org
The Stormwater Manager's Resource Center	Links to ordinances of several communities by specific topic.	National Organization	www. stormwater center.net
Colorado Watershed Assembly	Mission is to support collaborative efforts to protect and improve the conservation of land and natural resources of Colorado watersheds.	Colorado	www. coloradowater. org
Colorado Water Protection Project	Mission is to implement a comprehensive public relations campaign and support activities to increase public awareness in Colorado about the causes of and solutions to urban polluted runoff resulting from household activities including non-point source pollution.	Colorado	www.ourwater. org
Urban Drainage and Flood Control District	Ordinances and policies, flooding, erosion and sediment control, Phase II NPDES regulations.	Denver, Colorado	www.udfcd.org
Clean Water Action Plan-Watershed Success Stories	Summaries of successful watershed projects, some including erosion and sediment, best management practices	Various watersheds across the U.S.	www.cleanwater. gov/success/ index.html
North Fork River Improvement Association	Mission is to meet current and future demands for traditional uses of the river while improving stream stability, riparian habitat, and ecosystem function along the North Fork of the Gunnison River.	Hotchkiss, Colorado	www.nfria. paonia.com/index.htm
Roaring Fork Conservancy	Community outreach	Basalt, Colorado	www.roaringfork.org
Big Thompson Watershed Forum	Voluntary watershed protection program with stakeholders, with strong public and financial support. Mission is to facilitate cooperative water quality assessment, reduce or eliminate existing and potential water quality problems and educational programs.	Loveland, Colorado	www.btwatershed.org
Calleguas Creek	Non-point source pollution, flood protection and sedimentation control, and public outreach and education	Ventura County, California	www.calleguas. com/ccbrochure/introl d.html
Los Angeles County Watershed Management	Erosion control, stormwater quality, and best management practices, stormwater and runoff ordinances.	Los Angeles, California	ladpw.org/wmd/

6.4 Technical Strategies

This section identifies a broad range of potential watershed management practices designed to mitigate past and future effects based upon previously accepted and identified best management practices (BMPs). When properly installed and maintained, BMPs play an important role in controlling non-point source pollution, thereby protecting water quality and riparian habitats, mitigating floods and maintaining stream stability. Several BMP manuals have been developed at national, regional and local levels.

On the national level, the Urban Water Resources Research Council (UWRRC) of the American Society of Civil Engineers developed a National Stormwater BMP Database. This database has undergone intensive review by many experts and encompasses a broad range of parameters including test site location, watershed characteristics, climatic data, BMP design and layout, monitoring instrumentation, and monitoring data for precipitation, flow and water quality. This database is part of a larger project with the ultimate purpose of identifying factors that affect BMP performance, developing measures for assessing BMP performance and using the findings to implement design improvements.

The National Stormwater BMP Database Search Engine is available online at http://www.bmpdatabase.org/background.html, as well on CD. It enables users to access BMP data stored in the master stormwater database. The current database contains 98 BMPs at 84 test sites (UWRRC, 2001).

The Colorado Department of Transportation (CDOT) has developed an Erosion Control and Stormwater Quality Guide. The guide is intended to aid designers, field and maintenance personnel, consultants and contractors in designing and implementing measures to protect water quality. Guidelines are given for the application, use limitations, design, construction and maintenance of BMPs for erosion and sediment control and stormwater quality management (CDOT, 1995).

The City of Colorado Springs adopted the *Drainage Criteria Manual, Volume 2, Stormwater Quality Policies, Procedures, and Best Management Practices (BMPs)* for compliance with NPDES Phase I regulations. El Paso County will adopt similar measures to ensure compliance with the NPDES Phase II requirements.

6.4.1 Channel Stabilization Methods

Each channel stability problem is unique, and as such, the methods required to address each problem must to be tailored to fit site-specific conditions. Multiple methods exist to address the problems described in Section 4, Characterization of Watershed Problems and Issues. A list of methods and a brief discussion of solutions that may be appropriate for current and potential future problems found in the Fountain Creek Watershed is provided below. Some case examples are explained along with recommended stabilization methods to mitigate the problem. Other structural, nonstructural, industrial and commercial BMPs that are used in Colorado for stormwater and non-point source runoff management can be found in the City of Colorado Springs *Drainage Criteria Manual, Volume 2, Stormwater Quality Policies, Procedures, and BMPs* (2002) and the *Urban Drainage and Flood Control District Drainage Criteria Manual Volume 3* (1999).

6.4.1.1. Grade Control

Grade control measures provide stabilization for the channel bed, which are particularly important to locations such as Cottonwood Creek and Monument Creek where degradation is an ongoing problem. Two such examples explained below are Newbury Riffles and boulder drop structures (riffle drop).

6.4.1.1.1 Newbury Riffle

Newbury Riffles provide a simple way to control grade with a natural looking structure that checks the channel grade, adjusts with the river grade and does not require concrete.

6.4.1.1.2. Boulder Drop Structure (Riffle Drop)

Boulder drop structures (riffle drops) provide channel grade control for stream channels and are normally constructed in upstream/downstream pairs. The upstream drop structure provides a drop in water surface elevation of approximately 18 inches and the downstream structure provides a drop of approximately 6 inches. The spacing between the drop structures is typically 0.3 to 0.6 times the channel width.

Boulder drop structures are typically angled in an upstream "V" pattern to direct the river energy into the channel center and away from the banks, thus reducing bank erosion potential. The upstream drop structure should be made with a dip in the center of 4 to 18 inches. A firm foundation is required to prevent piping, sliding and undermining. The foundation is constructed of 36-inch or larger boulders imbedded in the channel with additional 36-inch diameter boulders added on top to increase drop height.

The benefits of boulder drop structures include:

- Constructed with natural materials
- Provides pool/riffle sequence
- Provides pool scour and grade control
- Enhances fish habitat and allows fish passage
- Reduces bank erosion upstream and downstream of structure
- Less expensive than concrete structures

The drawbacks of boulder drop structures include:

- Results in a hard point within the river and can eliminate natural meandering
- Requires periodic maintenance if rocks are displaced
- May require additional protection of footing

6.4.1.2 Bank Stabilization

Engineered bank stabilization measures are available in a wide variety of materials and approaches. Methods discussed below include J-Hook weirs, Bendway weirs, bioengineering and pole planting of cottonwood and willow.

6.4.1.2.1 J-Hook Weirs

Purpose - Provide stability for the river channel, reduce potential for bank erosion, and enhance stream habitat. May also be used to redirect flow.

Description - The structures normally are constructed in a series. These structures are designed to reduce erosion along the outside of meander bends. They will also establish a pilot channel by focusing flow within the channel to a central point. In so doing, a scour hole is created which can provide fish habitat. The structure must be adequately keyed into the streambank.

Lateral channel stability is achieved by the development of a pool-riffle or pool-run regime. The distance between structures should be dictated by the average spacing between pools in a channel with similar characteristics as well as local channel hydraulics. Spacing between structures may be much decreased along the outside of tight meander bends if adequate bank protection is to be attained. Large boulders (e.g., 2 feet to 3 feet in diameter) are required for construction in order to minimize the potential for displacement during high flows. Graded riprap may also be utilized. The structure should be tapered from the streambank to the outermost edge with the structure height at the streambank approximately twice the height of the outer edge.

Benefits

- Constructed with natural materials
- Provides fish habitat
- Reduces bank erosion
- Inexpensive

Drawbacks

- Requires careful design and installation to ensure proper function

6.4.1.2.2 Bendway Weirs, Rock Barbs

Purpose - To reduce erosion along the outside bank of a channel bend.

Description - The structures are constructed in series along the outside of a bend. The structures are spaced approximately 75 to 100 feet apart with the first one being installed at the bend entrance and the final at the bend exit (see detail). Each structure is approximately 0.25 to 0.5 times the base flow channel width in length and is tapered into the flowline. The structure is generally built of well-graded stone and is tapered with the instream end being approximately 2 feet in height and bank end approximately 4 feet

in height. The weirs are typically angled 10 to 25 degrees upstream. The structure must be adequately keyed into the streambank.

Benefits

- Structure is made of natural materials
- Provides sediment storage and local scour
- Provides fish habitat and allows fish passage
- Reduces bank erosion upstream and downstream of structure
- Less expensive than traditional streambank armoring

Drawbacks

- Potentially changes the course of a river if designed incorrectly
- Requires periodic maintenance if rocks are displaced
- Opposite bank erosion, if hydraulics are not correctly understood
- Root failure possible, if inadequately protected
- Potential for failure due to erosion or high flows is fairly high

6.4.1.2.3 Bioengineering

Purpose - Increase bank slope stability using native materials.

Description - The toe of the bank slope is armored with riprap, gabions, or other hard material below the channel bottom to an elevation equal to or greater than low flow stage. The channel bank above this point is graded to a 3:1 slope or less and reinforced using vegetative material, such as willow post plantings, wattles (bundles of stems), etc. This technique should be utilized on a portion of the streambank where channel hydraulics and tractive forces are not excessive.

Geotextile matting may be used to assist in stabilizing the bank. The material can be a permanent matting or one that will degrade through time. Installation of the matting (e.g., staking) should occur per manufacturer's recommendations. Matting greatly reduces the potential for surface erosion during high flow events. Planting species, such as willows, through the matting will increase flow resistance and act to reinforce the bank. Willow posts must be planted when dormant. Post should be greater than 1 inch

in diameter and be placed on a 3-foot by 3-foot grid pattern. The posts should be at least 3 feet long with about 2 feet below ground.

Benefits

- Structure is made of natural materials and visually appealing
- Improves stability
- Relatively low cost
- Less expensive than using hard materials

Drawbacks

- Should not be used where a beaver problem exists
- May fail if tractive forces above the flow stage are too great
- If plantings do not "take", banks are left largely unprotected

6.4.1.2.4. Pole Planting Of Cottonwood And Willow

Purpose - Additional planting of cottonwood and willow is intended to establish (or reestablish) native vegetation in riparian areas and provide bank stabilization. Pole planting techniques are especially useful on woody species such as willow and cottonwood.

Description - Cuttings should be gathered from trees in the surrounding area by cutting branches at a 45 – degree angle while the trees are dormant. If not planting the same day, cuttings may be stored in water for a few days. Poles should be planted cut-end down at a depth sufficient to reach the water table. The terminal end of the pole may be pruned (paint to prevent water loss) to prevent flowering and to promote growth at the rooting end. Before any project involving stream channels, the appropriate state (Water Resources, Division of Wildlife) and federal agencies (U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service) must be notified, as permits may be required. Protection from beaver may be necessary and can be achieved through installation of wire mesh guards around cuttings.

Benefits

- Stabilizes banks
- Creates wildlife habitat

- Poles can be planted deep enough to reach low water tables
- Resistant to high velocity flows once established

Drawbacks

- Management (grazing, beaver, etc.) is necessary to ensure successful establishment
- Some replanting may be necessary due to mortality

7.0 Conclusions and Recommendations and Implementation Strategies

7.1 Conclusions

The Fountain Creek Watershed Plan is the initial step in developing a comprehensive understanding of the Fountain Creek Watershed by providing a data inventory and assessment of existing problems and issues. All eleven local governments in the Fountain Creek Watershed and state and federal agencies were involved in the development of this Plan. It represents a major regional step towards a coordinated and cooperative approach to find solutions and reduce damage to roads, irrigation structures, utilities, homes, and county and city infrastructure.

Conclusions drawn from a review of this Plan include:

- Multiple factors are responsible for the erosion, sedimentation and flooding problems in the Fountain Creek Watershed. Many of these factors are related to the population growth that has occurred in the watershed in the past fifteen to twenty years. Population growth has caused an increase in impervious surface area, increase in wastewater treatment plant discharge, and an increase in importation of transbasin water. USGS Studies (Stogner, 2000) have shown that increases in streamflow during low flows are primarily a result of increased wastewater treatment plant discharge, importation of transbasin water, and management of the Fountain Creek transbasin return flow exchange decree.
- Most of the soils found in the Fountain Creek Watershed are easily erodable and have high to moderate runoff potential, which can contribute to the increase in erosion and sedimentation damage in the watershed. Solutions must take this into consideration.
- Solutions are needed to address both the sources of problems and also to mitigate existing damage. Specific policies must be implemented to address the occurrence and severity of erosion, sedimentation and flooding in the future, along with technical strategies to mitigate potential damage. Specific policies should include better enforcement and protection of existing regulations, development of new floodplain regulations, and improved drainage and planning. Other policies should include methods to reduce the amount of residential and existing industrial water use, thus reducing per capita stormwater system and wastewater discharge rates. This can be done through the use of water conservation (e.g. encouraging the use of xeriscaping), increased use of non potable water and alternatives to direct discharge of treated effluent into streams. Three examples of proactive steps that have already been initiated include 1) the City of Colorado Springs Streamside Ordinance, which guides the development and maintenance of property adjacent to stream corridors; 2) Drainage Basin

Fees imposed by El Paso County and the Town of Monument on new developments or substantial improvements; and 3) NPDES Phase II regulations in many of the communities to address stormwater problems. Policy and regulatory changes will require the support of the elected officials in each community.

- Actions taken to repair or mitigate damage in one area can have both positive and negative consequences to upstream and downstream areas. Negative consequences include redirection of flow, and velocity changes, which can cause erosion and/or sedimentation upstream and downstream.
- The Fountain Creek Watershed has diverse ecosystems, topography, climate, soils and land uses. Strategies found to be appropriate in one area can be inappropriate for other areas. Each of the four subwatersheds has different issues and problems.
- Solutions must incorporate a regional approach and framework. Future success of watershed management hinges on collective and collaborative work efforts that incorporate stakeholders into the decision making process.
- Public outreach and education is a critical component in watershed planning. Public outreach and education has already been accomplished by disseminating information through newsletters, web sites, public speaking engagements and public meetings. These efforts should be continued.
- Both short term and long term solutions are necessary to effectively remedy problems in the Fountain Creek Watershed. If problems are not addressed immediately, increasing deterioration of the watershed will occur. Without a proactive vision towards the future, damage will be more frequent and severe.
- Further information must be collected on erosion impacts and sediment loading in stream segments in the watershed. This information will be useful when reviewing future development plans and issuing development permits. This will be completed as part of the Army Corps of Engineers Watershed Study.

7.2 Future Planning Activities

The ACOE will build upon the Fountain Creek Watershed Plan by conducting a Watershed Study to provide more in-depth characterization of the watershed. This Study will take a regional perspective so that all local participating governments and stakeholders can benefit. The Study will result in the further evaluation of projects under other ACOE Authority Programs to address flood control, erosion, sedimentation and environmental restoration problems. In this Study the ACOE will:

- Conduct a hydrologic assessment of the watershed;
- Conduct hydraulic, erosion and sedimentation analysis;
- Develop, evaluate and prioritize conceptual alternatives including structural and non-structural measures;
- Develop support for conceptual alternatives including input for environmental permitting and project-related environmental assessments;
- Project future impacts from future urban development, storm events, and newly developed water supply sources;
- Develop technical and policy strategy recommendations; and
- Analyze impacts associated with future flows.

This Study will take 3 ½ years and is expected to be completed by the third quarter of 2006. A copy of the Scope of Work can be found in Appendix G.

7.3 Recommendations and Implementation Strategies

Stakeholders must become engaged in and understand the importance of finding solutions in order for this Plan to be an effective planning and educational tool. Recommending and implementing short and long term restoration and protection strategies requires the support of all local governments and stakeholders.

As this is a regional plan, implementation recommendations are made according to regional needs and concerns. Implementation recommendations are based on a review of information concerning the impacts that have been discussed in specific areas of the watershed, and strategies that have been found effective in other watersheds throughout the country.

Implementation Recommendations and Strategies

1. Critical Area and Strategy Identification

A. Develop a prioritized list of critical areas in the Fountain Creek Watershed that are identified as having erosion, sedimentation and flooding problems along Fountain Creek, Monument Creek and major tributaries using historical aerial photography (pre and post 1999), reports and other information. This analysis should focus on stream reaches where stream dynamics have caused lateral or vertical movement in the channel, and have, or may produce, potential problems to infrastructure or critical habitat. These areas will be evaluated to determine if they have current or potential channel stability problems. This analysis will form a better

understanding of both critical areas and also human and physical components affecting the watershed. The information will be used to identify existing and future development that may be at risk due to future channel instabilities. It can also be used to guide land use planning when considering future proposed development.

Implementation Strategy: Apply the prioritized list of stream segments in Section 4 of the Fountain Creek Watershed Plan to determine reaches requiring immediate attention. The following steps will identify the critical areas:

- Determine current and historic meander belts.
- Overlay and identify the location of FEMA floodplains, existing structures affecting stream capacity, future proposed development within floodplain areas to include, and proposed changes to existing or historic floodplains.
- Determine areas that have possible geomorphic and aquatic habitat changes from increased base flows.
- Include erosion and areas of instability on a master map and determine if there are areas with channel stability problems that are not within the boundaries of the FEMA Flood Insurance Rate Maps.
- Coordinate with local governments and the Regional Floodplain Department to develop potential solutions such as erosion buffer limits and minimum setbacks for development.

B. Recommend solutions for each critical area to mitigate existing and/or avoid future damage. Engineered solutions will incorporate a geomorphic assessment and upstream/downstream impacts of mitigation projects proposed by local governments, ACOE, federal and state agencies. A ranking procedure will be developed to prioritize stream reaches requiring remediation; evaluate institutional considerations such as structural and non-structural BMPs focused on urban and construction activities, stormwater detention and floodplain requirements; and determine how these requirements may impact channel stability. If possible, planning level costs for mitigation and remediation will also be determined. This information will be entered into the GIS database (see below).

Implementation Strategy: Review all information concerning problems areas to determine appropriate solutions and strategies for the identified problems. This will be coordinated in a regional manner following these steps:

- Assess stream morphology by collecting data on stream channel dimension, pattern, profile, channel materials, width/depth ratio and entrenchment.
- Compare geomorphic data collected with geomorphic values in nearby reaches of the creek that are stable (or with standard geomorphic values if none of the creek is stable) to assess causes of potential problems and to aid in design solutions.
- Determine the most appropriate BMPs to mitigate further damage and incorporate fluvial geomorphic characteristics of stream segments into project designs.
- Evaluate the economics of the design alternatives.
- Identify and evaluate upstream/downstream impacts such as unexpected channel adjustments or infrastructure damage that may result from streambank erosion control projects.

2. Geographic Information System (GIS)

A. Expand the existing Fountain Creek Watershed GIS database to include both existing information from local governments in the watershed and state and federal agencies, and new information including:

- Data from areas of high erosion and deposition such as pictures, rate of erosion, amount of deposition, relevant physical, hydrologic, geomorphic, slope or structural characteristics, and other information (GPS location, etc.) related to the identified unstable areas. This database currently contains only identification and qualitative descriptions of existing problems.
- Historic and existing water quality monitoring information available from USGS.
- Stream volume comparisons of current and historical data in correlation with the addition of sediment transport and water quality. Suspended sediment and cross-sectional data collected by the USGS (Edelmann, 2002) will be used.
- An evaluation of suspended sediment data (Edelmann, 2002) to determine the need for addition locations to collect suspended sediment.
- Sediment transport data and future information from the ACOE Watershed Study will be used to correlate areas of high sediment transport with the location of unstable areas.
- Identification of infrastructure at risk due to channel stability problems.

The database is stored at PPACG and a list is posted on the Fountain Creek Watershed website of what information has been collected. Depending on copyright restrictions and

other restrictions, this information will be made available in an electronic or hard copy format to other agencies.

Implementation Strategy:

- Develop separate intergovernmental agreements, if necessary, between PPACG and each of the eleven local governments, Colorado Springs Utilities, and state and federal agencies to obtain GIS data.
- Develop a process to obtain recent data from all local governments and agencies that have contributed data in the past
- Create standards and procedures for entering information into the database so it can be retrieved in a quick and efficient manner.

3. Further Research and Evaluation

A. Calculate the percentage of impervious surface area for subwatersheds. This data will be correlated with information on regionally important groundwater recharge areas and areas of high precipitation and/or irrigation where groundwater recharge will have the highest contribution to both groundwater supplies and surface water base flows. The data will also be correlated with information available on water quality, areas of high erosion, etc. Based on the results, recommendations will be made to decrease and/or stabilize the amount of future impervious surface area in certain subwatersheds.

Implementation Strategy: PPACG, local governments and the USGS will develop a methodology to determine the percentage of impervious surface area. Land use maps and aerial photography from the municipalities and counties will be overlaid on the existing USGS Hydrologic Unit Code drainage area maps. The following steps will be taken:

- Impervious surface area information will be collected every two to four years and stored in the Fountain Creek Watershed GIS database. Data will be categorized according to different land use categories such as commercial, industrial, residential, streets and easements, airports, military, agricultural and undeveloped.
- Research will be conducted to determine appropriate impervious surface area threshold levels for the subwatersheds.
- Threshold levels will be used to evaluate ordinances and other strategies to stabilize the amount of future impervious and less pervious surface areas.

- Strategies to minimize the amount of impervious surface area may include minimization and disconnection of impervious surfaces created by construction of parking lots, buildings and roads; removal of vegetation and soil; promotion of groundwater recharge; and reduction of the amount of runoff and associated pollutants.

B. Establish measurable criteria to determine if quantifiable differences or improvements are achieved as a result of implementing recommendations. A method will be developed to monitor both physical changes (e.g. appropriate land use, good stormwater standards) and social changes (e.g. reduced per person water use) in the watershed that are consistent with the Plan's vision to promote the health of Fountain Creek and its tributaries.

Implementation Strategy: Review the objectives of the Fountain Creek Watershed Plan and determine the best method to monitor each of the objectives and evaluate completion of the goals. Success criteria will be used to determine what has been effective in achieving each goal and quantifiable values will be assigned to each of the criteria as a method to measure effectiveness. Criteria will be determined based upon a literature review of methods that have been found effective in other watersheds.

4. Internal Coordination and Review

A. Develop a timely procedure to review work planned within the floodplain and significant wetland areas for comments and feedback to be given on possible consequences. This can be conducted as part of the Army Corps of Engineers' 401 and 404 permitting process, floodplain permitting process, or a jurisdiction's grading and erosion control permitting process. This could be activated for areas that have been identified as having either high erosion and instability problems or high quality wetlands and for projects that will significantly affect creek flow rates and/or the creek route.

Implementation Strategy: The ACOE, Regional Building Department, local governments and Colorado Springs Utilities will work together to develop a review process to identify if issuance of a 401 and 404 permit, floodplain permit, and/or grading and erosion control permit will impact: existing high erosion and instability problems; high quality wetlands; or significantly affect creek flow rates and/or the creek route. Additionally, a flow chart identifying all required review steps before the permit is approved will be developed. This

flow chart will include, but not be limited to defining the roles/responsibilities of each agency involved in the permitting process, establishing coordination between all agencies, consistency with regional plans, assessing potential impact to critical areas, and determining the length of time it typically takes before approval is obtained.

B. Recommend that cities and counties continue to update and revise drainage, floodplain and land use policies that promote better protection of the watershed. Ordinances and regulations that have been found to be effective in other watersheds will be evaluated to determine if they could be applied to the Fountain Creek Watershed. Regional drainage criteria and guidelines will be developed, possibly through an Memorandum of Understanding (MOU) with all participating agencies, using the existing information in the Plan and existing drainage planning policies and regulatory documents that local governments currently have in place.

Implementation Strategy:

- Review the zoning ordinances, regulations and drainage criteria that have been evaluated in Section VI, Summary and Evaluation of Technical and Policy Management Strategies, to proactively find solutions to the drainage problems in the watershed. Local governments will be encouraged to explore adoption of horizontal building setbacks (e.g. City of Colorado Springs Streamside Ordinance) from all stream channels, floodplains, wetlands and riparian areas. Greater setbacks will be encouraged when appropriate and consider a location relative to the eroding creek areas, soil permeability and erodability (soil type), slope, cover conditions, intensity of adjacent land use, quality of existing riparian habitat, and threatened and endangered species.
- Develop an educational program for local governments to inform their staff and constituencies about the importance of and techniques for protecting watersheds.
- Recommend new ordinances, regulations or policies to incorporate watershed protection.

C. Critical stream environment zones, floodplains, wetlands, and riparian areas should be protected through zoning and development regulations, or acquired through conservation easements, land exchanges, transfer of development rights, or similar resource protection techniques.

Implementation Strategy:

- Analyze existing reports and maps and coordinate with state and federal agencies and other stakeholders to determine high priority critical areas.
- Identify high priority critical areas that need further protection on a map and describe the area and rationale/justification for protection. These maps will be maintained by each local government planning department and incorporated into existing streamside protection maps.
- Coordinate with local governments and federal, state and other agencies to determine available resources to protect high priority critical areas.

5. Public Outreach and Education

A. Continue extensive public outreach and education to all stakeholders in the watershed by promoting and maintaining communication, coordination and collaboration. It is essential to seek the involvement of everyone from elected officials and decision makers to land owners for this Plan and subsequent documents to be effective.

Implementation Strategies

- Maintain a list of stakeholders in the Fountain Creek Watershed and proactively maintain media involvement.
- Maintain a repository of current information and post it on the Fountain Creek Watershed website (www.fountain-crk.org).
- Disseminate information using appropriate methods, which include quarterly newsletters, website updates, public speaking engagements, press releases and articles, and advertisements of meeting dates in local newspapers.
- Develop an education program in cooperation with other local, State and Federal agencies for schools, elected officials and civic groups, and work with other existing educational programs.

B. Use the Fountain Creek Watershed Technical Advisory Committee as a tool to advise the Boards of Pikes Peak Area and Pueblo Area Councils of Governments on current technical

issues, goals, plans, and programs affecting the watershed. This group will further promote the vision, goals and objectives of the Fountain Creek Watershed Plan and the ACOE Study.

Implementation Strategy: Hold monthly Fountain Creek Watershed Technical Advisory Committee meetings and solicit input from as many stakeholders as possible.

C. Support and encourage local governments and water providers to implement strategies and promote programs that require the wise use of water, such as long term water conservation efforts, increased use of non-potable water and alternatives to direct discharge of treated effluent into streams. By decreasing the demand for water and using existing resources as efficiently as possible, the need for future water, discharges per capita and flows can be reduced.

Implementation Strategy:

- Help municipalities, counties, utilities and other water providers promote local water conservation and use of non-potable water by supporting appropriate educational efforts and ordinances.
- Support further research to determine strategies that have been found to be effective in other cities and counties and evaluate if those strategies would be appropriate to use in this watershed.

Theses recommendations and strategies will be evaluated for possible grant funding and other options to further the vision and goals of the Fountain Creek Watershed Plan. This could be crucial in removing stream segments in the Fountain Creek Watershed from Colorado Department of Public Health and Environment's Water Quality Impaired list of streams that need further monitoring and evaluation for sediment concerns.

8. Plan Approval

Fourteen public meetings were held in locations within El Paso, Teller and Pueblo Counties to seek public input into development of the Fountain Creek Watershed Plan. These meetings were in addition to public speaking engagements, press releases and the monthly Fountain Creek Watershed Technical Advisory Committee meetings that were used to solicit public input. Both the PPACG and PACOG Boards of Directors approved the Fountain Creek Watershed Plan. The resolution of approval from each Board is contained in this Section.

PIKES PEAK AREA COUNCIL OF GOVERNMENTS

RESOLUTION BY THE PIKES PEAK AREA COUNCIL OF GOVERNMENTS ENDORSING THE *FOUNTAIN CREEK WATERSHED PLAN*

October 8, 2003

WHEREAS, the *Fountain Creek Watershed Plan* was developed under the auspices of the Pikes Peak Area Council of Governments (PPACG) and the Pueblo Area Council of Governments (PACOG) to address the need expressed by local governments, soil and water conservation districts, and private property owners for a more comprehensive understanding of the Fountain Creek Watershed; and

WHEREAS, the *Plan* represents the foundation of future efforts to identify and characterize the problems of the Fountain Creek Watershed and promote public education and outreach within the Fountain Creek Watershed; and

WHEREAS, this *Plan* represents an important step toward the continuation of a long-term regional cooperative effort between the PPACG and PACOG Boards; and

WHEREAS, the PPACG recognizes the Fountain Creek Watershed as a regional asset supporting diverse interests that can best be served through a comprehensive approach to identify and mitigate problems.

NOW, BE IT THEREFORE RESOLVED, that the Pikes Peak Area Council of Governments endorses the *Fountain Creek Watershed Plan* as a guide that will provide information and help obtain the resources necessary to develop effective solutions for the Fountain Creek Watershed.

RESOLVED, APPROVED, AND ADOPTED by the Pikes Peak Area Council of Governments this eighth day of October 2003 at Colorado Springs, Colorado.

LeNore Ralston, Chairperson
Pikes Peak Area Council of Governments

ATTEST:

Fred Van Antwerp, Executive Director
Pikes Peak Area Council of Governments

15 South Seventh Street Colorado Springs, CO 80905 Voice (719) 471-7080 Fax (719) 471-1226 www.ppacg.org ppacg@ppacg.org

RESOLUTION NO. 2003-029

A RESOLUTION APPROVING THE REVISED FOUNTAIN CREEK WATERSHED PLAN

WHEREAS, the revised *Fountain Creek Watershed Plan* was developed under the auspices of the Pikes Peak Area Council of Governments (PPACG) and the Pueblo Area Council of Governments (PACOG) to address the need expressed by local governments, soil and water conservation districts, and private property owners for a more comprehensive understanding of the Fountain Creek Watershed; and

WHEREAS, the revised *Plan* represents the foundation of future efforts to identify and characterize the problems of the Fountain Creek Watershed and promote public education and outreach within the Fountain Creek Watershed; and

WHEREAS, this revised *Plan* represents an important step toward the continuation of a long-term regional cooperative effort between the PACOG and PPACG Boards; and

WHEREAS, the PACOG recognizes the Fountain Creek Watershed as a regional asset supporting diverse interests that can best be served through a comprehensive approach to identify and mitigate problems.

NOW, THEREFORE, BE IT RESOLVED that the Pueblo Area Council of Governments adopts the revised *Fountain Creek Watershed Plan* as a guide that will provide information and help obtain the resources necessary to develop effective solutions for the Fountain Creek Watershed.

RESOLVED, APPROVED, AND ADOPTED by the Pueblo Area Council of Governments this 23rd day of October 2003.

INTRODUCED October 23, 2003

APPROVED:

PACOG Chairperson

ATTEST:

PACOG Recording Secretary

9. References

Allen, Hollis H., and James R. Leach. 1997. Bioengineering for Streambank Erosion Control. Technical Report EL-97-8.Washington, D.C. U.S. Army Corps of Engineers

Ayres & Assoc. 1996. Cottonwood Creek Drainage Basin Planning Study. Colorado Springs, CO.

Bentrup, Gary, and J. Chris Hoag. 1998. The Practical Streambank Bioengineering Guide: User's Guide for Natural Streambank Stabilization Techniques in the Arid and Semi-arid Great Basin and Intermountain West. Interagency Riparian Wetland Project, USDA.

Biedenharn, David S., Charles M. Elliott, and Chester C. Watson. 1997. The WES Stream Investigation and Streambank Stabilization Handbook. U.S. Army Corps of Engineer, Waterways Experiment Station. Vicksburg, MS.

Bossong, Clifford. 2001. Summary of Water Quality Data, October 1987 through September 1997, for Fountain and Monument Creeks, El Paso and Pueblo Counties Colorado: U.S. Geological Survey Water Resource Investigation Report 00-4263.

CH $_2$ M Hill. 1991. Monument Creek Drainage Basin Planning Study

Colorado Springs Dept. of Public Works. 1976. Popes Bluff Drainage Report. Colorado Springs, CO.

Colorado Department of Local Affairs. 2001. Population Estimates for Municipalities, 1980 – 1999, Ranked by Population. [Online]. Available: http://www.dola.state.co.us/demog/munirk99.pdf

Costa, John E. and Jim E. O'Conner. 1995. Geomorphically Effective Floods, in Natural and Anthropogenic Influences in Fluvial Geomorphology. Geophysical Monograph 89. American Geophysical Union .

Denver Engineering Corp. 1985. Madison/Wasatch Drainage Improvements -.Technical Addendum. Denver, CO.

Edelmann, P., Ferguson, S., Stogner, R., August, M., Payne, W., and J. Bruce. 2002. Evaluation of Water Quality, Suspended Sediment, and Stream Morphology with an Emphasis on Effects of Stormwater on Fountain and Monument Creek Basins, Colorado Springs and Vicinity, Colorado, 1981-2001: U.S. Geological Survey Water Resource Investigation Report 02-4104.

Federal Highways Administration. 2001. Bridge Scour and Stream Instability Countermeasures, Experience, Selection and Design Guidance. Hydraulic Engineering Circular No. 23. U.S. Department of Transportation. Washington, D.C.

Guerard, Paul Von,. 1985. Colorado Springs Water System, Colorado Springs Water Dept., Colorado Springs, CO.

Guerard, Paul von. 1989. Sediment-transport Characteristics and Effects of Sediment Transport on Benthic Invertebrates in the Fountain Creek Drainage Basin Upstream from Widefield, Southeastern Colorado, 1985-1988, U.S. Geological Survey Water-Resources Investigations Report 89-4161. Prepared in cooperation with the City of Colorado Springs Department of Utilities. Denver, Colorado.

Graf, William L. 1978. Fluvial Adjustments to the Spread of Tamarisk in the Colorado Plateau Region. Geological Society of America Bulletin, v. 89, p. 1491-1501.

JR Engineering. 2002. Smith Creek Drainage Basin Planning Study. Colorado Springs, CO.

JR Engineering. 1988. Cragmor Master Drainage Plan. Colorado Springs, CO.

Karcich & Weber Inc. 1972. Palmer Park Area Master Drainage Report. Colorado Springs, CO.

Karcich & Weber. 1976. Rockrimmon South Drainage Basin Master Drainage Study. Colorado Springs, CO.

Kiowa Engineering Corporation. 1990. Bear Creek Drainage Basin Planning Study. Colorado Springs, CO.

Kiowa Engineering Corporation. 1991. Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study. Colorado Springs, CO.

Krause, Brian, et al. 1995. Best Management Practices for Chatfield Basin. Prepared for Russell N. Clayshulte, Chatfield Basin Authority, Technical Review Committee.

Lane, E. W. 1955. The Importance of Fluvial Morphology in Hydraulic Engineering. American Society of Civil Engineering. Proceedings, 81, paper 745: 1-17.

Leigh Whitehead & Assoc. 1975. Palmer Park Master Drainage Report & Plan Addition No. 12. Colorado Springs, CO.

Leigh Whitehead & Assoc. 1981. Douglas Creek Drainage Basin. Colorado Springs, CO.

Leopold, L.B., Wolman, M.G. and Miller, J.P., 1964, Fluvial processes in Geomorphology: New York, Dover Publications, Inc., 522 p.

Lincoln DeVore. 1984. Southwest Area Drainage Basin (Cheyenne Creek, Cheyenne Run, & Spring Run. Colorado Springs, CO.

Lincoln DeVore. 1980. Bear Creek Drainage Basin Planning Study, Colorado Springs, CO.

Lovejoy & Williams. 1972. Nineteenth Street Upper Storm Drainage Project. Colorado Springs, CO.

Montgomery-Watson. 2000. Wastewater Infrastructure Strategic Plan. Denver, CO.

Montgomery-Watson. 1999. 1999 Flood Documentation Study. Denver, CO.

Muller Engineering Company. 1991. Fishers Canyon Drainage Basin Planning Study, Colorado Springs, CO

Muller, 1994. Fountain Creek Drainage Basin Planning Study. Prepared for the city of Colorado Springs.

Nadler, C.T., Jr. and S.A. Schumm. 1981. Metamorphosis of the South Platte and Arkansas Rivers, Eastern Colorado. Physical Geography. Volume 2, 95-115.

Obering, Wurth & Associates. 1988. Pine Creek Drainage Basin Planning Study. Denver, CO

Obering, Wurth & Associates. 1992. Pine Creek Drainage Basin Planning Study Amendment No.1. Denver, CO

Pikes Peak Area Council of Governments. 1999. Water Quality Management Plan for the Pikes Peak Region, Colorado Springs, CO.

Riley, Ann L. (1998) Restoring Streams in Cities, A Guide for Planners, Policymakers, and Citizens. Island Press. Washington, D.C.

Rosgen, D. L. (1994) A Classification of Natural Rivers. Catena, Volume 22: 1699-1999. Elsevier Science, BV. Amsterdam.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Colorado.

Schuler, T.R., 1994 The Importance of Imperviousness. Watershed Protection Techniques, vol.1(3): pp. 100-111.

Simons, Li & Associates. 1988. Little Johnson/Security Creek Drainage Bain Planning Study. Colorado Springs, CO.

Simons, Li & Assoc. 1985. Sand Creek Master Drainage Planning Study Technical Addendum. Colorado Springs, CO.

Smith, Bruce, and Don Prichard. 1992. Management Techniques in Riparian Areas. USDI-BLM Technical Reference 1737-6. 1992.

Stogner, Robert Sr. 2000. Trends in Precipitation and Streamflow and Changes in Stream Morphology in the Fountain Creek Watershed, Colorado 1939-1999: U.S. Geological Survey Water Resource Investigation Report 00-4130.

United Western Engineers. 1964. Camp Creek Drainage Study. Colorado Springs, CO.

United Western Engineers. 1972. Rockrimmon Master Drainage Plan. Colorado Springs, CO.

United Western Engineers. 1973. Rockrimmon North Drainage Basin Hydrologic Engineering Study. Colorado Springs, CO

United Planning Engineers. 1978. Roswell Drainage Area Drainage Study. Colorado Springs, CO

URS Consultants. 1994. Cottonwood Creek Drainage Basin Planning Study Appendix B (2sets). Colorado Springs, CO.

URS Corporation. 1987. Middle Tributary Drainage Basin Master Drainage Plan, Colorado Springs, Colorado

URS Corporation. 1984. Peterson Field Drainage Basin Master Plan Update. Colorado Springs, CO

URS Corporation. 1993. Spring Creek Drainage Basin Planning Study Appendix A and B. Colorado Springs, CO.

URS Corporation. 1987. Middle Tributary Drainage Basin Master Drainage Plan, Colorado Springs, Colorado

URS Corporation. 1987.Monument Branch Drainage Basin Planning Study Colorado Springs, CO: Clyde L. Pikkaraine, P.E.

URS Corporation. 1987. Monument Branch Master Drainage Plan, Colorado Springs, CO: Clyde L. Pikkaraine, P.E.

URS Corporation. 1988. Black Squirrel Creek Drainage Basin Planning Study, Colorado Springs, CO: Brian T. Law, P.E.

U.S. Army Corps of Engineers. 1973. Flood Plain Information, Fountain and Jimmy Camp Creeks, Colorado Springs, Fountain, El Paso County, Colorado. Albuquerque District, NM.

U.S. Army Corps of Engineers. 1971. Flood Plain Information, Monument Creek, Colorado Springs, Colorado. Albuquerque District, NM.

U.S. Geological Survey. 1987. Hydrologic Unit Maps, Water-Supply Paper 2294. Denver, CO: Seaber, P.R., Kapinos, F.P., and Knapp, G.L.

U.S. Geological Survey. 2000. Trends in Precipitation and Streamflow and Changes in Stream Morphology in the Fountain Creek Watershed, Colorado, 1939 – 99, Water Resources Investigations Report 00-4130. Denver, CO: R. W. Stogner, Sr.

U.S. Natural Resources Conservation Service, U.S. Department of Agriculture. 1996. Engineering Field Handbook. Chapter 16. Streambank and Shoreline Protection. US Department of Agriculture. Washington D.C.

U.S. Natural Resources Conservation Service, U.S. Department of Agriculture. 1993. How to Plant Willows and Cottonwoods for Riparian Rehabilitation. Technical Note, Plant Materials No. 23. Boise.

Weiss Consulting Engineers, Inc. 1980, Black Canyon Drainage Basin. Colorado Springs, CO.

Williams, Chris. 1991. Post-fire Sediment Yield from the Chaparral Vegetation Zone, Ash Creek Drainage Basin, Arizona, M.S. Thesis, Colorado State University, Fort Collins, CO.

Wilson & Company. 1989. Black Forest Drainage Basin Planning Study, Colorado Springs, CO.:

Wilson & Company. 1992. Windmill Gulch Drainage Basin Planning Study, Colorado Springs, CO

Wilson & Company. 1987. Jimmy Camp Creek Master Drainage Planning Study. Colorado Springs, CO.

10. Bibliography

This bibliography list represents a comprehensive list of investigations that have been conducted or can be applied to problems in the Fountain Creek Watershed.

ADAMS, D. B., 1988, "SELECTED HYDROLOGIC DATA FOR FOUNTAIN CREEK AND MONUMENT CREEK BASINS, EAST-CENTRAL COLORADO", USGS OPEN FILE 88-705

ALLAN BLOMQUIST & PETER VAN DRESSER, 1994, "BIBLIOGRAPHY OF SELECTED WATER-RESOURCES INFORMATION FOR THE ARKANSAS R. BASIN IN CO THROUGH 1985", USGS OPEN-FILE 94-331

AMERICAN CITY, 1993, "WATER RESOURCES DATA COLORADO WATER YEAR 1993", VOL 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN AND RIO GRANDE BASIN, USGS WATER-DATA CO-93-1

ANNA, L. O., 1991, "CALIBRATION, VERIFICATION, AND USE OF A STEADY-STATE STREAM WATER QUALITY MODEL FOR MONUMENT AND FOUNTAIN CREEKS, EAST-CENTRAL COLORADO", USGS OPEN-FILE 91-4055

BABCOCK, R. E., 1995, "GROUND-WATER FLOW AND EFFECTS OF AGRICULTURAL APPLICATION OF SEWAGE SLUDGE AND OTHER FERTILIZERS ON THE CHEMICAL QUALITY OF SEDIMENTS IN THE UNSATURATED ZONE AND GROUND WATER NEAR PLATTEVILLE, CO 1985-89", USGS, PPACG, 94-4037

BAILEY, E. W., 1995, "HYDROLOGIC ASSESSMENT OF A RIPARIAN SECTION ALONG BOULDER CREEK NEAR BOULDER, CO, 1989-1991", USGS OPEN-FILE 94-4111

BARB, C. F., 1995, "QUALITY OF WATER IN THE ALLUVIAL AQUIFER AND TRIBUTARY ALLUVIUM OF THE FOUNTAIN CREEK VALLEY, SOUTHWESTERN EL PASO CO., CO., 1991-92", USGS OPEN-FILE 94-4118

BAUMANN, D. D., DWORKIN, D. M., 1993, "WATER-QUALITY VARIATIONS AND TRENDS IN MONUMENT AND FOUNTAIN CREEKS, EL PASO AND PUEBLO COUNTIES, CO., WATER YEARS 1976-1988", USGS OPEN-FILE 91-4176

BIANCHI, LUIZ, AND SNOW, D. T., 1995, "INVENTORY OF BIOLOGICAL INVESTIGATIONS RELATED TO STREAM WATER QUALITY IN THE SOUTH PLATTE RIVER BASIN, COLORADO, NEBRASKA, AND WYOMING, 1891-1994", USGS OPEN-FILE 95-379

BINGHAM, D. L. AND KLEIN, J. M., 1981, "FOUNTAIN CREEK, PUEBLO CO.-ARKANSAS RIVER & TRIBUTARIES ABOVE JOHN MARTIN DAM, COLORADO--MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT", PHASE I, GENERAL DESIGN MEMORANDUM VOLS I & II, CORPS OF ENGINEERS

BIRCH, A. F., 1977, "A REPORT ON AN ARCHAEOLOGICAL AND HISTORICAL SURVEY OF THE FLOOD PLAIN OF FOUNTAIN CREEK IN PUEBLO"

BLACK AND VEATCH, ENGINEERS-ARCHITECTS, 1982, "AGRICULTURAL WATER QUALITY ASSESSMENT OF LOWER FOUNTAIN CREEK", SOIL CONSERVATION BOARD, DENVER, CO.

BUCKLES, W. G., 1980, "STREAM STUDY: COLORADO SPRINGS", CITY OF COLORADO SPRINGS, CO.

C. H. HOPER AND ASSOCIATES, 1993, "208 PLAN UPDATE, VOL VII", PLANNING & DEVELOPMENT, PUEBLO, CO.

CAIN, D. L., 1988, "CLASSIFICATIONS AND NUMERIC STANDARDS, ARKANSAS RIVER BASIN 3.2.0"

CAIN, DOUG, 1991, "BIG JOHNSON RESERVOIR/CREWS GULCH DRAINAGE BASIN PLANNING STUDY, KIOWA ENGINEERING CORP", KIOWA NO. 88.05.09

CAIN, DOUG, EDELMANN, PATRICK, 1987, "MIDDLE TRIBUTARY DRAINAGE BASIN PLANNING STUDY", URS CORPORATION, URS CORP NO. 46375

CARDWELL, W. D. E., 1968, "FLOOD PLAIN INFORMATION, FOUNTAIN CREEK, PUEBLO, COLORADO", CORPS OF ENGINEERS

CATHY M. TATE, JORGE R. ORTIZ-ZAYAS, 1980, "PUEBLO REGIONAL COMPREHENSIVE DEVELOPMENT PLAN (PRCDP), PUEBLO CO."

CENTER FOR COMMUNITY DEVELOPMENT, 1980, "COST-BENEFIT ASSESSMENT WASTELOAD ALLOCATION AND STREAM CLASSIFICATION ALTERNATIVES, ARKANSAS RIVER"

CH2M HILL, 1951, "APPENDIX SURVEY REPORT FOUNTAIN RIVER WATERSHED COLORADO 1951", USDA

CH2M HILL, 1965, THE FOUNTAIN RIVER FLOOD PROBLEM", PUEBLO REGIONAL PLAN.COM.

CH2M HILL, 1964, "GROUND WATER IN FOUNTAIN AND JIMMY CAMP VALLEYS IN EL PASO COUNTY COLORADO", GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1583

CHRONIC, F. AND CHRONIC, J., 1989, "SUSPENDED SEDIMENT AND SEDIMENT-SOURCE AREAS IN THE FOUNTAIN CREEK DRAINAGE BASIN UPSTREAM FROM WIDEFIELD, SOUTHEASTERN COLORADO", WATER RESOURCES INVESTIGATIONS REPORT 88-4136

CITY OF COLORADO SPRINGS, 1989, "SEDIMENT-TRANSPORT CHARACTERISTICS AND EFFECTS OF SEDIMENT TRANSPORTION BENTHIC INVERTEBRATES IN FOUNTAIN CREEK DRAINAGE BASIN UP STREAM FROM WIDEFIELD, SOUTHEASTERN COLORADO 1985-1988", GEOLOGICAL SURVEY WATER INVESTIGATIONS REPORT 89-4161

CITY OF COLORADO SPRINGS, EL PASO COUNTY, 1975, "WATER QUALITY, FOUNTAIN AND JIMMY CAMP VALLEYS, COLORADO", CO. WATER CONSERV. BOARD, CWRC NO. 26

CITY OF WOODLAD PARK LAND USE AND DEVELOPMENT CODE, FLOOD DAMAGE PREVENTION REGULATION. SEPTEMBER 30, 1998.

COLORADO DEPARTMENT OF NATURAL RESOURCES, 1976, "APPRAISAL OF WATER RESOURCES OF SOUTHWESTERM EL PASO COUNTY, COLORADO", CO. WATER CONSERVATION BOARD, CWRC NO. 33

COLORADO SPRINGS, 1991, "DRAINAGE CRITERIA MANUAL", CITY OF COLORADO SPRINGS

COLORADO SPRINGS WASTEWATER DIVISION, 1981, "PHASE 1 GENERAL DESIGN MEMORANDUM: VOLUME 1, MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT", ARMY CORP OF ENGINEERS

COLORADO SPRINGS ENGINEERING DEPARTMENT, 1981, "PHASE 1 GENERAL DESIGN MEMORANDUM: VOLUME 2, APPENDICES A THRU F", CORP OF ENGINEERS

COLORADO STATE SOIL CONSERVATION BOARD, 1973, "FLOOD PLAIN INFORMATION, FOUNTAIN AND JIMMY CAMP CREEKS, COLORADO SPRINGS, FOUNTAIN, EL PASO COUNTY, COLORADO", CORP OF ENGINEERS

COLORADO STATE SOIL CONSERVATION BOARD, 1976, FLOOD PLAIN INFORMATION, "COTTONWOOD CREEK, EL PASO COUNTY, COLORADO", CORP OF ENGINEERS

COLORADO SUPREME COURT, 1974, "CHEROKEE WATER DISTRICT V. COLORADO SPRINGS [SUPPLYING WATER (TO A CITY) OUTSIDE THE WATER DISTRICT], 519 P.2D 339-41, DENVER, CO.

COLORADO WATER QUALITY CONTROL DIVISION, 1970, "PIKES PEAK REGIONAL OPEN SPACE PLAN-REPORT I: AN INVENTORY OF PARK, RECREATION AND OPEN SPACE FACILITIES, SITES AND PROGRAMS IN THE PIKES PEAK AREA", PPACG.

COLORADO WATER QUALITY CONTROL DIVISION, 1970, "PIKES PEAK REGIONAL OPEN SPACE PLAN-REPORT II: A PARK, RECREATION AND OPEN SPACE PLAN FOR THE PIKES PEAK REGION", PPACG

DANIEL T. CHAFIN, 1971, PIKES PEAK REGIONAL OPEN SPACE PLAN-REPORT III, "RECOMMENDATIONS FOR IMPLEMENTATION OF THE PARK, RECREATION, AND OPEN SPACE PLAN FOR THE PIKES PEAK REGION", PPACG

DARDEAU, E. A., JR., AND ZAPPI, M. A., 1988, "BLACK SQUIRREL CREEK DRAINAGE BASIN PLANNING STUDY (REVISION)", URS CORPORATION

DASH, RUSSEL G., 1994, "FOUNTAIN CREEK DRAINAGE BASIN PLANNING STUDY, VOLUME III: SUPPORTING INFORMATION/TECHNICAL ADDENDUM BOOK 1 OF 2", CITY OF COLORADO SPRINGS

DRISCOLL, L. B., 1991, "WINDMILL GULCH DRAINAGE BASIN PLANNING STUDY", WILSON AND COMPANY, COLORADO SPRINGS, CO, WCEA #89820

DUMEYER, J. M., 1989, "BLACK FOREST DRAINAGE BASIN PLANNING STUDY", WILSON AND COMPANY, COLORADO SPRINGS, CO

DWORKIN, D. M., 1991, "FISHERS CANYON DRAINAGE BASIN PLANNING STUDY", MULLER ENGINEERING COMPANY, COLORADO SPRINGS, CO

DWORKIN, D. M. AND BAUMANN, D. D., 1990, "BEAR CREEK DRAINAGE BASIN PLANNING STUDY", KIOWA ENGINEERING COMPANY, KIOWA NO. 88.12.26

DWORKIN, D. M. AND BAUMANN, D. D., 1974, AN EVALUATION OF WATER REUSE FOR MUNICIPAL SUPPLY, SOUTHERN ILLINOIS UNIV., CARBONDALE, IL.

ECOLOGY CONSULTANTS, INC., 1987, "MONUMENT BRANCH DRAINAGE BASIN PLANNING STUDY", URS CORPORATION, COLORADO SPRINGS, CO, URS CORP NO. 46382

EDELMANN, PATRICK, 1984, "EFFECTS OF IRRIGATING WITH WASTEWATER ON GROUND-WATER QUALITY AT FORT CARSON MILITARY RESERVATION GOLF COURSE NEAR COLORADO SPRINGS, COLORADO", U.S.G.S. WATER-RESOURCES INVESTIGATIONS REPORT, USGS OPEN-FILE 83-4268

EDELMANN, PATRICK, 1987, "RELATIONS OF SPECIFIC CONDUCTANCE TO STREAMFLOW CHARACTERISTICS OF THE ARKANSAS RIVER BASIN, COLORADO", USGS OPEN-FILE 87-4041

EDELMANN, PATRICK AND CAIN, DOUG, 1988, "METHODS TO DETERMINE TRANSIT LOSSES FOR RETURN FLOWS OF TRANSMOUNTAIN WATER IN FOUNTAIN CREEK BETWEEN COLORADO SPRINGS AND THE ARKANSAS RIVER, COLORADO", USGS OPEN-FILE 88-4119

EDELMANN, PATRICK, 1988, "STREAMBANK EROSION STUDY: LOWER FOUNTAIN CREEK, PUEBLO COUNTY, COLORADO", SOIL CONSERVATION SERVICE, DENVER, CO.

EDWARD R. BANTA, 1988, "REGIONALIZATION OF MEAN ANNUAL SUSPENDED-SEDIMENT LOADS IN STREAMS, CENTRAL, NORTHWESTERN, AND SOUTHWESTERN COLORADO", USGS OPEN-FILE 87-4193

EL PASO COUNTY DEPARTMENT OF PUBLIC WORKS, 1984, "ASSESSMENT OF WATER RESOURCES AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO", USGS OPEN-FILE 83-4270

ELLIOT, JOHN G., 1985, COLORADO'S LITTLE FISH, A GUIDE TO THE MINNOWS AND OTHER LESSER KNOWN FISHES IN THE STATE OF COLORADO", COLORADO DIVISION OF WILDLIFE, DENVER, CO

ENGINEERING SCIENCE, 1985, "SOURCES OF WATER AND NITROGEN TO THE WIDEFIELD AQUIFER, SOUTHWESTERN EL PASO COUNTY, COLORADO", USGS OPEN-FILE 87-4193

FARROW, JOHN, 1994, "BIBLIOGRAPHY OF SELECTED WATER-RESOURCES INFORMATION FOR THE ARKANSAS RIVER BASIN IN COLORADO THROUGH 1985", USGS OPEN-FILE 94-331

FARROW, JOHN, 1989, "HYDROLOGIC EFFECTS OF PUMPAGE FROM THE DENVER BASIN BEDROCK AQUIFERS OF NORTHERN EL PASO COUNTY, COLORADO", USGS WRIR 88-4033

GAGGIANI, NEVILLE G., 1973, "FLOOD HAZARD ANALYSES, SAND CREEK, CITY OF COLORADO SPRINGS, AND EL PASO COUNTY", COLORADO WATER CONSERVATION BOARD, EL PASO COUNTY, CO.

GILBERT, MEYER, AND SAMS, INC., 1995, "WATER QUALITY OF STORM RUNOFF AND COMPARISON OF PROCEDURES FOR ESTIMATING STORM-RUNOFF LOADS, VOLUME, EVENT-MEAN CONCENTRATIONS, AND THE MEAN LOAD FOR A STORM FOR SELECTED PROPERTIES AND CONSTITUENTS FOR", USGS OPEN-FILE 94-4194

GILBERT, MEYER, AND SAMS, INC., 1995, "QUALITY OF WATER IN THE ALLUVIAL AQUIFER AND TRIBUTARY ALLUVIUM OF THE FOUNTAIN CREEK VALLEY, SOUTHWESTERN EL PASO COUNTY, COLORADO, 1991-92", USGS OPEN-FILE 94-4118

GLOVER, ROBERT E., AND JENKINS, EDWARD D., 1991, "MONUMENT CREEK DRAINAGE BASIN PLANNING STUDY, VOLUME III: APPENDIXES A-B, D-H", CITY OF COLORADO SPRINGS

GROGGER, PAUL K., 1975, "WATER QUALITY/WASTEWATER EXISTING DATABASE, VOLUME I: WATER QUALITY DATABASE", PPACG

GUY J. LEONARD, 1993, "WATER-QUALITY VARIATIONS AND TRENDS IN MONUMENT AND FOUNTAIN CREEKS, EL PASO AND PUEBLO COUNTIES, COLORADO, WATER YEARS 1976-88", USGS OPEN-FILE 91-4176

GUERARD, PAUL VON, 1985, "COLORADO SPRINGS WATER SYSTEM", COLORADO SPRINGS WATER DEPT., COLORADO SPRINGS, CO

GUERARD, PAUL VON, 1986, EPIDEMIOLOGICAL INVESTIGATION OF COMMUNITY HEALTH EFFECTS OF LANDSCAPE IRRIGATION USING RECLAIMED WASTEWATER: THE COLORADO SPRINGS STUDY, CITY OF COLORADO SPRINGS

GUERARD, PAUL VON, AND WEISS, WILLIAM B., 1982, "AGRICULTURAL WATER QUALITY ASSESSMENT OF LOWER FOUNTAIN CREEK", PPACG

J. E. VAILL, J. M. KUZMIAK, AND STEVENS, M. R., 1990, "WATER QUALITY OF FOUNTAIN AND MONUMENT CREEKS, SOUTH-CENTRAL COLORADO, WITH EMPHASIS ON RELATION OF WATER QUALITY TO STREAM CLASSIFICATIONS", USGS OPEN-FILE 88-4132

KARCICH AND WEBER, INC.", 1976, "APPRAISAL OF WATER RESOURCES OF SOUTHWESTERN EL PASO COUNTY, COLORADO", COLORADO WATER RESOURCES CIRCULAR NO. 33, COLORADO WATER CONSERVATI, "DENVER, CO"

KARCICH AND WEBER, INC.", 1976, "PROBLEM IDENTIFICATION, LEGAL ASPECTS OF FLOOD CONTROL, ALTERNATIVE CONTROL MEASURES", "KARCICH AND WEBER, INC.", "COLORADO SPRINGS, CO"

KARCICH AND WEBER, INC. AND THK ASSOCIATES, INC.", 1974, "DRAFT FOR REVIEW AND COMMENT: FACTORS LIMITING BIOLOGICAL PRODUCTION IN MONUMENT AND FOUNTAIN CREEKS, EL PASO COUNTY, COLORADO", "ECOLOGY CONSULTANTS, INC.", "FORT COLLINS, CO"

KIMBROUGH, ROBERT, 1994, "FOUNTAIN CREEK DRAINAGE BASIN PLANNING STUDY, VOLUME I, CITY OF COLORADO SPRINGS", COLORADO SPRINGS, CO.

KIOWA ENGINEERING COMPANY, 1986, "SPECIAL STUDY ON WATER QUALITY CHARACTERISTICS AND WASTELOAD ASSIMILATIVE CAPACITY OF MONUMENT CREEK, EL PASO COUNTY, 1985-86", COLORADO DEPT. OF HEALTH, DENVER, CO.

KLEIN, JOHN M., AND BINGHAM, DONALD L., 1975, "APPRAISAL OF WATER RESOURCES OF NORTHWESTERN EL PASO COUNTY, COLORADO", COLORADO WATER RESOURCES CIRCULAR NO. 22, COLORADO WATER CONSERVATION BOARD, DENVER, CO.

KLEIN, JOHN M., AND BINGHAM, DONALD L., 1975, "WATER QUALITY, FOUNTAIN AND JIMMY CAMP VALLEYS, COLORADO, 1975", COLORADO WATER RESOURCES CIRCULAR NO. 26, COLORADO WATER CONSERVATION BOARD, DENVER, CO.

KUHN, GERHARD, 1986, "RECONNAISSANCE WATER-QUALITY APPRAISAL OF THE FOUNTAIN CREEK ALLUVIAL AQUIFER BETWEEN COLORADO SPRINGS AND PUBLO, COLORADO, INCLUDING TRACE ELEMENTS AND ORGANIC CONSTITUENTS", USGS OPEN-FILE 86-4085

KUHN, GERHARD, 1995, "SUMMARY OF BRIDGE SCOUR ANALYSES AT SELECTED SITES IN COLORADO, 1991-93", USGS OPEN-FILE 95-296

KUHN, G., 1995, "HYDROLOGIC CHARACTERISTICS OF THE ALLUVIAL AQUIFER AND ADJACENT DEPOSITS OF THE FOUNTAIN CREEK VALLEY, EL PASO COUNTY, COLORADO", USGS, "DENVER, CO", MAP WRIR 94-412

KUHN, R. ORTIZ, 1978, AREAWIDE URBAN RUNOFF CONTROL MANUAL, PPACG, "COLORADO SPRINGS, CO"

KUZMIAK, JOHN M., AND STRICKLAND, HYLA H., 1975, "ARTIFICIAL-RECHARGE EXPERIMENTS IN THE ALLUVIAL AQUIFER SOUTH OF FOUNTAIN, EL PASO COUNTY, COLORADO", COLORADO WATER RESOURCES CIRCULAR NO. 31, COLORADO WATER CONSERVATION BOARD, DENVER, CO.

KUZMIAK, J.M. & STRICKLAND, H.H, 1974, "FLOOD PLAIN INFORMATION: FOUNTAIN CREEK, COLORADO SPRINGS, MANITOU SPRINGS, COLORADO", PPACG, COLORADO SPRINGS, CO.

LEWIS, MICHAEL E., 1975, "FLOOD HAZARD ANALYSES, PORTIONS OF JIMMY CAMP CREEK AND TRIBUTARIES, EL PASO COUNTY, COLORADO", SOIL CONSERVATION SERVICE, PORTLAND, OR.

LEWIS, MICHAEL E., 1989, "UPDATED DRAINAGE BASIN IDENTIFICATION AND FEE ESTIMATION REPORT, EL PASO COUNTY, COLORADO", EL PASO COUNTY DEPT. OF PUBLIC, COLORADO SPRINGS, CO.

LIVINGSTON R. K., KLEIN, J. M., AND BINGHAM D., 1994, "FOUNTAIN CREEK DRAINAGE BASIN PLANNING STUDY, VOLUME III: SUPPORTING INFORMATION/TECHNICAL ADDENDUM BOOK 2 OF 2", CITY OF COLORADO SPRINGS

LIVINGSTON R. K., KLEIN, J. M., AND BINGHAM D., 1996, UPPER FOUNTAIN CREEK SEDIMENT STUDY, WRITTEN REPORT", CITY OF COLORADO SPRINGS

LIVINGSTON R. K., KLEIN, J. M., AND BINGHAM D., 1986, "A COORDINATED COUNTY-WIDE PROGRAM OF DATA COLLECTION AND INTERPRETATIVE STUDIES IN WATER-RESOURCE QUALITY, EL PASO COUNTY, COLORADO", WATER RESOURCES DIVISION, DENVER, CO.

LIVINGSTON R. K., KLEIN, J. M., AND BINGHAM D., 1986, "SPECIAL STUDY ON WATER QUALITY CHARACTERISTICS AND WASTELOAD ASSIMILATIVE CAPACITY OF MONUMENT CREEK, EL PASO COUNTY, 1985-86", COLORADO DEPT. OF HEALTH, DENVER, CO.

MILLER, ROBERT DOUGLAS, 1991, "MONUMENT CREEK DRAINAGE BASIN PLANNING STUDY, VOLUME I: REPORT, CITY OF COLORADO SPRINGS", PPACG

MULLER ENGINEERING COMPANY, 1991, "WILLIAMS CREEK RESERVOIR SITE ASSESSMENT", CH2M HILL, GREENWOOD VILLAGE, CO.

MULLER ENGINEERING COMPANY, INC., 1983, "MANAGEMENT OF COTTONWOOD-WILLOW RIPARIAN ASSOCIATIONS IN COLORADO"

MULLER ENGINEERING COMPANY, INC., 1976, "MULTIPLE-USE AND WATER QUALITY MANAGEMENT STUDY", PPACG

MULLER ENGINEERING COMPANY, INC., 1975, "WATER QUALITY/WASTEWATER EXISITNG DATA BASE, VOLUME II: WASTEWATER SYSTEMS AND POINT DISCHARGES DATA BASE", PPACG

MULLER ENGINEERING COMPANY, INC., 1975, "WATER QUALITY/WASTEWATER EXISTING DATABASE, VOLUME III: NON-POINT SOURCES EXISTING DATABASE", PPACG

NELSON, HALEY, PATERSON AND QUIRK, INC., 1980, "AREAWIDE URBAN RUNOFF CONTROL MANUAL", PPACG

NELSON, HALEY, PATTERSON AND QUIRK, INC., 1975, "REVIEW OF RESEARCH NON-POINT SOURCE POLLUTION", PPACG

NELSON, HALEY, PATTERSON, AND QUIRK, INC., 1988, "COLORADO NONPOINT ASSESMENT REPORT", WATER QUALITY CONTROL DIV., DENVER, CO.

NELSON, HALEY, PATTERSON, AND QUIRK, INC., 1989, "COLORADO NONPOINT ASSESSMENT REPORT", WATER QUALITY CONTROL DIV., DENVER, CO.

PIKES PEAK AREA COUNCIL OF GOVERNMENTS, 1985, "WATER QUALITY: PIKES PEAK REGION"

PIKES PEAK AREA COUNCIL OF GOVERNMENTS, 1994, "A MASTER PLAN FOR THE PIKES PEAK GREENWAY, CITY OF COLORADO SPRINGS"

PUEBLO CO. DEPT. OF PLANNING & DEVELOPMENT, 1995, "HYDROGEOLOGY OF THE ALLUVIAL AQUIFERS AT THE PUEBLO DEPOT ACTIVITY NEAR PUEBLO, COLORADO", USGS OPEN-FILE 95-4137

PUEBLO REGIONAL PLANNING COMMISSION, 1996, "WATER-QUALITY DATA FOR THE ARKANSAS RIVER BASIN, SOUTHEASTERN COLORADO, 1990-93", USGS OPEN-FILE 95-464

RADELL, M. J., LEWIS, M. E., AND WATTS, K. R., 1972, "PROCEDURES FOR DETERMINING PEAK FLOWS IN COLORADO", SOIL CONSERVATION SERVICE, PORTLAND, OR.

RUDDY, B. C., 1987, "EFFECT OF DIVERSION WATER ON THE CHANNEL MORPHOLOGY OF FOUNTAIN CREEK, COLORADO UMI", DOCTORIAL THESIS FOR UNIV. OF CO. AT BOULDER, UNIV. OF CO, BOULDER, BOULDER

RUDDY, B. C., 1988, "METHODS TO DETERMINE TRANSIT LOSSES FOR RETURN FLOWS OF TRANSMOUNTAIN WATER IN FOUNTAIN CREEK BETWEEN COLORADO SPRINGS AND THE ARKANSAS RIVER, CO", USGS OPEN-FILE 87-4119

SEABER, P.R., KAPINOS, F.P., AND KNAPP, G.L., 1987, "HYDROLOGIC UNIT MAPS", USGS WATER-SUPPLY PAPER 2294, 63 P.

SOIL CONSERVATION SERVICE, 1989, "STREAMBANK PROTECTION ALTERNATIVES, COST ANALYSIS", SOIL CONSERVATION SERVICE, DENVER, CO

SOIL CONSERVATION SERVICE, 1988, "STATE OF COLORADO STREAMBANK EROSION STUDY", SOIL CONSERVATION SERVICE, DENVER, CO.

SOIL CONSERVATION SERVICE, 1975, "RECOMMENDATIONS FOR STREAM CLASSIFICATION-FOUNTAIN/MONUMENT SUBBASIN (INCLUDING RESULTS OF AQUATIC SAMPLING", PPACG

STATE SOIL CONSERVATION BOARD, 1976, "LAKES IN THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO", USGS SURVEY MISCELLENEOUS INVESTIGATIONS SERIES MAP I-857-E

TAYLOR, O. JAMES, 1970, "FLOOD PLAIN REGULATION, POLICY SERIES, THE URBAN DRAINAGE AND FLOOD...", DENVER, CO.

THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, 1971, "PORTABLE PLANT MEETS TERTIARY REQUIREMENTS", AMERICAN CITY, V. 86, NO. 3, P. 63

THE WILDLIFE SOCIETY, THE COLORADO CHAPTER", 1975, "MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED AS OF 1974 BY THE U.S. ENVIRONMENTAL DATA SERVICE AND BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, FRONT RANGE URBAN CORRIDOR, COLORADO", USGS MISCELLENEOUS INVESTIGATIONS SERIES MAP I-857-D

UGLAND, R.C., COCHRAN, B.J., HINER, M.M., AND STEGER, R.D., 1975, "ENGINEERING REPORT ON FEASIBILITY OF FOUNTAIN VALLEY PIPELINE OF FRYINGPAN-ARKANSAS PROJECT", DENVER, CO.

UNIVERSITY OF COLORADO NATURAL RESOUCES LAW CENTER, 1974, "BIBLIOGRAPHY AND INDEX OF GEOLOGY AND HYDROLOGY, FRONTRANGE URBAN CORRIDOR, COLORADO", USGS BULLETIN 1306

UNIVERSITY OF COLORADO NATURAL RESOURCES LAW CENTER, 1996, "THE WATERSHED SOURCE BOOK, WATERSHED-BASED SOLUTIONS TO NATURAL RESOURCE PROBLEMS", BOULDER, CO.

URS CORPORATION, 1984, "REPORT OF THE GROUNDWATER LEGISLATION COMMITTEE", "DENVER, CO."

URS CORPORATION, 1974, "WATER RESOURCES AND HISTORICAL WATER USE FOR COLORADO SPRINGS, COLORADO", DEPARTMENT OF RESOURCES PLANNING AND DEVELOPMENT, 60 P., COLORADO SPRINGS, CO

URS CORPORATION, 19??, "DRAINAGE STUDIES ON BASINS WITHIN AND NEAR THE CITY, , "COLORADO SPRINGS, CO.", 3 VOLUMES

U. S. ARMY CORPS OF ENGINEERS, 1974, "INDUSTRIAL WATER RE-USE AND SEWAGE SLUDGE", ENERGY ENVIRONMENT AND WATER RESOURCES, UNIVERSITY OF NEBRASKA COUNCIL OF WATER RESOURCES, LINCOLN, NEBRASKA, P. 272-276

U.S. ARMY CORP OF ENGINEERS, 1971, "CATHODIC PROTECTION FOR COATED STEEL PIPELINES", JOURNAL OF AMERICAN WATER WORKS ASSOCIATION, V. 63, NO. 2, P. 85

U.S. ARMY CORP OF ENGINEERS, 1946, "SELECTED WELL LOGS OF COLORADO", COLORADO SCHOOL OF MINES QUATERLY, V. 41, NO. 1, P.435

U.S. ARMY CORP OF ENGINEERS, 1977, "THE DECISION TO REUSE WATER", AMERICAN WATER WORKS ASSOCIATION ANNUAL CONFERENCE, ANAHEIM, CALIF., 1977, PROCEEDINGS, PAPER 9-4, 20 P.

U.S. ARMY CORP OF ENGINEERS, 1969, "PERMEABILITY OF CRYSTALLINE ROCK INTERPRETED FROM MEASURED ORIENTATIONS AND APERTURES OF FRACTURES", ANNALS OF THE ARID ZONE, V. 8, NO. 2, P.231

U.S. ARMY CORP OF ENGINEERS, 1973, "EXTENT OF DEVELOPMENT AND HYDROLOGIC CONDITIONS OF THE ALLUVIAL AQUIFER, FOUNTAIN AND JIMMY CAMP VALLEYS, COLORADO, 1972", COLORADO WATER CONSERVATION BOARD, CWRC NO. 23, DENVER, CO.

U.S. ARMY CORPS OF ENGINEERS, 1947, "TEMPERATURE AND HEAT FLOW IN A WELL NEAR COLORADO SPRINGS, COLORADO", AMERICAN JOURNAL OF SCIENCE, VOL. 245, NO.12 P.733

U.S. DEPARTMENT OF AGRICULTURE, 1977, "WATER DISTRIBUTION FOR COLORADO SPRINGS", KANSAS CITY, KS, 34 P.

U.S. DEPARTMENT OF AGRICULTURE, 1984, "ELEVATED NITRATE CONCENTRATIONS IN THE WIDEFIELD AQUIFER SOUTH OF COLORADO SPRINGS, COLORADO", "GEOLOGICAL SURVEY RESEARCH, FISCAL YEAR 1981", USGS PROFFESIONAL PAPER 1375, P.187

U.S. GEOLOGICAL SOCIETY, 1956, "REPORT ON AN AQUIFER TEST AT MONUMENT, COLORADO", USGS OPEN FILE REPORT

U.S. GEOLOGICAL SOCIETY, WATER RESOURCES DIVISION, 1985, "MANITOU SPRINGS FLOOD HAZARD MITIGATION PLAN", U.C.C.S., COLORADO SPRINGS, CO.

WATER DEPARTMENT, CITY OF COLORADO SPRINGS, 1977, "ENVIRONMENTAL BASELINE DESCRIPTIONS FOR USE IN THE MANAGEMENT OF FORT CARSON NATURAL RESOURCES, REPORTS-GENERAL GEOLOGY AND SEISMICITY", U.S. ARMY CORP OF ENGINEERS WATERWAYS EXPERIMENT STATION TECHNICAL REPORT M-77-4, 29 P.

WATER QUALITY CONTROL COMMISSION, 1975, "LAND-USE CLASSIFICATION MAP OF THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO", USGS MISCELLENEOUS INVESTIGATIONS SERIES MAP I-857-B

WILSON AND COMPANY, 1980, "HYDROLOGY AND WATER QUALITY DATA BASE, PUEBLO COUNTY, COLORADO", HYDRO ENGINEERING, PUEBLO, CO.

WILSON AND COMPANY, 1975, "WATER REUSE-A FLEXIBLE AND EFFICIENT MANAGEMENT ALTERNATIVE FOR MUNICIPAL WATER SUPPLY", WATER RESOURCES RESEARCH, V. 11, NO. 5, P. 607

WOHL, ELLEN E., 2001, "VIRTUAL RIVERS: LESSONS FROM THE MOUNTAIN RIVERS OF THE COLORADO FRONT RANGE", YALE UNIVERSITY PRESS, NEW HAVEN, CN.

WOODLING, JOHN, 1976, "WATER RESOURCES OF EL PASO COUNTY", COLORADO WATER RESOURCES CIRCULAR NO. 32, COLORADO WATER CONSERVATION BOARD, DENVER, CO.

ZONING ORDINANCE, TOWN OF GREEN MOUNTAIN FALLS. PREPARED BY PPACG, 1997.

11. Glossary

ACOE: United States Army Corps of Engineers. For the purposes of this Plan, usage will refer to the Albuquerque District unless stated otherwise.

ACRE-FOOT: An expression of water quantity. One acre-foot will cover one acre of ground one foot deep. An acre-foot contains 43,560 cubic feet, 1,233 cubic meters, or 325,829 gallons (U.S.).

Alluvial: A general term for unconsolidated material deposited by a stream or other body of running water.

Anthropogenic: human induced causes or factors.

Aquatic: Water habitat dependent. Usually refers to such things as fish, macroinvertebrates, algae and other plants that require complete water submersion for survival.

Aquifer: A geologic formation, group of formations, or part of a formation that that contains sufficient saturated permeable material to yield sufficient quantities of water to wells or springs.

Bankfull Flow: The channel-forming flow of the stream usually equivalent to 1½ to 2 year storm recurrence interval.

Base Flow: That part of stream discharge that is not attributable to direct runoff from precipitation or melting snow. Primarily sustained by groundwater discharge into the stream.

Baseline: A selected set of data that forms a known starting point that will enable determining of system status and help determine trends as the system changes.

Bedload: That part of the sediment transported by a stream that is moved in the form of rolling and salting sediment particals on the bed of the channel.

Benthic: Pertaining to the bottom of a body of water. Benthic algae, for instance, is submerged algae growing on the bottom of a water body.

Biochemical Oxygen Demand (BOD): The amount of oxygen needed for biological decomposition and chemical oxidation of sediments.

Biodiversity: Biological diversity; variety of organisms in a given area.

Biota: All living organisms that exist in a region.

Buffer areas: Zones created or sustained to buffer effects of unnatural land use practices on animals and plants and their habitats.

Channelization: The straightening and smoothing of river channels, frequently for flood control, sometimes accompanied by paving or bank armoring.

Colluvial: These sediments are massive to moderately well stratified and nonsorted to poorly sorted with any range of particle sizes, from clay to boulders, and blocks that have reached their present position by direct, gravity-induced movement.

Conjunctive Use: The utilization of land, air or water for more than one purpose or by more than one person, or the sequential use of a resource dependent on availability of source. Use of both groundwater and surface water at differing times of year, based on availability, is conjunctive use of water resources.

Contiguous Habitats: Wildlife or other habitat that is connected physically, even if parcel lines or other political divisions otherwise bisect it.

DBPS: Drainage Basin Planning Studies. All relevant DBPS's are listed in Section 8, Refernces, of Fountain Creek Watershed Plan.

Discharge: Volume of water flowing past a reference point per unit of time (e.g. cubic feet per second, cfs).

Dissolved oxygen concentration (DO): The amount of oxygen dissolved in water.

Diversion: In water rights, diversion is the alteration of natural water flow in a drainage. It includes such activity as collection of water in a reservoir before it reaches a main stream channel, as well as pumping from the stream.

Drainage Basin: Land area drained by a given river or stream; watershed.

Ecology: The study of the interactions of living things and their environment.

Ecosystem: An interdependent community of plants and animals interacting with one another and with the chemical and physical factors making up their environment.

Effluent: Wastewater, partially or completely treated or in its natural state, flowing out of a treatment process of treatment plant.

Entrapment Zone: The area where salty ocean water moving upstream mixes with fresh water flowing downstream. The mixing dynamics in this zone traps nutrients, organic and inorganic materials (e.g. fish and invertebrate eggs), and other food sources. These circumstances enable considerable plant and animal growth. An entrapment zone's success or health depends on its location and surrounding conditions.

Ephemeral Sream: A stream that flows only a short time (days or weeks) in direct response to precipitation.

Erosion: The movement of soil by water and wind and frost. Sheet erosion – water moves over the soil surface in thin layers like a sheet; also called "invisible" because it is difficult to observe rill erosion – as water picks up speed moving downhill, the sheets begin to form rills, or small channels. Gully erosion – if left unchecked, rills caused by erosion become larger, forming gullies.

Eutrophication: Excess decomposition of dead matter in water that lowers the dissolved oxygen concentration such that fish and other aquatic animal life are threatened.

Floodplain: Flat areas bordering streams that are subject to flooding.

Fluvial: These sediments generally consist of gravel and sand with a minor fraction of silt and rarely of clay. The gravels are typically rounded and contain interstitial sand.. These materials have been

transported and deposited by streams and rivers.

Fluvial geomorphology: The study of landforms and land-forming processes pertaining to rivers and streams.

Geomorphology: The study of land forms, the evolution of landscapes, and land-forming processes.

Gabion: A metal or wickerwork basket filled with earth or stones, often used for earth stabilization.

Gradient: Degree of slope from horizontal or steepness of a geographic feature.

Groundwater: Water that occurs below the surface of the land.

Groundwater recharge: Replenishment of water removed or otherwise drained from an underground aquifer.

Habitat: The specific area or environment in which a particular type of plant or animal lives. To be complete, an organism's habitat must provide all of the basic requirements for life of that organism.

Hazardous Waste: Any toxic waste that may pose a serious threat to human health or the environment when improperly managed.

Humus: Decayed organic matter in or on the soil's surface.

Hydrology: The study of relationships between water and the geologic environment.

Hydrologic Unit Code (HUC): This framework is a nationwide system of watershed delineation and is used to catalog major drainage basins. It recognizes that a watershed is a composite of multiple smaller systems, and that each system has individual concerns and issues that must be recognized.

Hydrographic: The description and studies of bodies of water (e.g. lakes and rivers): as the measurement of flow and investigation of the behavior of streams and the charting or graphing of them.

Impoundment: A structure built to retain water, commonly a reservoir or pond.

Impervious Surface Area - A hard surface area which either prevents or retards the entry of water into the soil. Examples include, but are not limited to, structures, walkways, patios, driveways, carports, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, haul roads and soil surface areas compacted by construction operations.

Indicator Species: A species whose characteristics show the presence of specific environmental conditions and are representative of a certain habitat type or function.

Indigenous: Species that originated naturally or has resided or utilized a given site since a given baseline time or date.

Infiltration: The downward entry of water into the soil.

Insecticides: Chemicals used to kill insects.

Intermittent Stream: A seasonal flowing stream, usually one receiving flow from a spring, snowmelt

or other seasonally constant source other than storm runoff.

Land Stewardship: A land ethic or cultural value set that promotes existing land use practices that protect the resources for succeeding generations.

Leaching: Removal of salts, nutrients and other materials from the soil by water movement through the soil profile.

Levee: Raised bank of earth built to control or confine water, sometimes known as a dike.

Marsh: A wetland where the dominant vegetation is non-woody plants such as grasses and sedges as opposed to a swamp where the dominant vegetation is woody plants like trees.

Monitoring: Scheduled sampling of selected environmental and biological variables.

Mulch: Any substance which is spread or allowed to remain on the soil surface to decrease the erosion effects of rain drop impact, water runoff or wind.

Native: Species that have originated naturally in a particular region.

Natural Processes: Those physical, chemical and biological processes that normally function in nature without adjustment or interference from human activity.

Natural Resources: Naturally occurring resources, such as soil, water, air and trees that are needed by an organism, population or ecosystem to sustain or optimize survival.

Nitrogen: A common necessary elemental nutrient that, in excess concentrations, can cause environmental problems. Excess concentrations can come from fertilizers, septic systems and animal wastes. Nitrogen dissolves in rainfall or irrigation water and leaches to the groundwater.

NOAA: National Oceanic and Atmospheric Administration

Nonpoint Source Pollution: Water pollution from dispersed and uncontrolled sources (such as surface runoff from rain storms).

NPDES: National Pollutant Discharge Elimination System, a provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the US EPA, or a state or other delegated agency.

NRCS: Natural Resources Conservation Service

Nutrients: That portion of any element or compound in the soil that can be readily absorbed and assimilated to nourish growing plants.

One Hundred Year Frequency Storm: means a storm that is capable of producing rainfall expected to be equaled or exceeded on the average of once in 100 years. It also may be expressed as an exceedence probability with a 1 percent chance of being equaled or exceeded in any given year

Organic Matter: Residue of plant or animal origin.

Percolation: Downward movement of water through soil.

Perennial Stream: A stream with year-round channel flow .

Pesticide: A chemical substance used to kill or control pests such as weeds, insects, algae, rodents, or other undesirable agents.

pH: The symbol used to indicate an acid or alkaline condition (the relative concentration of hydrogen ions). A pH of 7 indicates neutrality, less than 7 is acid, and greater than 7 is alkaline. Most rainwater is slightly acidic (pH=6) by nature.

Phosphorus: A common nutrient that in excess concentrations can cause problems in the environment. Phosphorus attaches to soil particles via chemical attraction. When soil erosion occurs and sediment enters water bodies, the phosphorus is carried with it.

Piedmont: a visible crystalline plutonic rock almost completely composed of plagioclase feldspar with minor amounts of pyroxene and olivine.

Pierre Shale: consists of dark-gray to brown claystone or mudstone, and occasional beds of sandstone and limestone, and thin beds of bentonite.

Point source pollution: A source of pollutants from a single point of conveyance such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source of pollution.

Pollutant: A harmful chemical or waste material discharged into the environment. Persistent pollutants are those that do not degrade, causing potential long-term chronic toxicity to the environment.

Pollution: Impairment of lank, air or water quality by agricultural, domestic or industrial waste to a degree having an adverse affect on beneficial uses or the facilities that serve such beneficial uses.

Rare, Threatened and Endangered Species: Rare is a classification given only to a species when, although not presently threatened with extinction, it exists in such small numbers throughout its range that it may become endangered if its present environment worsens. A species s threatened when, although not presently at risk of extinction, it is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts. A species is considered endangered when it faces possible extinction throughout all or a significant portion of its range. The predominant cause is loss of habitat.

Resource Conservation District: Autonomous units of local government, originally formed by local vote under state law, governed by an unpaid Board of Directors, with the purpose of providing local direction for federal and state governments to protect the soil, water and other natural resources of the District.

Restore: To bring back to the original condition, or to put back in place something that was lost. Ecological restoration is closely associated to the terms rehabilitation, recovery and reclamation.

Revetment: Facing, as with cement or rock, to support an embankment and prevent its erosion.

Riffles: The fast, shallow waters of a stream where current passes over gravel bars between two pools.

Riparian: Plant community succession naturally occurring along the bank of a natural freshwater waterway such as a river, stream, or creek. Riparian zones support diverse and abundant terrestrial

wildlife species, protect stream banks and adjacent land from erosion, and contribute significantly to aquatic communities by providing shade, cover from predators, nutrients, a buffer from nearby land use activities, and a filter for overland soil erosion.

Riparian Stations: A station on a larger network that serves as a collection point for watershed monitoring data.

Rip-rap: Rock covering used to protect streambanks from erosion.

River Reach: A section of river between two specified points or possessing some common characteristic(s).

Riverine: Of, related to, or growing in rivers and streams.

Runoff: Water from rain, melted snow or agricultural or landscape irrigation that flows over the land surface.

Salinity: The relative dissolved salt content of water or soil.

Salmonid: Any species of a genus of Pacific Ocean fishes that can breed in rivers and streams tributary to the North Pacific. A fish in the salmon or trout family.

Scour: Localized concentrated erosion by flowing water, usually in stream bottoms or floodplains.

Sediment: Soils, mud, sand, silt, clay, and other particles transported from outside a stream system, or generated by erosion in the stream, that settle on the bottom of waterways.

Sediment Load: Clays, silts, and sometimes sand that are held in suspension by turbulence in river water.

Sediment Yeld: The amount of sediment transported from a river basin or other drainage area.

Sensitive Habitat: Habitat, such as riparian corridors or wetlands, that exhibits rapid response to environmental changes.

Stakeholders: Anyone who lives in a watershed or has land management, administrative or other responsibilities or interests in it. Stakeholders include (among others) private individuals, businesses, government agencies, special interest groups, wildlife and fisheries.

Storm Drain: A channel or pipe that carries rain water runoff from developed areas to a receiving water body such as a lake or river. Sometimes also called a storm sewer system (which is usually separate from sanitary sewer systems).

Stormwater Runoff: Direct response of a watershed to precipitation and includes the surface and subsurface runoff that enters a ditch, stream, storm sewer or other concentrated flow during and following the precipitation.

Stormwater Utility: An administrative organization that has been created for the purposes of planning, designing, constructing, and maintaining stormwater management, sediment control and flood control programs and projects.

Stream degradation: A lowering of the elevation of streambeds and flood plains by erosional

removal of alluvium; may be caused when upstream sources of sediment are blocked, or if instream flows are increased above historic levels.

Stream Flow: Volume of water carried by a stream. Stream flow has two major components: runoff and baseflow.

Stream Stabilization: The coordination of hydraulics, hydrology, physics, biology, and geology to establish a stable stream system in equilibrium with the natural forces acting on and in the stream.

Streambed: The part of the stream over which a column of water moves.

Substrate: Inorganic material that forms the bottom of a stream.

Sustainable Land Use: Use of low input land management systems and concepts that leave the land in the same or better condition than before that use commenced. Land management measures that can continue indefinitely without natural resource depletion.

Swales: Low, usually damp areas of ground.

Total dissolved solids (TDS): The amount of dissolved material in water.

Toxic: Poisonous, or likely to cause harm to human beings and other life through direct contact, ingestion, or inhalation.

Transect: A line between two points of a study area along which data is collected.

Turbidity: Degree to which light penetration is blocked because water is muddy or cloudy.

USGS: United States Geological Survey

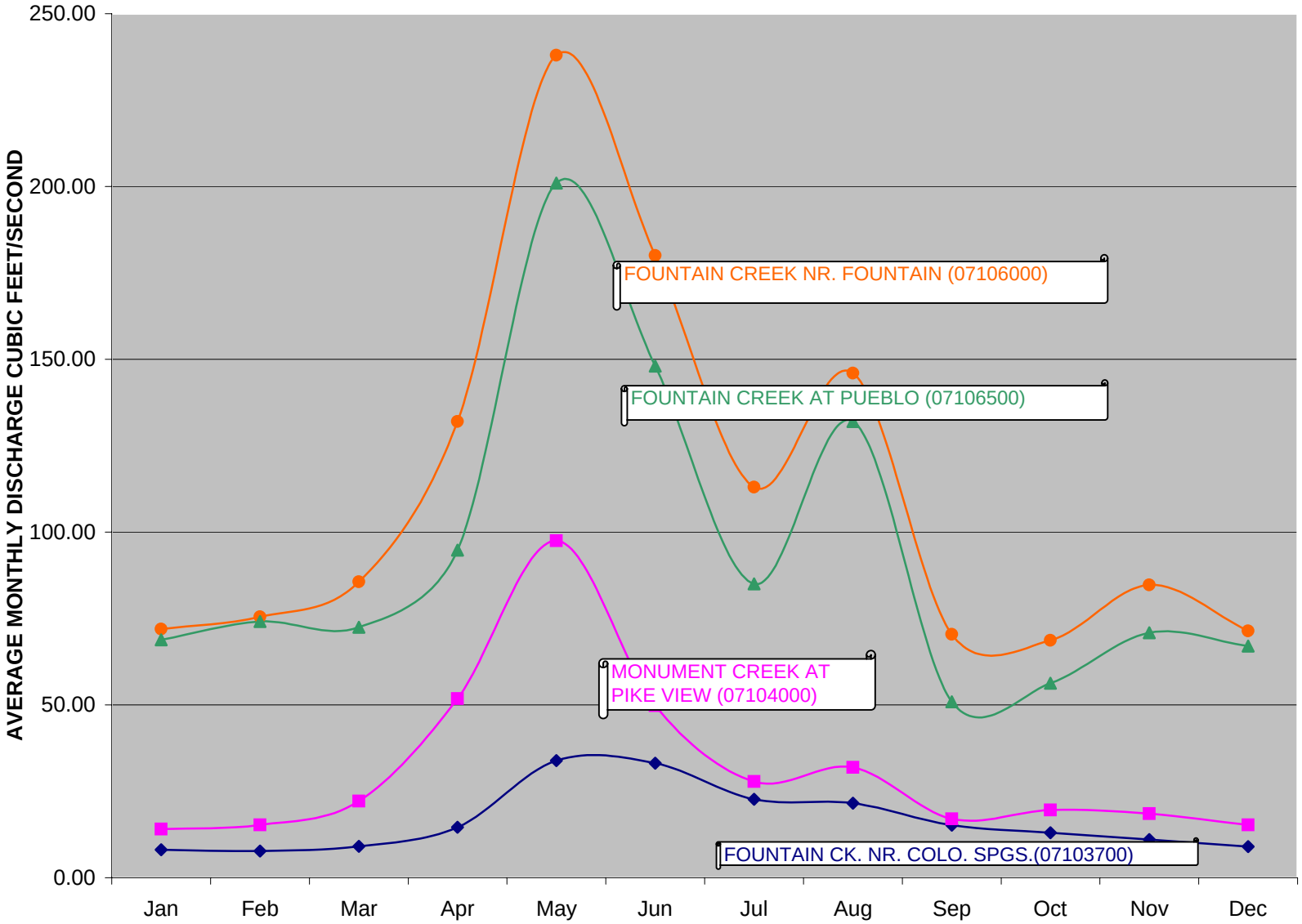
Water table: Upper level of a saturated zone in an aquifer below the soil surface.

Watershed: A geographic area from which water, sediments and dissolved materials are drained by a river and its tributaries to a common outlet. This outlet can be larger river, a lake, an estuary or an ocean. Also called a drainage basin. A watershed is separated from adjacent watersheds by a ridge or drainage divide. Watersheds can contain subwatersheds. Watersheds and subwatersheds usually take their name from the river or creek that drains them.

Well: A deep hole or shaft sunk into the earth to obtain water.

Wellhead Protection: Practices that of prevent pollutants from seeping into well water at or near any active or abandoned well.

Wetlands: Transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Two major types of concern locally are seasonal wetlands inundated by winter and spring rainfall and flooding, and tidal wetlands flooded daily by ocean tides.



COMPARISION OF TRIBUTARIES AND MAIN STEM GAUGES

Appendix B
GIS Database Development

Overview

An inventory of all available existing Geographic Information System (GIS) resources was conducted to determine existing and new information to include in a GIS analysis of the Fountain Creek Watershed. The following information was entered into the GIS database: hydrologic characteristics (peak flood discharges, daily streamflows, low flows); physical characteristics (channel dimensions, improvements, hydraulic capacities, stream classification); erosion/sedimentation characteristics (channel and streambed material, areas of erosion and deposition, sediment transport data); water quality characteristics (physical, chemical and biological data; beneficial uses; stream standards); and habitat characteristics (aquatic and terrestrial habitat; species). Federal, state, and local agencies, as well as private industries and nonprofit groups sharing an interest in the Fountain Creek Watershed were identified and listed

GIS Data Collection Management—The GIS Data Source Database

Data relevant to hydrologic, physical, erosion/sedimentation, water quality and habitat characteristics developed by federal, state and local agencies was collected and cataloged and used to develop the fundamental tables of a relational database. To organize this information and provide the ability to do queries, a Microsoft® Access (Access 2000) database was designed to be the single point of access for information regarding the GIS database for the watershed.

The major data items included in the database are:

- Principle GIS points of contact for each agency as well as their coordinate system, datum, and units used.
- A column indicating if the information included was either explicitly expressed or implied in the Scope of Work for development of the GIS database.
- A list of mapped features, or GIS data *themes*, was developed to organize the GIS data collection effort. Similar themes were clustered into nine *subjects*. This list was initially organized by identifying the available data sets that would meet the requirements for the GIS database.

All data sets from all agencies were considered important in the data-gathering process for this project. The data was collected, inventoried and visually reviewed for quality assurance.

This process allows thematic and geographically overlapping data sets to be weighed, to determine which data set offers the greatest value to the watershed GIS database.

There are and will continue to be a number of cases in which data sets from more than one source will be used to represent a single theme in the database. For example, boundaries of state and federal government lands are available from the Colorado Department of Public Health and Environment (CDPHE), the Colorado Department of Transportation (CDOT), El Paso County (EPC), PPACG and a partnership project between the Natural Resource Conservation Service (NRCS) and the United States Forest Service (USFS).

Reports

To access the information form the GIS Database, three report templates were designed and are accessible from the GIS Data Source Database main menu by selecting "Reports" from the interface (see Figure below):

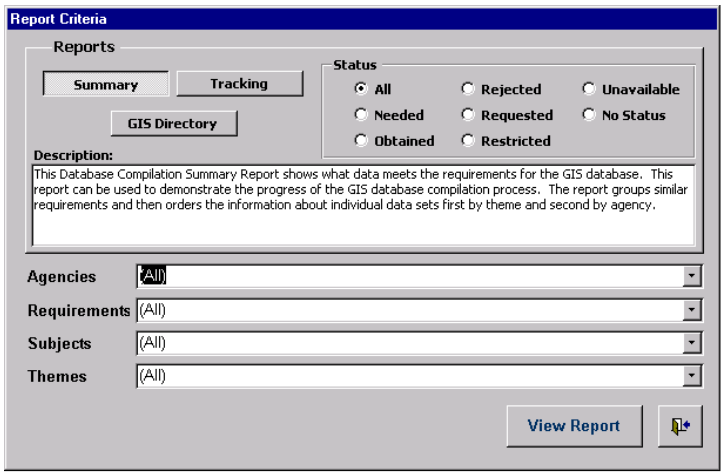


Figure B-1: Screenshot of Access database opening screen

As indicated in the upper left hand corner in the figure above, these three main buttons are:

I Summary

The Database Compilation Summary Report shows the data that meet the requirements for the GIS database. This report can be used to demonstrate the progress of the GIS database compilation process. The report groups similar requirements and then orders the information about individual data sets, first by theme then by agency.

II Tracking

The Agency Tracking Report shows the availability of data from each agency. This report can be used as a checklist for requesting data from an agency and following up on requests. The report orders the information about individual data sets first by agency and then by theme.

III GIS Directory

The GIS Directory Report shows the contents of the GIS database as structured in the GIS directory. The report orders the information about individual data sets first by subject, second by theme and third by agency. Finally, the contents of the "Raw" and "Projected" directories are shown for each data set simultaneously.

Selecting "All" from the options listed under "Status" will show both the current and projected contents of the GIS database. Selecting "Obtained" will show only the current contents of the GIS database.

Selecting individual agencies, subjects or themes from the drop-down boxes on the interface can further filter each of these three reports. Filtering by requirements is a function available for the Summary and Tracking reports, which can help answer questions about specific data sets in GIS database.

All reports can be refined by the options shown under the "Status Window" on the interface. *Needed* data sets have been identified as meeting the GIS database requirements but have not been requested. *Requested* data sets have been requested from an agency but have not been obtained. *Obtained* data sets have been received from an agency and placed in the appropriate subfolder under the "Raw" directory structure. An *Unavailable* data set does not exist, and a *Restricted* data set has not been made available to the GIS database users by the agency from which it was requested.

The status date in each report reflects when each data set was requested or obtained or was found unavailable or restricted, or *Rejected* when the project team determined that the data was unusable or unreliable. The criteria for rejecting data from the data set was not established, so there are currently no data sets that have been rejected.

GIS Database Contents

At the root directory of the GIS directory structure, there are six file folders and three files. The information contained in each of the six folders, shown on the left hand side of Figure B-2.is described below.

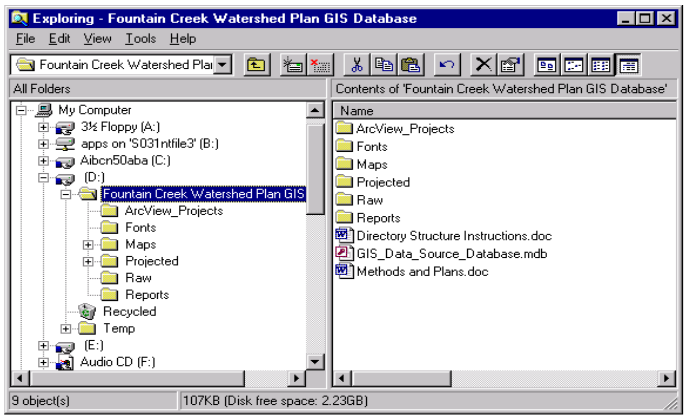


Figure B-2: Screenshot of Access database reporting form

I ArcView® Projects

Four ArcView® project files (.apr) contain the mapping and GIS analysis work.

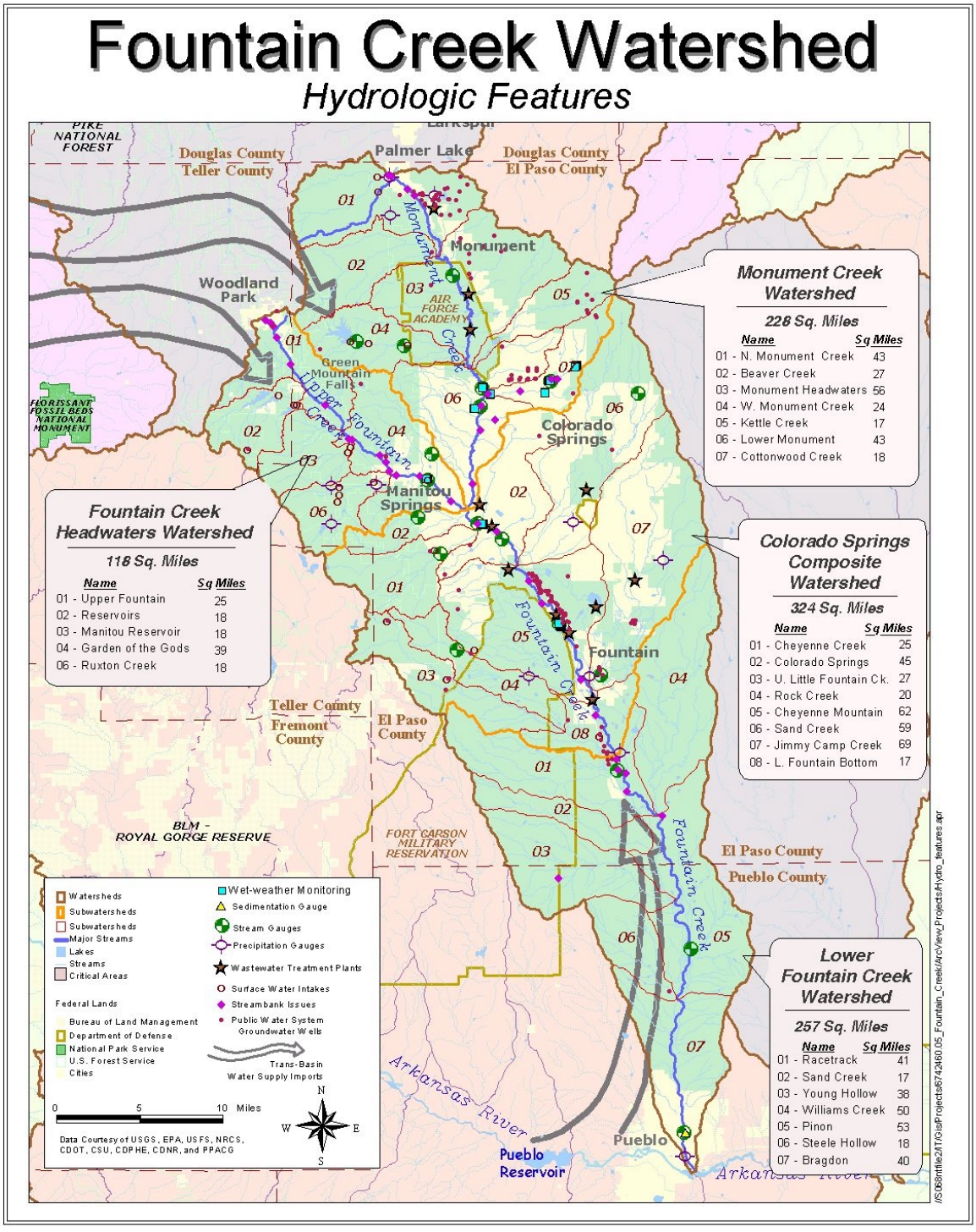
- *Fountain Creek Extraction* (Ftn_crk_extraction.apr)
  Catalogs all the themes created during the aerial photo feature-extraction process, includeing geomorphic, hydrologic, and anthropogenic (human) features within two critical areas of the watershed, identifies valley-long reference line, creek channel center line, and left and right creek banks for all 44 miles of rectified photos along the mainstem of Fountain Creek. Maps created from this file are named: Hanna_Frost_geomorph, Hanna_Frost_human, Pueblo_geomorph, and Pueblo_human.

- *Hydrologic Unit Code (HUC) Framework* (Huc_framework.apr)
  Produces the Hydrologic Unit Code Framework map. Various outputs of the Huc_graphic layouts included in Huc_framework.apr were used for newsletters, the Fountain Creek Watershed Plan website, GIS Database CD covers, and as part of the title screen for the GIS Data Source Database.

- *Hydrologic Features* (Hydro_features.apr)
  Produces a modified version of the HUC Framework map focusing on the locations of water source input, point discharge, and monitoring programs (Figure III-1). Labels subdivided subwatershed names and their representative areas.

- *Regional Reference* (Reg_reference.apr)
  Produces a reference map that shows the Fountain Creek Watershed with respect to the physical geography of the region. Features a raster background image with highways and municipal boundaries which requires the ArcView® Spatial Analyst extension.

Figure B-3


Fountain Creek Watershed
Hydrologic Features
PIKE NATIONAL FOREST
Douglas County
Teller County
Palmer Lake
Douglas County
El Paso County
Monument
Woodland Park
AIR FORCE ACADEMY
Monument Creek
Green Mountain Falls
Upper Fountain Creek
FLORISSANT FOSSIL BEDS NATIONAL MONUMENT
Colorado Springs
Manitou Springs
Fountain
Fountain Creek
Teller County
Fremont County
El Paso County
BLM - ROYAL GORGE RESERVE
FORT CARSON MILITARY RESERVATION
El Paso County
Pueblo County
Arkansas River
Pueblo Reservoir
Pueblo
Monument Creek Watershed
228 Sq. Miles
Name Sq Miles
01 - N. Monument Creek 43
02 - Beaver Creek 27
03 - Monument Headwaters 56
04 - W. Monument Creek 24
05 - Kettle Creek 17
06 - Lower Monument 43
07 - Cottonwood Creek 18
Fountain Creek Headwaters Watershed
118 Sq. Miles
Name Sq Miles
01 - Upper Fountain 25
02 - Reservoirs 18
03 - Manitou Reservoir 18
04 - Garden of the Gods 39
06 - Ruxton Creek 18
Colorado Springs Composite Watershed
324 Sq. Miles
Name Sq Miles
01 - Cheyenne Creek 25
02 - Colorado Springs 45
03 - U. Little Fountain Ck. 27
04 - Rock Creek 20
05 - Cheyenne Mountain 62
06 - Sand Creek 59
07 - Jimmy Camp Creek 69
08 - L. Fountain Bottom 17
Lower Fountain Creek Watershed
257 Sq. Miles
Name Sq Miles
01 - Racetrack 41
02 - Sand Creek 17
03 - Young Hollow 38
04 - Williams Creek 50
05 - Pinon 53
06 - Steele Hollow 18
07 - Bragdon 40
Watersheds
Subwatersheds
Subwatersheds
Major Streams
Lakes
Streams
Critical Areas
Federal Lands
Bureau of Land Management
Department of Defense
National Park Service
U.S. Forest Service
Cities
Wet-weather Monitoring
Sedimentation Gauge
Stream Gauges
Precipitation Gauges
Wastewater Treatment Plants
Surface Water Intakes
Streambank Issues
Public Water System Groundwater Wells
Trans-Basin Water Supply Imports
0 5 10 Miles
N
W E
S
Data Courtesy of USGS, EPA, USFS, NRCS, CDOT, CSU, CDPHE, CDNR, and PPACG
\\S06fntfile2\IT\GisProjects\674246\0.05_Fountain_Creek\ArcView_Projects\Hydro_features.apr

II Fonts

Several True Type fonts are included under this file folder. These fonts must be installed to view a set of Colorado road markers used in the Reg_reference.apr file. Instructions for installing these fonts are in the Directory Structure Instructions.

III Maps

Maps that have been published in hard copy for newsletters or displayed as posters in public meetings can be found under the *Maps* directory in four subfolders: eps, jpg, pdf, and prt Encapsulated Postscript files (.eps) are found under the *eps* subfolder, jpeg graphic interchange files (.jpg) are found under the *jpg* subfolder, Adobe® portable document files (.pdf) are located under the *.pdf* subfolder, and print files (.prt) are found under the *prt* subfolder.

IV Projected

All data sets within the *Projected* directory and its subfolders were either created in or have been re-projected to the State Plane Coordinate System, Colorado Central Zone, North American Datum of 1983 (NAD83), with mapping units in U.S. Statute Feet. The data within the Projected directory and its subfolders may have been clipped or merged, but the outer boundaries of each data set vary; a standard boundary for clipping all data sets has not yet been determined. Filenames of each projected data set with the GIS database can be found by issuing the GIS Directory Report in the GIS Data Source Database.

V Raw

The *Raw* directory contains data sets collected from each of the representative agencies that contributed to the GIS database. These data sets have not been clipped, merged, or re-projected. Spatial data within the GIS database have been organized into a four-level hierarchy. This structure is identical for both the Projected and Raw directories. Similar GIS data themes have been clustered into nine subjects. Each subject is represented as a file folder under both the Projected and Raw directories.

These data sets for both the “Projected” and “Raw” folders have been organized into

1) subject-oriented subfolders,
2) GIS Data Theme Subfolders, and
3) Agency Name subfolders

An agency-level file folder contains the original data if the folder is located under that Raw directory structure, or reprojected data if the folder is located under the Projected directory

structure.

Metadata can be found at the final level within the Raw directory structure, along with its associated data set. The Raw directory structure contains the original data as it was obtained from the agency, and the Projected directory structure contains data that has been created in or reprojected to the State Plane Coordinate System, Colorado Central Zone, NAD83 Datum, with mapping units in U.S. Statute Feet.

Reports

A number of reports issued from the GIS Data Source Database have been converted to Adobe Acrobat pdf. Each such static report includes the date of issue in its filename. For example a Database Compilation Summary Report issued on April 4, 2001, would be found under the filename GIS_Compilation_Summary_040901.pdf.

Featured Data Sets

Some of the key data sets that have been acquired for the GIS Data Source include:

Fountain Creek Features

A time-series comparison of geomorphologic, hydrologic and anthropomorphic features derived from 1955 and 1999 Farm Service Agency aerial photography was extracted from rectified photo imagery. The value, development, and purpose of this data set is discussed following Airphoto Rectification and Feature Extraction Methodologies.

Watersheds for the State of Colorado

The draft GIS database of HUC boundaries for the State of Colorado from the United States Forest Service – Natural Resource Conservation Service (USFS-NRCS joint project has been acquired and incorporated into daily GIS database workflows. Cartographic production and GIS database schema plans are centered and focused on the attributes of the representative units of this data set.

Colorado National Hydrography Data Set (NHD) Densification Project

This collaborative project among the U.S. Geological Survey (USGS), the USFS, and the Colorado Division of Wildlife (DOW) has developed a 1:24,000-scale polygon and line ArcInfo® coverage compiled from USGS Digital Line Graph (DLG) files and EPA Reach files. It has been further attributed to include detailed water feature information for point, line and area hydrographic features. This data set will likely be the featured data set for thematic display of hydrographic information across the watershed and a good data candidate for

hydrologic modeling and analysis. The DOW released a partial pre-draft version of this data set to the Fountain Creek Watershed Plan project team for cartographic use only (no analysis).

Hill-Shaded Color-Relief Background Image
A raster color-relief elevation image derived from 30-meter Digital Elevation Model (DEM) files has been hill-shaded, preparing an attractive background for reference and thematic maps. The Fountain Creek Watershed Regional Reference map is one example of its use.

B.6 Future Analysis Recommendations

Future plans for GIS data collection and management include:

Goal 1: Automate data conversion.
Automating data conversion routines is critical to the sustained development of the Fountain Creek Watershed GIS Database. Many of the representative data sets for this database will continue to be revised and updated by the agencies that manage them. Any translation or revision to these data sets upon their integration into the GIS database will be more efficiently and accurately performed through automated routines. A clearly defined and automated process will be developed in Feature Manipulation Engine or in ArcGIS® using Visual Basic for Applications® (VBA) that will reproject, convert, clip, merge, and add attributes to representative data sets.. A standard set of attributes has been defined that will further describe mapped features within the Fountain Creek Watershed. These and other unique attributes will be added as part of the automated data conversion process.

Goal 2: Develop a metadata standard.
A standard for metadata will be developed. Metadata meeting this standard will be prepared for each representative data set and metadata not meeting this standard will not be included in the database.

Goal 3: Create a thematic map series.
A series of high-quality maps will be produced representing the critical issues and areas addressed and examined in the Plan. These will include but will not be limited to maps showing channel instability, erosion, deposition and sedimentation, flooding, and the economic impacts of these issues.

Goal 4: Plan for the distribution of and remote access to the GIS database to Plan stakeholders.
Additional efforts will be made to outline plans for data distribution, including development

of a map service that will grant stakeholders online access to the GIS Database.

Goal 5: Help facilitate intergovernmental agreements for GIS data sharing between PPACG and key agencies.

PPACG is expected to take a lead role in these negotiations, which negotiations will invlove establishing a common ground between each agency's political, economic, and legal objectives resulting in a cooperative data-sharing agreement.

Appendix C
Critical Reach Analysis (Airphoto Rectification and Feature Extraction Methodologies)

General Approach

Watersheds by their very nature, are dynamic systems that change over time The purpose of the following studies is to gain a better understanding of erosion, sedimentation and flooding problems in selected critical reaches within the Fountain Creek Watershed through time-series analysis of aerial photographs of the stream corridors.

Aerial photographic time-series analysis provides a better understanding of the relationships between each study area and the human and physical components affecting its stream corridor. Multiple years of photographs were acquired and rectified into the proper coordinate system using geographic information system (GIS) and remote sensing tools. Using the photographs as a backdrop, various features were then collected using GIS to provide a better understanding of erosion, sedimentation and flooding problems in a stream reach. These GIS data sets were subsequently used to compare changes in the channel and floodplain over time. Field investigations of the channels and floodplains were completed to observe fluvial landforms that reflect the condition of the streams and changes in stream geomorphology in the recent past.

Six critical Reaches have been analyzed so far in the Fountain Creek Watershed:

- Monument Creek, about 2½ miles, upstream of Monument Lake between the Towns of Monument and Palmer Lake
- Black Forest Tributary, about 1 mile, in the Gleneagle area just north of the Air Force Academy's auxiliary air field
- Cottonwood Creek, about 2 miles, from Union Blvd. to where Cottonwood Creek crosses under I-25
- Jimmy Camp Creek, about 1 ½ mile, from Fontaine Blvd. along Marksheffel Rd. to just upstream of Link Rd.
- Fountain Creek, about 3 miles, about 2 miles up and down from exit 151 (Pikes Peak Race Track).
- Fountain Creek. Pueblo Critical Area, about 4 miles above the confluence with Fountain Creek and Arakansas River.

A description of the analysis is available in a separate report entitled Fountain Creek Watershed GIS Critical Reach Analysis, which will be available on the Fountain Creek Watershed. This report is available on the Fountain Creek Watershed Webpage (www.fountian-crk.org) or by contacting PPACG at 719-471-7080.

Background

This study was conducted to gain a better understanding of erosion, sedimentation and flooding problems in the four selected critical areas through a time-series analysis of aerial photographs from 1955, 1983 and 1999 or 2001 of the stream corridors. GIS tools were used to extract features such as bank limits, meander belts, and rapidly eroding banks. Vegetation, transportation facilities (such as bridges crossing the stream reaches), and structures adjacent to streams were also analyzed. Field investigations were conducted to examine stream morphology, floodplains and channel corridors. These channel statistics were calculated for each of the three years of photographs that were analyzed.

The study examined features of the different stream reaches and how the stream channels have changed over time and in many places have become constrained by development. The result of this development is that the streams have changed from flowing in response to storm events to flowing year-round. This creates problems with sediment and ultimately flooding and channel degradation, which in turn can threaten buildings and infrastructure. The analysis of the aerial photographs demonstrates that floodplain maps can become outdated over time due to development, channel changes and a number of other factors. Preventative measures, such as watershed restrictions on well watering, reuse programs and identifying erosion-prone areas, may be necessary to prevent further damage. Information derived from aerial photography analysis, GIS tools and field investigations will supplement the information in floodplain maps and help to highlight problem spots for erosion. Analysis of historical movement of stream channels can also be used to estimate future movement.

Aerial Photograph Rectification Methodology

The project team researched two different aerial photography acquisition methods. The first method required flying the study area and generating ortho-rectified aerial photos through photogrammetric means. This method was eliminated from consideration because its cost was prohibitive. Instead, the team located existing sources of aerial photos. The project team learned that photos from various years were available from several sources including the U.S. Department of Agriculture (USDA)-Farm Service Agency Aerial Photography Field Office in Salt Lake City, Utah and other aerial-photograph vendors.

Aerial photos covering a specific time period were purchased for the study area and delivered in black/white, unrectified ".tif" image format or color geo-referenced .tif format. It was not necessary to obtain photos with complete stereo coverage. As a result, the USDA photos have approximately 20 percent end lap and 50 percent side lap (with side lap only in corners of the photos). The color .tif

image was clipped from a larger data index to show only the study area. After the photo sets were acquired, the rectification process could begin. The following steps were followed to rectify the aerial photos.

Select which photo to rectify, and then identify ground control points from a known source to rectify the photos. URS chose to use U.S. Geological Survey (USGS) Digital Raster Graphic (DRG) data sets (digital USGS 1:24,000 topographic quads) as the source data because they were readily available and could be easily manipulated into the proper projection. Control points were chosen based on their presence on the DRGs and on all photo years to minimize efforts. A minimum of four control points was located on each photo and the corresponding DRG.

The photos were rectified using the control points selected. This procedure both rectified and projected the aerials into the proper projection. Each completed photo was then loaded into ArcMap® and displayed against the reference DRG to ensure both data sets adequately aligned with each other. Accuracies within the study areas typically range from approximately 10 feet to 150 feet in the x and y directions, with better accuracy generally found in the middle of the photo and along the stream segment to be studied. Aerial photo rectification errors are mainly caused by slight variations in photo scale within the image, especially near the edges. These errors are usually encountered in the rectification process and therefore were deemed minor and ignored.

Edge information such as fiducial marks and black "no-data" areas were eliminated from each USDA black/white aerial photo after the rectification process was complete. The aerials were loaded into ArcMap® and displayed to clearly determine the edge between the actual photo image and its extraneous edge information. This edge was digitized to form a closed square on the screen and saved. These digitized edges were then converted to ArcInfo® polygon coverages. The aerials were converted from .tif images into ArcInfo® GRID files. The GRID files of each aerial were then clipped with the polygon "edge" file to delete all GRID data beyond the clipping boundary. Finally, the photos were converted from GRIDs back to .tif files. The color .tif images were not modified because they did not have any "no-data" areas.

Feature Extraction Methodology

Once the aerials were rectified, each was loaded into ArcMap® to begin the process of extracting features from the photo and into a shapefile. A GIS database schema was developed to guide the

feature extraction process. The schema outlines the individual features to extract and includes each feature's attribute definitions and ranges, and is included as part of the GIS data delivery.

Using the feature definitions and ranges from the database schema, shapefiles were created to receive the collected feature data. Data were collected from the rectified photos and placed in the proper ArcMap® themes by digitizing features directly on the computer screen. Features were collected within ArcMap® at a view scale of 1:3,000. This data scale displays all years' photos with enough detail to locate the required features. In many cases, ArcInfo® was also needed to help edit and process data, especially those data sets representing area features. Each feature and its extraction guidelines are outlined below.

Valley Length Reference Line

This feature was collected for quick and easy reference within GIS and provides a base to measure the sinuosity of the stream within each critical reach. The reference line was placed along the axis of the stream valley as determined from the most recent aerial photo.

Channel Centerline

This feature traces the center of the visible active flow area and indicates where the majority of the stream flow is located. The main channel was determined on the photos by simply locating the channel that is the largest and appears the most active. However, on many of the photos, stretches of channel could not be easily located because of dense streamside vegetation, steep narrow banks or a combination of these circumstances. In these cases, the centerline was approximately placed using streamside vegetation and other features as guides.

Left and Right Creek Banks

Identifying water within the channel and tracing each bank determined the creek banks. Many areas feature braided streams with multiple channels. In these cases, the creek banks were traced to include all the braided channels present. If only one channel was present, then the creek banks followed its edges exclusively. Where dry stretches occurred, the creek banks were assumed. Care, however, was taken to not include some features along the channel, such as point bars and beaches.

Critical Area/Reach Outline

These features were created as a reference for later feature collection within each study area. They are created using the northern and southern extents of the study area and a buffer of the most recent year's creek centerline.

Meander Belt

The meander belt is defined as the zone along the valley floor across which a meandering stream shifts its channel from time to time. This is important in determining the past and potential future channel changes during and after periods of flooding. Meander belt features were first identified on hard-copy prints of aerial photos by the team geomorphologist. Meander belt lines for each reach were then digitized on the screen with the aid of the photo backdrop, saved, created as polygons and attributed.

Prominent Scour and Deposition Areas

Where applicable, prominent scour areas and prominent deposition areas were collected for each critical reach. Scour areas are determined by the presence of exposed alluvium and sparse scrub-like vegetation immediately adjacent to channel edges. These locations are good indicators of recent channel movement during floods. Deposition areas are locations where alluvium have been deposited and typically occur in areas of decreasing stream gradient or upstream of channel obstructions. Scour and deposition areas were outlined on hard-copy prints by the team geomorphologist, digitized, created as polygons and attributed.

Vegetation

Vegetative cover was collected to help capture the human-induced changes within each critical reach. Data were collected only within the meander belt for a particular year, instead of the entire critical reach, to avoid costly time commitments and to focus attention on those areas immediately adjacent to streams.

General vegetation patterns were initially identified on hard-copy plots of each critical reach. From these, simple vegetation classes were developed. They include shrubland, forest, barren, potential wetlands, grassland, water, and riparian areas. A brief description of each vegetation class follows.

- Shrublands were identified by upland open-canopy forests with scrub-like vegetation such as oaks.
- Forest areas were identified as closed-canopy areas and were primarily pine trees or thick oak stands.

- Riparian areas consisted of willows, tamarisk and other vegetation immediately adjacent to stream banks.
- Barren areas were located within channels, had little to no vegetation and consisted of mainly sand and gravel.
- Grasslands were mainly located on dry upland areas and could be either prairies or pastures.
- Potential wetlands were collected for areas that were noticeably wet, but away from the channel.
- Water features were farm ponds and lakes.

These areas were then identified on-screen in ArcMap® and digitized within meander belts, saved, converted to polygons, and attributed. In addition, any transportation features or structures located within the meander belt were combined with the vegetation data and included as part of the final shapefile.

Unstable/Eroding Banks

These features represent locations within each critical reach where creek banks are either unstable or actively eroding. They are often near scour areas and edges of the meander belt. Active bank erosion features were first identified in the field, then correlations between field observations and recent aerial photographs were used to judge where the features are located on hard-copy prints by the team geomorphologist, digitized, and attributed within ArcMap®.

Transportation and Major Structures/Built-Up Areas

These features were collected to help document the important role humans play within each critical reach. Both feature sets were delineated directly within ArcMap® using the appropriate photos as backdrops and saved as polygons. All paved roads and railroads within each critical reach were identified, along with any gravel roads located within the meander belt. All major structures and built-up areas within each critical reach were also digitized. Groups of houses, entire neighborhoods and parking lots were aggregated as large polygons when possible.

Surficial Geology

The team was able to locate a hard-copy map of surficial geology that covered all study areas (Geologic Map of the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado, USGS 1979, 1:100,000-scale). Unfortunately, this map was not readily available in a GIS format, so it was not included in the GIS analysis.

Other Data

Federal Emergency Management Agency (FEMA) Q3 digital floodplain data for El Paso County were obtained for the Fountain Creek Watershed Plan. When possible, each study area was clipped from the Q3 data and included with the GIS data deliverable. Additional data sets were collected if the team thought the effort would help explain a reach's geomorphology.

Compilation of Fountain Creek Watershed Drainage Basin Planning Study Data

Study #	Study Title	Subwatershed	Hydrologic Characteristics			Physical Characteristics				Erosion/Sedimentation Characterisitics		
			peak flood discharges (cfs)	daily streamflows	low flows (cfs)	channel dimensions	channel improvements	hydraulic capacities	stream classification	channel and streambed materials	areas of erosion or deposition	sediment transport data
1	**Black Squirrel Creek Drainage Basin Planning Study**	**Monument Creek**	Peak is at confluence with Monument Creek. Developed: 100 yr, 24 hr=3834 Historic: 100 yr, 24 hr=3950 10 yr, 24 hr=1098			Channel is described as 13 reaches, based on the ten present condition design point locations shown on Fig 3. Top width: 30-100 ft?? Bottom width 6-250 ft Ranges from shallow, broad channel to quite deep and narrow, generally w/sandy bottom and well vegetated slopes.	Existing and proposed developed conditions on maps, Figures 3, 4, 5 in back pocket. Don't know which proposed improvements have been implemented since 1989. Several "stock ponds" along creek are recommended to be removed, and were not taken into account in flow calculations. Some culverts analyzed to be undersized. Recommendations mainly subregional detention w/ partially & fully lined major drainage channels.	Slope information not found. Overbank velocities for 100-yr flow range from 1-13 fps, w/ average of 5.75 fps.		Western 1/4 (by length along the main channel) is Truckton-Blakeland-Bresser Group soils, & the remainder is Kettle-Pring-Peyton Group. Granular soil, well drained, easily erodible. 99% type B, 1% types A & C	State Highway 83 (due to under-sized culvert)	east of SH 83 (forest) more stable than west of SH 83 (rangeland)
2	**Black Forest Drainage Basin Planning Study**	**Monument Creek**	Peak is at design point E, which is the primary channel crossing under I-25. Developed: 100 yr, 24 hr=1900 10 yr, 2 hr=610 Historic: 100 yr, 24 hr=2090 10 yr, 2 hr=645			Most of the channels are natural, unimproved valleys & swales which are dry except during rainfall events, with one primary channel which begins at the northern most reach of the basin having year-round flow thru 50% of its reach. This main channel is approximately 20' wide and 10' deep. Two other channels are large enough to be considered major drainage ways. These two channels are broad grassed swales. See Table 8 on pages 23-24 for information on each major drainageway, including depth, width, flow, slope, normal depth, velocity and length.	There are a total of six tributaries in this basin which cross I-25 via box culverts. Several detention ponds exist in the Gleneagle development area (see page 6). See Table 9 on pages 25-27 for evaluation of existing structures. 15 out of 22 structures deemed inadequate. Five proposed development alternatives were evaluated, and Alternative 5 was chosen. See page 30 for description, pages 34-35 for drawing and evaluation, and Appendix B for preliminary design of Alternative 5. Don't know which of the improvements are in place at this time.	Slope varies from 2.8-5%. See Table 8 for slopes of major drainageways. Main channel flow exceeds 2000 cfs in some areas.		Soil types in basin are primarily B, with some C and D. They are Alamosa Loam (C), Brussett Loam (B), Kettle Gravelly Loamy Sand (B), Kettle-Rock Outcrop Complex (B/D Rock), Kutch Clam Loam (C), Peyton-Pring Complex (B), Pring Coarse Sandy Loam (B), Tomah-Crowfoot Loamy Sands (B). Exact percentages not given, but shown on map.	Some areas of main channel have severe erosion, mostly along one reach and at culvert outlets, while other area is stable vegetation -covered banks. Other reaches shown little or no sign of erosion.	
3	**Middle Tributary Drainage Basin Planning Study**	**Monument Creek**	Peak discharge at design point 17, which is confluence of Middle Tributary basin and Monument Creek. Developed: 100 yr, 24 hr=904 10 yr, 24 hr=259 Historic: 100 yr, 24 hr=905 10 yr, 24 hr=259			Ranges from shallow, broad channel to quite deep and narrow, generally w/sandy bottom and well vegetated slopes.	Recommendations focus on subregional detention with partially lined channels. See Figure 3 in back pocket for proposed structures and their flow.	Slope information not found.		Soils are approx. 75% type B and 25% split between types C and D. These include Kettle Rock Outcrop (D), Kutch Clay Loam (C), and the following type B soils: Cruckton Sandy Loam, Kettle Gravelly Loam, peyton sandy loam, peyton pring complex, stapleton sandy loam, tomah-crowfoot loamysand. Most of these soils have moderate erosion potential.	Reaches 4, 7, and 8	
4	**Monument Creek Drainage Basin Planning Study (Volume I of III)**	**Monument Creek**	At confluence with Fountain Creek. Future Developed: 100 yr=32,800 10 yr=7,660 Existing Developed: 100 yr=27,900			Upstream reach is in natural channel state, with unvegetated width between 20-35 feet, w/base flow depth of 0.5-2 feet. Downstream reach (south of Woodmen Rd) has "disturbed" cross section, with width of 30-200 feet, w/base flow depth of only a few inches. Extensive charts are in report concerning historic channel characteristics.	Area south of Woodmen Rd has been changed from natural channel state more than north of Woodmen. Much of the natural floodplain channel has been filled in for development, raising flood levels, reducing riparian vegetation, and increasing flood velocities and bank erosion risk. Preliminary plan recommendations consist of: a series of sloping boulder riffle drops for grade control, protection of infrastructure, etc.; creation of vegetated bench areas adjacent to the base flow channel to retard flow velocities and enhance bank stability; regrading and revegetating steep, eroding channel banks to reduce erosion potential and improve public safety; repair of undermined riprap or gabion slope protection structures; installation of grouted rock energy dissipators at several locations; installation of fencing at the top of steep bedrock banks; planting of screening vegetation to soften the appearance of existing concrete or rock bank protection	High velocities in downstream reach during floods due to loss of vegetation. Some bridges analyzed to be submerged in developed conditions. They are: abandoned RR bridge in reach M1, pedestrian bridge in M2, Polk St bridge in M3. Overbank flooding is estimated to occur during the 100 yr flood in reaches M2, M3, and M5. Average Mannings n values range from 0.04-0.07. Recommended equilibrium slope of 0.2% for future improvements. Extensive charts are in report concerning slope and other channel characteristics.		Soil types are 11% group A, 52% group B, 3% group C, and 34% group D. In general the soil has a moderate runoff potential. Exact soil types can be found in Volume II of this study.	Monument Lake spillway channel shows significant erosion. Upstream reach shows evidence of some streambank and streambed erosion. High sediment loads downstream of Woodmen Rd have created a wide, braided base flow channel, reducing riparian veetations and impairing aquatic habitat and water quality. Downstream reach in general exhibits significant streambank and streambed instability.	Low sediment transport in upstream reach during base flow conditions. Downstream reach sediment transport appears high, with a significant sediment contribution evident from Cottonwood Creek and other tributaries to Monument Creek. DS sediment during base flows consist primarily of bed load (sand and fine gravel).
5	**Monument Branch Drainage Basin Planning Study**	**Monument Creek**	At confluence with Monument Creek, design point 14. Developed: 100 yr, 24 hr= 2459 10 yr, 24 hr=778 Historic: 100 yr, 24 hr=2459 10 yr, 24 hr=778			Ranges from shallow, broad channel to quite deep and narrow, from well-defined to slightly-defined, generally w/sandy bottom and well vegetated slopes.	Several "stock ponds" along creek are recommended to be removed, and were not taken into account in flow calculations. Some culverts analyzed to be undersized. Recommendations mainly subregional detention w/ partially lined major drainage channels.			Soils are 100% type B . These include Kettle Gravelly Loam, Kettle Rock Outcrop , peyton sandy loam, peyton pring complex, pring coarse sandyloam, tomah-crowfoot loamysand. Most of these soils have moderate erosion potential. All are well-drained	Siltation at design point 8 in culvert and one wingwall. Erosion and sid sloughing expected in upper end of reaches 7 and 4. Some erosion expeceted in channel bottome during low flows and some bank erosion during higher flows in reaches 3 and 5.	
6	**Monument Branch Master Drainage Plan**	**Monument Creek**										
7	**Cottonwood Creek Drainage Basin Planning Study**	**Monument Creek**	Design point 21 Developed: 100 yr, peak flow= 3400 cfs				See section 5 - Master Plan Recommendations	Slope varying at diff. Sections.				Significant sediment supply located in the terraces deposists in the bed of channel.
8	**Fountain Creek Drainage Basin Planning Study**	**Fountain Creek**	Downstream of confluence with Monument Creek, design point 31. Developed: 100 yr, 24 hr= 39,167 10 yr, 24 hr=19,067 Historic: 100 yr, 24 hr=33,480 10 yr, 24 hr=12,226			Divided into 8 reaches in study area. Reach 1 is the only primarily natural, unchannelized reach in the study area.	Lots of rubble in Fountain Creek above confluence w/Monument Creek (not necessarily an improvement). Detention along channel, either local or regional, not feasible. Must detain at development sites. Several alternative development plans were analyzed. Each of the 8 reaches has a recommended alternative. Common components include riffle drops, vegetated benches, & regrading steep eroding banks. Preliminary plans for each reach are on pages 7.0-15 to 7.0-25. Volume II contains a complete inventory of drainage facilities.	Flooding problems in reaches F2, 3, 5, 6, 7, & 8.		Pierre shale bedrock covered by surficial deposits. Composite classification of type C. See Volume II for list of all soils encountered.	More common above confluence w/ Monument Creek, sporadic and mainly adjacent to development/structures. Degraded areas in reaches F2, 4, 5, 6, 7, & 8.	Sediment comes mainly from upstream, tributary basins. Data for each reach is on pages 5.0-7 & 8, tables 5.5-1 & 2. Including cubic yds per reach and whether the reach is subject to degredation or aggredation, and equilibrium slope. Average equilibrium slope is either 0.0072, 0.0153, or 0.0125
9	**City of Woodland Park Stormwater Master Plan**	**Fountain Creek**	Downstream of confluence with Crystola Creek, design point 15. Existing: 100 yr, 24 hr=8,415 10 yr, 24 hr=1,788				Various problem areas identified, with several alternatives analyzed and recommended alternatives chosen (pages VI-7 to VI-11 and Figures VI-6 thru VI-9).			Rule-Cheeseman-Plome-Crystola Association soils, w/ Rule & chesseman predominant. Well-drained, low to high permeability depending on texture, organic matter, and compaction. Textures range from gravelly coarse sand and gravelly loamy sand to loams. Highly erodible soils.	Woodland Park is experiencing severe erosion caused by stormwater runoff. The erosion magnifies flood problems as the sediment fills up the natural channels and culverts.	

Compilation of Fountain Creek Watershed Drainage Basin Planning Study Data

Study #	Study Title	Subwatershed	Hydrologic Characteristics			Physical Characteristics				Erosion/Sedimentation Characterisitics		
			peak flood discharges (cfs)	daily streamflows	low flows (cfs)	channel dimensions	channel improvements	hydraulic capacities	stream classification	channel and streambed materials	areas of erosion or deposition	sediment transport data
10	**Bear Creek Drainage Basin Planning Study**	**Colorado Springs Composite**	Confluence with Fountain Creek, design point 1. Developed: 100 yr, 24 hr= 4,540 10 yr, 24 hr= 1,460 Historic: 100 yr, 24 hr= 4140 10 yr, 24 hr=1140			Divided into 13 reaches based on drainageway characteristics and/or problems. Range from wide and flat to steep and narrow.	Existing structure inventory in Appendix B. Recommended improvements generally riprap banks and invert improvements and better locate drainage facilities in basin.	22% slope between upper basin boundary and Gold Camp Road. 3-5% for remainder of channel. All existing structures deemed inadequate to pass 100 yr flow except culver under I-25 (structure inventory in Appendix B). Flooding discussed pages 45-46.		5% is type A, 70% type b, 10% type c, 15% type d. Type A soils are Chaseville Gravelly sand loam, chaseville-midway complex, ellicott loamy coarse sand, gravel pits, and razor stoney clay loam. Type B soils are Bresser Sand loam, fluvquentic haplaquolls, jarre-tecolote complex, and ustic torrifluvents. Type C soils are heldt clay loam and razor-midway complex. Type D soil is kutler-broadmoor rock outcrop.	Inadequately sized structures cause erosion/deposition at several points. Problems at reaches 1, 2,3, 6,8,12.	
11	**Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study**	**Colorado Springs Composite**	Confluence with Fountain Creek, design point 1. Developed: 100 yr, 24 hr= 3676 10 yr, 24 hr= 1372 Historic: 100 yr, 24 hr= 4398 10 yr, 24 hr=1742			Divided into 5 reaches. Summary table 4 of reach descriptions on page 34.	See table 5 for existing structure inventory. Regional detention recommended in general. Summary of recommendations on table 11 on page 59.			Predominantly type B soils.	Downstream of US 85/87 is severely degraded in reach 1. Also problems in reache 2.	
12	**Fishers Canyon Drainage Basin Planning Study**	**Colorado Springs Composite**	At I-25, just upstream of confluence with Fountain Creek, design point 9. Developed: 100 yr, 2 hr= 3170 Historic: 100 yr, 2 hr= 3090			Ranges from narrow and deep to wide and flat.	See figure IV-1 for drainage concerns needing improvements.	Average slope of 1.5%. Insufficient culvert and channel for 100 year storm at I-25 to Fountain creek.		Loamy, but w/significant percentages of clay in some areas. Rock outcrops in highest eleveation on mountain side. Steep upper sections are generally type C and the reaminder of the basin is either type B or C.	Channel bed and bank erosion is occuring due to urbanization and inadequately planned drainage systems.	
13	**Windmill Gulch Drainage Basin Planning Study**	**Colorado Springs Composite**	Confluence with Fountain Creek, design point A. Developed: 100 yr, 24 hr= 1305 10 yr, 24 hr= 635 Historic: 100 yr, 24 hr= 1160 10 yr, 24 hr= 545			Upper reaches are natural channels, typically wide, grassed swales. Southern one-third is developed.	Existing channel and structure inventories on tables 7-8, pages 20-21. Some structures unable to handle 100 yr flow. Recommendations preliminary design beginning page 32, mostly detention and culvert improvements.	Mannings n=0.045		Type A soil is blakeland loamy sand, which is predominant in basin. Other soils present are type B and are: ascalon sandy loam, blendon sandy loam, bresser sandy loam, fort collins loam , keith silt loam, stoneham sandy loam, tructon loamy sand , truckton sandy loam, and wiley silt loam.	Upper reaches show little to no erosion. Only area showing slight erosion is east of Powers approx 2000' south of Drennan.	
14	**Engineering Study and Revision of The North Shooks Run Templeton Gap Drainage Basin**	**Colorado Springs Composite**	At intersection of Templeton Gap floodway and Nevada Avenue.in 1970 of 1090cfs.			Broad, shallow, unpaved ditches and streams in their more or less natural state.North and East boundaries very steep drops, southern boundary much smoother, getting steeper near Austin Bluff. Eastern relatively low profile with smooth flow towards sowthwest.	Near the main greenbelt in subbasin B, in the general area of Union and Montebello and in the lower ground along Academy Boulevard drainage structures will need to be opened so that they can act as subsurface soils drains as well as surface drainage appurtennances. Paving on sides and bottom of major greenbelts.	Slope information not available		The soils within the basin are derived from Dawson's formation and basic material is a sandstone which actually is rather weakly bound clay/sand conglomerate. Large lenses of clays, varying from quite sandy to being very high plastic clays can be anticipated at almost any point within the basin.	North and East boundary are badly eroded	In the lower more level ground-at south of Cragmor bluff and north of Templeton Gap Floodway plus south of Mount View Lane and Acacia Drive.
15	**Little Johnson/Security Creek Drainage Basin Plannig Study**	**Colorado Springs Composite**	Design point 45. Developed: 100 yr, 24 hr= 3996 10 yr, 24 hr= 1976 Historic: 100 yr, 24 hr= 2850 10 yr, 24 hr= 1403			Varying from concrete lined channels to grasslined channels, to 36" storm sewer	Various alternatives to reduce the flood damage Pg.31	Mannings n=.025-0.045, design velocites = 6ft/sec, slopes 4H:1V		Predominantly made up of Type A and B soil groups with some C groups alsong U.S. Highway 85/87 and the railroad.		

Reach Descriptions, Major Infrastructure Listing, and Channel Rating

Reach	Endpoint Landmarks	Beg Sta (mi)	End Sta (mi)	Beg Elev (ft)	End Elev (ft)	Chan Slope (ft/ft)	Stream Class[1] (Rosgen)	Infrastructure	Water Features	Land use	Stability Class[2]
Lower Fountain Creek											
4a	Arkansas River to Hwy 50	0	2.61	4638	4692	0.004	C4 to C5	Pedestrian Bridge Treatment Plant Pipe Missouri Pacific RR Bridge Topeka/Santa Fe RR Bridge 4th Street Bridge 8th Street Bridge Levee System	Misc Storm Drains w/ flap gates	Urban, Urban park	2
4b	Hwy 50 to Bragdon	2.61	11.8	4692	4940	0.005	C4 to C5	Hwy 50 Bridge Hwy 47 Bridge	Greenville Ditch	Suburbs, Agricultural	3
4c	Bragdon to Pueblo Cty Line	11.8	21.96	4940	5150	0.004	C4 to C5	Pinon Bridge Pipeline (S7)	Eder Banister Ditch Eder Benesch Ditch Sutherland Ditch Young Galloway Ditch (at Young's Hollow)	Agriculture	3
4d	Pueblo Cty Line to SW Boundary	21.96	31.03	5150	5365	0.004	C4 to C5	Old Pueblo Road Bridge Topeka/Santa Fe RR Bridge	Jackson and Burke Ditch (At Wigwam) Ditch No. 13/9 (at Midway Ranch) Cotton Slough Ditch (at Williams Ck) Ditch No. 18/Tom Wanlass at Buttes Ditch 14 (above Williams Ck) Ditch 20 (above Williams Ck)	Agriculture	3

Appendix F

This appendix contains the Policy Matrix as referenced in Section 6. The following policies were reviewed, incorporated into the Matrix, and referenced by the corresponding number given below:

(1) Drainage Criteria Manual, City of Colorado Springs and El Paso County, as revised October 1994.

(2) City Code, Colorado Springs, Colorado, current through Ordinance 02-50 passed March 26, 2002, electronic code

(3) City of Woodland Park, Stormwater Fee Program, Chapter 13.50 Stormwater Management

(4) City of Woodland Park, Resolution No. 299, Series 1994 modifying the Design Criteria for Stormwater Detention Ponds contained in the City Specifications by Incorporation of the PPACG Area Wide Urban Runoff Control Manual.

(5) City of Woodland Park, Driveway Permit Application

(6) City of Woodland Park, Ordinance No. 709, Series 1997, Adding Chapters 18.40 to 18.41 to the Municipal Code of the City of Woodland Park to provide for Grading Regulations and to Provide for the control of soil erosion and sedimentation, and amending 18.06 of the municipal code.

(7) City of Woodland Park, Title 20, Flood Damage Prevention Regulations

(8) Town of Palmer Lake, Land Use Permit

(9) Town of Palmer Lake, Municipal Code Chapter 17.50

(10) Town of Palmer Lake, Ordinance No. 3 of 2000, Relating to the Drainage Structures, Adding a new Chapter 16.80 to Palmer Lake Municipal Code

(11) City of Fountain, Chapter 16.10, Flood Damage Prevention

(12) City of Manitou Springs, Subdivision Regulations, 2002

(13) Teller County Land Use Regulations, Teller County Planning Department, Effective Date July 2002.

(14) Teller County Roadway Design and Construction Standards, 1999, Teller County, Colorado, Adopted July 8, 1999.

(15) Town of Monument, Ordinance No. 7-2002, Amending Ordinance 16-2000.

(16) Town of Monument Subdivision Ordinance, Chapter 12 Subdivision

(17) City of Pueblo, Storm Drainage Design Criteria and Drainage Policies, June 9, 1997.

(18) Town of Green Mountain Falls, Zoning Ordinance, 1997.

(19) City of Colorado Springs Engineering Division, "Drainage Criteria Manual Volume 2, Stormwater Quality Policies, Procedures and Best Management Practices," November 2002

(20) El Paso County, Land Development Code, June 29, 2000

(21) Pueblo County, County Code, Electronic Version November 2000.

(22) City of Colorado Springs, Mandated Stormwater Quality Requirements for Construction and New Development Activities, July 29, 2002. Revision to City Code and adoption of the Drainage Criteria Manual Volume 2.

(23) Pueblo County, Zoning Resolution, February 28, 2002

(24) Pueblo County, Subdivision Regulations, February 28, 2002.

(25) Regulations for Flood Hazards, Pueblo County, 2002

(26) Manitou Springs Municipal Code, Electronic Version, current through Ordinance 2101 and the May, 2002.

(27) City of Fountain, Zoning Regulations, Title 17, 1988.

(28) City of Colorado Springs, Comprehensive Plan 2000, electronic version

(29) El Paso County Floodplain Regulations, Addendum A,recently revised and needs to be readopted.
(30) City of Colorado Springs, Streamside Ordinance, Streamside Design Guides,
(31) El Paso County, Prudent Line Addendum, June 21, 2001
(32) El Paso County, Drainage Basin Fee Resolution, September 1999
(33) El Paso County, El Paso County Policy Plan, electronic version.
(34) City of Fountain, Interim Drainage Ordinance

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Drainage Planning Policies	Colorado Urban Drainage and Flood Control Act	Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Sections 30-28-106 (Adoption of Master Plan – Contents), 30-28-107 (Surveys and Studies) 30-28-133 (Subdivision Regulations)	1	1.2.1 Planning must account for Initial Drainage and Major Drainage. Initial system, 10-yr design, Major Drainage, 100-yr. Overall Conveyance system must convey 10-yr and 100-yr.	11	16.10.120- Requires a development permit and submittal of application to the Regional Floodplain Administrator.	18	16-205 - Policy is to preserve the integrity of existing and natural drainage patterns in order that development will not cause storm drainage and floodwater patterns to exceed the capacity of natural c constructed drainage ways, to subject other areas to increased potential for damage by flood erosion or sedimentation, or to pollute natural streams.
		Title 30, Article 23 Colorado Statutes (Planning and Zoning), Section 31-23-107 (Public Property Dedicated)	1	1.2.2- Four levels of drainage planning: Drainage Basin Planning Study, Master Development Drainage Plan, Preliminary Drainage Report, Final Drainage Report	27	17.22.040- A site plan is required for all uses located in all zoning districts with the exception of detached single-family and two-family dwelling units. Site plan shall contain but not limited to existing and proposed drainage facilities; specific natural features, such as mature trees, drainageways floodplains, and steep slopes; and other not specific to drainage or erosion control.	18	16-205- It is the policy of the town to require future development to provide for structures and/or detention facilities necessary to ensure that the runoff characteristics of a site after development are no more disruptive to natural streams, land uses or drainage systems than are the runoff characteristics calculated for its natural site.
		Title 32, Article 7 Colorado Statutes (Regional Service Authorities), Section 32-7-142 (Urban Drainage and Flood Control)	1	1.2.5- Drainage strategy should be a multipurpose, multiple means effort involving public and private interests but include conveyance and storage facilities.				
		Title 32, Article 11 Colorado Statutes (Urban Drainage and Flood Control), Section 32-11-219 (Cooperative Powers)	28	Strategy LU 102b: Promote Cooperative Planning within the Potential Urban Growth Area- Promote cooperative planning within the Potential Urban Growth Area to: provide adequate urban services and infrastructure; coordinate the review of development proposals; and coordinate long range plans for infrastructure and services, including, but not limited to, transportation, parks, open space, air quality, fire protection, police, utilities, and drainage.				
			28	Strategy N 203d: Incorporate Natural Features-Protect natural environmental features, including rock outcroppings, drainage areas, wildlife habitat, unique topographic features, and view corridors by incorporating them into new and developing neighborhoods, consistent with the guidelines of the Wildfire Mitigation Plan.				
			28	Objective CIS 4: Protect Drainageways- An important element of the City's public safety and quality of life is the system of drainageways. A major concern is that the public safety and quality of drainageways need to be maintained or improved as adjacent areas are developed. There is a need to protect the drainageways as amenities and a significant natural resource for people and wildlife, in addition to their public safety aspects.				
			28	Strategy CIS 401a: Utilize the Drainage Basin Planning Studies to establish the method of drainage treatment for each specific basin and to determine the new development responsibilities for drainage facilities. Ensure adequate City funding to update these studies on a periodic basis				
			28	Policy NE 202: Protect and Restore Natural Ecosystems and Habitat-Protect natural ecosystems and habitat from the adverse impacts of urbanization and land use, fostering their continued beneficial functions. Preserve, protect and enhance the hydrologic, ecological, and aesthetic functions of riparian areas, natural water bodies and drainage systems. Preserve, protect and enhance the interface between wildlands and urban development for resource and public safety protection.				
			28	Strategy CCA 101d: Develop Drainage Design Standards- Develop and adopt drainage design criteria to ensure that site drainage can be accomplished in a manner that minimizes site disturbance and negative impacts on natural site features. Site drainage should serve as an amenity that is incorporated into the overall landscape design of a site.				
			19	1.0- manual is meant to provide owners, developers, engineers, and contractors with information they will need to comply with City stormwater quality requirements for drainage planning/design relating new development/significant redevelopment and construction activities. Manual is to assist users in determining what requirements apply and what BMPs are necessary for a given site.				
			19	The Manual covers the following areas:1. Basics of stormwater quality and regulatory requirements. 2 Requirements for the development and implementation of an Erosion and Stormwater Quality Control Plan. 3. Information on the use, design and maintenance of construction BMPs that can be used to comply with the Erosion and Stormwater Quality requirements. 4. Information on construction inspection and enforcement. 5. Requirements and procedures for inclusion of permanent stormwater quality elements in new developments/significant redevelopments. 6. Information on the use, design and maintenance of New Development BMPs that can be used for compliance with the New Development requirements. 7. Procedures for assessing existing structural controls for retrofitting wit water quality features.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Drainage Planning Policies	12	16.06.030 Master Plan- Demonstrate that land is suitable for development and all hazards have been identified. Demonstrate that the development protects natural resources of land, demonstration that development layout provides protection from wind.	16	12.11.030- Prior to an issuance of a land use permit. The subdivider shall provide storm sewers, culvert, bridges, and other flood and runoff control structures to applicable Town specifications.	9	17.50.100- Site plan, grading and erosion control plan must be approved by Town prior to development.	17	2.10-The Policy of the City of Pueblo is to require that adequate measures be taken to insure that development will not exacerbate existing drainage problems. Some of the major drainage problems have been outlined in "City of Pueblo- Master Storm Drainage Study, May 1995." A review of this study, and discussions with City staff, should take place in the initial stages of planning for development within the City.
	12	16.08.030- Preliminary Plat- Contents- Plat shall show approximate location of all inundation or storm water overflow and location, widths and direction of flow of all water courses including the drainage of 100-year storm; proposed location of bridges, culverts, and other revisions for collection and discharging surface drainage; All areas with slopes 30% or greater are subject of designation as "no-build" zone.	16	12.13.010- Plan shall include drainage channels within 100-feet of tract; show the boundary of the existing 100-year floodplain, if applicable; preliminary drainage plan with quantity of flow and demonstrate adequacy of drainage facilities, off-site flow onto site; design points with flow quantity.	10	The person or entity response for paying established fee may prepare, at their own expense, a Drainag Basin Planning Study. This study can be used to amend drainage fees.		
	12	16.08.100- Final Plat- Material to Accompany- A drainage plan, prepared by a registered professional engineer. The drainage plan shall include, based on the finished grades and level of development, all necessary present and future culverts and other drainage structures and storm sewers, by size, designe to accommodate the runoff from the subdivision. Surrounding land uses shall be taken into consideration as well as all basins which are occupied in whole or in part by the subdivision. Cost estimates for all drainage structures and improvements shall be provided.						
	12	16.10.030- Minor Subdivision-Material to Accompany- Approximate location of all areas subject to inundation or stormwater overflow and location, widths, and direction of flow of all water courses including the drainage of a 100-year storm. If, in the opinion of the Planning staff or the City Engine and based on the anticipated severity, a drainage plan is warranted, such may be required. Proposed location of bridges, culverts, and other provisions for collection and discharging surface drainage. Cost estimates for all drainage structures and improvements shall be provided.						

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Drainage Planning Policies			1	1.2.1 Planning must account for Initial Drainage and Major Drainage. Initial system, 10-yr design, Major Drainage, 100-yr. Overall Conveyance system must convey 5-yr and 100-yr.	21, 24	16.56.010 and GES-I Drainage- The drainage system shall be designed to consider the drainage basin as a whole and shall accommodate not only runoff from the proposed development area, but also, where applicabl the system shall be designed to accommodate the runoff from those areas adjacent to and upstream from the subdivision itself, as well as its effects on lands downstream;	13	Table 7: Criteria; Drainage; Activity will not adversely affect drainage patterns. Adequate drainage is or can be provided. For CUP-Mining
			1	1.2.2- Four levels of drainage planning: Drainage Basin Planning Study, Master Development Drainage Plan, Preliminary Drainage Report, Final Drainage Report	23	Section 16, part m: PUD, Design Standards, Drainage: Development within the PUD District shall be designed and constructed to include adequate stormwater management including planning, financing, design, construction, operation, and maintenance. All drainage facilities whether public or private shall be constructe in accordance with the provisions of Section XI of the Pueblo County Subdivision Regulations.	13	Table 7: There are no adverse impacts on surrounding properties, related to drainage changes for Rezoning or PUD.
			1	1.2.5- Drainage strategy should be a multipurpose, multiple means effort involving public and private interest but include conveyance and storage facilities.	23	Section 40, part h: Rural Land Use Process, Design Principles: A drainage report adhering to the Pueblo County Subdivision Regulations shall be submitted to the Department of Public Works for approval. All construction activities disturbing more than 5 acres will require a NPDES permit issued by the CDPHE. The stormwater management plan must be reviewed by the Pueblo County Department of Public Works.	13	Table 7: Criteria: Hydrology: Activity will not adversely affect hydrology. (CUP-mining)
			20	51.1- A preliminary drainage report shall be submitted (7 copies) at the time of preliminary plan submittal. Subsequent to preliminary plan approval, a final drainage report shall be submitted (7 copies) with the final plat. When specific improvements are required, the construction drawings and specifications must be submitted for review with the final plat. All reports shall be typed on 8½" by 11" paper and shall be bound with the report or included in a folder/pocket attached to the report. All reports shall include a cover letter and shall be prepared by a registered professional engineer licensed in Colorado. The report shall be properly certified and signed by such engineer.	24	Section VIII- Preliminary Plan Requirements- Map shall show water courses and proposed storm water drainage systems.. Drainage system shall be documented by an accompanying preliminary drainage report.	13	Table 7: Criteria: Impact: Ensure minimal adverse environmental, social and economic impacts in the development of sites in the impact areas and in the entire county. (New Community) The natural and socio-economic environments of the impact area, and of all the unincorporated area of County will be protected and enhanced. (New Community) The variance will not be injurious to the neighborhood or otherwise detrimental to the public welfare.
			33	1-A-Plan should be relied on by the Planning Commission and the Board of County Commissioners for guidance, direction and expectations concerning broader land use planning issues including growth management, compatibility, land use equity, property rights, and service standards. A secondary purpose of this Plan is to provide a framework to tie together the more detailed sub-area and topical elements of the Master Plan	24	Section XI, Design Standards: Part 9: The drainage system shall be designed to consider the drainage basin as a whole and shall accommodate not only runoff from the subdivision area but also, where applicable, the system shall be designed to accommodate the runoff from those areas adjacent to and upstream from the subdivision itself, as well as its effects on lands downstream.	13	Table 7: Natural Character: Sufficient provisions have been made by the applicant to preserve such natural features as water bodies and steep slopes, and to establish and maintain accessible open-space network for conservation, natural beauty and recreation. (New community)
			33	1-B- Section 2- Natural Systems-The rapid movement of surface water, often caused by concentrated heavy rains, may cause erosion, deposition, and flooding. In addition, failure of underground piping and surface collapse may occur where granular soil materials move into subsurface open cavities.	24	Section XI, Design Standards: Part 9: Complete drainage systems for the entire subdivision area shall be designed by a Professional Engineer. Drainage system shall be designed to permit the unimpeded flow of natural water courses and to ensure adequate drainage of all low points.	13	EN-40- Environmental Impact. Analysis of environmental impacts of the proposed new community on the following: quality of surface waters, groundwater aquifers and groundwater recharge; geomorphology, geology, and soils; and others not specific to drainage and erosion.
			33	Goal 11.1 Promote regional planning and management approaches which protect the integrity of drainage systems and minimize long-term system-wide environmental impacts, costs and recognized flood dangers within the County.				
			33	Policy 11.1.1 -Determine basic design and land requirements in each watershed for drainage facilities at the earliest possible juncture in the planning process to maximize planning options and minimize acquisition and construction costs.				
			33	Policy 11.1.2 -Encourage an approach based on the entire watershed, to flood protection which incorporates a combination of on-site, sub-regional and regional retention and detention facilities to effectively reduce negative downstream impacts including erosion, flooding, channel and water quality degradation.				
			33	Policy 11.1.3 Set aside the areas needed to accommodate the drainage facilities necessary for full basin build-out.				
			33	**Policy 11.1.4** Require development plans to effectively address both quantitative and qualitative impacts of drainage within the project site.**Policy 11.1.5** Effectively utilize automated land use mapping and data management (GIS) to keep drainage basin planning studies current**Policy 11.1.6** Continue to support cooperative multi-jurisdictional approaches to drainage system planning and operations.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Drainage Planning Policies (cont.)			19	3.0-An Erosion and Stormwater Quality Control Plan must be developed and submitted to the City Engineer to obtain an Erosion and Stormwater Quality Control permit. Criteria for when an Erosion and Stormwater Quality Control Plan is required are listed in Section 3.2: General Principles – Applicability. Site planning and drainage planning should, whenever possible, occur concurrently with site grading and erosion and stormwater quality control planning.				
			19	3.0- BMPs-Planning Process- Planning for the inclusion of appropriate BMPs should occur early in the site development process. The planning process can be divided into five separate steps: 1. Gather information on topography, soils, drainage, vegetation, and other predominant site features. 2. Analyz the information in order to anticipate erosion, sedimentation and stormwater quality problems. 3. Devise a plan that schedules construction activities and minimizes the amount of erosion created by development. 4. Develop an Erosion and Stormwater Quality Control Plan which specifies effective erosion, sediment, and stormwater quality control measures. 5. Follow the Erosion and Stormwater Quality Control Plan and revise it when necessary.				
Stormwater Utility	Colorado County Public Improvement District Act Colorado Public Utility Law	Title 30, Article 20 Colorado Statutes (Public Improvements), Sections 30-20-512.5 (Local Improvement Districts – Authority to Establish), 30-20-513 (Determination of Special Benefits – Factors Considered), 30-20-514 (Power to Levy Taxes)						
		Article 20, Section 6 Colorado Constitution (Home Rule for Cities and Towns)						
		Title 40, Article 1 Colorado Statutes (Definitions), Section 40-1-101 (Public Utility Law)						
		Title 40, Article 3 Colorado Statutes (Regulation of Rates and Charges)						
Design Storms	Federal Water Pollution Control Act of 1972 (Clean Water Act)	Title 40 CFR, Part 125 (Criteria and Standards for NPDES)	1	2.1- All drainage systems must be planned, designed and constructed to handle runoff form both the initial and major design storms. The initial design storm shall be the 5-year event. The major design storm shall be the 100-year event.	1	Required to detain 5-100 year storm. The major storm is 100-year event.		
	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002) Colorado Land Use Act	Title 24, Article 65 Colorado Statutes (Colorado Land Use Act), Section 24-65-105 (Model Resolutions – Subdivisions – Improvement Notices)						
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)						
		Title 37, Article 87 Colorado Statutes, Section 37-87-102 (Natural Streams and Use Thereof by Reservoir Owners)						
Financial Responsibility	Conservancy Law of Colorado – Flood Control	Title 37, Article 5 Colorado Statutes (Financial Administration, Flood Control Conservancy Districts)	1	1.3- Developers are required to pay for drainage facilities in their subdivision.	34	Developers are required to construct stormwater facilties and detention on-site.		
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	22	7.3.504.G- Building permit will not be issued until appropriate financial securities have been posted with the City Engineer to assure implementation of the approved grading, erosion and stormwater quality control and reclamation plans.				
			22	7.7.902- Studies of Drainage Basins- If public funds are not available and land development in a specific drainage basin is causing the need for a new or updated DBPS, a specific land developer(s) may be required to finance a new or updated study, subject to conditions and requirements of the City Engineer. The land developer(s) will be eligible for credit for the cost of the studies in accord with the provisions of 7.7.907.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Drainage Planning Policies (cont.)								
Stormwater Utility	26	13.36.100-There is established a storm drainage and flood management utility to provide reasonable protection to the public against the dangers to life and property presented by storm water runoff and flooding.					27	Section 2- The stormwater utility enterprise is empowered to coordinate, design, construct, manage, operate, and maintain the stormwater and flood management systems and stormwater facilities of Pueblo and to perform such other functions and activities as the City Council may assign.
	26	13.36.120 Assessments--Rate- Each individual water service account shall be assessed at the rate of three dollars per month.					27	Section 4- The stormwater utility enterprise is authorized to issue revenue bonds for the payment or other financing of eligible stormwater utility projects and activities, or for the purpose of refunding ar revenue bonds issued for such purpose.
	26	13.36.140 Use of funds- Expenditure of funds generated by this assessment shall be limited to capital improvements for storm drainage and flood management purposes.					27	Section 5- The stormwater utility enterprise may borrow funds in such amounts from such persons or entities and upon such terms and conditions as the City Council may determine to be in the best interests of the stormwater utility enterprise.
Design Storms							17	4.3.5- Open Channels- Open channels which are used for urban drainage must be capable of conveying runoff from all tributary lands, using the 100-year design storm criteria.
Financial Responsibility			15	A land developer may qualify for a reimbursement of a portion of the construction costs if the developer builds on-site detention meeting specific criteria. Since on-site detention benefits the regio 50% of the cost of a small on-site pond may be reimbursed if the following criteria are met: regional system not in place, pond is less than 15 ac-ft, pond is not part of regional plan, release of historical flow rate, the Town must approve design and construction, and landowners must maintain.	9	17.50.130- The minimum fee for issuance of a permit under this ordinance shall be set forth in Sectio 17.80.010. In addition, the costs incurred by the Town for hiring a registered professional engineer to review projects shall be borne by the applicant. Hourly rates shall be set in the contract agreement with the Town Engineer.		
			16	12.15.020- Storm drainage provided- Storm drainage shall be provided for the development by the developer based on plans submitted by him to the Town and approved by the Town Engineer. Plans shall be prepared in accordance with Town design standards. Storm inlet protection should provide safeguards against entry by small children and animals.	10	16.80.050- 100% of the following improvements will be eligible for reimbursements: Land and construction cost of large on-site ponds required in Drainage Basin Planning Study; other reimbursable items identified in Drainage Basin Planning Study; and cost of approved Drainage Basin Planning Study.		

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Drainage Planning Policies (cont.)				**Policy 11.1.7** Approve site-specific development plans only if there are financial and other assurances that on site drainage facilities will be appropriately constructed, that downstream infrastructure will accommodate the additional impact, and maintenance issues are fully addressed**Policy 11.1.8** Promote planning approaches which allow for interim solutions for drainage problems in less developed basins**Policy 11.1.9** Support the development of drainage basin management plans which meet the unique needs of rural and rural-residential areas.				
Stormwater Utility								
					24	Section XV- Variances: Should the subdivider clearly demonstrate that, because of peculiar physical conditions pertaining to his land, the literal enforcement of one or more of these regulations is impractical or will exact undue hardship, the Board may permit such variance or variances as may be reasonable and within the general purpose and intent of the rules, regulations, and standards established by these regulations.	14	6.4-Drainage- Storm drainage systems shall be designed in accordance with the Drainage Criteria, Appendix G..
Design Storms			1	2.1- All drainage systems must be planned, designed and constructed to handle runoff form both the initial and major design storms. The initial design storm shall be the 10-year event. The major design storm shall be the 100-year event.	21, 24	16.56.010-Drainage Criteria and Section General Engineering Specifications: The Pueblo County Drainage Criteria Manual will use a storm duration of six hours for hydrologic computations. A return frequency of five years will be used for determining runoff for minor collection systems (drainage areas less than four hundred (400) acres and peak flows less than five hundred (500) cfs). A return frequency of one hundred (100) years will be used for determining runoff for major collection systems (drainage areas four hundred (400) acres and larger and for all peak flows equal to or exceeding five hundred (500) cfs).	14	G- Drainage Criteria- The 100-year storm for all facilities which will carry 500 cfs or more as calculated on the 100-year storm, and the 5-year storm for all other facilities.
Financial Responsibility			1	1.3- Developers are required to pay for drainage facilities in their subdivision.	24	Section XIII- Utilities and Improvements: The following improvements shall be constructed at the expense of the subdivider as stipulated in the Subdivision Improvement Agreement in a manner approved by the Board which is consistent with sound construction and local practice. Where specific requirements are spelled our in other sections of these regulations, they shall apply: Storm sewers or storm drainage system, as required.		
			20	49.3.D-Determination of credit for land used for public detention facilities. The credit to which a subdivider shall be entitled from the appropriate sub-fund of the basin involved in the Subdivision Drainage Fund shall b determined on a per acre basis as set forth in the appropriate approved Drainage Basin Planning Study. The per acre land credit shall be equal to and limited by the unit detention reservoir land fee in use at the time of detention facilities by the subdivider.				
			20	49.3.D-The credit to which a subdivider shall be entitled from the appropriate subfund of the basin involved i the Subdivision Storm Drainage Fund, as set forth in sub-section a. above, shall be determined on the basis of the actual cost incurred in constructing the drainage facilities, plus ten percent (10%) for engineering expense				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Financial Responsibility (cont.)			22	7.7.907-Subdivider of the land may be credited from the Subdivision Storm Drainage Fund if the amount of the required fees is less than the cost of providing new detention facilities.				
Development Near Channels, Irrigation Ditches and Drainageways	Federal Endangered Species Act of 1973 National Flood Insurance Act of 1968 National Flood Disaster Protection Act of 1973 National Flood Insurance Reform Act of 1994	Colorado Statutes: Title 24, Article 65, Section 24-65-105; Title 30, Article 28, Section 30-28-133; Title 33, Article 2, Section 33-2-106; Title 24, Article 80, Part 4, Section 24-80-406 and 24-80-409; Title 25, Article 8, Part 5; Title 25, Article 10, Sections 25-10-104, 25-10-105, 25-10-110, and 25-10-111; Title 37, Article 92, Part 3, and Section 37-92-501; Title 37, Article 1.	1	1.4.2- If historical storm water flows are increased, or if historical channels are unstable in their natural condition, these channels must be adequately stabilized to prevent excessive erosion.			18	16-714-No structure shall be closer than twenty-five (25) feet from any major drainageway.
	Federal Water Pollution Control Act of 1972 (Clean Water Act) National Environmental Policy Act of 1969 Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	Title 50 CFR, Parts 13, 17, and 81; Title 7 CFR Part 650; U.S.C. Title 42, Chapter 50 (NFIA);Title 44 CFR, Parts 9, 10, 65, 70, and 78;U.S.C. Title 33, Chapter 26; Title 33 CFR, Parts 320, 330, and 323; Title 40 CFR, Parts 122, 125, 129, 130, 131, and 403; U.S.C. Title 42, Chapter 55 (NEPA); Title 40 CFR, Part 1501, 1502, 1505.	1	1.4.2- Development shall be a minimum of 1-foot above the estimated 100-year flood water surface elevation of major drainageways, channel outfalls, upstream sites of irrigation ditches, dam and reservoir sites.				
	Colorado Land Use Act Colorado Individual Disposal Systems Act Conservancy Law of Colorado – Flood Control	U.S.C. Title 16, Chapter 35 (ESA)	1	1.4.2 Developers in and along a drainageway are required to implement the proper measures to maintain or create stable characteristic of the drainageway.				
Stormwater Runoff Detention	Colorado Agricultural Chemicals and Groundwater Protection Act	Title 25, Article 8 Colorado Statutes (Health), Section 25-8-205.5 (Pollution from Agricultural Chemicals)	1	1.5-Detention Storage of storm water runoff may be necessary in certain drainage basins to attenuate peak flood flows.	34	Detention facilities required on all subdivisions. Detention facilities are owned by subdivision.		
		Title 25, Article 1 Colorado Statutes, Part 7 (Regional Health Departments), Section 25-1-709 (Services – Programs) (for vector control)	1	2.5.1- Detention basins can be used to maintain historical runoff flows.	34	Detention facilities are used to maintain historical runoff.		
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	28	Policy CIS 401: Plan and Construct Drainageways as Amenities-Plan and construct drainageways as amenities to the City by incorporating a comprehensive system of detention ponds in conjunction with "soft linings" or natural drainageways as the preferred method of treatment whenever possible.				
Stormwater Runoff	Federal Water Pollution Control Act of 1972 (Clean Water Act)	U.S.C. Title 33, Chapter 26 (CWA)						
	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	Title 40 CFR, Parts 122 (NPDES), 125 (Criteria and Standards for NPDES), 131 (Water Quality Standards), and 403 (General Pretreatment Regulations for Existing and New Sources of Pollution)						
Quality of Stormwater Runoff	Federal Endangered Species Act of 1973 Federal Water Pollution Control Act of 1972 (Clean Water Act)	U.S.C. Title 16, Chapter 35 (ESA)	1	1.6- Developers are required to submit an erosion control plan for all development in accordance to criteria.		Skimmer plates used in industrial areas. (not a policy, encouraged and recommended by Public Works)		

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Financial Responsibility (cont.)								
Development Near Channels, Irrigation Ditches and Drainageways					10	16.80.030- Fees further defined by applying the Prudent Line approach to channels in low density areas. "Prudent Line" is defined as an approach to channel design that is applicable in less dense area and entails the use of a buffer zone on either side of a channel. This zone shall be a no build area and have a maintenance easement to the Town of Palmer Lake in excess of the flood hazard area.	17	2.4- The Policy of the City of Pueblo is to restrict development from within the 100-year floodplain o a natural drainage channel, or form within an approved erosion buffer zone for channels with high erosion potential, whichever is greater, and to require that all provisions of Chapter 9, Title XVII of the Code of Ordinances concerning Flood Damage Prevention, be followed.
Stormwater Runoff Detention							17	2.6- The Policy of the City of Pueblo is to restrict the rate of stormwater runoff from developed land t approximately the rate of runoff from the land in its historic or native condition. Exceptions are granted when the following cases occur: adequate drainage facilities are provided to convey the increased runoff form the development to Arkansas River or Fountain Creek floodplain, regional detention facility is in place that has been designed to accommodate increased flows in development, and when it is determined by the City that there will be negligible downstream impacts from the increased runoff due to the development.
							17	4.3.6- Stormwater Detention Facilities- Stormwater detention facilities shall be designed with adequate storage capacity to insure that release rates do not exceed either the 10-year or 100-year historic flow rates from the tributary basin. Inflows to the detention facility shall be calculated assuming fully developed conditions in the tributary basin.
Stormwater Runoff			16	12.15.020- Effects of surface runoff shall be provided in preliminary plat and must address effects of surface runoff on the proposed development. Lots shall drain away from proposed structures and sha not interfere with other structures.			17	3.2.3- Downstream Impacts- Discussion and analysis of the 100-year peak flows leaving the master planned area and their impact on downstream properties and drainage facilities. Include discussion o any proposed detention facilities. If downstream drainage improvements are required, provide preliminary cost estimates and a phasing plan.
							17	3.3.6- Identify locations and 100-year peak flow rates of drainage leaving the site and discuss their impact on downstream facilities and properties. Discuss any downstream improvements that are to be made in conjunction with the development. Provide detailed supportive hydrologic and hydraulic analyses.
Quality of Stormwater Runoff							17	2.13-The Policy of the City of Pueblo is to prohibit the discharge of any toxic or hazardous substances into the storm water system which may cause the municipal discharge to violate any water quality standard.

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Financial Responsibility (cont.)			33	Chapter 1-B- Section 11- Out of a total of 139 identified drainage basins approximately 30 have now been studied in detail, with fees developed; however, these calculated per-acre fees are only collected at the platting stage, and do not include funding for maintenance.				
			33	**Goal 11.2** Develop a more equitable and inclusive system for funding the planning, construction and maintenance of regional drainage facilities.**Policy 11.2.1** Support the development of drainage funding methods which most equitably allocate costs according to the relative impacts caused by each property.**Policy 11.2.2** Promote the development of a dedicated funding source for the operation and maintenance of existing and new regional drainage systems.**Policy 11.2.3** Discourage the inclusion of high-cost drainage improvements in drainage basin planning studies (e.g. those which benefit a particular property) unless a system-wide benefit can be demonstrated.				
Development Near Channels, Irrigation Ditches and Drainageways			1	1.4.2- If historical storm water flows are increased, or if historical channels are unstable in their natural condition, these channels must be adequately stabilized to prevent excessive erosion.	23	Section 40, part h: Rural Land Use Process, Design Principles: All man-made drainage channels and management facilities should blend and harmonize with the natural environment. Extensive grading, contouring, and earthwork should be avoided.		
			1	1.4.2- Development shall be a minimum of 1-foot above the estimated 100-year flood water surface elevation of major drainageways, channel outfalls, upstream sites of irrigation ditches, dam and reservoir sites.				
			1	1.4.2 Developers in and along a drainageway are required to implement the proper measures to maintain or create stable characteristic of the drainageway.				
Stormwater Runoff Detention	4	4.1.1- Detention facilities shall be designed for low flow, 5 year, and 100-year. The total pond volum shall be the above three mentioned added together.	1	1.5-Detention Storage of storm water runoff may be necessary in certain drainage basins to attenuate peak flood flows.	21	16.56.010-Detention Storage. All development must restore runoff characteristics to at least natural conditions.	14	Appendix G- Drainage Criteria- Drainage Facilities- Detention basins or other devices shall be used to maintain historical runoff amounts and rates.
			1	2.5.1- Detention basins can be used to maintain historical runoff flows.	21, 24	16.56.010 and Section GES-I Drainage:- Drainage Control. Each development shall provide for the on-site or off-site detention of excess stormwater runoff from that development	14	Appendix G- Drainage Criteria- Drainage Facilities- If Detention facilities are not possible, then flows must be controlled not to exceed historical runoff amounts.
					23	Section 40, part h: Rural Land Use Process, Design Principles: Sound alternatives to detention/retention ponds are encouraged as a means of controlling and managing storm water drainage. Storm water detention/retention basins should be sited, formed and re-vegetated so that they harmonize with the natural surroundings and complement natural water flows. Excessive grading, clearing, and alteration of the site should be avoided and soil erosion minimized.		
Stormwater Runoff			20	Chapter V- Section 49.2-Historical flow patterns and runoff amounts will be maintained in such a manner that will reasonably preserve the natural character of the area and prevent property damage of the type generally attributed to runoff rate and velocity increases, diversions, concentration and/or unplanned ponding of storm runoff. Runoff volumes and peaks within the development site and in areas affected by runoff will not exceed the runoff levels attributable to the site in its natural state.	21, 24	16.56.010 and GES-I Drainage: No development shall cause downstream property owners, water courses, channels or conduits to receive stormwater runoff from proposed developments at a higher peak flow rate than would have resulted from the same storm event occurring over the site of proposed development with the land in its existing, natural or undeveloped condition;		
			20	Chapter V- Section 49.2-That any drainage system proposed as part of any development proposal is based on consideration of the drainage basin as a whole and is capable of accommodating not only runoff from the proposed development, but also, where applicable, the runoff from areas adjacent to and "upstream" from the development itself.				
Quality of Stormwater Runoff			1	1.6- Developers are required to submit an erosion control plan for all development in accordance to criteria.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Quality of Stormwater Runoff (cont.)	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	Title 50 CFR, Parts 13 (General Permit Procedures), 17 (Endangered and Threatened Wildlife and Plants) and 81 (Conservation of Endangered and Threatened Species of Fish, Wildlife, and Plants – Cooperation with the States)	22	7.3.504.D.- Component of the submittal package for hillside development shall include stormwater quality control facilities.				
		Title 7 CFR Part 650 (Compliance with NEPA)	22	7.3.504.D.- Applicant must submit a stormwater quality control plan with grading and erosion control plan as part of the development plan.				
		U.S.C. Title 33, Chapter 26 (CWA)	22	7.3.504- All stormwater quality control facilities shall be maintained by the property owner.				
		Title 40 CFR, Parts 122 (NPDES), 125 (Criteria and Standards for NPDES), 131 (Water Quality Standards), and 403 (General Pretreatment Regulations for Existing and New Sources of Pollution)	22	7.7.906.B- All stormwater quality requirements, including Best Management Practices (BMPs), policies and procedures must be complied with as outlined in the Drainage Criteria Manual- Volume 2 Stormwater Quality Policies, Procedures, and Best Management Practices (Manual). Permanent stormwater quality BMPs are required for all "New Development and Significant Redevelopment" which includes development/redevelopment of 1 acre or larger except for the following zones (R-Estate, R-1 6000, R-1 9000, R-2, and DFOZ) that include total development/redevelopment of 2 acres will be reviewed on a case by case basis.				
			22	7.7.1505- Stormwater quality requirements- stormwater discharges from construction sites shall not cause or threaten to cause pollution, contamination, or degradation of state waters; Concrete wash water shall not be discharged to or allowed to runoff to state waters; vehicle tracking of soils off-site shall be minimized, all wastes composed of building materials must be properly disposed of per regulatory requirements, no chemicals are to be used, which have the potential of being released in stormwater unless permission for the use of a specific chemical is granted in writing by the City Engineer, BMPs shall be properly installed; individuals shall comply with the "Colorado Water Quality Control Act" and "Clean Water Act"				
			28	Strategy NE 401a: Protect and Maintain Stormwater Quality- Protect and maintain the quality of stormwater within all drainage basins as a necessary component of existing ecosystems and as a critical resource for the community. Implement practices and programs, including public education, to protect and maintain the quality of stormwater discharges. Adopt zoning/subdivision regulations and Best Management Practices and provide incentives to reduce impervious areas. Strengthen erosion prevention and sedimentation control regulations.				
			28	Strategy NE 401b: Control Water Pollution-Control and monitor the discharge of pollutants associated with stormwater through pollution control plans, improved land use configurations, use of detention ponds, Best Management Practices and other requirements to control degradation of streams, lakes and other drainage facilities.				
			19	2.0- Non-Stormwater Discharges- The following discharges are non-stormwater and have suggested measures to reduce pollution: vehicle washing (non-residential), rinsing of trucks carrying materials such as concrete trucks, swimming pool/spa draining (non-residential), and hydrostatic testing.				
			19	There are several non-stormwater discharges and flows that are not considered illicit or illegal unless they are identified by the municipality or the State as sources of pollutants. This list is available in the Criteria Manual. The general permit allows for quick coverage of these types of discharges. Compliance is required with state water quality standards and effluent guidelines. Monitoring and reporting of the quality of the discharge is also required.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Quality of Stormwater Runoff (cont.)							17	4.6- Water Quality- Special measures and /or facilities shall be provided with respect to storm water discharge from any land associated with industrial activity or from sites upon which industrial activities or other activities with a potential for release of hazardous substances had been conducted in the past.
							17	4.6- Water Quality- That the discharge of any pollutants in stormwater discharge will be reduced to the maximum extent practicable; that the stormwater discharge will comply with any state, federal or local effluent limitations applicable to stormwater discharges; that any spill of hazardous substances or toxic material will be contained to avoid entry into any municipal stormwater facilities; that there will not be a release or threatened release of hazardous substances or hazardous wastes; and that stormwater will not be discharged into municipal facilities which may cause or contribute to a violatio of a water quality standard.

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Quality of Stormwater Runoff (cont.)			20	Chapter V- Section 19.2-Where development will cause the introduction of new pollutants into the runoff water, provision will be made for the storage, treatment and removal of such pollutants.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Channelization	Federal Endangered Species Act of 1973 National Flood Insurance Act of 1968 National Flood Disaster Protection Act of 1973 National Flood Insurance Reform Act of 1994 National Environmental Policy Act of 1969	U.S.C. Title 16, Chapter 35 (ESA) Title 50 CFR, Parts 13, 17, and 81; Title 7 CFR Part 650; U.S.C. Title 42, Chapter 50 (NFIA); Title 44 CFR, Parts 9, 10, 65, 70, 72, and 78; U.S.C. Title 42, Chapter 55; Title 40 CFR, Part 1501, 1502, 1505; Title 33, Article 2 Colorado Statutes, Section 33-2-106.	1	2.2.1- Channel modifications shall be minimal however many historical channels are in a dynamic unstable condition and will required stabilization. When a channel improvement is necessary, the historic route should be maintained if possible. A comprehensive study of flow in natural channels requires consideration of sediment transportation, river morphology, etc.				
	Conservancy Law of Colorado – Flood Control	Colorado Statutes: Title 30, Article 30, Section 30-30-102; Title 37, Article 1; Title 37, Article 92, Part 3, Section 37-92-501; Title 25, Article 8, Part 5; Title 24, Article 80, Part 4, Section 24-80-406 and 24-80-409; Title 33, Article 2 Colorado Statutes, Section 33-2-106.						
Erosion and Sediment Control		Title 35, Article 70 Colorado Statutes (Conservation Districts), Section 35-70-108 (Powers and Duties of Districts)	1	2.6-Erosion Control Plan is required from developer prior to commencement of any grading and where platting occurs. Temporary erosion and sedimentation control facilities shall be constructed prior to any grading or clearing and must be satisfactorily maintained during construction.	1	Developer required to look at downstream facilities and adverse impact.	18	16-206- Erosion- It is the policy of the Town to prevent the acceleration of the erosion of the soil and rock , as erosion contributes to stream sedimentation, dust, gullying, alteration of drainage patterns, exacerbation of flood hazards, loss of natural vegetation, visual scars, leaching of minerals into lakes and streams, destruction of animal habitats and increased maintenance costs of roads and similar facilities.
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	1	4.8.1- Erosion control plan to control erosion during construction and is required with final drainage report.			18	16-308- 5-acre Hillside Single-Family Residential District. Minimize water runoff and soil erosion problems incurred in adjustment of the natural terrain.
		Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning)	1	4.8.1- Plan must include permanent structures for conveying storm runoff, site grading, final site stabilization, temporary sediment control features including sediment basins and stabilization of the site where temp. features have been removed.			18	16-312- HO Hillside Overlay Zone- Minimize water runoff and soil erosion problems incurred in adjustment of the terrain to meet development needs.
			22	7.3.504- No cleared, graded, or otherwise disturbed land may be left without temporary protective stabilizing cover longer than sixty (60) days or without permanent cover longer than one year from the date of disturbance as described in the erosion and stormwater quality control plan.			18	16-714-e-No cleared, graded or otherwise disturbed land may be left without temporary protective stabilizing cover longer than thirty (30) days or without permanent cover as described in the erosion control plan longer than one year from the date of disturbance.
			22	7.3.504- All erosion control facilities shall be maintained by the property owner.				16-714-e- Criteria for erosion control shall include visual compatibility with the surrounding landscape, sustained survivability under arid conditions, and effectiveness in prevention of soil erosio and slope failure.
			22	An erosion and stormwater quality control plan is required to be submitted to the City Engineer for review and acceptance in conjunction with a grading plan. Signoff and acceptance of both the grading plan and the erosion and stormwater quality control plan, or a combined plan, by the City Engineer shall constitute a grading permit authorizing the approved land disturbance and implementation of the approved erosion and stormwater quality control measures.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Channelization								
Erosion and Sediment Control	12	16.24.030.K- Cuts and Fills. All cuts, fills, and any other area disturbed during construction shall be treated to prevent erosion and sedimentation, whether by planning or other methods, according to an approved erosion and sedimentation control plan.	16	12.15.020- All cuts, fills, and the area disturbed during construction shall be treated to prevent erosion, whether by planting or other methods, according to an approved erosion control plan.	9	17.50.060-Efforts shall be made to abate the dust caused by the development of sites. During construction it is mandatory that measures be taken to minimize adverse effects on neighboring properties.	17	2.5- The Policy of the City of Pueblo is to require that adequate measures be implemented to minimize oil erosion by development.
	12	16.26.020- Natural Features to be preserved. In the layout of streets and blocks, natural features such as drainage ways, rock formations, soil vegetation and topography shall be preserved as much as possible. Cuts and fills shall be minimized and revegetated or treated to prevent erosion according to an acceptable erosion control plan. Grading also shall be reduced as much as possible.	16	12.15.020- Erosion control plan shall be a part of the total site development plan and prescribe the steps necessary including scheduling to assure erosion control during all phases of construction. The erosion control plan shall consist of the best selection of erosion control practices and sediment trapping facilities with an adequate implementation schedule to accomplish adequate control.	9	15.50.060.C- During construction all disturbed areas shall be protected from erosion.	17	3.3.7- Discuss erosion control measures and management practices to be utilized within the subdivision to reduce soil pollutant loads in stormwater runoff. Address both temporary and permanent facilities and time frames to be utilized for the construction of all erosion control measures Discuss the maintenance of temporary and permanent facilities.
			16	12.15.020- Erosion Control Specifications: Particular attention shall be given to concentrated flows o water, either to present their occurrence or to provide appropriate conveyance devices to prevent erosion.	9	17.50.060.C- Disturbed areas shall be vegetated with erosion control grasses, shrubs, and/or trees.	17	4.3.5.C.2- Erosion Buffer Zone- For channels in highly erodible soils, the 100-year floodplain may b contained entirely within the vertical banks of the channel, however, due to bank erosion the width of the channel may increase with time. In these cases, an erosion buffer zone must be established and delineated on the plat. This must be documented by an Engineer and be approved by the City.
			16	12.15.020- Erosion Control Specifications: Sediment trapping devices shall be required at a point where sediment-laden water might leave the site.			17	4.4.1- Erosion Control Plan- General Requirements- The erosion control plan shall consist of acceptable erosion control practices and sediment trapping facilities in conjunction with an appropriate schedule in order to accomplish adequate control. Adequate erosion control measures shall be constructed prior to land disturbing activities such that no adverse affects of site alteration will impact surrounding properties. Particular attention sha be given to concentrated flows of water, either to prevent their occurrence or to provide appropriate conveyance devices to prevent erosion. Plan must include permanent structures for conveying storm runoff, final site stabilization, temporary sediment control features including sediment basins and stabilization of the sites where temporary features have been removed.
			16	12.15.020- Prior to construction, the Erosion Control Plan must have the required approval signature of the Town Manager and show proof of any required dust control permit.			17	4.4.3- Erosion Control Plan Implementation- No clearing, grading, excavation, filling, or other land disturbing activities shall be permitted until the City approves the erosion control plan.
			16	12.15.020- Guidelines for erosion control- The objectives of erosion control design are the prevent damage to adjacent properties due to sediment, dust, or storm water runoff from the construction site; and minimize the onsite effects of erosion.				

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Channelization			1	2.2.1- Channel modifications shall be minimal however many historical channels are in a dynamic unstable condition and will required stabilization. When a channel improvement is necessary, the historic route should be maintained if possible. A comprehensive study of flow in natural channels requires consideration of sediment transportation, river morphology, etc.				
Erosion and Sediment Control	5	Runoff and sediment from erosion from lots and driveway must not enter the street.	1	2.6-Erosion Control Plan is required from developer prior to commencement of any grading and where platting occurs. Temporary erosion and sedimentation control facilities shall be constructed prior to any grading or clearing and must be satisfactorily maintained during construction.	21, 24	16.56.030 Erosion and GES III-Erosion: All measures necessary to minimize soil erosion and to control sedimentation in the disturbed land shall be provided. Specifically, the design and implementation of the proposed measures shall ensure: That any development is designed and executed in a manner which will save and protect as much of the desirable native vegetation as possible; That a reclamation plan for revegetation on all disturbed areas be guaranteed; That all cuts and fills are adequately designed and engineered to prevent detachment and transportation of soil particles from slope.	13	Table 7: Criteria: Erosion: Site can be developed so as not to increase soil erosion form the site during and after the construction. CUP-mining
	6	18.40.020- Erosion Control Plan must be submitted for any land-disturbing activity disturbing 7500 s.f. or more.	1	4.8.1- Erosion control plan to control erosion during construction and is required with final drainage report.	24	VI Related Procedures, Section 8- Application for Multi-Family Development Site Plan Review, Part C: The Pueblo County Department of Public Works shall determine whether the developer will be required to provide Soil Erosion and Sedimentation Control plans and Specifications prepared by a registered Professional Engineer or USSCS. If such plan is required, the site plan will not be complete until such plans are submitted.	13	Section 5.2- All manufactured slopes, other than those constructed in rock, shall be planted or otherwise protected from the effects of storm runoff erosion.
	6	18.40.030- Erosion Control Plan should meet the following objectives: Identify critical areas, limit time of exposure, limit exposed areas, control surface water, prevent unnecessary removal of vegetation.	1	4.8.1- Plan must include permanent structures for conveying storm runoff, site grading, final site stabilization, temporary sediment control features including sediment basins and stabilization of the site where temp. features have been removed.	24	VIII- Preliminary Plan Requirements- The Planning Commission shall determine from a review of the preliminary plan whether the soil slope, vegetation, and drainage characteristics of the of the site are such as t require substantial cutting, clearing, grading, and other earth moving operations in the construction of the subdivision or otherwise entail an erosion hazard, and if so, the Commission shall require the subdivider to provide soil erosion and sedimentation control plans and specifications. If such plan is required, the site plan will not be complete until such plans are submitted.	14	6.4.4- Temporary Erosion Control- Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with the Drainage Criteria.
	6	18.40.070-Stream and watercourse banks and channels downstream from any land-disturbing activity shall be protected from increased degradation by accelerated erosion caused by increased velocity of runoff from the land-disturbing activity.	20	Chapter II, B: Prevent the acceleration of the erosion of soil and rock in order to reduce or eliminate erosion related problems such as stream sedimentation, dust, gullying, alteration of drainage patterns, exacerbation of flood hazards, loss of natural vegetation, visual scars, leaching of minerals, destruction of animal habitats, and increased maintenance costs for roads and other facilities.			14	Appendix G- Drainage Criteria- Landscaping and Erosion Control- Effective erosion control, revegetation, and reclamation is of great importance. Appropriate steps must be taken for landscape development and erosion control of roadside areas. Cut and fill slopes should be flat as practical.
	6	18.40.090- the relocation of a stream where relocation is an essential part of the proposed activity, shall be planned and executed so as s to minimize changes in the stream flow characteristics, except when justification for significant alteration to flow characteristics is provided.	20	Chapter V- Section 51: The required erosion control plan is a plan for controlling erosion during construction in compliance with the laws, regulations, resolutions and Erosion Control Standards as outlined in the Subdivision Criteria Manual. This plan shall be prepared by a Registered Professional Engineer. This plan shall be a part of the development plans for the total site and prescribe the steps necessary including scheduling to assure erosion control during all phases of construction including final stabilization. The erosion control shall be sufficient to control the runoff from the Design Storm required by the Drainage Criteria, Section DC of the Subdivision Criteria Manual.			14	Appendix G- Drainage Criteria- Silt Fence shall be used to protect all streams, rivers, lakes, and other water resources from contamination by silt, sediment, and construction debris.
	6	18.40.180, A security may be required in form of an escrow account, surety bond, irrevocable letter c credit , or other undertaking satisfactory to the City. Security will remain in force until improvements are completed with approved plan and improvements are inspected.	20	Chapter V, B: The erosion control plan shall consist of the best selection of erosion control practices and sediment trapping facilities in conjunction with an appropriate implementation schedule to accomplish adequate control. Adequate erosion control measures shall be constructed in conjunction with land disturbing activities such that no adverse affect of site alteration will impact surrounding properties. Particular attention shall be given to concentrated flows of water, either to prevent their occurrence or to provide appropriate conveyance devices to prevent erosion. Sediment trapping devices shall required at all points where sediment laden water might leave the site. The plan must include permanent structures for conveying storm runoff, final site stabilization, temporary erosion control features including sediment basins and finally, stabilization of the site where temporary features have been removed. Plans showing improvements or construction to be completed outside the property line of the site will not be approved unless the plan is accompanied by an appropriate legal easement of the area in which such work is required.			14	Appendix G- Drainage Criteria- Erosion control blankets and/or bales and/or silt fences shall be required during any construction to minimize impact to any existing public or private roadway or property.
			33	Policy 11.3.6 Encourage the effective use of control measures to mitigate the short and long term erosion impacts of development.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Erosion, Sediment Control and Stormwater Quality (combined)	Federal Endangered Species Act of 1973	U.S.C. Title 16, Chapter 35 (ESA)	28	Strategy NE 302a: Use Drainage Basin Planning Studies for Stormwater Management - Use the established method of drainage treatment for a particular Drainage Basin Planning Study for all proposed development or redevelopment, or require an amendment to the Study if changes are proposed or required. Use Best Management Practices to address erosion, sediment control and stormwater quality during construction and after development. Minimize the adverse impacts of stormwater runoff, including erosion/sedimentation, to drainageways and other drainage facilities.				
	Federal Water Pollution Control Act of 1972 (Clean Water Act)	Title 50 CFR, Parts 13 (General Permit Procedures), 17 (Endangered and Threatened Wildlife and Plants) and 81 (Conservation of Endangered and Threatened Species of Fish, Wildlife, and Plants – Cooperation with the States)	19	3.0-This section of the Stormwater Quality BMP Manual provides a set of criteria and technical guidance for erosion, sediment, and stormwater quality control at construction sites. These criteria were developed to help mitigate (1) the increased soil erosion and subsequent deposition of sediment off-site and (2) other potential stormwater quality impacts during the period of construction from start of earth disturbance until final landscaping and other potential permanent stormwater quality measure are effectively in place.				
	National Environmental Policy Act of 1969	Title 7 CFR Part 650 (Compliance with NEPA)	19	Implementation and maintenance of erosion, sediment, and stormwater quality control measures are ultimately the responsibility of the property owner. Because site conditions will affect the suitability and effectiveness of erosion, sediment, and stormwater quality control measures, a plan specific to each site is required. In addition, should the approved plan not function as intended, and it is determined by the City that additional or revised measures are needed, the owner will have to implement such changes as needed to reduce soil erosion and sediment discharged from the construction site and to minimize other stormwater quality impacts.				
	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	U.S.C. Title 33, Chapter 26 (CWA)	19	Typical activities for which an Erosion and Stormwater Quality Control Plan is generally not required are designated as minor land disturbing activities and include: 1. Any project involving earth disturbing activity of less than 1 acre, and which disturbs less than 500 cubic yards of material (cut and/or fill). 2. Individual home landscaping, gardening, maintenance and repair work. 3. Agriculture and related activities. 4. Other land disturbing activities which will result in minimum soil erosion or the movement of sediment into waters or onto property off the project site and that include land disturbance of less than 1 acre and less than 500 cubic yards of material (cut and/or fill). An Erosion and Stormwater Quality Control Plan may be required for specific minor land disturbing activities if deemed necessary by the City Engineer.				
		Title 40 CFR, Parts 122 (NPDES), 125 (Criteria and Standards for NPDES), 131 (Water Quality Standards), and 403 (General Pretreatment Regulations for Existing and New Sources of Pollution)	19	Any land disturbance by any owner, developer, builder, contractor, or other person shall comply with the Basic Grading, Erosion and Stormwater Quality Requirements and General Prohibitions as noted below. In many cases, this will require the design, implementation and maintenance of Best Management Practices (BMPs) as specified in the Manual, even if an Erosion and Stormwater Quality Control Plan is not required.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Erosion, Sediment Control and Stormwater Quality (combined)			16	12.15.020- If entire site is graded at one time, but construction is expected to last several months or years, use one of following measures: Mulch, temporary seeding, "permanent" seeding, straw bale barriers, silt fence, storm drain inlet protection, diversions, sediment traps, slope drains, outlet protection, rip-rap, grade control structure, and level spreader.				

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Erosion, Sediment Control and Stormwater Quality (combined)			20	Chapter V, Section 49.1The design and operation of the proposal shall ensure: That any development is designed and executed in a manner which will minimize disturbance of natural vegetation and soil cover. Special attention should be paid to areas adjacent to streams, lakes, and reservoirs. That development proposals include adequate provision and guarantee for revegetation and for soil stabilization during and after development of a site. That all cuts and fills are adequately designed and engineered and vegetated to control erosion as well as stability of the entire mass. That development and accessibility patterns are controlled to prevent the destruction of vegetation or soil cover due to amounts or concentrations of use or development. That natural drainage patterns are preserved and protected from increased water flows which could alter such patterns or subject existing channels and adjacent areas to increased erosion.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Erosion, Sediment Control and Stormwater Quality (combined)		U.S.C. Title 16, Chapter 35 (ESA)	19	3.0. Stormwater discharges from construction sites shall not cause or threaten to cause pollution, contamination, or degradation of State Waters. Concrete wash water shall not be discharged to or allowed to runoff to State Waters, including any surface or subsurface storm drainage system or facilities. Building, construction, excavation, or other waste materials shall not be temporarily placed or stored in the street, alley, or other public way, unless in accordance with an approved Traffic Control Plan. BMPs may be required by City Engineering if deemed necessary, based on specific conditions and circumstances (e.g., estimated time of exposure, season of the year, etc.). Vehicle tracking of soils off-site shall be minimized. All wastes composed of building materials must be removed from the construction site for disposal in accordance with local and State regulatory requirements. No building material wastes or unused building materials shall be buried, dumped, or discharged at the site.				
		Title 50 CFR, Parts 13 (General Permit Procedures), 17 (Endangered and Threatened Wildlife and Plants) and 81 (Conservation of Endangered and Threatened Species of Fish, Wildlife, and Plants – Cooperation with the States)	19	3.0- No chemicals are to be used by the contractor, which have the potential to be released in stormwater unless permission for the use of a specific chemical is granted in writing by the City Engineer. In granting the use of such chemicals, special conditions and monitoring may be required.. Bulk storage structures for petroleum products and other chemicals shall have adequate protection so as to contain all spills and prevent any spilled material from entering State Waters, including any surface or subsurface storm drainage system or facilities.				
		Title 7 CFR Part 650 (Compliance with NEPA)	19	3.0- All persons engaged in earth disturbance shall implement and maintain acceptable soil erosion and sediment control measures including BMPs in conformance with the erosion control technical standards of the Manual and in accordance with the Erosion and Stormwater Quality Control Plan approved by the City of Colorado Springs, if required. All temporary erosion control facilities including BMPs and all permanent facilities intended to control erosion of any earth disturbance operations, shall be installed as defined in the approved plans and the Manual and maintained throughout the duration of the earth disturbance operation. The installation of the first level of temporary erosion control facilities and BMPs shall be installed and inspected prior to any earth disturbance operations taking place. Any earth disturbance shall be conducted in such a manner so as to effectively reduce accelerated soil erosion and resulting sedimentation. All earth disturbances shall be designed, constructed, and completed in such a manner so that the exposed area of any disturbed land shall be limited to the shortest practical period of time.				
		Title 33 CFR, Parts 320 (General Regulatory Policies), 330 (Nationwide Permits), and 323 (Permits for Discharges of Dredged or Fill Material into Waters of the U.S.)	19	3.0- All work and earth disturbance shall be done in a manner that minimizes pollution of any on-site or off-site waters, including wetlands. Suspended sediment caused by accelerated soil erosion shall be minimized in runoff water before it leaves the site of the earth disturbance. Any temporary or permanent facility designed and constructed for the conveyance of stormwater around, through, or from the earth disturbance area shall be designed to limit the discharge to a non-erosive velocity. Temporary soil erosion control facilities shall be removed and earth disturbance areas graded and stabilized with permanent soil erosion control measures pursuant to the standards and specifications prescribed in the Manual, and in accordance with the permanent erosion control features shown on the Erosion and Stormwater Quality Control Plans approved by the City of Colorado Springs, if required. Soil erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within twenty-one (21) calendar days after final grading, or final earth disturbance, has been completed.				
		Title 40 CFR, Parts 122 (NPDES), 125 (Criteria and Standards for NPDES), 131 (Water Quality Standards), and 403 (General Pretreatment Regulations for Existing and New Sources of Pollution)	19	3.0- Disturbed areas and stockpiles which are not at final grade but will remain dormant for longer than 30 days shall also be mulched within 21 days after interim grading. An area that is going to remain in an interim state for more than 60 days shall also be seeded. All temporary soil erosion control measures and BMPs shall be maintained until permanent soil erosion control measures are implemented. No person shall cause, permit, or contribute to the discharge into the municipal separate storm sewer pollutants that could cause the City of Colorado Springs to be in violation of its Colorado Discharge Permit System Municipal Stormwater Discharge Permit. The owner, site developer, contractor, and/or their authorized agents shall be responsible for the removal of all construction debris, dirt, trash, rock, sediment, and sand that may accumulate in the storm sewer or other drainage conveyance system and stormwater appurtenances as a result of site development. No person shall cause the impediment of stormwater flow in the flow line of the curb and gutter, including the temporary or permanent ramping with materials for vehi				
		U.S.C. Title 42, Chapter 55 (NEPA)	19	Individuals shall comply with the "Colorado Water Quality Control Act" (Title 25, Article 8, CRS), and the "Clea Water Act" (33 USC 1344), regulations promulgated, certifications or permits issued, in addition to the requirements included in the Manual. In the event of conflicts between these requirements and water quality control laws, rules, or regulations of other Federal or State agencies, the more restrictive laws, rules, or regulations shall apply. The quantity of materials stored on the project site shall be limited, as much as practical, to that quantity required to perform the work in an orderly sequence. All materials stored on-site shall be stored in a neat, orderly manner, in their original containers, with original manufacturer's labels.				
		Title 40 CFR, Part 1501 (NEPA and Agency Planning), 1502 (Environmental Impact Statement), 1505 (NEPA and Agency Decisionmaking)	19	Materials shall not be stored in a location where they may be carried by stormwater runoff into a State Water at an time. Spill prevention and containment measures shall be used at storage, and equipment fueling and servicing areas to prevent the pollution of any State Waters, including wetlands. All spills shall be cleaned up immediately after discovery, or contained until appropriate cleanup methods can be employed. Manufacturer's recommended methods for spill cleanup shall be followed, along with proper disposal methods.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Erosion, Sediment Control and Stormwater Quality (combined)								

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Erosion, Sediment Control and Stormwater Quality (combined)								

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Erosion, Sediment Control and Stormwater Quality (combined)		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	19	The following best management practices must be included in the Erosion and Stormwater Quality Control Plan. See section 3.3 – Construction BMP Factsheets and Guidelines for Implementing Construction BMPs for additional details.1. Erosion and Sediment Control • Sediment Trapping Devices (perimeter controls, vehicle tracking, inlet protection) • Sediment Control Devices (Basins ar Check Dams) • Stabilization Requirements (ground stabilization and slope controls); 2. Spill Prevention and Response; 3. Material Management; 4. Inspection and Maintenance				
		Title 33, Article 2 Colorado Statutes (Non-Game and Endangered Species), Section 33-2-106 (Management Programs)	19	3.0- Plan Elements-An Erosion and Stormwater Quality Control Plan shall be developed that consists of a narrative description of the construction project and appropriate plans/map. Adequate erosion control measures shall be constructed prior to land disturbing activities such that no adverse affect of site alternatives will impact the surrounding properties. Particular attention shall be given to concentrated flows of water either to prevent their occurrence or to provide appropriate conveyance devices to prevent erosion. Sediment trapping devices shall be required at all points where sediment laden water might leave the site.				
		Title 25, Article 8 Colorado Statutes (Water Quality Control), Part 5 (Permit System)	19	3.0-The Erosion and Stormwater Quality Control Plan shall include permanent structures for conveying storm runoff, how the site will be graded, final site stabilization, temporary sediment control features including sediment basins and finally, stabilization of the site where temporary features have been removed. Plans showing improvements or construction outside the property line of the site will not be approved unless the plan is accompanied by an appropriate legal easement or written acceptance by the adjacent property owner for the area in which such work is required.				
		Title 37, Article 92 (Water Right Determination and Administration), Part 3 Colorado Statutes and Section 37-92-501 (Jurisdiction Over Water – Rules and Regulations)	19	3.0-Plan Requirements-A brief description of the soils on the site including information on soil type and names, mapping unit, erodibility, permeability, hydrologic soil group, depth, texture and soil structure. In addition, an estimate of the runoff coefficient of the site before and after construction activities should be included. This information may be obtained from the soil report for the site, or, if available, from soils reports from adjacent sites.				
			19	3.0-Best Management Practices (BMPs)-The objective of erosion control is to limit the amount and rate of erosion occurring on disturbed areas until the site is stabilized. The objective of sediment control is to capture the soil that has been eroded before it leaves the construction site. Despite the use of both erosion control and sediment control measures, it is recognized that some amount of sediment will remain in runoff leaving the construction site. This should be minimal. The best management practices for a site are usually comprised of four major elements: • Erosion Control Measures. Used to limit erosion of soil from disturbed areas at a construction site.• Sediment Control Measures. Used to limit transport of sediment to off-site properties and downstream receiving waters. • Drainageway Protection Measures. Used to protect streams and other drainageways located on or adjacent to the construction site from erosion and sediment damages. • Other Stormwater Quality Control Measures. Used to control other potential pollutants from impacting stormwater runoff.				
			19	3.0- Summary of Criteria- All runoff leaving a disturbed area shall pass through at least one BMP before it exits the site. The list below is a summary of recommended BMPs. Silt Fence, Sediment Basin, Temporary Swales/Berms, Vehicle Tracking Controls, Check Dam, Slope Drain, Erosion Control Blankets, Inlet Protection, Surface Roughening, Temporary Mulching/Seeding, Chemicals, Oils and Material Storage, and Maintenance.				
			19	3.0-Additional Information-Requirements/Modifications to Plan City Requested: Additional information may be required for projects where the City Engineer deems that soil erosion, sedimentation, or stormwater quality control problems will not be adequately handle by the submitted plan. Such data may include, but not be limited to, other engineering studies, computations, schedules, and supportive data such as product design information and specifications as deemed necessary by the City Engineer.				
			19	3.0-Owner/Contractor/Engineer Proposed-Minor field modifications may be approved by the City Engineering Inspector. Such modifications would include minor adjustments to BMP field locations or a change to a similar BMP to better correspond to actual site conditions or to improve BMP performance. No plan changes or formal written approval will be required, except that documentation of acceptance should be provided by the City Engineering Inspector to the contractor/owner. All other requested modifications shall be in writing and submitted to City Engineering. Such proposed modifications, including revised plans, shall be submitted at least ten (10) working days prior to desired date of implementation. City Engineering will reapprove the Plan/Permit if the proposed modifications are acceptable.				
			19	4.0- New Development Stormwater Management- Four-Step Process: The following four-step proces is recommended for selecting structural BMPs in newly developing and redeveloping urban areas: Ste 1: Employ Runoff Reduction Practices; Step 2: Stabilize Drainageways; Step 3: Provide Water Qualit Capture Volume (WQCV); Step 4: Consider Need for Industrial and Commercial BMPs.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Erosion, Sediment Control and Stormwater Quality (combined)								

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Erosion, Sediment Control and Stormwater Quality (combined)								

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Floodplain Standards	National Flood Insurance Act of 1968	U.S.C. Title 42, Chapter 50 (NFIA)	1	2.8- Any structure located in 100-year floodplain shall have lowest floor 1-foot above 100-year water surface elevation.	11	Methods of Reducing Flood Losses: Restricting or prohibiting development activities which are dangerous to health, safety, and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities; requiring development activity be protected against flood damage at initial construction; controlling alternation of natural floodplains stream channels, and natural protective barriers which accommodate channel flood waters; control filling, grading, dredging and other development which may increase flood damage; preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas; prohibiting any development in regulatory floodways if any increase in flood levels during the base flood discharge would result.	18	16-813- A development permit shall be obtained before construction or development begins within any area of special flood hazard as identified by the Federal Insurance Administration in report entitle "The Flood Insurance Study for the Town of Green Mountain Falls," dated June 5, 1985.
	National Flood Disaster Protection Act of 1973	Title 44 CFR, Parts 9 (Wetland Protection), 10 (Environmental Considerations), 65 (Identification and Mapping of Special Hazard Areas), 70 (Procedure for Map Correction), 72 (Procedures and Fees for Processing Map Changes), and 78 (Flood Mitigation Assistance)	2	(2) 7.8.302: Residential Construction: New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to one foot (1') or more above the base flood elevation. Non residential Construction shall be floodproofed 1' below flood level, structurally resistant to hydrostatic or hydrodynamic loads, and buoyancy, and be certified by professional engineer or architect. Manufactured Homes may be placed in FIRM zone A1-30, AH, or AE in the following areas: outside a manufactured home park or subdivision, in a new manufactured home park or subdivision, an expansion to an existing manufactured home park or subdivision, or in an existing park that has experienced substantial damage due to flooding, in such case lowest floor shall be one foot about the base flood elevation. Lowest floor of the manufactured home is to be at or above the base flood elevation or supported by foundation elements that are no less than 36" above grade.	11	16.10.150- A variance may be granted but approval will be through City Council and will hear and decide on the variance. Approval of variance will be based off several factors including good and sufficient cause, that failure to grant variance would cause exceptional hardship to applicant, flood heights will not be increased. Variances will not be issued if base flood level is increased.	18	16-813-b- The following information is required and certified by a licensed professional engineer or architect. Elevation in relation to mean sea level of lowest floor; elevation in relation to mean sea lev to which any structure has been floodproofed; provide that where a non-residential structure is intended to be made watertight below the base flood level a professional engineer shall develop plans and methods of construction; description of the extent to which any watercourse will be altered or relocated as a result of the proposed development; and a fee established by the Board of Trustees shall be submitted with the application.
	National Flood Insurance Reform Act of 1994	Title 24, Article 65 Colorado Statutes (Colorado Land Use Act), Section 24-65-105 (Model Resolutions – Subdivisions – Improvement Notices)	2	7.8.303: FLOODWAYS: Prohibit development, including fill, new construction, substantial improvements and other development, except as provided for in this part, unless certification by a registered professional engineer is provided demonstrating that the development shall not result in any increase in flood levels during the occurrence of the base flood discharge.	11	16.10.160.A- Anchoring- All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of structure.	18	16-815- Planning Commission duties shall include but not limited to permit review, utilize all base flood data available, obtain and record elevation of lowest floor (including basement), verify and record actual elevation of floodproofed structures, notification of appropriate agencies prior to any alternation or relocation of watercourse and submit information to Federal Insurance Administration, interpretation of FIRM boundaries.
	Colorado Land Use Act	Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	28	Policy NE 302: Protect Drainageway and Floodplains -Limit development of land within floodplains, which should remain, or be returned, to its natural state. Development can reduce a floodplain's ability to store and convey water, intensifying velocity and depth of floodwater in other areas. Areas subject to significant flooding also pose a threat to citizens and property. Floodplains are lands identified in the Streamside Overlay Zone and FEMA designations.	11	16.10.160.B- New construction shall be with methods, practices, materials, and utility equipment resistant to flood damage. Enclosed areas below the lowest floor subject to flooding shall be designed to automatically equalize hydrostatic flood forces on walls and must be certified by registered professional engineer or architect.	18	16-816- Variance Procedure, Appeal Board; Planning Commission and Board of Trustees shall consider all technical evaluation, all relevant factors, standards specified including the danger that materials may be swept onto other lands leading to injury of others, danger to life and property, susceptibility of the proposed facility and contents to flood damage; importance of service provided to community, availability of alternative locations, compatibility of proposed use with existing and anticipated development; expected heights, velocity, duration, rate of rise and sediment transport of th flood waters expected at the site; costs of providing governmental services during and after flood conditions.
		Title 37, Article 87 Colorado Statutes, Section 37-87-102 (Natural Streams and Use Thereof by Reservoir Owners)	28	Policy NE 302: Plan and utilize floodplains and drainageways as greenways for multiple uses including conveyance of runoff, wetlands, habitat, trails, recreational uses, utilities and access roads when feasible, considering the primary intended use.	11	16.10.160.C- Utilities- Designed to minimize infiltration into system and on-site waste disposal systems shall be located to avoid impairment to them or contamination form them during flooding.	18	16-817- Conditions for Variance; Variances shall only be issued upon a showing of good and sufficient cause; determination that failure to grant the variance would result in exceptional hardship t the applicant; determining that granting of variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud or victimization of the public.
					11	16.10.160.D- Subdivision Proposals- Subdivision proposals shall be consistent with the need to minimize flood damage, utilities should be located to minimize flood damage, adequate drainage to reduce exposure to flood damage, base flood elevation data and delineation shall be provided by applicant.	18	16-818- All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.
					11	16.10.170- Residential construction- the lowest floor including the basement shall be elevated one foo (1') or more above the base flood elevation. Non-residential- be floodproofed up to 1' above base flood elevation and have structural components capable to resist hydrostatic load.	18	16-820- Flood Hazard Reduction; Utilities; All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system; new and replacement sanitary sewers shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters; on-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding..

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Floodplain Standards	26	15.20.030 Statement of purpose- It is the purpose of this chapter to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific area	16	12.07.020- If proposed subdivision is within the 100-year boundary, subdivider shall submit a floodplain development plan consisting of a map and supporting data. Supporting data must relate how the subdivisions will satisfy the provisions of the Town's floodplain regulations and the map shal show all lots within the floodplain, within 200-feet of floodplain, and location of all structures which lie within floodplain.			17	4.3.5.C- Natural Drainage Channels- Flood plain Delineation- Where a natural drainage channel is adjacent to , or within a proposed development, the 100-year flood plain of the channel shall be determined and delineated on the subdivision plat. The 100-year flood plain shall be established by thorough engineering analysis which takes into account all physical properties of the channel and energy losses along the channel. Appropriate allowances
	26	15.20.070 Basis for establishing the areas of special flood hazard-The areas of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for the City of Manitou Springs," dated February 1, 1984, with accompanying Flood Insurance Rate Maps and any amendments, is adopted by reference and declared to be a part of this chapter. The Flood Insurance Study is part of this chapter.						
	26	15.20.040 Methods of reducing flood losses- Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increase in erosion or in flood heights or velocities; Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction; Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters; Controlling filling, grading, dredging, and other development which may increase flood damage; and, Preventing or regulating the construction of floo barriers which will unnaturally divert floodwaters or which may increase flood hazards in other areas.						
	26	15.20.180 Specific standards- Residential Construction. New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated one foot or more above base flood elevation.						
	26	15.20.180 Specific standards-Nonresidential Construction. New construction and substantial improvement of any commercial, industrial, or other nonresidential structure shall either have the lowest floor, including basement, elevated to one foot or more above the level of the base flood elevation; or, together with attendant utility and sanitary facilities, shall be floodproofed so that from a point one foot above the base flood level the structure is watertight with walls substantially impermeable to the passage of water; have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and be certified by a registered professional engineer or architect that the standards of this subsection are satisfied.						
	26	15.20.180 Specific standards-Openings in Enclosures below the Lowest Floor.- For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are subjec to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided; The bottom of all openings shall be no higher than one foot above grade; Openings may be equipped with screens, louvers, or other coverings or devices, provided that they permit the automatic entry and exit of floodwaters.						
	26	15.20.180 Specific standards-Manufactured Homes-Manufactured homes shall be anchored in accordance with Section 15.20.170(A). All manufactured homes or those to be substantially improved shall conform to the following requirements: Require that manufactured homes that are placed or substantially improved on a site outside of a manufactured home park or subdivision, or in an expansion to an existing manufactured home park or subdivision, or in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood, be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation, collapse and lateral movement.						

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Floodplain Standards	7	20.03.030-No structure or land shall hereafter be constructed, located, extended, converted or altered without full compliance with the terms of Floodplain Provisions.	1	2.8- Any structure located in 100-year floodplain shall have lowest floor 1-foot above 100-year water surface elevation.	21	16.36.100-Construction of buildings shall not be permitted in a designated floodway with a return frequency more often than a one hundred (100) year storm.	13	Table 2: Approvals and Permits: Development, includes building or any sitework, in a flood hazard area is subject to approval of a flood area permit. A variance to a flood hazard area standard is subject to approval of a flood area variance.
	7	20.04.010-A flood hazard development permit shall be obtained before construction or development begins within any area of special flood hazard. Plan shall be submitted to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and elevation of lowest floor, level of floodproofed area, certification by a professional engineer or architect that floodproofing methods can meet criteria, and description of the extent to which any watercourse will be altered.	20	Chapter II, D: Prevent development in floodplains, geologic hazard areas, or other natural hazard areas which is incompatible with the hazard in terms of threats to public welfare, private property, and public property	21, 24	16.36.100 & Section XI, Design Standard Part 9- Building construction may occur in that portion of the designated floodplain where the return frequency is between a one hundred (100) year and a maximum probable storm provided all usable floor space is constructed above the designated maximum probable flood level.	13	Table 7: Criteria: Flood. Protection of adjacent property from flood or water damage. (CUP-general, industrial, mining). Site is not prone to flooding (CUP-mining)
	7	20.05.030-Since the floodway is an extremely hazardous area due to the velocity of floodwaters which carry debris, potential projectiles, and erosion potential, the following provisions apply: Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge. If above mentioned are met then all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Chapter 20.05.	20	Chapter V- Section 49.2- Land subject to natural hazards shall be identified by the subdivider, subject to existing county hazard inventories. Such land shall not be developed until such time as the hazard has been removed or the impact of said hazard mitigated as determined by the Planning Director. Lots subject to hazards which may be eliminated through specialized engineering shall be so identified on the plat. Identification of such hazards shall include a statement of the specific hazard and a statement of the engineering alterations required to eliminate the hazard. The following hazards shall be subject to this regulation: One hundred (l00) year floodplain as identified by the subdivider, appropriate review agency, or as identified in the county floodplain inventory. Development in the floodplain shall be limited to uses compatible with the hazard and shall specifically exclude residential uses, sewage and water treatment plants, commercial shopping areas, and industrial sites.	21, 24	16.36.100 & Section XI, Design Standard Part 9-Where floodway velocities are generally determined to be under five feet per second and maximum floor depth will not exceed three feet, such uses as cultivated agriculture, nurseries, parks and recreation facilities, and accessory parking may be permitted.	13	FL-10- Flood Hazard Areas. Base flood is the flood having a 1% chance of being equaled or exceeded in any given year. Area of Special Flood Hazard is the land in the floodplain within community subject to a 1% or greater chance of flooding in any given year.
			29	1.9- No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this regulation and other applicable regulations. Violations of the provisions of this section by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor.	21, 24	16.36.100 & Section XI, Design Standard Part 9-Floodlands. All lots containing land which is less than two feet above the elevation of the one hundred (100) year recurrence interval flood or, where such data is not available, five feet above the elevation of the maximum flood of record, must have adequate building sites documented with consideration to the location of the building and, where applicable, of wells and septic tanks.	13	FL-30-1- Flood Hazard Area Standards-Anchoring- All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure and capable of resisting the hydrostatic and hydrodynamic loads.
			29	1.12 Warning of Disclaimer of Liability.-The degree of flood protection required by this section is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods ca and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This section shall not create liability on the part of El Paso County, any officer or employee thereof, or the Federal Insurance Administration, for any flood damages that result from reliance on this section or any administrative decision lawfully made there under.	21, 24	16.36.100 & Section XI, Design Standard Part 9-Any contemplated floodplain encroachment or channeling shall be thoroughly analyzed and its effect on stream flow determined before it is undertaken. Any construction, dumping and filling operations in a designated floodway constitutes an encroachment.	13	FL-30-2- Flood Hazard Area Standards-Construction Materials and Methods. All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage and methods and practices that minimize flood damage. Service facilities designed and/or located so as to prevent water from entering or accumulating within components during conditions of flooding.
			29	1.13 A development permit shall be obtained before construction or development begins within any area of special flood hazard. The permit shall expire at the end of 12 months from the issuance if start of construction has not taken place. Application for a development permit shall be made on forms furnished by the floodplain administrator and may include, but not be limited to: plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities; and the location of the foregoing. Specifically, the following information is required and is to be certified by a licensed professional engineer or architect: A.Elevation in relation to mean sea level or the lowest floor (including basement) of all structures; B.Elevation in relation to mean sea level to which any structure has been floodproofed; C. Evidence that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Section 1.18(B); and, D.Description of the extent to which any watercourse will be altered or relocated as a result of proposed development.	21, 24	16.36.100 & Section XI, Design Standard Part 9-Trailer parks, mobile homes and similar uses shall not be permitted in any designated floodway.	13	FL-30-3- Flood Hazard Area Standards- Floodways- Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge. If this standard is satisfied, all new construction and substantial improvements shall comply with all other applicable provisions of Flood Hazard Area Standards.
			29	1.15 Duties and responsibilities of the floodplain administrator. Duties of the floodplain administrator shall include, but not be limited to:Permit Review,Use of Other Base Flood Data, Information to be Obtained and Maintained, Alteration of Watercourses, Interpretation of FIRM Boundaries.	21, 24	16.56.020.B.1. and GES II- Floodplain-:Subdivision applications, including subdivision variance, incorporating land within a floodplain shall be accompanied by a floodplain hydrology report prepared by a registered professional engineer which establishes the water surface elevation of a flood with a one percent chance of occurring in any given year.	13	FL-30-4- Flood Hazard Area Standards- Manufactured Homes. All manufactured homes must be elevated and anchored to resist flotation, collapse or lateral movement and capable of resisting the hydrostatic and hydrodynamic loads.

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Floodplain Standards					11	16.10.180-Floodways- Prohibit encroachments, including fill, new construction, substantial improvements, and other development in floodways unless a certified professional engineer or architect demonstrates that the flood level do not increase.	18	16-823-Specific Standards- Residential construction; new construction and substantial improvement of any residential structure shall have the lowest floor elevated to or above the base flood elevation; non-residential construction shall have lowest floor elevation at or above the base flood elevation or b floodproofed so that below the base flood level the structure is watertight and be able to resist hydrostatic pressure; manufactured homes shall not be placed in floodway.
							18	16-824- Floodways; Prohibit encroachments including fill, new construction, substantial improvements and other development unless a technical evaluation demonstrates that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Floodplain Standards	26	15.20.180 Specific standards-Recreational Vehicles. A recreational vehicle shall meet the permit requirements and elevation and anchoring requirements of this code unless:It is on the site for fewer than one-hundred eighty consecutive days, It is fully licensed and ready for highway use, It will meet the requirements of subsection (D) of this section.						
	26	15.20.180- Require that manufactured homes to be placed or substantially improved on sites in existing manufactured home parks or subdivisions that are not subject to the provisions of subsection (D)(1)(a) of this section be elevated so that either the lowest floor of the manufactured home is at or above the base flood elevation or the manufactured home chassis is supported by reinforced piers or other foundation elements that are no less th thirty-six inches in height above grade and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.						

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Floodplain Standards			29	1.16 Variance procedure. The County Drainage Board, as established by the El Paso County Commissioners, shall hear appeals from a decision of the floodplain administrator and requests for variances from the requirements of the section and make recommendations to the El Paso County Commissioners. In passing upon such applications, the El Paso County Commissioners shall consider all technical evaluations, all relevant factors, standards specified in other sections of the section, and: the danger that materials may be swept onto other lands to the injury of others; the danger to life and property due to flooding or erosion damage; the susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner; the importance of the services provided by the proposed facility to the community; the necessity to the facility of a waterfront location, where applicable; the availability of alternate locations for the proposed use which are not subject to flooding or erosion damage; the compatibility of the proposed use with existing and anticipated development; the relationship of the proposed use to the comprehe	23	Section 26- Floodplain District (S-3)- The standards of this district (S-3) are designed to retain and provide areas for the unobstructed passage of flood waters and give protection from floods to the population, building and structures located therein and in the surrounding areas.	13	FL-30-5 Flood Hazard Area Standards- Nonresidential Construction in areas with base flood elevation data. New construction and substantial improvement of any commercial, industrial or other non residential structure shall either have the lowest floor (including basement) elevated to the level of the base flood elevation; or, together with attendant utility and sanitary facilities, shall : 1. Be floodproofed below base flood elevation; 2 have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy 3. Be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting the provisions of this paragraph.
			29	1.16- Conditions for Variances. Development permits may be issued by the regional floodplain administrator for the reconstruction, rehabilitation or restoration of structures listed on the designated historic landmark, without regard to the procedures set forth in the remainder of this subsection. Infill of vacant lots within the Historic Preservation District may be issued variances provided that the provisions of this subsection are met. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result. Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.4. Variances shall only be issued upon: A showing of good and sufficient cause; A determination that failure to grant the variance would result in exceptional hardship to the applicant; and A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud or victimization of the public.	23	Section 40, part c: Rural Land Use Process, Rural Land Use Process: Identify 100-year floodplain. Rural Land Use Plan shall show the contour and elevation of the floodplain which shall be identified as "Special Flood Hazard Area- 100-year Floodplain." Permit and/or compliance with additional floodplain regulations may be required prior to development in the "Flood Hazard Area".	13	FL-30-6- Flood Hazard Area Standards- Openings in Enclosures Below the Lowest Floor in area with base flood elevation data. For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces.
			29	1.16- Conditions for Variance-Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and tha the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.	24	Section XI, Design Standards: General Standards: Land subject to hazardous conditions such as floodplains (and others not relevant to this policy evaluation) shall be identified and shall not be subdivided until: the hazards have been eliminated or will be eliminated by subdivision and construction plans and a permit under Chapter 1, "Pueblo County Regulations for Areas and Activities of State and Local Interest" has been issued.	13	FL-30-7 Flood Hazard Area Standards- Residential Construction in areas with base flood elevation data. New construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated to or above the base flood elevation.
			29	1.17-Anchoring-All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.	24	Section XI, Design Standards: Part 9: Any use of land is prohibited where flooding would create a public health problem. Including but not limited to shallow wells, uncased deep wells, sanitary land fills, septic tanks, etc.	13	FL-40- Flood Hazard Area Variance- The Board of Adjustment shall hear and decide appeals and requests fo variances. The Board shall review and consider various items prior to approving the variance request which include but not limited to: importance of service provided by proposed facility; necessity of the facility to have a waterfront location; and will only be issued if the base flood elevation does not increase; that failure to grant variance would result in exceptional hardship to applicant, and additional flood hazards are not created.
			29	1.17-Construction Materials and Methods. All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage;	25	Section 1.3- Purpose of resolution is to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed.		
			29	1.17-Construction Materials and Methods.All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage;	25	Section 3.2- The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled "The Flood Insurance Study for the County of Pueblo," dated September 29, 1989, with an accompanying Flood Insurance Rate Map (FIRM) is hereby adopted by reference and declared to be a part of this ordinance.		
			29	1.17-Construction Materials and Methods. All new mechanical and utility equipment shall be designed and/or elevated to prevent water from entering or accumulating in components;	25	Section 4.1- Establishment of development permit- A development permit shall be obtained before construction, development, or substantial improvement begins within any area of special flood hazard established in Section 3.2.		
			29	1.17-Construction Materials and Methods. All new construction and substantial improvements with fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louver or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.	25	Section 4.3-4- Alteration of Watercourses- Notify adjacent communities and the Colorado Water Conservatio Board prior to any alteration or relocation of a watercourse, and submit evidence of such notification to FEM and require that the flood-carrying capacity of the watercourse is not diminished by alteration or relocation, and maintenance is provided for.		

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
			29	1.17-Utilities. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system; New and replacement sanitary sewage systems shall be designed t minimize or eliminate infiltration into the systems and discharge from the systems into flood waters; and, On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.	25	Section 4.4 Appeal and Variance Procedure-The Pueblo County Planning Commission shall hear and decide appeals and requires for variances from the requirements of this ordinance. The Commission shall consider a technical evaluations, all relevant factors, standards specified		
			29	1.17-Subdivision Proposals. All subdivision proposals shall be consistent with the need to minimize flood damage; All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage; All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and, Base flood elevation data shall be provided for subdivision proposals and other proposed developments which contain at least fifty lots or five acres (whichever is less).	25	Section 4.4-2- Conditions for Variance- Variances may be issued for lots of 0.5 ac or less and surrounded by other contiguous lots with existing structures constructed below the base flood level. Variances shall not be issued if any increase in flood levels during the base flood discharge would result; variances shall only be issued upon showing a good and sufficient cause, failure to grant variance would cause exceptional hardship, and that granting the variance will not result in increase flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public.		
			29	1.18-Residential Construction. New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated one foot or more above base flood elevation.	25	Section 5.1.1- Anchoring- All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of structure. All manufactured homes shall be anchored according to FEMA manual, " Manufactured Home Installation in Flood Hazard Areas."		
			29	1.18- Openings in Enclosures below the Lowest Floor. For all new construction and substantial improvement fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following criteria:a. A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided; The bottom of all openings shall be no higher than one foot above grade; Openings may be equipped with screens, louvers, or other coverings or devices, provided that they permit the automatic entry and exit of floodwaters.	25	Section 5.1-2 Construction Materials and Methods- All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage. All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.		
			29	1.19 Floodways.Located within areas of special flood hazard are areas designated as floodways, the following provisions apply: A. Prohibited encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood discharge. B. If subsection A of this section is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions. C. Prohibit the placement of any mobile homes except in an existing mobile home park or existing mobile home subdivision.	25	Section 5.1-3- Utilities- All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system; new and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge form the systems into flood waters; on-site waste disposal shall be located to avoid impairment to them or contamination from them during flooding; electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during flooding.		
			29	Nonresidential Construction. New construction and substantial improvement of any commercial, industrial, or other nonresidential structure shall either have the lowest floor, including basement, elevated to one foot or more above the level of the base flood elevation; or, Together with attendant utility and sanitary facilities, shall:Be floodproofed so that from a point one foot above the base flood level the structure is watertight with walls substantially impermeable to the passage of water;Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; andBe certified by a registered professional engineer or architect that the standards of this subsection are satisfied.	25	Section 5.1-5 Encroachments- The cumulative effect of any proposed development, when combined with all other existing and anticipated development, shall not increase the water surface elevation of the base flood more than one foot at any point.		
			29	D. Manufactured Homes. Manufactured homes shall be anchored in accordance with Section 1.17(A). All manufactured homes or those to be substantially improved shall conform to the following requirements:Require that manufactured homes that are placed or substantially improved on a site outside of an area that has incurred "substantial damage" as the result of a flood, be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation, collapse and lateral movement. Require that manufactured homes to be placed or substantially improved on sites in existing manufactured home parks or subdivisions that are not subject to the provisions of subsection (D)(1)(a) of this section be elevated so that either the lowest floor of the manufactured home is at or above the base flood elevation, or the manufactured home chassis is supported by reinforced piers or other foundation elements that are no less that thirty-six inches in height above grade and be securely anchored to an adequately anchored fo	25	Section 5.2-1- Residential Construction- New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to or above base flood elevation.		
			29	1.18- Recreational Vehicles. A recreational vehicle shall meet the permit requirements and elevation and anchoring requirements of this code unless: It is on the site for fewer than one-hundred eighty (180) consecutive days. It is fully licensed and ready for highway use.. It will meet the requirements of subsection (D) of this section.	25	Section 5.2-2- Non-residential Construction- New construction and substantial improvement shall have the lowest floor, including the basement, elevated to the level of the base flood elevation or be floodproofed below the base flood level, capable of resisting hydrostatic forces, structure is watertight below the base flood level.		
			29	1.18 Below-Grade Residential Crawlspace Construction. New construction and substantial improvement of any below-grade crawlspace shall: Have the interior grade elevation, that is below base flood elevation, no lower than two feet below the lowest adjacent grade; Have the height of the below-grade crawlspace measured from the interior grade of the crawlspace to top of the foundation wall, not to exceed four feet at any point; Have an adequate drainage system that allows floodwaters to drain from the interior area of the crawlspace following a flood; Meet provisions of section 1.17(A), Anchoring; 1.17(B), Construction Materials and Methods; 1.18(C), Openings in Enclosures Below the Lowest Floor.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
Floodplain Standards (cont.)								
Streamside Approach / Prudent Line	National Flood Insurance Act of 1968	U.S.C. Title 42, Chapter 50 (NFIA)	30	Section 508- Streamside Overlay Zone-The Streamside Overlay Zone encompasses all land which is located within the reference distance of the top of the bank or within the 500-year floodplain as illustrated on the FEMA map of specific intermittent and perennial streams within the City as represented by the Official Streamside Overlay Map which have been identified as significant due to their natural characteristics, wildlife habitat, riparian vegetation or open space and recreational opportunities.				
	National Flood Disaster Protection Act of 1973	Title 44 CFR, Parts 9 (Wetland Protection), 10 (Environmental Considerations), 65 (Identification and Mapping of Special Hazard Areas), 70 (Procedure for Map Correction), 72 (Procedures and Fees for Processing Map Changes), and 78 (Flood Mitigation Assistance)	30	Section 508- Streamside Overlay Zone-Purpose- Certain areas of the City are characterized by intermittent and perennial streams which provide significant wildlife habitat, riparian vegetation, open space, and multi-use trail opportunities which add to the character, attractiveness, and quality of life o the community. It is the purpose of the Streamside Overlay Zone District to guide the development and maintenance of the property adjacent to these stream corridors in a manner that is compatible with the environmental conditions, constraints, and character of these areas.				
	National Flood Insurance Reform Act of 1994	Title 24, Article 65 Colorado Statutes (Colorado Land Use Act), Section 24-65-105 (Model Resolutions – Subdivisions – Improvement Notices)	30	Section 508- Development Plan Review Criteria- Additional to review criteria existing, any area with the Streamside Overlay Zone shall be consistent with the recommendations of the Design Manual and Land Suitability Analysis and shall comply with the following review criteria: Natural landform beer maintained, stream ecosystem incorporated in design, minimize impact wildlife habitat and the ripari ecosystem, potential community trail networks and recreational opportunities identified, protection of potential flood damage, natural features within streamside area identified, etc.				
	Colorado Land Use Act	Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Section 30-28-133 (Subdivision Regulations)	30	Section 508- Development Standards include the following subtopics: Submittals, Approvals, and Administration; Land Suitability Analysis including New Streamside Master Plan, major amendment to streamside master plan, streamside development plan, streamside concept plan, slope analysis, riparian vegetation and wildlife, geology, soils and natural features, topographic map, analysis packag ; assurances may be required prior to approval of a grading plan or building permit as an offset to the potential cost of reparations to sensitive streamside areas where development is approved to take plac adjacent to said areas; Grading and Erosion Control Plan approval; and Streamside Site Plan.				
		Title 37, Article 87 Colorado Statutes, Section 37-87-102 (Natural Streams and Use Thereof by Reservoir Owners)	30	Section 508- Land Use Requirements- Site Imperviousness Standards- Allowable Impervious Cover i 10% for areas within the streamside overlay, parcels within the 100-year floodplain impervious allowance varies from 0-8 percent additionally sites will be allowed up to 2.5 times the above mentioned amount if they provide water quality capture volume. Standards set the minimum lot size by zone base on the percent of parcel within overlay for residential and commercial is set in ordinance.				

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Floodplain Standards (cont.)								
Streamside Approach / Prudent Line								

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
Floodplain Standards (cont.)			33	ISSUE 11.4 Reduce Flood Danger- Reasonable alternatives for addressing existing structures which are located in the flood plain are limited; however there are a number of engineering, regulatory and warning systems approaches which can partially mitigate this danger and potential for financial loss. Planning for flood protection while reducing flood danger is a challenge because flood-prone areas are extensive and actual floodplain boundaries are subject to change due to channel migration caused by erosion. Rates of bank erosion may be accelerated as a result of upstream development activities and result in changes to the FEMA the Regulatory 100-year Flood Plain designation. Additional development within floodplain areas increases risk of loss and impedes the ability of drainage channels to convey stormwater. However, the strictest interpretation of floodplain regulations may severely limit the use of private property.				
			33	**Goal 11.4** Promote public safety and reduce loss of private property**Policy 11.4.1** Strongly discourage land use development from locating in designated floodplains.**Policy 11.4.2** Strongly discourage land use development from locating in areas below dams, spillways, and levees that would require the State Engineer to upgrade the classification of these structures. **Policy 11.4.3** Encourage the removal of existing structures within the flood-plain when this can be accomplished in a cost-effective and equitable manner.**Policy 11.4.4** Support the construction of facilities which will protect existing structures in flood-prone areas if this can be accomplished in a manner which is environmentally sensitive and will not significantly reduce the ability of the floodway to carry peak flows.				
			33	**Policy 11.4.5** Support the continued refinement and use of regional flood warning systems**Policy 11.4.6** Continue to encourage the disclosure of flood hazards to current and future property owners**Policy 11.4.7** Limit new development in and modification of flood plains in accordance with regionally adopted flood-plain regulations**Policy 11.4.8** Encourage "prudent line" approaches which adequately set structures back from flood-plain boundaries, especially in areas which may be prone to bank erosion				
Streamside Approach / Prudent Line			31	2. Prudent Line Applicability: Prudent line approach is applicable and recommended for open channel segments located downstream from land having less than or equal to a cumulative 15% impervious surface cover under future conditions and the main channel can adequately convey future conditions 10-year event flows. Prudent line approach may apply to open channel segments located downstream from land having between a cumulative 15 and 20 percent impervious surface cover under future conditions and the main channel can adequately convey future conditions 10-year flows, justification must be given for recommending prudent line approach. Prudent line approach is not recommended for open channel segments located downstream from land having greater than a cumulative 20 percent impervious surface cover under future condition or main channel lacks adequate conveyance capacity for the future conditions 10-year flows.				
			31	2.1 Transition Issues- Transition issues on the prudent line reaches require special consideration because of the differential velocities that often arise, thus causing sediment deposition and/or excessive erosion, transitions involve one of the following cases: the transition between an improved channel reach and a prude line reach or vice versa and the transition that is necessary at road crossings on a prudent line reach.				
			31	2.2 Defining the Prudent Line- The criteria for defining the prudent line is defined as the enveloping curve considering the 100-year floodplain boundary, the erosion during a 100-year event, or the long term erosion over a 30-year period.				
			31	2.3- The Maintenance Line- Due to the dynamic nature of stream channels, and the limitations to predict futu channel conditions, the prudent line may be encroached upon in the future. To plan for this potential occurrence, any prudent line application should incorporate a "maintenance line," located somewhere inside t prudent line. Should the channel begin to encroach on the maintenance line, some remedial measures should be considered so that the prudent line is not jeopardized. These remedial measures could include rock rip rap regrading and revegetating, spur dikes, or other available channel stability countermeasures. County will be responsible for performing channel rehabilitation measures on the prudent line channel resulting from significant hydrologic events or from long-term erosion. The property owner will be responsible for providing protection to his or her structures.				
			31	2.4- Maintenance Access- Providing maintenance access to the prudent line channel is very important.				

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
			30	Section 508- Land Use Requirements- Streamside Buffers- The specific width of the required streamside buffer is relative to the streamside characteristics specified with three different stream types, criteria is specific in what is allowed in each stream zone which include the following categories streamside, middle, and outer. The are specific uses which are prohibited in Overlay area. Fences must be open, split-rail, or wood plank design and shall not be placed in 100-year floodplain. Grading should be limited in Overlay area.				
			30	Section 508- Land Use Requirements- Exemptions- Properties and/or development activities shall be exempted from all or a portion of the Streamside Ordinance requirements. Streamside sites may qualify for partial or total exemption if area is progressively reclaimed to a more natural and/or function stream condition. Any development proposal located in Overlay zone existing prior to the adoption of the this Ordinance will be exempt where no grading, disturbance, or development is proposed beyond the existing footprint.				
			30	Section 508- Land Use Requirements- Exemptions Properties separated from stream by a public street or separate privately held parcel of land created prior to the date of adoption of this Ordinance if property is separated by 150 feet or more from stream thread. Sites with a prudent line setback adopted prior to the adoption date of the Streamside Ordinance are exempt from the Streamside Development Plan, Land Suitability Analysis, Streamside Grading, and Impervious Cover Requirements of the Ordinance. Work to install, replace, repair, rehabilitate or maintain public facilities, including but not limited to utilities, stormwater/drainage facilities, trails and parks. There are limited permitted uses as specified in Ordinance.				
Drainage Basin Fees	Colorado Urban Drainage and Flood Control Act	Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Sections 30-28-106 (Adoption of Master Plan – Contents), 30-28-107 (Surveys and Studies) 30-28-133 (Subdivision Regulations)	1	3.1- Drainage Basin Fees represent the share of drainage improvements within basin expressed as dollars per acre. Fees are a one time due at the final plat recording.	34	Interim Drainage fees for Jimmy Camp Creek $5999 per impervious acre.		
		Title 30, Article 23 Colorado Statutes (Planning and Zoning), Section 31-23-107 (Public Property Dedicated)	2	7.7.902- In the best interest of the basin, fees will be established. Cost will be divided among the unplatted basins for regional detention facilities and will be credited towards drainage fees for property.				
		Title 32, Article 7 Colorado Statutes (Regional Service Authorities), Section 32-7-142 (Urban Drainage and Flood Control)						
		Title 32, Article 11 Colorado Statutes (Urban Drainage and Flood Control), Section 32-11-219 (Cooperative Powers)						
Grading (cont.)	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	Title 9, Article 5 Colorado Statutes (Safety – Industrial and Commercial), Section 9-5-102 (Applicability of Standards)	22	7.7.1503: GRADING PLANS: No person shall undertake any grading on private property that will result in: Excavation or fill of five hundred (500) cubic yards or more, The grading of a site with land disturbance of one (1) or more acres, or. Grading on any property with a natural slope in excess of eight percent (8%), or Any combination of the above three (3) or any grading or other disturbance of land in an area zoned hillside area overlay zone under section 7.3.504			18	16-714-e- Grading and Erosion Control Plan shall minimize terrain disturbance and to restore and stabilize those areas which are disturbed. Erosion control/ reclamation plan or program shall state in detail how each type of restoration situation will be dealt with.

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
Drainage Basin Fees			15	Drainage impact fees are based on the following information and criteria, Year 2002 El Paso County Drainage Basin Fees: Fees are dollars per impervious area- Crystal Creek- $15,464; Dirty Woman Creek- $15,464; Jackson Creek- $3,975; Monument Branch- $14,228; Palmer Lake $6,961; and Teachout Creek- $2,761.	8	Drainage fee is $6,498 per acre if parcel is greater than 2.5 acres then final fee is $4874 per acre. Fee varies depending on the zoning and percent impervious.		
					10	16.80.010-Fee shall be paid at time of issuance of a building permit. Fee is required if impervious area is being increased.		
					10	16.80.050- A fee reduction up to the total fee for the land and required by the Town to dedicate for the Prudent Line.		
					10	16.80.080- Drainage fees collected will be placed in the Town Drainage Fund.		
Grading (cont.)	12	16.28.030 Required improvements.-Grading Plans. To ensure that a minimum amount of earth is moved, that all lots drain properly and that storm drainage will be carried away from the development, a grading plan shall be prepared by the developer and approved by the city engineer.			9	15.50.060-Earthwork cut can not have a slope steeper than 2:1 and fill slope steeper than 3:1. The minimum horizontal separation between the fill slope and cut slope is 5-feet.		

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
			31	3. Calculating the Prudent Line- One procedure for calculating the prudent line is for channels in sandy soils and another for those incised into more erosion-resistant material. A detailed procedure is available in the Prudent Line Addendum. It is important to account for the vertical component creating a prudent line window.				
			31	3.5 Maintenance Line- To insure long term performance of the prudent line, a maintenance line should be established inside the prudent line. The recommended maintenance line is equal to one-half the prudent line. This will provide adequate time to analyze, design, and construct potential countermeasures to protect the prudent line if channel migration is greater than expected.				
			31	3.7 Sediment Deposition Issues- A reach experiencing sediment deposition will also experience change over time resulting in unexpected channel migration, flooding, and potential damage.				
Drainage Basin Fees	3	13.50.050-Stormwater Fee is adjusted annually based on Denver-Boulder CPI-U. Current rates are $704 for 1st 3000 sf and $235 for every additional 1000 sf	1	3.1- Drainage Basin Fees represent the share of drainage improvements within basin expressed as dollars per acre. Fees are a one time due at the final plat recording.			13	FE-10- Fees- Fees shall be paid to the Planning Department upon the filing of any application which include a floodplain permit of $200 and development plan review minimum of $500.
	3	13.50.050.A- Fee is collected when any construction project on any lot, parcel or tract of land increases the area of impermeable surface by at least 1000 s.f.	20	Drainage fees are as per the schedule adopted by the Board of County Commissioners. As identified for applicable Drainage Basin.				
	3	13.50.060.A- Stormwater monthly user charge, tabulated with monthly water and sewer charges. $2 per month for first 3000 sf and an additional $0.67 for each additional 1000 s.f. of impervious surface rounded to nearest 1000 s.f.	32	Drainage basin fees shall be paid at the time of recording the plat. Drainage basin fees are calculated on a per impervious acre basis for residential and for non-residential subdivisions regardless of the size of the lots.				
			32	If a drainage fee is considered not to be roughly proportional both in nature and extent to the impact of the proposed use or development of property in the County, the person or entity responsible for paying the established fee may prepare, at their expense, a Drainage Basin Planning Study. If such study is prepared pursuant to DOT criteria and demonstrates by standard engineering methods, that the existing fee is substantially in excess of the impact of the proposed use or development, the DOT shall request that the Board of County Commissioners amend the attached schedules to more accurately reflect the impact of the proposed use or development of the property in the County.				
			32	Credits and/or reimbursements are handled as follows: A subdivision which has no requirements to construct reimbursable drainage facilities pays cash drainage basin fees at the time of recording the final plat. When the cost for reimbursable drainage facilities is less than the drainage fees for a subdivision, the amount of the engineers cost estimate is subtracted from the fees due to obtain the balance due in cash at the time of recording the plat. When the engineer's cost estimate for providing reimbursable drainage facilities is greater than the drainage fees due for a subdivision, no cash fees are paid at the time of recording the plat. Actual costs of the facilities in excess of the fees due are eligible for credit or reimbursement from the drainage basin fund as funds become available.				
			32	A fee reduction of 25% for those portions of developments that consist entirely of 2.5 acre and larger lots.				
			32	If DOT determines that the use of the Prudent Line is appropriate in a proposed use or development of property in the County, a fee reduction up to the total fee for the land required by the County to be dedicated for the Prudent Line. If reduction exceeds the total fee, the remainder of the credit will be paid by the County when the basin account has sufficient funds to do so.				
			32	Additional fee reductions include: 50% of reasonable construction cost of small on-site detention ponds (less than 15 ac-ft), 100% of the reasonable land and construction cost of large on-site ponds that are either required facilities in a Drainage Basin Planning Study, 100% of the reasonable land and construction cost of other regional facilities that are identified as reimbursable in a Drainage Basin Planning Study, 100% of the cost of approved Drainage Basin Planning Studies will be eligible for credits or reimbursements.				
			32	Drainage basin fees vary from $0 to $15,000 per Impervious Acre depending on the basin.				
Grading (cont.)	6	Section 18.41.020- Permits and grading plans are required for any land disturbing activity of areas greater than 7500 s.f. without first obtaining a grading permit. Grading plan must be approved by the City of Woodland Park.	20	Chapter V, C: Subdivision grading adjacent to existing development shall not produce severe changes in grade. Utility and drainage easements shall be modified as necessary to produce a usable and desirable transition between developments. Beyond the easement area, lot grades in excess of 4:1 shall in all cases be terraced or otherwise permanently stabilized. All lots shall be graded such that all structures are protected from the 100-year storm. In all cases lots shall be graded away from structures. Any disturbance to approved grading shall be promptly restored by and at the expense of the responsible party. Guarantees for drainage and erosion control shall not be released until associated permanent site grading is completed and stabilized as required by the drainage and erosion control plan.	21, 24	16.56.030 and GES-III-Erosion: When possible, developments should consider fitting the buildings and streets to the natural topography. Slopes greater than 3:1 are undesirable, while slopes of 6:1 are the most desirable.	13	GR-10 Grading- Grading of Natural Features- When subdividing. In the layout of streets and blocks, natural features such as drainage-ways, rock formations, soil, vegetation, and topography shall be preserved as much as possible.

	State/Federal Laws and Regulations	Applicable Code Citations	Source	City of Colorado Springs	Source	City of Fountain	Source	Town of Green Mountain Falls
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes)	22	7.3.504- Hillside Overlay- No land shall be subdivided, graded, or otherwise disturbed for purposes of development, or any other purpose until the plans for grading, erosion and stormwater quality control are approved by the Manager and the City Engineer.			18	16-714-g- All facilities, vegetation and other items required by the approved grading erosion control plan shall be properly maintained by the owners of the property. This obligation to maintain shall not apply to individual lots except as the individual lots may be subject to maintenance obligations incurred under the approved grading, erosion control and reclamation plan.
		Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning)	22	7.7.1501- Purpose: The intent is to require persons who engage in grading or who have grading undertaken to accomplish the grading in a safe manner and with the appropriate erosion and stormwater quality controls and Best Management Practices (BMPs) so that grading does not result in adverse effects to persons or property, or both.				
			19	3.0-When site grading precedes final development, a Grading Plan and an Erosion and Stormwater Quality Control Plan must be submitted. This plan may have to be modified at the time a final site development plan is prepared. This modified plan must be submitted for review concurrent with the development plan, or prior to final plat approval (if no development plan required), or prior to approval of a building permit (existing platted lots).				
Easements		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes); Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning) Title 31, Article 35 Colorado Statutes (Water and Sewage), Part 3 (Water Mains and Other Improvements – Cities and Towns); Title 38, Article 30.5 Colorado Statutes (Conservation Easements)			34	Drainage easements on platted lots.		
Required Improvements		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes); Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning); Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Sections 30-28-106 (Adoption of Master Plan – Contents), 30-28-107 (Surveys and Studies), 30-28-133 (Subdivision Regulations); Title 30, Article 23 Colorado Statutes (Planning and Zoning), Section 31-23-107 (Public						
Misc.	National Environmental Policy Act of 1969	U.S.C. Title 42, Chapter 55 (NEPA)	22	7.7.908: CITY RESPONSIBLE FOR ACCEPTED FACILITIES: All drainage facilities and appurtenances constructed or provided under this Part and designated by the City Engineer as public drainage facilities with public maintenance, shall upon written acceptance by the City become the property of the City and the City shall be responsible for the operation and maintenance of the facilities.			18	Hillside Development- Grading/erosion control/reclamation plan shall minimize terrain disturbance and to restore and stabilize those areas which are disturbed. Plan must be submitted and approved prior to land being subdivided, graded, or disturbed for any other purpose. Plan shall state in detail how each type of restoration situation will be handled per specific situation.
		Title 40 CFR, Part 1501 (NEPA and Agency Planning), 1502 (Environmental Impact Statement), 1505 (NEPA and Agency Decisionmaking)						
Street Design		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes); Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning);			1	City of Fountain follows Ciyt of Colorado/ El Paso County Standard Specfications and Construction Standards.		
		Title 30, Article 28 Colorado Statutes (County Planning and Building Codes), Sections 30-28-106 (Adoption of Master Plan – Contents), 30-28-107 (Surveys and Studies), 30-28-133 (Subdivision Regulations); Title 30, Article 23 Colorado Statutes (Planning and Zoning), Section 31-23-107 (Public Property Dedicated)						
Construction	Effluent Limitation Guidelines and New Source Performance Standards for Construction and Development (proposed rule at FR 67, No. 121, June 24, 2002)	Title 30, Article 28 Colorado Statutes (County Planning and Building Codes); Title 31, Article 23 Colorado Statutes (Municipal Planning and Zoning)						

	Source	City of Manitou Springs	Source	Town of Monument	Source	Town of Palmer Lake	Source	City of Pueblo
					9	15.50.100- In computing the "average slope" for any parcel placed in the District, any "average slope" not meeting the requirements of this Ordinance will be disregarded if the lot owner creates a Conservation Easement in favor of the Town as contemplated by Title 38, Article 30.5 of the Colorad Revised Statutes. Said easement remains the sole responsibility of the property owner.		
Easements	12	16.22.030- Drainage Easements- Where a subdivisions is traversed by a watercourse, drainageway, channel, or stream there shall be provided a storm water easement or drainage right-of-way of such width as to be adequate for both water flow and maintenance operation.					17	4.5- Easement Requirements. Single storm sewers shall have a minimum width of 20-feet. Open channel easements shall be wide enough to contain flood flows, freeboard, and associated facilities plus a 12-feet wide vehicular access adjacent to the channel as per Appendix A-33.
							17	4.5.D- Detention Ponds- as required to contain storage, freeboard, and associated facilities plus 12-feet wide vehicular access around perimeter and to the nearest public ROW.
Required Improvements	12	16.24.030- Required Improvements- Storm drainage shall be provided for the development by the subdivider based on plans submitted and approved by the City Engineer. A storm of 100-year return frequency of 6 hours duration shall be used as the design and installation of any storm drainage improvement. The developer shall install all storm drainage improvements required per any drainage plan and report. Developer shall ensure that all lots drain away form any proposed structures and that such drainage does not interfere with other structures in adjoining or other lots in the subdivision.						1
Misc.	12	16.30.010-If proposed street, or its construction, will, in the opinion of the City Engineer, threaten landslides or rockslides from the street or areas adjacent to then the application will be denied unless the applicant present a prevention plan for such event. If plan is approved then a surety bond will be required by City and will be an amount and time period set by Planning Director.						
Street Design	12	16.32.010- Streets will be designed to carry the5-year runoff within the street section. The 100-year runoff shall be analyzed and the one hundred-year flood level shall not inundate any floor elevation.						
Construction	12	16.32.010- City will inspect drainage facilities one year after completion, if facilities are deemed acceptable then improvements will be incorporated into the City Drainage System.						

	Source	City of Woodland Park	Source	El Paso County	Source	Pueblo County	Source	Teller County
			20	Chapter V, C: Grading permit is required issued by the County Engineer. The Board of County Commissioners must approve the preliminary plan prior to grading permit to be issued. Grading and Erosion Control plan has met all requirements of County Criteria. Applicant must complete and submit "Grading Permit Acknowledgment Form".			13	GR-10-2 Grading for Streets- in a PUD. All manufactured slopes, other than those constructed in rock, shall be planted or otherwise protected from the effects of storm runoff erosion and shall be of such a character so as to cause the slope to blend with the surrounding terrain and development. The developer shall provide for the maintenance of the planting until growth is established.
							13	SL-10- Slope Any construction in the A-1 zone, on slopes that are 30% or greater, will require a conditional use permit from the Planning Commission. RR, R1, R1M, R2 Zones. When slopes exceed 29%, no development is permitted except in Planned Unit Developments where individual building and waste disposa sites plus safe, convenient, and smooth access by conventional vehicle can be provided. If slopes exceed 29% then maximum density is one unit per 5 acres.
Easements			20	Chapter V, Section 49.2 If a subdivision is traversed by a water course, drainageway, or channel, the storm water or drainage right-of-way (easement) shall conform to the lines of such water course and shall be of such width and construction as may be necessary to provide adequate storm water drainage and to provide access to and maintenance thereof. The minimum standard for identification of the drainage channel shall be the 100-year Floodplain. Drainage channels should be left in a natural state unless channelization is recommended by the El Paso County Engineer.			13	EA-10-1 and 5.2.A- Drainage Easements-When Subdividing: Where a subdivision is traversed by a water course, drainage way, channel, or stream, there shall be provided a storm water easement or drainage right-of-way of such width as will be adequate for both water flow and maintenance operations. Minimum width shall be 10-feet.
Required Improvements								
Misc.			33	Goal 11.3 Promote the planning and design of drainage facilities which maximize on-site amenities while minimizing detrimental downstream erosion. Policy 11.3.1 Where feasible, support the use of natural or naturalistic drainage approaches rather than hard line solutions. Policy 11.3.2 When possible, safely design and incorporate drainage facilities as an aesthetic element within developments. Policy 11.3.3 Fully evaluate the relative impact of proposed drainage improvements on the maintenance of water quality. Policy 11.3.4 Promote the effective use of innovative short and long term strategies including sediment ponds, buffer strips and constructed wetlands as a means of reducing peak flows and improving storm water quality. Policy 11.3.5 Protect the integrity of wetlands, riparian areas and associated wildlife habitat through a combination of careful land development and drainage system design.	23	Section 16, part h: Where non-County maintenance is proposed for roads, facilities, etc. The applicant shall submit for review and approval a maintenance plan for such facilities.		
			33	C. Drainage Basin Plans and Studies In El Paso County 1. Drainage Basin Master Plan (1984) 2. Windmill Gulch Master Drainage Plan (1985) 3. Black Squirrel Creek Drainage Basin Planning Study (1989) 4. Drainage Basin Delineation and Naming Study (1986) 5. Middle Tributary Drainage Basin Planning Study (1987) 6. Monument Branch Drainage Basin Planning Study (1987) 7. Little Johnson/ Security Drainage Basin Planning Study (1988) 8. Pine Creek Drainage Basin Planning Study (1988) 9. Updated Drainage Basin Identification and Fee Estimation (1988) 10. Black Forest Drainage Basin Planning Study (1989) 11. Big Johnson Drainage Basin Planning Study (1991) 12. Windmill Gulch Drainage Basin Planning Study (1991) 13. Fishers Canyon Drainage Basin Planning Study (1991) 14. Big Johnson/ Crews Gulch Drainage Basin Planning Study (1991) 15. Cottonwood Creek Drainage Basin Planning Study (1992) 16. Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study (1993) 17. Sand Creek Drainage Basin Planning Study (1996)				
Street Design					23	Section 30, part h: Off-Street Parking Standards, Drainage: Off-street parking areas shall be constructed in a manner to insure the drainage of stormwater, therefrom, without flooding or damage to surrounding properties or public roads. Temporary water ponding is allowable if part of a drainage detention system approved by the Public Works Director or part of a subdivision's approved drainage plan.	14	Appendix G- Street flows. Streets shall have limited use as a waterway for storm runoff with flow capacities in quantities as approved by County Engineer.
					24	Section XII: Mountain Subdivisions: Part 1: Proper drainage and necessary culverts as approved by the Public Works director or a professional engineer employed or contracted by the county.		
Construction								

Appendix G
Fountain Creek Watershed Activity Matrix

Project Title	Project Type(s)	Sponsoring Agency/Jurisdictional Influence	Description Of Activity	Goal of Activity	Time Line	Funding Source and Budget Cost
Regional Projects						
Fountain Creek Watershed Planning Group						
Fountain Creek Watershed Plan - Phase I	Watershed Management and Education, outreach and communications	Fountain Creek Watershed Planning Group (Rich Muzzy 719-471-7080). Study encompasses entire Fountain Creek Watershed. Report available at PPACG or at www.fountain-crk.org.	Develop a comprehensive regional plan that will provide a coordinated approach to identify, discuss, and prioritize critical concerns regarding protection of the watershed.	Develop a watershed plan that will identify and prioritize watershed issues, develop and review existing technical and policy strategies.	Three year project (2000-2003), Phase I completed December 2001	Colorado State Soil Conservation Board $96,000 and EPA Grant $110,000
Fountain Creek Watershed Plan - Phase II	Economic impact and Watershed management	Fountain Creek Watershed Planning Group/Entire Watershed	Summary of regulations and ordinances for cities/towns and counties in the watershed, that affect stormwater management, erosion control and floodplain restrictions. Activity Matrix	Determine possible common policies between jurisdictional entities, unique policy, and how policies could be improved in the future.	Dec-02	310 Grant
Fountain Creek Watershed Plan - Phase III	Economic impact and Watershed management	Fountain Creek Watershed Planning Group/Entire Watershed. For more information, contact Rich Muzzy at 719-471-7080 x109.	Incorporate all information into Fountain Creek Watershed Plan - GIS activities; expand on Technical and Policy Strategies; Conclusions and recommendations; prioritization of problem areas.	Provide guidance on the problems and issues causing flooding and erosion, improve current management practices and policies, and develop implementation strategies. The management plan will consist of four main sections: Introduction; Technical and Policy Tools; Technical and Policy Strategies; and Conclusions and Recommendations This will be developed from a regional perspective and incorporate the concerns and planning issues of all three counties and eight cities/towns within the watershed.	Sep-03	319 Grant - total $109,400 (not including in-kind). About $50,000 for development of the Plan.
Aerial Photography Analysis	Erosion, sedimentation and hydrology	Project impact (Haley Rich) and Colorado Water Conservation Board (Brain Hyde). For more information contact Rich Muzzy (719-471-7080 x109)	Four sections will be analyzed: 1) Jimmy Camp Creek from Fontaine Blvd. to Link rd. 2) Cottonwood Ck. from Union Blvd. to I-25 3) Black Forest Drainage Basin from Detention Pond to Monument ck. 4) Monument ck from confluence of N and S Mon ck to outlet of Monument ck dam	The information generated through this project will provide the basis to identify the historical and present meander patterns of the creek. This will be important because it will help determine specific portions of the stream corridors where major transportation features should be located, places where building would be ill-advised, and areas of historic and current bank erosion. This will also help determine the temporal stability of stream sections.	Jun-03	Project Impact - $25,000 and CWCB Severance Tax - $17,000
Fountain Creek Watershed GIS Database	GIS	Colorado Water Conservation Board (CWCB) Fountain Creek Watershed Planning Group. Study encompasses entire Fountain Creek Watershed. Report available at PPACG.	Development of a GIS database - collection and consolidation of GIS Resources in the watershed and analysis of two critical areas in the mainstem of Fountain Creek. Aerial photos from 1955 and 1999 purchased for mainstem of Fountain Creek.	Development of a GIS database - include collection of existing GIS resources and aerial photo analysis of sections of mainstem of Fountain Creek	Developed August 2001	CWCB Severance Tax funding - $50,000
Army Corps of Engineers						
Army Corps of Engineers Reconnaissance Study	Erosion, sedimentation and hydrology and Watershed Management	Army Corps of Engineers (Kris Schafer - 505-342-3201) and Fountain Creek Watershed Planning Group Study encompasses entire Fountain Creek Watershed. More information - www.fountain-crk.org	Reconnaissance Study, Phase I Investigation, and recommendation for Corps' Watershed Study.	Develop project study plan to include schedule and cost of Watershed Study; Review and update old Fountain Creek Study; Re-affirm Federal interest and Economic justification; and Execute Cost sharing agreement.	Completed Feb 2002	Reconnaissance Study 100% Federally funded -$100,000 and Watershed Study 50% - Federal 50% - State/Local cost share
Army Corps of Engineers Watershed Study	Erosion, sedimentation and hydrology	All eleven local government in the watershed will be participating; City of Colorado Springs is the lead local sponsor.	For updated project memos, including Scope of Work and Cost share, see www.fountain-crk.org	The main items in the Scope of Work include: aerial photography and GIS mapping; environmental and cultural resource studies; hydrology, hydraulics, erosion and sedimentation analysis; and identification and prioritization of potential "spin-off" watershed improvement projects.	March 2003 - March 2006	Total cost - 3 million - cost split 50%- Federal govt and 50% State/local govts. CWCB and DOLA each contributing $300,000.

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Project Title	Project Type(s)	Sponsoring Agency/Jurisdictional Influence	Description Of Activity	Goal of Activity	Time Line	Funding Source and Budget Cost
Post Flood Assessment Report, September 1999	Education, outreach and communications	U.S. Army Corps of Engineers. Report available at PPACG	Assessment on April- May 1999 of flood in Arkansas River and its tributaries (which includes information on Fountain Creek flood damage).	Document the April 29 flood event, past flood history and flood management performance within the Arkansas River Watershed at Pueblo, and Monument Creek ……. This report also addresses deficiencies and makes recommendations for improvements.	Study completed and published September 15, 1999	Corps of Engineers
USGS						
Evaluation of Water Quality, Suspended Sediment, and Stream Morphology with an emphasis on Effects of Stormwater on Fountain and Monument Creek Basins, Colorado Springs and vicinity, Colorado , 1981-2001. (WRIR 02-4104)	Erosion, sedimentation and hydrology **and** Watershed Management	USGS (contact Pat Edelmann - 544-7155). Report available at http://co.water.usgs.gov/Pubs/index.html#WRI	This report document water quality and suspended sediment with an emphasis on evaluating effects of stormflow on the Fountain Creek Basin in the vicinity of Colorado Springs. Water quality data collected at 11 sites from 1981 to 2001 were used to evaluate the effects of stormflow on water quality. Suspended sediment data collected at 7 sites from 1998 to 2001 were used to evaluate the effects of stormflow on suspended sediment concentrations, discharges and yields. Data were separated into 3 flow regimes: base flow, normal flow and storm flow.	Evaluate Water Quality, Suspended Sediment and Stream Morphology (see description of activity).	Completed October 2002	USGS
Summary of Water Quality Data, October 1987 through September 1997, for Fountain and Monument Creeks, El Paso and Pueblo Counties, Colorado	Erosion, sedimentation and hydrology **and** Watershed Management	USGS (contact Pat Edelmann - 544-7155). Report available at http://co.water.usgs.gov/Pubs/index.html#WRI	Comparisons of various water quality data, from 1987 to 1997, was made to in-stream regulatory standards. Nonparametric tests to quantitatively detect monotonic trends indicate that many water quality parameters do not have significant monotonic trends ; detected trends were mostly downward.	Water quality data from 11 stations on Fountain and Monument Creeks, for the period October 1987 Through September 1992 and October 1992 through September 1997. Data was evaluated for temporal and spatial trends for these two periods.	Completed 2000	USGS
Trends in Precipitation and Streamflow and Changes in Stream Morphology in the Fountain Creek Watershed, Colorado 1939-99 (WRIR 00-4130)	Erosion, sedimentation and hydrology	USGS, Turkey Creek and Central Soil Conservation District, Pueblo County. Report available at http://co.water.usgs.gov/Pubs/index.html#WRI	Provide data and statistical information to those responsible for watershed management.	Evaluate trends in streamflow of Fountain and Monument Creeks; Evaluate trends in precipitation in or near the Fountain Creek drainage basin; and Evaluate changes in channel erosion and shape for the Fountain Creek Drainage Basin.	Completed - December 2000	USGS, Turkey Creek SCD
Fountain Creek Water Quality Monitoring Network	Water Quality	US Geological Survey (Pat Edelmann 544-7155) and Colorado Springs Utilities(Carol Baker - 668-8699 and Vicki Card) and City of Colorado Springs -- Public Works (Lisa Ross - 385-5064). For monitoring network locations: http://co.waterdata.usgs.gov/nwis/current/?type=flow&group_key=huc_cd	Collection of physical, chemical, and biological data at selected sites throughout the Fountain Creek watershed. The "Municipal Stormwater Discharge Permit Monitoring Network" is a sub-activity of this larger spatial coverage program.	Obtain data for (1) developing discharge permits and associated regulatory requirements; (2) facilitating informed participation in the development/evaluation of emerging regulations, and (3) understanding water quality issues/trends.	On-going	USGS, Colorado Springs Utilities ratepayers, and City of Colorado Springs taxpayers
Other						
Regional Stormwater Services Project	Erosion, sedimentation and hydrology **and** Watershed Management	City of Colorado Springs - Public Works (Bruce Thorson - 385-5054) -El Paso County - Dept. of Trans. (Andre Brackin - 520-6440).	Investigate several organizational structures and fundinng options to address stormwater and flood control, including the City of Colorado Springs. City and County elected officials decided not to continue work on establishing a separate organizational structure or funding mechanism, however, they approved an IGA that outlines a process and procedures for jointly cost-sharing in stormwater and drainage projects.	Provide an organizational structure and funding mechanism for stormwater management and flood control activities by the City of Colorado Springs and El Paso County.	IGA approved in October 2000	City of Colorado Springs taxpayers and El Paso County
City and County of Pueblo Stormwater Project	Erosion, sedimentation and hydrology and water delivery	City of Pueblo- Pueblo County. Looking at possible inclusion in SW District or formation of a stormwater utility.	Are interested in RSSP (above). Possible participation. Evaluating options including formation of a Stormwater Utility.	Provide a dedicated regional organization and funding mechanism for stormwater management and flood control.	2000-2001	District/IGA taxing authority. Prop.tax, sales tax, enterprise, or combination.

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Project Title	Project Type(s)	Sponsoring Agency/Jurisdictional Influence	Description Of Activity	Goal of Activity	Time Line	Funding Source and Budget Cost
April - May 1999 Flood Documentation Report	Education, outreach and communications	Colorado Water Conservation Board (CWCB)/Includes El Paso and Pueblo Counties	Documentation of April-May 1999 flooding in 12 Colorado Counties where Presidential Disasters were declared.	Justify use of FEMA mitigation funds	December 1999 project completion	State and FEMA; total $40,000
Water Quality Management (208) Plan	Education, outreach and communications	PPACG/El Paso, Teller and Park Counties. Executive summary available at http://www.ppacg.org and entire report available at PPACG.	Identify and address wastewater treatment facilities; construction priorities; surface water and groundwater issues; and address issues and strategies associated with nonpoint source pollution.	Address Regional Water Quality issues. Provide guidance to regulatory agencies and recommends strategies to address regional water quality needs.	Completed October 1999. Update in Progress to be completed by October 2003.	604(b) Grant from Colorado Water Quality Control Division
City of Colorado Springs and Colorado Springs Utilities Infrastructure Authority	Water Supply, Wastewater and Stormwater Capital Improvements and Watershed Management	City of Colorado Springs and Colorado Springs Utilities (Todd Dahlberg - 668-4419)	Establish City Infrastructure Authority under Home Rule Powers. This would be used to finance estimated 20-40 year capital needs (Water infrastructure - 500 million, wastewater infrastructure -440 million, and stormwater 410 million).	Mission: To achieve an understanding and mutually acceptable resolution to the issues and concerns relative to meeting the significant Water, Wastewater and Stormwater infrastructure demands of our growing community. Develop/review ends and executive limitation policies concerning regionalization and partnership.	End of second quarter 2000 (report on compilation of suggested changes or additions to Ends or Exec Limit. Policies)	Revenue generating authority
Preble's Jumping Mouse Regional Habitat Conservation Plan	Watershed management	City of Colorado Springs (Lisa Ross - 385-5064), El Paso County (Mike Bonar - 520-6987), Colorado Springs Utilities (Kirsta Scherff-Norris)	Determining and "rating" areas of potential habitat for the PMJMs, determining types and degree of potential impacts, and recommending BMPs to limit impacts and preserve habitat	Obtaining a "Section 10" Permit under the Endangered Species Act that would allow local control, administration, monitoring and management of land use requirements to preserve the PMJM	1998 - 2004	Colorado Dept. of Natural Resources, City of Colorado Springs, Colorado Springs Utilities, El Paso County. All General Fund
Fountain Creek Flood Hydrology	Watershed Management	Army Corps of Engineers - Alb. District Office (Bruce Beach and Mike Velasquez) and Colorado Water Conservation Board (Tom Browning and Brain Hyde). Would extend from the northern end of El paso County to Pueblo County and west of Teller County.	Use paleohydrology information and other technical information to revise preliminary flood frequency analysis work performed by Mike V.	Conduct a detailed hydrologic analysis of Monument and Fountain Creeks - use results of Bob Garrett's (USGS) field work on paleohydrology in combination with flood frequency analysis work by the Alb Corps of Eng. In the future, this hydrology could be used to perform a new hydraulic analysis to remap the floodplains for Fountain and Monument Creeks depending on the availability of funding from FEMA.	To be completed by 1/1/2003	Corps of Engineers - $70,000 + $15,000 from CWCB
Storage Study Phase II - Preferred Storage Options	Watershed Delivery	Southeast Colorado Water Conservation District (Steve Arveschoug -- 719-544-2040). For more information and a copy of the report: http://www.secwcd.org/Current.htm	Storage Study Committee of the Storage Needs Assessment Enterprise is developing a plan to develop storage for future agriculture and municipal needs.	Group must find a way to provide for 173,100 acre-feet of additional storage in the Arkansas River Basin. Six possible options: Fry-Ark project Reoperation; Turquoise Reservoir, Pueblo Reservoir, or Lake Meredith Enlargement; Gravel Lake Storage, and non-structural alternatives.	Winter 2000	Over 30 local water user groups, federal and state resource agencies and recreation groups.
Union Park reservoir and pipeline	Water Delivery	Arapahoe County/El Paso County. Many counties or cities that could add later.	Divert water from Taylor and Gunnison rivers and hold on a high altitude (10,000 ft) reservoir 900,000 acre-ft. Cost is about 1.5 billion.	Increase supply for County residents, reduce groundwater depletion.	Under litigation	
Local Projects						
Jimmy Camp Drainage Study	Hydrology, Erosion and Sedimentation	City of Fountain	Study of drainagein the 100 year flood basin of Jimmy Camp	Support drainage fees and improvemetns	Mar-03	Impact fees
Jimmy Camp Environmental Study	Environmental Analysis	Colorado Open Lands	Study of plants, animals, etc. in the Jimmy Camp Basin	Support protection of area	Mar-03	EPA
Design and Repair of Monument Lake Dam	Economic Impact	Seeking a sponsoring agency/El Paso County and Town of Monument - Betty Konarski (481-2769).	Seeking funding to fix deficiencies identified in Monument Lake Dam to ensure present and future public safety.	Fix deficiencies of the Monument Lake Dam: Deteriorated outlet works; absence of outlet energy dissipating structure; spillway capacity inadequate; and unacceptable tree growth on dam embankment.	Seeking funding	Approximately 1,862,000
Woodland Park Drainage Project	Erosion, sedimentation and hydrology	City of Woodland Park (David Buttery, 687-5213). Affects downstream entities.	Bank stabilization using rip-rap bottom stacked boulder wall, and a concrete box culvert.	Stream stabilization to mitigate stream bank erosion, bank instability, and channel sedimentation along the portion of Fountain Creek that is inside the City of Woodland Park.	In-progress, completion: Oct/Nov. 1999	Stormwater capital fees and monthly drainage fees

Appendix G
Fountain Creek Watershed Activity Matrix

Project Title	Project Type(s)	Sponsoring Agency/Jurisdictional Influence	Description Of Activity	Goal of Activity	Time Line	Funding Source and Budget Cost
Streamside Protection Overlay Zone Project	Economic impact and Water Quality	City of Colorado Springs -- Planning Group (Gary Park 385-5091). Project within City of CS limits. For more information: http://www.springsgov.com/Page.asp?NavID=1167	This ordinance will establish jurisdictional limits, application processes, physical standards, suitable land uses and qualitative review criteria for development of the streams within the City. Developing an Ordinance for a Streamside Overlay Zone along all streams with FEMA-designated Floodplains and developing an accompanying Design Criteria Manual	Create a buffer zone around the creek to better control future development within 200 feet of the top of bank or the 500 year floodplain. This ordinance is still in its draft stage; a public review is being completed	Final Ordinance: December 2002	- City of Colorado Springs General Fund (City Property Tax)
Colorado Springs Utilities Jimmy Camp Creek Wastewater Treatment Plant	Wastewater Treatment Plant	Colorado Springs Utilities				
Colorado Springs Utilities Northern Wastewater Treatment Facility	Wastewater Treatment Plant	Colorado Springs Utilities	The NWRF is a new, phased-construction advanced wastewater treatment facility. The facility will treat 20 mgd initially and 30 mgd at final buildout. The NWRF will be located near Pikeview Reservoir at Garden of the Gods Road and Mark Dabling Boulevard and will serve existing and future customers in northern Colorado Springs. Colorado Springs has grown dramatically in the past 50 years, along with the size of CSU's service area.	The NWRF is part of the Wastewater Infrastructure Strategic Plan (WISP), which is an integrated plan to identify wastewater management requirements through the year 2040.	Completed and on-line 2004	
Fountain Creek Watershed Signs	Education, outreach and communications	City of Colorado Springs (Lisa Ross - 385-5064) and City of Woodland Park (David Buttery - 687-5213)	70 signs were installed at 35 locations (one in each direction) in the City of Colorado Springs. Each sign specifies the creek crossing and Fountain Creek Watershed.	Public education	Completed 2002	City of Colorado Springs
BMP Manual	Watershed Management	City of Colorado Springs				
El Paso County Land Development Code and Engineering Criteria Revisions.	Economic impact **and** Watershed Management	El Paso County	EPC to advertise request for proposals by end of 99.	Provide specific criteria revisions for development in the County. Includes provisions for drainage and flood control.	1999-2000.	El Paso County
Confluence Park (northeast of Cimarron Street's intersection with I-25)	Erosion, sedimentation and hydrology	City of Colorado Springs	City Park at the confluence of Fountain Creek and Monument Creek. In the preliminary planning stages.	Stream stabilization, park development, urban renewal.	Phase 1 expected to begin construction in summer of 2001.	Initially 11.5 million approved during 1999 SCIP process.
Kettle Creek Hydrology Study	Erosion, sedimentation and hydrology	USAFA contracted out w/ URS Corporation (for copy of report contact Graham Thompson - 533-7872)	Extensive topography, photography, soils, and existing and future land use data was collected to construct a GIS-based hydrologic, hydraulic and erosion models of the Kettle Creek Watershed. The project also included field investigations to assess PMJM habitat, wetlands habitat, stream morphology and to identify sediment sources.	Recommendations included: 1) installation, inspection and maintenance of construction BMPs throughout the watershed; 2) establishment of a channel buffer zone to moderate sediment delivery and diminish return flows; 3) use of off channel detention ponds to preclude increased peak flows and sediment delivery.	Completed October 2002	USAFA

Appendix H
Army Corps of Engineers Watershed Study Scope of Work

Table of Contents:

Fountain Creek Watershed Study
Synopsis of Project Scope

This scope of work and cost estimate describes the work to be accomplished under the Fountain Creek Watershed Study. Both have been prepared in coordination with the local sponsor, the City of Colorado Springs, as well as other stakeholders in the basin.

Under authority of a House Resolution adopted on September 23, 1976, the Albuquerque District prepared an expedited reconnaissance report in accordance with section 905(b) of the Water Resources Development Act of 1986. The purpose of the report was to determine if there is a Federal interest in participating in cost shared feasibility level studies of water resource problems and opportunities in the Fountain Creek Watershed. The report was initiated on March 1, 2001, and submitted on October 16, 2001, with the recommendation that further feasibility level studies be pursued. The reconnaissance report was approved on November 7, 2001, with the stipulation that the District conduct the study as a watershed study.

As a watershed study, the associated report is not intended to be a decision document. That is, it is not intended to recommend, or serve as the basis for authorizing a specific project. The primary goal is to develop the study from a regional perspective in which all local participating governments benefit by "spinning off" projects under other authorities to address flood control, erosion, sedimentation and environmental restoration problems. The planning process and key objectives of the study include:

- Incorporate public input and involvement
- Assess watershed characteristics and conditions
- Outline watershed issues/concerns with erosion/sedimentation as a key component
- Analyze watershed issues/concerns (using GIS where practical and information available)
- Develop, evaluate and prioritize conceptual alternatives including structural and non-structural measures
- Spin-off projects under other authorities as appropriate throughout the study
- Complete watershed plan and final report

Major tasks and activities include:

First, the study will define, and evaluate existing conditions in the watershed. This will be accomplished primarily through comprehensive hydrologic, hydraulic, and geomorphic modeling. Additionally, environmental studies will be performed in order to characterize the basin, and to develop the baseline data for any potential NEPA processes associated with future projects done in the watershed. Other work will consist of a preliminary economic evaluation, geotechnical sampling to support the sediment evaluation, analysis of existing data, preliminary identification of utilities, infrastructure, and other constraints, real estate evaluation, and public involvement. The use of GIS mapping and analysis will be an important tool in these work activities, subject to the availability of information and required level of effort. Possible areas for GIS mapping/analysis include: soils, geology, channel stability/instability, sediment

generation/deposition, flood hazards, infrastructure/buildings/property, habitat, wetlands, land use, corridor vegetation, etc.

Second, once existing conditions are analyzed, the study will attempt to identify, and prioritize remedial projects, both structural and non-structural, which address flood control, erosion, sedimentation, and environmental restoration in the basin. The non-structural measures will include those that may enhance overall water quality or reduce water quality impacts. These projects will be developed to a conceptual level of detail so that preliminary cost estimates can be determined in order to establish priorities. Potential projects will also be evaluated as to their eligibility for Federal involvement. It will be the goal of the study team to identify viable projects early, so that they can be pursued via other authorities.

Information revealed, or unforeseen circumstances during the course of the study may be cause to revise the scope of the study. This will be done by mutual agreement between the Corps and the City of Colorado Springs. In addition, there will be several agreed to "checkpoints" whereby representatives of both the Corps and the City will evaluate the progress of the study and, if necessary, take corrective action such as re-establishing milestones, revising scope, or revising cost estimates.

The product of this study will be a watershed study plan and report, addressing approximately 150 miles of Fountain Creek and its tributaries (see Appendix A), and will document the information described above. Organization of the final report will be structured to reflect this watershed plan and study and the overall planning process as noted above. The plan will provide a framework for future work in the basin, and it is hoped that the study will be adopted regionally as the recognized baseline for watershed planning. It is anticipated that the study will take approximately 3 years to complete.

This study will be a cooperative effort between the Corps of Engineers and the City of Colorado Springs as the lead sponsor, along with 10 other local governments in the watershed, the Colorado Water Conservation Board, and the Colorado Department of Local Affairs. As the lead sponsor, the City will be the signatory to the Feasibility Cost Sharing Agreement. The City, in turn, will enter into cost-sharing agreements with the other participating entities in the watershed. Estimated total project costs, including in-kind services to be provided by the City of Colorado Springs, are shown in the "Summary of Costs" table below. The City will also allow appropriate in-kind services from other participating entities and will submit all appropriate in-kind services to the Corps on behalf of the City of Colorado Springs. Upon approval by the Corps, the City will provide the in-kind service credit to the appropriate participating entities. The City, through their designated representative(s), will be an integral part of the project team. They will be party to decisions made regarding the study, reviews, negotiations for engineering and other services, public involvement, and will also provide in-kind services as determined by this scope of work.

I. Aerial Photography, Surveys and Mapping

Scope of Work. New aerial photography and mapping will be required in support of the hydrologic, and geomorphologic modeling, as well as environmental surveys. The new mapping (approximately 60 creek miles as outlined in Appendix A) will supplement existing mapping that is being provided by the City (Colorado Springs Utilities). The City (through Colorado Springs Utilities) will provide the new mapping and will ensure compatibility with their existing mapping as an in-kind service creditable to the City's share of the study. In addition, supplemental ground surveys will be needed to supplement the existing mapping provided by the City. It is estimated that 174 cross sections, 1000 ft. in length, will be needed to accurately perform hydrologic and sediment modeling. Ground surveys will be contracted by the Corps.

II. Hydrology and Hydraulics

Scope of Work. Hydrology, hydraulics and sediment modeling will be done to varying levels of detail depending on stream reach. The individual reaches, and their corresponding levels of analysis are outlined in Appendix A. Peaks and hydrographs for six frequency discharges (5yr, 10yr, 25yr, 50yr, 100yr, 500yr) will be determined by modifying an existing HEC-HMS model, which is currently being prepared for the Fountain Creek Hydrologic Analysis, which is being done by the Corps in cooperation with the Colorado Water Conservation Board. The HEC-HMS model will be created to produce discharge-frequency curves and provide existing conditions of the watershed. Future "without project" aggradation and degradation will be forecasted by calculating sediment transport supply and capacity. Overflow boundaries at critical areas along Fountain Creek and/or its tributaries will be analyzed for existing conditions and "with project" conditions, if applicable. Potential bank erosion will be analyzed and a stable channel design will be provided for all potential alternatives. Each alternative will be analyzed and designed to provide the maximum benefit without jeopardizing engineering integrity. Hydraulic analysis will consist of determining pre-project floodplains and water surface profiles in accordance with Appendix A. Water surface profiles will be computed using the HEC-RAS program. Cross sections will be derived from the digital terrain model using the INROADS program and/or Geo-RAS (ArcView). Cross sections will be supplemented with field measurements and surveying. The Government will select hydraulic loss coefficients during site visits. Future condition without-project floodplains will be based on the results of the stream morphology/sediment transport study. Existing and future baseflow (incl. wastewater discharges and water/irrigation use) conditions will be determined and erosion impacts analyzed. Assumptions for future condition hydrologic and hydraulic analysis will be mutually agreed to by the City and the Corps. These modeling and analysis efforts will be used in conjunction with GIS to enhance study analysis and evaluation of alternatives. Estimated costs for this activity were done using a unit cost per-mile of stream reach based on the level of analysis, which is shown in Appendix A. This activity will be accomplished by the Corps using contract and in-house labor.

III. Geotechnical Studies

Scope of Work. In order to characterize the surficial soils and sediments within the Fountain Creek and its tributaries, the Corps proposes to sample and analyze surface and near-surface soils and sediments. Results of the sampling and analysis will be incorporated into the watershed study report. The Corps and/or its contractor will collect soil and sediment samples to include an initial field/site reconnaissance, followed by collection of samples utilizing simple auger drilling methods. A report will be then generated presenting soils and sediments geotechnical characteristics in tabulated and narrative styles. The results of field reconnaissance, drilling/soil and sediment collection will be utilized to support hydraulic characteristics of the reaches within the Fountain Creek Drainage and its tributaries. The geotechnical data will also be available to support necessary designs, specifically, geotechnical materials requirements (stone, gabions, etc.) and preliminary designs for structures. These recommendations will be included in the final report.

IV. Civil Engineering

Scope of Work. The work will include conceptual development of alternatives identified for possible selection of the remedial projects addressing project purposes identified in the feasibility agreement. The remedial project solutions will be developed and designed by contract to an extent sufficient to arrive at a project cost estimate required for plan formulation and the selection process. Project sketches and pertinent design informations will be presented in an engineering appendix to the watershed study. The appendix will include a narrative of all design features and cost estimates. Structural features will be designed so that a firm estimate of costs can be made based upon unit quantities of materials. Minor features may be estimated on a lump sum basis after determining the size of the feature and comparison of costs of similar features. Estimates of first cost shall be based on current average unit construction price levels and itemized into major unit elements.

V. Economics

Scope of Work. This item will be performed by the Corps and will include the following:

Gather Historical Flood Damage Information
Determine Future Conditions in the Basin
Delineate the Affected Area into Economic/Hydrologic Reaches
Determine Existing Inventory, Project Floodplain Growth
Determine Depth/Damage, Erosion Damage (Existing, and Future)
Determine Economic Feasibility of Proposed Conceptual Plans

Future basin land use will be estimated to insure that project formulation and analysis accounts for flow changes over time (including stormwater runoff and impacts to baseflow from wastewater discharges and water/irrigation use). Changes in land use patterns may impact drainage conditions, which affect project sizing, damages and benefits. The projections will be made using available mapping, examining Federal and State demographic estimates, local master plans, and consulting with local planners. This activity will use information developed by the local sponsor. The "Determine Future Conditions in the Basin" activity is performed to evaluate the impacts of future development to the H&H data applied to the existing structures (as in changes in stage for a given event) or new structures (as in expanded floodplains, infill within existing floodplains). The Corps will use available mapping, demographic estimates, and consultations with local experts to gain a sense of what the Fountain Creek watershed will look like in the future, in terms of number, location and quality of damageable property types. The existing inventory serves as a guideline for valuing that future growth.

To present the report to the public and the Corps' review authorities, a succinct narrative report of the economic evaluations discussed above shall be prepared in accordance with applicable Corps regulations. Documentation of the source material and a display of the results of the economic analysis will be presented.

VI. Real Estate Analysis

Scope of Work. A real estate evaluation will be conducted by the Corps which will provide a gross appraisal of land use and land values that may be affected by proposed implementation projects. The evaluation will be based largely on the review of existing data, including county assessors records, comparable sales, etc. The real estate analysis differs from the economic analysis in that it typically supports the design and cost functions of the study team as they formulate a given alternative's cost , whereas the economic valuation of a given property, per Corps guidance, is the depreciated replacement cost of the improvements, excluding land value. The Corps' Real Estate Division will also provide assistance, if needed, to the City in obtaining any necessary rights of entry required during the prosecution of the watershed study. The real estate evaluation will be presented in the watershed study report.

VII. Environmental Studies

Scope of Work. Environmental work will consist of conducting an inventory of existing natural resources including geology, soils, in-stream biota, wildlife and threatened and endangered species along the 150 miles of river corridor. Review of existing GIS information will be performed. Historical conditions of natural resources will be evaluated including vegetation, in-stream biota, wildlife, and threatened and endangered species. An analysis of the status and trends of wetlands within the watershed will be performed, and a data search will be conducted to determine the amount of wetland acreage that has been lost through filling or converted for other uses such as agriculture

and urban development. In addition, future trends of wetland loss will be estimated. Mapping of vegetation types along creek corridors, including non-native vegetation, esp. Russian olive (*Eleagus angustifolia*) and salt cedar (*Tamarix chinensis*) will be performed. The change in the amount of infrastructure and impervious surfaces, and its impact to the watershed will be evaluated. The use of best management practices in the watershed will be analyzed. The study will include an investigation of wastewater and agricultural return flows, as well as an analysis of agricultural practices within the watershed. When appropriate, this information will be used to prepare GIS maps and conduct GIS analysis. Emphasis will be placed on identifying environmentally sensitive areas which might prevent project development. The Corps' Environmental Branch intends to accomplish the environmental studies task via contract. The environmental studies will be presented as a section of the watershed study report, and will also include a compilation of existing ecosystem restoration projects that have occurred or are planned in the watershed. The estimated costs include contract oversight by the Corps.

VIII. Hazardous and Toxic Waste Studies

Scope of Work. A literature and data search, including available GIS information, will be conducted by the Corps to identify known hazardous, toxic, or radiological waste sites in the study reach. The known sites, if any, will be summarized, and an inventory and possible GIS map of available data (e.g. agency, location, etc.) will be produced for use in further development of implementation projects. Samples taken pursuant to Section III, Geotechnical Studies, will undergo laboratory analysis to test for contaminants. Results of the literature and data search, as well as sampling results, will be summarized and incorporated into the watershed study report. Emphasis will be placed on identifying any HTRW which might prevent project development.

IX. Cultural Resource Studies

Scope of Work. The Corps and/or its contractor will examine existing data to determine the number and location of known archaeological sites including those documented historic properties listed on the State Register and National Register of Historic Places that occur within the watershed. A determination will be made as to areas that have been surveyed for cultural resources and those areas that have not been surveyed. On a general basis, the rate at which new site discoveries are being reported and properties listed will be studied, and an investigation will be done into how natural processes and cultural changes in land-use such as encroachment on watershed streams and development are affecting known sites and cultural properties. The Corps will consult and coordinate data acquisition with the Colorado State Historic Preservation Officer. Results of the analysis and possible GIS mapping will be summarized and incorporated into the watershed study report.

X. Cost Estimates

Scope of Work. The Corps' Cost Engineering Branch will develop very preliminary estimates based on a conceptual level of design for alternatives that are identified in the watershed study. This scope of work assumes up to 10 different project alternatives. Preparation of the estimates will include necessary site visits, construction quantities evaluation, and development of unit cost construction estimates. The draft cost estimates will be revised and finalized, incorporating design refinements and other changes. The estimates will be presented in the watershed study report, including narrative descriptions of the assumptions and methodology used.

XI. Public Involvement

Scope of Work. The responsibility for this task will be shared between the Corps and the Local Sponsor. It is anticipated that some or all of the work will be contracted to a firm which specializes in public involvement. It is also estimated that the City, as well as the other participating entities, will provide in-kind services to this task. Generally, this effort will include developing a public involvement plan; developing a mailing list of all public and private interests, including Federal and State agencies, who will be kept informed of study progress and results; conducting one public workshop which will serve as a scoping meeting; and conducting a final public meeting to present study conclusions. The public workshop will solicit input from local interests as well as concerns to be addressed in the study. Additional public meetings may be held throughout the study as necessary to keep the public informed of the progress. The meetings may be held during the monthly watershed committee meetings. The Fountain Creek Watershed Technical Advisory Committee meetings will be held on a monthly basis, and will be used to brief the status of the watershed study efforts. A final public meeting will be held to present the findings of the study. Oral testimony at the final public meeting as well as written comments received during the public review session will be considered official comments to the draft report. All comments will be addressed and responded to, prior to finalizing the report.

XII. Plan Formulation

Scope of Work. The Corps' project team will include a planner who will be responsible for the overall formulation of study objectives and alternatives, and day-to-day organization and management of the watershed study. The planner will work with the other team members to establish schedules for production and delivery of the various elements of the study. The planner, working with the project manager and the other team members (which includes the local sponsor) will first establish the without-project or "baseline" condition of the watershed. Next, preliminary objectives will be identified, to include opportunities and constraints, which will be defined for Ecosystem Restoration, Sediment Management, Flood Damage Reduction, Erosion Protection, and Recreation (as

part of a multi-use project). Opportunities and constraints to be considered will include utilities, infrastructure, environmental and other items. From this, the team will identify potential structural and non-structural measures for evaluation. The array of potential actions will be evaluated without respect to organizational (Corps) constraints, and will be presented in the findings of the study based on technical and economic feasibility, prioritized based on need, and categorized in accordance with the likelihood of Federal participation. The planner will be responsible for compilation, quality control, and review of the final watershed study report, as well as incorporation of review comments, reproduction, and distribution.

XIII. Report Preparation

Scope of Work. Documentation of study findings and results will be continuous by each organization as work proceeds. The work associated with this task will consist of preparing and reproducing preliminary drafts, a final draft, and the final report on the study. The final report will include a Main Report with appendices, including GIS mapping/analysis. Organization of the final report will be structured to reflect this watershed plan and study and the overall planning process as outlined in the "Synopsis". The Corps and the City will discuss and agree on the specific outline and content of the final report. Preliminary in-progress review reports will be prepared for two checkpoint meetings with the Independent Technical Review Team, and South Pacific Division (SPD). All report completion activities include assembling pertinent data, writing, editing, typing, drafting, revising, reproducing, and distributing the draft watershed plan, related technical appendices, and GIS information. Reproduction of both the draft and final reports will be done via contract. This estimate assumes distribution of both draft and final reports to all stakeholder representatives.

XIV. Technical Review

Scope of Work. All planning documents will be reviewed prior to being finalized. The quality control process will include technical team meetings, meetings with the local sponsor and stakeholders, and Corps in-house technical review. The quality control process will be on-going throughout the study (seamless peer review), but at particular milestones, specific efforts will be made to assess the quality and progress of the study (independent technical/policy review). Corps Independent Technical Review (ITR) guidelines will be followed, including development of a Quality Control Plan. Review teams will be established at the beginning of the study. Completion of specific documents will be identified by specific milestone dates. The Review Team will perform their review at the specific milestones and document each review. A South Pacific Division representative will participate in the initial Review Strategy meeting as part of the Division's quality assurance partnership with the District. Division representatives will, throughout the course of the study, aid in resolving technical issues that cannot be resolved within the District level teams. The estimated cost for this task assumes credit for in-kind review on the part of the City and other local participating entities with the City.

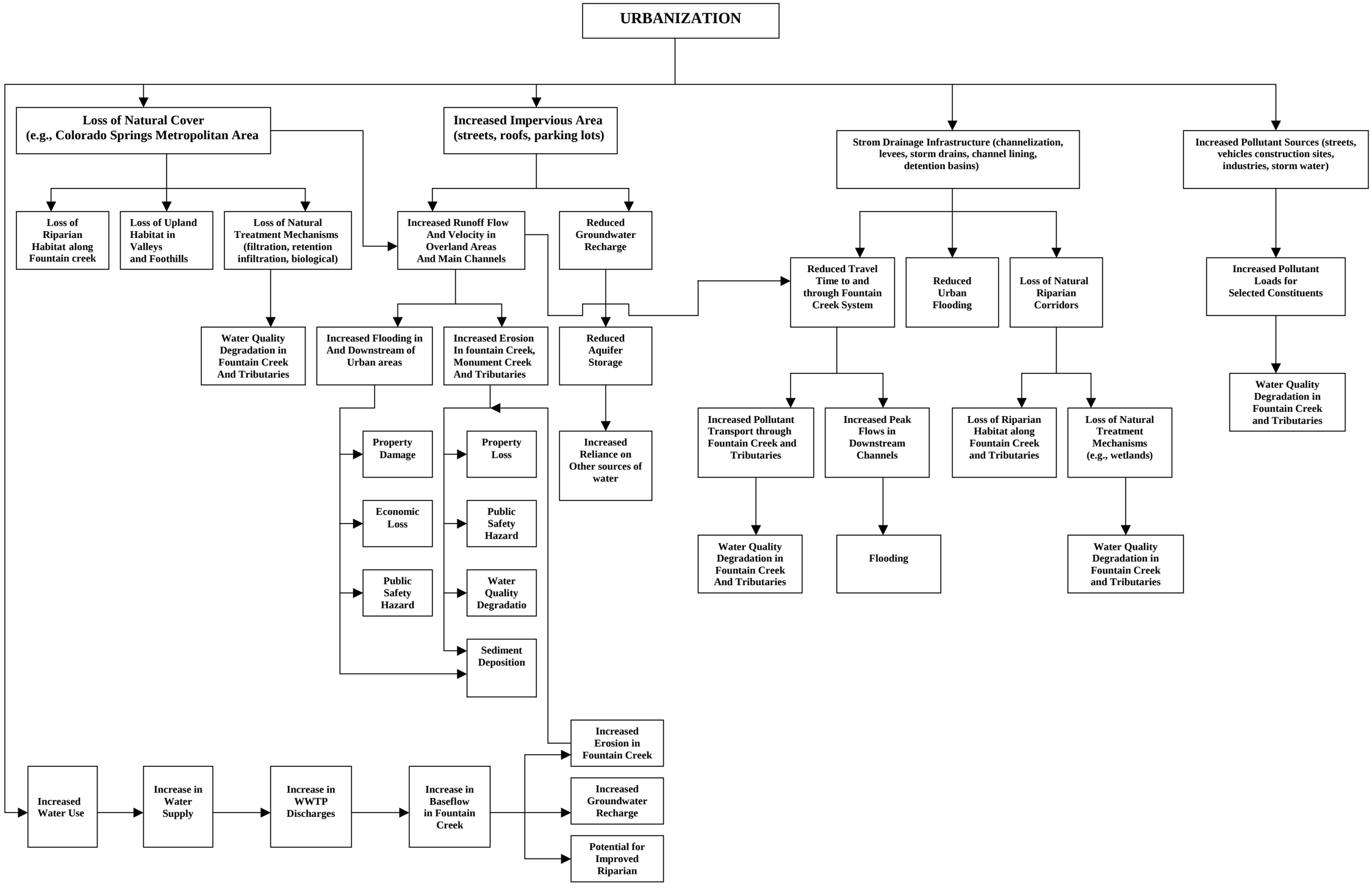
XV. Project Management

Scope of Work. The Corps project manager is responsible for managing the overall study, including cost and schedule through use of the Project Management Information System (PROMIS), preparation of present and future budget year submissions; coordination with the non-Federal sponsor, maintenance of the Project Management Plan, which presents the Federal and non-Federal requirements, costs, and schedule required for implementation of the recommended plan. The Corps project manager, with assistance from the non-Federal project manager (City in-kind services), will monitor expenditures, prepare project management reports as needed, and report study status and issues to the District Engineer.

XVI. Supervision and Administration

a. Scope of Work. This task includes the District-wide supervision and administration overseeing the prosecution of work throughout the study and report preparation. .

Appendix I - Impacts to Fountain Creek Watershed: Causes and Effects



Appendix J

Fountain Creek Watershed Plan
Public Questions, Comments and Responses
Public Comment Period: September 11-October 8, 2003

This document contains a summary of public comments and questions made during the public comment period from September 11 through October 8 for the Fountain Creek Watershed Plan. This document does not attempt to respond to each comment individually; rather, summaries of similar comments are provided and responses given.

All comments were made during the two public meetings, at PPACG's committee meetings or by mail. The two public meetings held for comments were:

- September 24, 2003, Colorado Springs Academy Room, Number in Attendance: 4
- September 29, 2003, Pueblo Probationary Department, Number in Attendance: 16

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1. Under Detention, Part 6.2.2.1, where it is stated that there are no specific Federal or State laws or regulations mandating stormwater detention, three precedential laws regulating stormwater runoff exist.

   Response: This Plan references only existing laws and regulations that specifically discuss stormwater detention. Any laws and regulations that are subject to a legal interpretation to determine their applicability in mandating stormwater detention are not discussed.

2. Under Policy Strategies, Part 6.2.3, flow bulking should be included as a watershed concern that is not addressed by existing policies.

   Response: A bullet was added under Part 6.2.3 entitled "Flow Bulking". The following language was included: "Currently there is no ordinance specifically related to flow bulking. Flow bulking refers to the quantity and size of sediment and may affect the hydrologic analysis of the drainage basin. Bulking transported by storm runoff may significantly increase the volume of flow, affect flow characteristics and can be a major characteristic in the hydraulic design of drainage structures. Bulking factors are typically used in determining design for facilities that are located within mountainous regions subject to fire and subsequent soil erosion".

3. Under Part 6.2.3, Policy Strategies, an inventory should be completed of which structures have not been installed at all, which structures were not installed properly, which are not functioning or have failed entirely, and which drainage basins do not have Drainage Basin Planning Studies.

Response: Included in the Conclusions, Recommendations and Implementation Strategies Section on page 7-3 is a recommendation to develop a prioritized list of critical areas in the Fountain Creek Watershed that have been identified as having erosion, sedimentation and flooding problems. This has also been identified as a component of the Army Corps of Engineers Watershed Study. Solutions will be recommended to mitigate existing and/or avoid future damage. Due to changes in individual drainage basins and information that supersedes the recommendations contained in some of the Drainage Basin Planning Studies, it would be difficult to determine the adequacy of existing and historically proposed structures.

4. The Bibliography is incomplete. Omitted are most "Drainage Basin Planning Study" documents. The Bibliography on pages 9-1 through 9-11 lists only 3 out of the 26 Drainage Basin Planning Studies that were completed in the City of Colorado Springs and only 8 out of the 31 Basins that have been studied in El Paso County.

   Response: The Drainage Basin Planning Studies conducted for the City of Colorado Springs and El Paso County were added to the Bibliography and are also mentioned in the appropriate section of the Fountain Creek Watershed Plan.

5. There were two mistakes in the Bibliography, under listings for 1) Ruddy, B.C. 1987 and 2) Miller, Robert Douglas, 1981.

   Response: These mistakes have been corrected

6. There are three recent documents that should be included in the Bibliography that were developed as part of a court case that has not been resolved.

   Response: Reports and information, not published, and developed for the purpose of litigation will not be included in the Bibliography. Until a judgment is rendered for this case, this information is still subject to legal interpretation.

7. How can we make cities/counties implement the recommendations contained in the Plan? It is important that this Plan be implemented.

   Response: The Fountain Creek Watershed Plan is not regulatory but rather is intended to recommend solutions and strategies that municipalities, counties and other stakeholders can adopt. The endorsement of the Plan by the PPACG and PACOG Boards will help affirm the resources necessary to develop effective solutions. Upon approval by both Boards, PPACG and PACOG will also seek endorsement from each of their member governments in a joint resolution of support. PPACG staff will also be working with representatives from the local governments in implementing the recommendations contained in the Plan.

8. How will the Watershed Plan be integrated into the Army Corps of Engineers Watershed Study?

Response: The information contained in the Plan will be integrated into and serve as a foundation for the Army Corps of Engineers Watershed Study. This includes information on critical area identification, background data (population, geomorphology, flooding), GIS data and stream stability analysis.

9. How is the proposed Southern Delivery System (SDS) being incorporated into the Plan and Army Corps Watershed Study?

   Response: A general description of the SDS is given in the Plan under Section 2.1.6, Municipal Water Supply Development. The Army Corps of Engineers is coordinating with the United States Bureau of Reclamation (Federal sponsor for the SDS) regarding the SDS and information such as the increase in return flows from the SDS is being included in the Watershed Study.

10. Some of the information listed in Section 2.11, Regulatory Programs is redundant with the information contained in Section 6.1, Summary of current State and Federal Regulatory Programs.

    Response: Section 2.11 was deleted and all information not contained already in Section 6.1 was included in Section 6.1.

11. Population projections listed in Table 2-8, under Section 2.10, Population and Socioeconomic Characteristics, should be changed to be consistent with the text and reflect the population just within the watershed boundaries and not outside the watershed.

    Response: Population projections for those cities and counties that are only partially within the watershed were adjusted to reflect the population residing within the boundaries of the watershed.

12. Information listed in Section 6.2.2.1, Common Policies, as being required by CRS needs to be changed to reflect different requirements for counties and municipalities; and some of the information listed as being required by CRS is only voluntary and not mandatory.

    Response: Language in section 6.2.2.1 was changed, where applicable, to reflect different requirements for municipalities and counties regarding stormwater detention and design requirements. Language was also changed to reflect that the CRS, in some instances, gives a grant of authority and it is not a requirement by law.

13. Several comments noted that it was good to see so much cooperation between the municipalities and counties in the watershed and the importance in keeping it up.

    Response: No response necessary.

14. How were the critical areas identified in the Plan determined and will these areas and any additional critical areas be investigated in the ACOE Watershed Study?

    Response: The information contained in the Plan on critical areas was obtained from the technical representatives of the cities and counties, State and Federal agencies, and a review of available reports and studies. All of this information along with other information provided from members of the Technical Advisory Committee was sent to the ACOE.

YEAR	Monthly mean streamflow, in ft3/s											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1959	8.13	8.87	9.93	14.60	14.10	16.60	11.80	10.40	7.57	12.30	8.36	6.37
1960	6.59	7.10	11.20	15.90	17.20	14.20	13.20	7.48	7.42	7.90	6.96	6.48
1961	6.05	4.85	6.14	9.55	10.60	24.30	30.30	27.10	30.30	21.30	10.50	8.47
1962	9.83	7.93	8.27	12.30	14.40	12.60	8.66	7.31	10.20	6.45	6.17	7.77
1963	5.21	5.20	6.26	5.90	7.75	7.01	8.77	11.20	9.56	5.44	7.05	5.64
1964	5.17	4.76	5.21	8.36	8.57	13.70	6.48	13.20	8.58	6.49	4.98	5.75
1965	6.04	4.97	4.91	11.20	18.90	56.60	31.70	60.90	29.80	15.30	13.40	13.90
1966	12.50	9.70	11.20	9.29	10.50	9.89	19.00	25.30	16.30	7.79	7.31	5.23
1967	5.55	5.33	7.45	11.10	13.80	15.90	12.70	21.30	8.37	9.18	9.95	7.74
1968	8.90	6.88	8.85	10.20	9.93	12.90	7.93	24.40	11.40	7.71	5.78	5.06
1969	5.59	6.52	7.92	7.32	33.80	25.50	22.70	15.80	13.00	19.70	13.50	8.73
1970	8.16	8.54	7.58	16.40	23.20	18.30	19.60	13.80	11.30	11.00	9.11	6.71
1971	6.39	6.89	7.88	11.20	18.20	13.20	17.10	13.80	10.50	7.51	10.10	7.26
1972	6.08	4.44	5.88	7.20	7.93	10.20	7.45	7.95	9.13	5.56	6.48	4.76
1973	5.57	5.60	6.47	13.30	87.80	75.60	45.20	24.50	10.90	22.80	18.80	13.30
1974	9.21	9.81	12.90	12.40	9.75	9.21	10.30	5.48	6.30	6.27	5.64	6.04
1975	5.35	4.91	5.39	7.06	11.10	23.30	16.60	6.47	6.58	5.47	6.82	5.95
1976	4.51	5.76	7.28	8.15	8.64	7.16	8.43	20.50	10.20	10.20	7.60	5.75
1977	7.07	7.85	7.66	11.90	10.00	12.10	12.00	9.40	5.95	6.66	7.22	5.71
1978	6.09	5.89	8.82	8.84	9.53	8.11	8.37	7.68	5.00	5.29	5.31	5.82
1979	4.54	4.78	6.75	18.00	21.30	47.20	14.90	9.62	14.10	12.10	10.50	6.92
1980	7.25	7.48	7.64	21.40	172.00	60.80	36.30	17.40	18.90	13.60	11.60	10.20
1981	8.27	7.76	8.54	9.80	9.99	11.50	12.00	21.30	14.90	26.40	15.40	9.28
1982	10.20	8.21	9.17	7.54	15.70	20.60	13.10	18.40	19.50	17.20	10.30	10.50
1983	9.35	10.00	11.80	22.10	71.10	127.00	100.00	38.30	34.00	23.40	19.10	13.50
1984	11.70	9.67	10.50	16.40	45.20	20.10	12.30	37.50	25.90	44.00	34.60	18.80
1985	18.50	13.60	15.20	33.40	104.00	61.90	27.10	24.80	21.40	18.30	15.30	12.80
1986	14.20	13.60	12.80	10.70	10.00	13.50	11.50	11.80	8.70	9.54	10.30	8.95
1987	8.11	11.30	12.90	17.20	30.90	45.60	27.50	14.40	10.20	9.30	8.88	8.02
1988	7.46	7.35	9.30	12.30	13.10	13.80	9.63	11.50	6.93	5.63	8.81	7.05
1989	8.27	7.23	10.40	8.74	6.37	6.69	7.80	7.99	8.12	7.47	5.67	4.14
1990	4.46	4.71	7.55	9.25	14.90	8.39	18.10	19.30	8.07	12.30	6.75	5.64
1991	5.68	5.75	7.53	7.22	8.75	19.30	18.80	25.90	15.70	10.20	11.00	10.30
1992	9.08	8.37	10.60	21.40	17.10	18.10	14.50	16.40	14.50	8.97	16.80	13.80
1993	10.30	10.10	9.80	8.07	9.08	10.20	13.80	11.10	6.52	8.00	6.51	4.42
1994	4.46	6.85	11.00	16.40	78.40	51.40	20.20	13.70	9.57	13.30	9.05	9.38
1995	7.45	7.50	9.26	15.10	105.00	127.00	108.00	31.90	22.80	15.30	15.90	15.90
1996	15.50	10.70	10.20	15.00	21.50	14.10	31.30	25.50	29.80	20.80	11.70	8.43
1997	7.62	7.58	9.32	17.70	59.70	198.00	42.70	56.90	36.10	19.70	22.20	17.70
1998	10.90	12.30	16.90	32.30	66.00	31.20	27.90	46.50	25.60		17.40	15.20
1999	10.50	9.82	7.63	65.10	163.00	66.20	45.00	90.50	43.20	25.70	15.20	16.00
AVERAGE	8.09	7.72	9.07	14.57	33.87	33.15	22.70	21.58	15.19	13.04	11.07	9.01

07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS