City of Boulder, Colorado

June 2009

Water Quality Strategic Plan

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Executive Summary

Boulder Creek is a well-loved recreational, aesthetic and natural asset in the City of Boulder (Boulder). Boulder Creek and its' tributaries are vital for providing drinking water, agricultural irrigation water, aquatic habitat, recreation, and power generation, and water quality determines the suitability of water for most of these uses. Water quality in the Boulder Creek Watershed is affected by natural factors such as geology, climate, and human-caused factors, such as wastewater effluent, runoff from roads and urbanized areas, agricultural practices, and atmospheric contaminants. The relative effect of these factors on water quality has changed over time and will continue to shift as population and urbanization increase and more demands are placed on our water resources. Poor water quality and the destruction of stream habitats can lead to the decline and degradation of this valuable resource and protective measures need to be taken. The Water Quality Strategic Plan (WQSP) outlines actions to protect and preserve Boulder's water resources.

Purpose of the Water Quality Strategic Plan

The WQSP is the first planning effort to address water quality policies and priorities for Boulder. The purpose of the WQSP is to develop clear and concise water quality goals, develop strategies and performance measures to achieve these goals, and provide a process to address current and future water quality challenges.

The WQSP is a five-year plan that supports many of the principles and policies of the Boulder Valley Comprehensive Plan (BVCP). The WQSP is designed to fit within the broader framework of the BVCP, which provides the overall policy direction for planning decisions within the Boulder Valley, including protection of water resources. The WQSP activities will be implemented by the City of Boulder's (City's) Water Quality and Environmental Services (WQES) Group, which is part of the Public Works, Utilities Division.

Water Quality Goals

Water quality goals were developed using an inventory of existing water quality goal statements found in the City's master plans, policies, and regulations, starting with the BVCP. From this exercise, five goal statements were developed and include:

1. Provide safe and high quality drinking water.
2. Manage pollutants from wastewater and other point-sources.
3. Manage pollutants from stormwater and other non-point sources.
4. Protect, preserve and restore natural water systems.
5. Conserve water resources.

Recommendations

The recommendations developed for the WQSP are based primarily on the objective of adopting citywide water quality goals, and integrating these goals into planning and policy instruments. In addition, the recommendations address strategies to meet an unprecedented number of new or proposed federal and state water quality regulations. The recommendations include:

Recommendation 1: Evaluate and update policies in the Boulder Valley Comprehensive Plan to incorporate water quality goals. WQES staff will review and recommend updates to the BVCP to ensure incorporation of water quality goals. The BVCP is scheduled to be updated in 2010.

Recommendation 2: Perform analyses on City plans, policies and projects to identify gaps in meeting water quality goals. WQES staff will review relevant plans, policies, and projects, such as master plans, design and construction standards, and the Boulder Revised Code to: 1) ensure that the City complies with all state and federal laws and regulations on water quality and environmental protections; and, 2) meet water quality goals.

Recommendation 3: Develop annual work plans and water quality reports. Annual work plans and reports will be developed for each of the seven WQES Group programs. These programs include: Stormwater Quality, Water Quality Education, Water Conservation, Industrial Pretreatment, Drinking Water Quality, Water Quality Planning and Laboratory Services. Staff will use the work plans to direct program activities specific to the WQSP goals.

Recommendation 4: Prepare for future water quality regulations. WQES staff will prepare for future water quality regulations, ensure regulatory compliance, and incorporate capital improvement requirements needed to meet regulations in the City's budget planning process.

Investment Plan and Funding Options

The WQSP will be implemented primarily by the WQES Group. The investment program is based on annual operating budgets for WQES programs, and does not include capital improvement projects. Implementation options are presented at three funding levels, according to the City's Business Plan process, and includes Fiscally Constrained, Action, and Vision plans. Figure A summarizes the funding plans.

The most significant challenge the WQES Group faces in implementing the WQSP is preparing for new water quality regulations. The WQSP identifies the funding gap between the Fiscally Constrained Plan and the Action Plan.

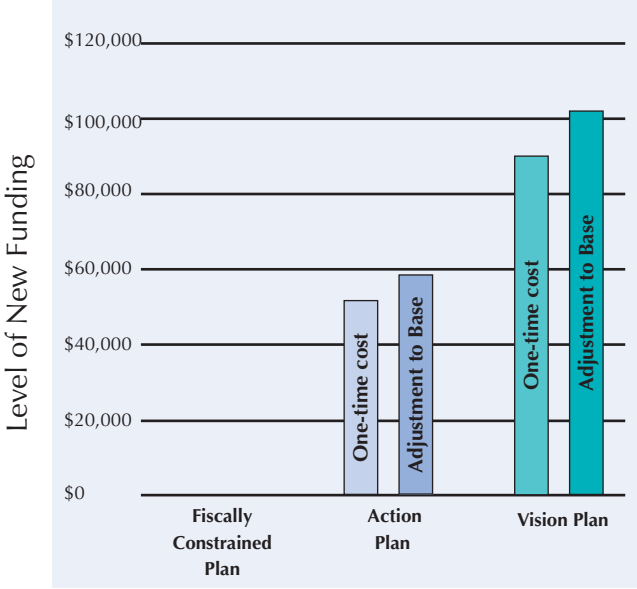

Figure A - Funding Plans

Introduction

What is in the Water Quality Strategic Plan?

The WQSP contains the following sections:

- The Boulder Creek Watershed
- Water Quality Trends and Challenges
- Boulder's Water Quality Goals
- Strategic Plan Recommendations and Performance Measures
- Investment Program
- Next Steps

Boulder City Council Environmental Goal:

"To enact and enhance city policies that cause the Boulder community to become a nationwide environmental leader among communities. The City will be a role model of exemplary environmental practices."

The Water Quality Strategic Plan (WQSP) is the first comprehensive planning effort to address water quality policies and priorities for the city of Boulder (City). The WQSP is a five-year plan that will be initiated upon review by the Water Resources Advisory Board (WRAB).

The purpose of the WQSP is to develop clear and concise water quality goals, develop recommendations and performance measures to achieve these goals, and provide a process to address current and future water quality challenges. The success of the WQSP will be based on the following actions:

- Clearly defining the City's water quality goals
- Coordinating water quality-related planning and program services
- Creating a way to assess success in meeting water quality goals
- Providing a framework to effectively manage water quality programs
- Anticipating and planning for new and increasingly complex water quality regulations and issues

The WQSP supports many of the principles and policies of the Boulder Valley Comprehensive Plan (BVCP). The WQSP is designed to fit within the broader framework of the BVCP, which provides the overall policy direction for planning decisions within the Boulder Valley. The BVCP also outlines the City's communitywide goals and provides a general statement on the community's desires for development and preservation in the Boulder Valley, including protection of water resources.

Protection and improvement of water quality is specifically discussed in Section 4 of the 2005 BVCP. In Section 4.26 the BVCP states: "The city and county will protect, maintain and improve water quality within the Boulder Creek basin and Boulder Valley watersheds as a necessary component of existing ecosystems and as a critical resource for the human community." BVCP Section 4.27 states: "Water resource planning efforts will include such things as water quality master planning."

The WQSP has been developed, and will be implemented by the City's Water Quality and Environmental Services (WQES) Group within the city of Boulder Public Works, Utilities Division. The WQES Group is funded through the City's Water, Wastewater, and Flood enterprise funds.

The WQES Group supports the Utilities Division water services and is comprised of seven programs:

- Stormwater Quality
- Water Quality Education
- Water Conservation
- Industrial Pretreatment
- Drinking Water Quality
- Laboratory Services
- Water Quality Planning

The primary function of these programs is to protect water quality and ensure that the City complies with state and federal water quality regulations, such as the Clean Water Act and Safe Drinking Water Act. The WQES Group also provides water quality program management and serves as an in-house technical resource for the City's Utilities Division and other City departments. Services include monitoring the performance of wastewater treatment and drinking water treatment processes, monitoring the health of natural systems such as creeks and lakes, and water conservation and planning. The WQES Group provides project management services to integrate water quality enhancement and compliance goals into planning efforts and City capital improvement projects.

Water Quality and Environmental Services Group

The Water Quality and Environmental Services (WQES) Group, through environmentally sustainable principles and policies, supports the City of Boulder Utility's Division's mission by complying with regulations, protecting Boulder's water quality, maintaining and rehabilitating its aquatic ecosystems, and by implementing innovative risk management. Water Quality and Environmental Services staff have expertise in aquatic ecology, water chemistry, biology, environmental engineering, limnology, groundwater hydrogeology, statistical analysis, water conservation, environmental education, and compliance with regulations and policy.

The WQES Group's objectives are to develop and implement comprehensive, coordinated programs that respond to water quality issues and ensure regulatory compliance, and to address present and future needs and issues. To achieve these objectives the WQES Group:

- Operates an ambient monitoring network on major streams and lakes. Monitoring activities are conducted at over 50 sites, which are tested for more than 100 water quality variables. The aquatic community also is assessed at more than 10 sites. Water chemistry and biological data assist in determining stream health and the impacts of pollution sources.
- Conducts issue-based, site-specific studies, usually by intensive sampling over a short period. Studies assess point and non-point source pollution impacts, and treatment process optimization for wastewater and treated water facilities.
- Cooperates with industry, regional government entities, and others to protect water quality from impacts arising from sources such as agriculture, mining, forestry, and municipal and industrial discharges.
- Conducts and participates in scientific studies to better understand the impacts of human disturbance on ecosystem structure and function. Study partners often include the U.S. Environmental Protection Agency, the U.S. Geological Survey, the Colorado Division of Wildlife, the University of Colorado, Boulder, the Colorado School of Mines, and Boulder County.
- Develops and recommends water quality standards, policies, objectives, and guidelines to protect Boulder's water quality.
- Manages and operates high-quality analytical laboratory services for the Utilities Division and manages water quality data in a secure information system.

The Boulder Creek Watershed

Stream habitat along South Boulder Creek

Boulder Creek and its tributaries are vital for providing drinking water, agricultural irrigation water, aquatic habitat, recreation, and power generation and water quality determines the suitability of water for most of these uses. Water quality in the Boulder Creek Watershed is affected by natural factors such as geology and climate, and human-caused factors, such as wastewater effluent, runoff from roads and urbanized areas, agricultural practices, atmospheric contaminants, and other sources. The relative effect of these factors on water quality has changed over time and will continue to shift as population and urbanization increase and more demands are placed on our water resources.

Watershed Physical Features

The Boulder Creek Watershed has great diversity in geology, climate, and land cover. The Boulder Creek Watershed is located in the larger South Platte River Watershed and is bordered by the St. Vrain River and Clear Creek watersheds (see Figure 1). Primary tributaries of Boulder Creek

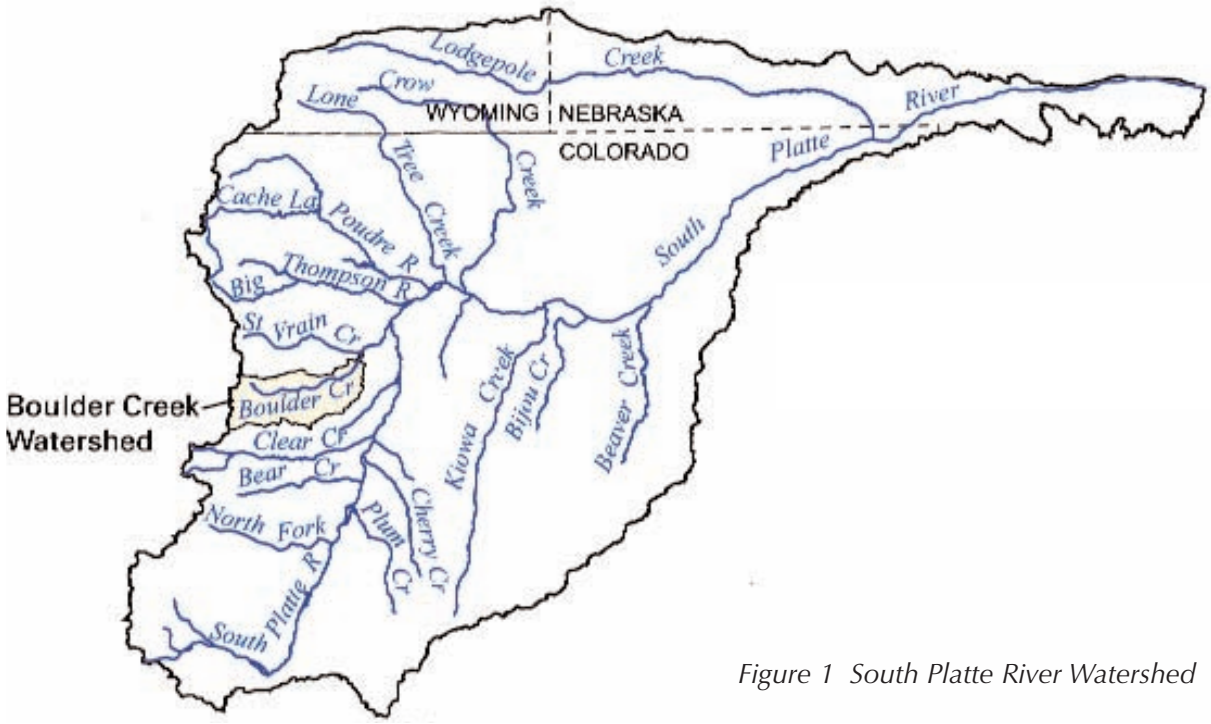

Figure 1 South Platte River Watershed

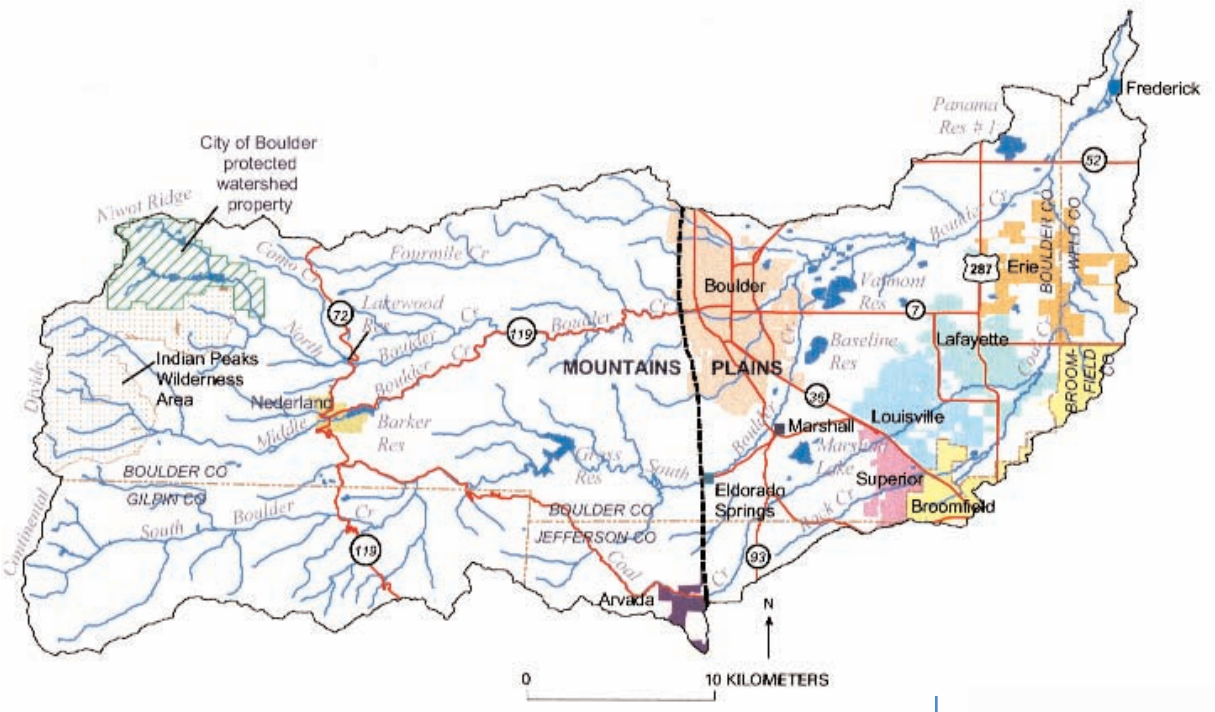

Figure 2 Boulder Creek Watershed

include the North, Middle, and South Boulder Creeks, Four Mile Creek, Coal Creek, and Rock Creek, along with several smaller streams. The Boulder Creek Watershed is approximately 447 square miles in area. It ranges in elevation from over 13,000 feet in the Silver Lake Watershed to approximately 5,000 feet at the mouth of Boulder Creek as it enters the St. Vrain River near Longmont, approximately 20 miles northeast of the City of Boulder (Boulder) (see Figure 2).

The Boulder Creek Watershed can be divided into three general areas: 1) the upper watershed from the Continental Divide to the foothills; 2) the urban watershed, or the transitional zone from the foothills to the plains, including Boulder; and, 3) the lower watershed, or the area below the City's wastewater treatment facility (WWTF) to the confluence with the St. Vrain River. These three areas have great variation in land use, geography, ecosystem type, pollution sources, stream channel characteristics and stream regulatory classifications and standards .

The upper watershed is mostly undeveloped, forested land located in the Roosevelt National Forest. Potential water quality impacts include effluent from sewage treatment plants and septic systems, sedimentation from transportation activities such as snow removal and road maintenance, ski area activities and other recreational uses, development, and new and historic mining operations.

Boulder Creek Near the Continental Divide

Boulder Creek in the Urban Corridor

Boulder Creek in the Agricultural Reach Below the City

In the urban portion of the watershed, development increases impervious surfaces, which results in increased runoff and degradation of water quality from sediment and other pollutants, increased flood potential and stream bank erosion, and possible lowering of groundwater levels. The indirect impact of development on water quality is linked primarily to transportation infrastructure. The Center for Watershed Protection has estimated that over 80 percent of imperviousness in urban areas is due to transportation infrastructure such as roads and parking lots needed to support development.

In the lower watershed, water quality impacts are dominated by agriculture and rural and estate residential development. The City's N 75th Street WWTF also discharges to Boulder Creek, and during most months of the year is a primary source of water in Boulder Creek. The WWTF is required to meet multiple state and federal regulations to control pollutants entering Boulder Creek.

Water Quality Regulations

The federal Clean Water Act requires states to establish water quality standards for surface waters. In Colorado, the state agency with responsibility for establishing stream standards to protect water quality is the Colorado Department of Public Health and Environment (CDPHE). The standards are enforced through the Water Quality Control Division and Water Quality Control Commission. Standards have three minimum components: (1) designated use classifications; (2) water quality criteria; and (3) policies to protect against degradation of water quality. These standards are outlined in Appendix A.

Measuring the Health of Boulder Creek

Water Quality: Water quality in the Boulder Creek watershed varies substantially as water moves from the upper, more pristine sections of the watershed through the urbanized area of Boulder and on to the plains east of Boulder. In general, the quality of water is better in the high-elevation headwaters, where human activity is limited, or restricted, and there are few contaminant sources. In addition, water quality tends to decline downstream as diversions remove water from Boulder Creek and its tributaries. Downstream, water quality declines also with increases in population density and in the number of potential contaminant sources, including point and nonpoint sources. A comprehensive evaluation of the water quality and function of the Boulder Creek Watershed is documented in the 2006 U.S. Geological Survey (USGS) report State of the Watershed: Water Quality of Boulder Creek, Colorado (USGS Circular 1284). This document can be found at: http://pubs.usgs.gov/circ/circ1284

Rainbow Trout (Salmo gairdneri)

Fish Species: Approximately 50 fish species, of which about 18 are nonnative, inhabit the South Platte River Watershed. Introduced species usually fare best in manmade reservoirs; but in streams they generally are not successful, because they must compete with species adapted to the watershed and fluctuating hydrologic conditions. Nonnative trout are an exception. Rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), and brook trout (Salvelinus fontinalis) were stocked in Boulder Creek soon after settlement and are now the principal fish species in the upper portion of the watershed and within Boulder.

In lower Boulder Creek, native white suckers (Catostomus commersoni) and fathead minnows (Pimephales promelas), along with nonnative common carp (Cyprinus carpio), are the most abundant species downstream from the city's N 75th Street WWTF . These fish tolerate extreme variations of temperature, dissolved oxygen, turbidity, and flow. Studies of Coal Creek found that native creek chub (Semotilus atromaculatus) and fathead minnow were most abundant.

Mayfly Nymph

Brown Trout (Salmo trutta)

Measurements of Aquatic Ecosystem Health: The aquatic ecosystem is complex, dynamic, and often difficult to evaluate. However, the health of aquatic ecosystems generally can be evaluated using biological, chemical, physical indicators of integrity.

Biological Indicators: The term "biological integrity" first appeared in the federal Clean Water Act (CWA). The CWA sought to "restore and maintain the chemical, physical and biological integrity of the nation's waters." The term was later defined as "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a composition and diversity comparable to that of the natural habitats of the region." In other words, biological integrity can be used to measure the health of the aquatic community.

The city of Boulder (City) has been collecting data on the biological aquatic communities in Boulder Creek since 1999. The purpose of the data collection is to evaluate the impact of urbanization, and wastewater discharges, and to define baseline conditions. The data is composed of benthic macroinvertebrates (insects) collected during biannual surveys. Stream insects, such as mayflies and stoneflies, make good indicators of watershed health because they:

- live in the water for all or most of their life
- stay in areas suitable for their survival
- are easy to collect
- differ in their tolerance to the amount and types of pollution
- often live for more than one year
- have limited mobility

Measuring the Health of Boulder Creek, *continued*

Bioassessment data is collected along Boulder Creek at seven sites. One site is above the city and one is at South Boulder Creek. These two sites make up a "reference" reach since they are relatively not impacted by urban and other development. The remaining sample sites are located within Boulder, and one is below the urbanized area. In 2005, to evaluate the impact from wastewater discharges on Boulder Creek, the study was broadened to include three additional sites above and below the city of Boulder WWTF.

Generally, as pollutants or other "stressors" increase in a stream or water system, biological integrity decreases. The U.S. Environmental Protection Agency (EPA) developed a Biological Condition Gradient as a general system to evaluate impairment of stream systems using biological data (see Figure 3).

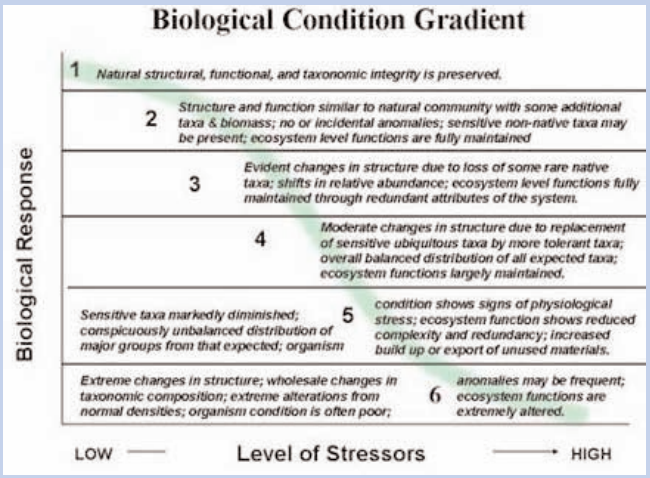

Figure 3 - Biological Condition Gradient

Chemical Indicators. Water chemistry is the most commonly measured indicator of water body health and is also used to measure compliance with state and federal water quality standards. Monitoring the chemistry of surface waters can be simplistic, focusing on standard field measurements for constituents such as pH, temperature, specific conductance, and dissolved oxygen. More complex monitoring requires water samples to be collected and analyzed by a laboratory. Some of the common parameters analyzed in surface waters include ammonia and other forms of nitrogen, various forms of phosphorus, multiple forms of bacteria, alkalinity, hardness, and multiple metals.

The City implements a comprehensive surface water quality monitoring program within the Boulder Creek Watershed to support both regulatory and nonregulatory programs. These programs include compliance monitoring for state and federal regulations and support for protecting the city's drinking water supplies. The City monitors water quality at 30 locations along Boulder Creek and its tributaries and at point source locations such as wastewater treatment plant discharges. Monitoring is conducted monthly, with over 100 parameters either measured in the field or analyzed in the laboratory.

Physical Indicators: Physical indicators measure the quality of habitat in an aquatic ecosystem. Habitat quality has profound influences on the aquatic community in a stream and can limit the health of the ecosystem even if the chemistry of the water indicates good water quality.

To measure the habitat value and the habitat quality of a stream system the City uses the U.S. EPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (EPA 841-B-99-002). The evaluation involves a quantitative measure of physical parameters that make up a riparian habitat. These measures include a summary of riparian vegetation features, in-stream parameters (including width, depth, flow, and substrate), and stream type and origin. The parameters are rated and placed into condition categories that range from "optimal" to "poor."

The purpose of the habitat assessment is to evaluate the physical characteristic of Boulder's riparian areas. The City completed habitat assessments on Boulder Creek and its major tributaries using the EPA method in 1990, 1995, and 2001. The habitat information most recently was used to make recommendations in the City's Greenways Master Plan which identify and prioritize stream restoration projects.

Water Quality Trends and Challenges

Since the passage of the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) in the 1970s, there have been tremendous strides in cleaning up our nation's rivers and lakes. These improvements came largely from controlling pollutants from factories and wastewater treatment plants. In the 1990s, the CWA was amended to include control of nonpoint source pollutants from urban stormwater runoff, which lead to further water quality improvements. However, despite these regulations, 40 percent of the nation's rivers in a recent EPA study were still too polluted for fishing or swimming.

One explanation for the shortfall in reaching the "drinkable, swimmable, fishable" goal in the CWA is the complex nature of water quality. Water pollutants come from very diverse sources, such as air pollutants from the burning of fossil fuels, or from urban and agricultural land uses, which are difficult to control or regulate. This makes it ever more important to manage source waters to provide safe drinking water, to control pollutants from our urban areas, and to remove pollutants in our wastewater.

Locally, the USGS report titled State of the Watershed: Water Quality of Boulder Creek, Colorado, outlined water quality changes since the early settlement of the Boulder Creek basin. These changes were attributed to human caused factors, such as mining wastewater effluent, stormwater runoff, agricultural practices, and atmospheric contamination. The report suggested that a clear knowledge of water quality and effective water resource and land use planning is needed to face future water quality challenges.

City of Boulder Operations and Infrastructure

The City maintains and operates substantial infrastructure to meet SDWA and CWA requirements, protect public and environmental health and generally enhance water quality. The City is responsible for maintaining wastewater and stormwater collection system piping and treated water distribution piping. Throughout the collection and distribution system are multiple pump stations that are required to keep water moving through the system.

Mechanical treatment facilities are also maintained and operated, including one 25 million gallon per day (mgd) wastewater treatment facility and two water treatment facilities, with a treatment capacity of 40 mgd and 16 mgd. The collection and transport of stormwater is accomplished through pipes and open channels, with no form of treatment. Stormwater detention

Water Quality and Community Values

Boulder has a long history of preserving its local environment and natural resources. For water quality, this goes beyond regulatory compliance. One example is the preservation of Boulder Creek. In 1894 Boulder experienced a 100-year flood, which damaged a large portion of the downtown area. In 1969 Boulder again experienced a major flood. After these two events, there was a great deal of pressure to protect Boulder from flooding.

An engineered solution that was a standard practice at the time would have confined Boulder Creek in a concrete channel as it traveled through town. However, the City made a conscious decision to use non-structural methods--working with nature rather than against it. By preserving the natural creek corridor and limiting or removing development in flood-prone areas, the creek's natural systems and high water quality were maintained. Boulder Creek today is celebrated as a classic trout fishery and a community asset for recreation and beauty. The City intends to continue this environmentally protective tradition of preserving community-valued resources.

Boulder Creek flood - 1969

Water sampling at Barker Reservoir

facilities are typically maintained by the City, which allows some regulation of stormwater flow plus a limited level of treatment.

All of the City's water, wastewater, and stormwater infrastructure and operational information is documented in multiple master plans and operating manuals. These master plans and manuals are resources that the WQSP will utilize to meet the City's water quality challenges.

Boulder's Water Quality Goals

The Boulder Valley Comprehensive Plan (BVCP) outlines the City's environmental goals. When the BVCP was adopted in 2005, Boulder City Council established a goal of becoming a national environmental leader. City Council's water-related environmental priorities included promoting water conservation. City Council also aimed to strengthen water quality improvement efforts by protecting biodiversity and native ecosystems, by managing the City's water sources through a larger watershed approach, and by reducing pollution sources.

The City must establish strong but achievable water quality goals to protect the environment and public health, and to address future water quality challenges. The WQES Group developed water quality goals by first completing a comprehensive inventory of existing water quality goal statements found in the City's master plans, policies, and regulations, starting with the BVCP. The group also reviewed water quality regulatory compliance requirements. The goals support the city of Boulder, Utilities Division Mission Statement:

Our Mission is to provide quality water services, as desired by the community, in a manner which emphasizes efficient management of fiscal and natural resources, and protects human and environmental health.

Goal 1. Provide safe and high-quality drinking water.
The City is required to provide drinking water that meets all state and federal requirements. Drinking water safety cannot be taken for granted. A number of potential threats to drinking water exist within the raw source water and within the treated water distribution system. Improperly disposed of chemicals, animal and human wastes, pesticides, naturally-occurring substances such as bacteria, can contaminate drinking water and pose a health risk. To ensure the quality of drinking water, protection strategies must be implemented from "source to tap."

Goal 2. Manage pollutants from wastewater and other point sources.
The City is responsible for operating the N 75th Street WWTF and meeting Colorado Discharge Permit System (CDPS) permit requirements. Adequate wastewater treatment is critical in protecting public health and the environment. Currently, the WWTF treats an average of 16 mgd and discharges treated wastewater into Boulder Creek. A number of smaller wastewater treatment systems, as well as individual septic systems, also discharge into the Boulder Creek Watershed. These include the Town of Nederland wastewater treatment facility, which discharges into Barker Reservoir, a source of drinking water for the City.

A warning sign posted on Boulder Creek. Elevated bacteria levels in Boulder Creek can occur, prompting posting a warning sign for public awareness.

Proactive Management

Protecting water quality often entails an overreliance on regulatory structures and compliance monitoring. As a result, managing water quality becomes reactive, in response to monitoring that reveals inadequate water quality. Reactive management can address existing problems but is rarely successful in anticipating new challenges. For water quality and natural resource management to be successful, the City must manage water resources proactively, rather than reactively.

One example of a proactive approach was the City's management of the ammonia standards for wastewater treatment discharges. In the early 1980s, the state proposed more stringent ammonia discharge limits for the City's wastewater treatment facility. In response, the City partnered with CU and other municipalities that discharge wastewater in the region to conduct an extensive study of ammonia levels in stream segments below wastewater facilities. This proactive collaboration enabled a necessary time frame (two N 75th Street WWTF CDPS permit cycles) while the City collected site-specific data and created an effective plan for additional ammonia removal measures at the facility.

Goal 3. Manage pollutants from stormwater and other nonpoint sources.

The City is required to implement programs required under the State of Colorado Municipal Separate Storm Sewer System (MS4) discharge permit to protect the quality of stormwater, which is discharged into water bodies such as streams. In urban areas, stream and water quality degradation generally are related to development. Adding impervious areas such as roads, parking lots, and buildings to land that once had natural cover increases surface runoff and reduces groundwater infiltration, which damages natural stream hydrology and aquatic systems. Urban and agricultural runoff containing sediment, fertilizers, and pesticides also can pose a threat to water quality. Protecting water quality means managing pollutants from these diverse sources.

Goal 4. Protect, preserve, and restore natural water systems.

Natural water systems include riparian and wetlands habitat as well as stream flow. Intact riparian ecosystems provide ecological benefits, which play an important role in maintaining water quality, protecting aquatic life, and preserving the aesthetic, recreational, and economical value of Boulder's waterways.

Goal 5. Conserve water resources.

Conserving water is integral to protecting water quality. Water conservation practices can improve water quality by increasing the amount of water flowing in streams and reducing the amount of treated wastewater discharges. Water conservation also diminishes the need to find new water sources and construct storage facilities. Water conserving landscaping can minimize irrigation runoff, reducing impacts to local streams.

Meeting these five water quality goals will provide water quality protection, which means clean water to drink, clean streams and lakes to swim in, and healthy waterways that support fish and other wildlife.

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The City owns and operates a 25 million gallon per day wastewater treatment facility (WWTF) located east of the city of Boulder. Major WWTF improvements were completed in 2008 which changed the treatment process to an activated sludge treatment process and increased the WWTF capacity. The WWTF improvements were required to meet new and more stringent regulations.

Strategic Plan Recommendations and Performance Measures

Is the City's water safe to drink?
Can people swim in Boulder's streams and reservoirs?
Does the City adequately treat wastewater?

The WQES Group developed four recommendations that will allow the City to meet its water quality goals. The success of the WQES Group in implementing the recommendations in the WQSP will be evaluated using the following performance measures listed under each of the recommendations.

Recommendation 1: Evaluate and update policies in the Boulder Valley Comprehensive Plan to incorporate water quality goals.
WQES staff will review and recommend updates to the Boulder Valley Comprehensive Plan (BVCP) to ensure incorporation of water quality goals. The BVCP is scheduled to be updated in 2010.
Performance Measure: Adoption of the five water quality goals into the Boulder Valley Comprehensive Plan in 2010.

Recommendation 2: Perform analyses on City plans, policies and projects to identify gaps in meeting water quality goals.
WQES staff will review relevant plans, policies and projects such as master plans, design and construction standards, and the Boulder Revised Code to: 1) ensure that the City complies with all state and federal laws and regulation on water quality and environmental protections and; 2) to meet water quality goals.

The planning analysis includes a prioritization of plans based on water quality implications and integration of water quality goals into the City's planning processes. A two-step procedure would include:
Step 1: Create assessment filters to prioritize which City policies, plans and projects will be evaluated first. These filters, or criteria, will be based on the potential impact on water quality and regulatory compliance. This screening will help identify two review categories:

Priority Items: Priority items are "high leverage" documents that include multiple water quality goals, affect the City's compliance with state or federal regulations, impact critical water quality issues, and address problems that pose imminent threats to human health or the environment. These plans or policies will be reviewed first, with actions to bring the City into compliance occurring as soon as possible. Strategies will be developed to implement policy objectives as a stop-gap measure until more permanent changes can be made during the scheduled plan update. An example of a priority item could be: When new state regulations require that municipalities have regulations in place that prohibit certain discharges into storm

sewer systems, staff will review and update existing code to comply with the new regulations.

Secondary Items: Secondary items are policies or plans that meet one or more goals, and address less critical water quality problems. These plans will be reviewed and recommendations developed following scheduled or planned updates. An example of a secondary item could be: The City's current Greenways Master Plan, which addresses a number of water quality goals, is adequate to meet most of the goals, so review will occur with the next update to the master plan.

The screening filter to assess plans and policies would be based on rating the degree of potential water quality impacts. Some examples of criteria include: regulatory compliance, public health risk, pollutant of concern, high value resource, and critical habitat.

Step 2: Integrate assessment filters and water quality objectives into City planning processes. The City currently has a robust planning process to review and update plans, policies and projects. These include the Master Plan Review Team, the Community Environmental Assessment Program (CEAP), and the Boulder Valley Comprehensive Plan update. These planning activities involve assembling interdepartmental review teams and incorporating various objectives and performance measures into updates to plans, policies and the design of public projects.

Performance Measures:All policy and master plans reviewed and updated to incorporate water quality goals; development of a matrix of water quality indicators and evaluation of plan review based on criteria.

Recommendation 3: Develop annual work plans and water quality reports. Each year the WQES Group will identify and outline priorities to achieve the City's water quality goals and to document monitoring, community involvement, and watershed management efforts and regulatory compliance. The WQES Group will develop annual work plans for each of its seven programs. Staff will use the work plans to direct program activities specific to the WQSP goals. An overall WQES annual work plan summary will be developed regarding major work plan components, planning tasks, and annual operating and CIP budget recommendations.

This recommendation also calls for the development of an annual report detailing progress on meeting water quality goals. The annual report will be based on specific objectives and water quality indicators, and will present water quality data collected by the WQES Group. The data also can be used by other Utility Division groups and City departments.

WQES staff would participate in the established planning processes by developing specific water quality objectives and performance measures based on water quality goals as they relate to the plan being updated.

Performance Measure: Development of program work plans and annual reports.

Pending or Proposed Water Quality Regulations

- Wastewater related regulations include temperature and the presence of mercury, ammonia, and emerging pollutants such as endocrine disrupting compounds, or chemicals derived from industrial, agricultural, and domestic processes, including those used in the manufacture of plastics, detergents, pesticides, and flame retardants, which have the ability to disrupt normal hormonal actions in humans and wildlife.
- Drinking water regulation revisions for lead and coper and for bacterial contaminants are in process. Other potential 0contaminants such as endocrine disrupting compounds are being studied or monitored to determine whether regulation is needed.
- Stream standards and total maximum daily loads (TMDLs), or calculations of the maximum amount of pollutants that a waterbody can receive and still safely meet water quality standards, include standards related to sediments, aquatic life, and nutrients such as nitrogen and phosphorus, as well as pathogens like E. coli bacteria.
- Stormwater regulations include airborne contaminants, pathogens, and sediments.

A more detailed description of water quality issues is located in Appendix B.

Water Quality Regulations Trends

The City will be proactive in preparing for future water quality regulations, ensure regulatory compliance, and incorporate capital improvement requirements in the city's budget planning process.

The City has had to respond to an unprecedented number of proposed water quality regulations in recent years. In the past nine years, for example, there have been eight new regulations for drinking water under the Safe Drinking Water Act. Currently, the City faces 23 new or proposed water quality regulations under the Safe Drinking Water Act and the Clean Water Act. Regulatory trends include:

- More complex regulatory requirements and compliance standards, which make it more difficult to achieve compliance
- More sophisticated (and sometimes costly) treatment required to address pollutants being regulated
- More complicated and more costly chemical and biological analytical and sampling methods
- Lower detection limits required in laboratory analysis
- Higher frequency of sample collection
- Greater number of water treatment and natural systems affected
- Overlap of treatment systems and potentially conflicting needs (for example wastewater regulations may impact drinking water standards)

These new regulatory challenges will require a concerted, significant response. *A more detailed description of water quality issues is located in Appendix B.*

Recommendation 4: Prepare for future water quality regulations.

The City will anticipate and prepare for future water quality regulations, ensure regulatory compliance, and incorporate capital improvement requirements in the City's budget planning process. The foundation of water quality planning is forecasting future water quality criteria and permitting issues related to emerging water quality issues and new regulations. These issues often surface first on the national level and must be evaluated in terms of their potential impact on state regulatory programs, the City's water quality programs, and regulatory requirements that apply to City facilities, such as the wastewater and water treatment facilities.

The new regulations are anticipated to focus on old and new chemicals that are not currently regulated, but can pose a risk to public or environmental health. Some contaminants are now being recognized as "emerging pollutants," and come from sources such as personal care products and the disposal of pharmecueticals. The impact of many emerging pollutants is just beginning to be understood and regulated. Many emerging pollutants are present in very low concentrations, and with recent improvements in measuring methods, are being identified in waters across the nation and the world.

Future water quality regulations present a significant management challenge with potentially costly consequences, including:

- increased drinking water and wastewater treatment facility costs,
- more stringent land-use controls, and
- costly stormwater treatment and other pollutant prevention strategies.

Elements of Recommendation 4

To meet current and future water quality challenges the City must develop a systematic approach to track and plan for emerging water quality issues. This approach represents a refined program initiative for the WQES Group and would include the following activities:

- Research and development, including tracking federal and state regulations and evaluating how these regulations impact city operations. To determine possible impacts, special studies, water quality modeling, and possible bench testing will be conducted with environmental consulting services or through further development of staff and resources.
- Partnerships, including institutions and agencies such as the Water Research Foundation, USGS, CU, EPA, and CDPHE. These partnerships would research emerging water quality issues and potential local impacts. The City would seek funding from partner institutions and agencies to conduct research.
- Regulatory stakeholder involvement, including federal and state regulators, in developing water quality policies and regulations. Regulatory stakeholders might include other entities in the Boulder

Creek Basin, CDPHE, Denver Regional Council of Governments, other committees, commissions, and work groups.

- Water quality education, including community involvement in developing community standards for drinking water and environmental quality, and the commitment of individuals to make behavior changes needed to solve today's complex environmental problems.

Performance Measure: Develop and implement a program to conduct special studies, track new and proposed regulations, and participate in rule-making activities.

Award Winning Water Quality Education

One of the most effective ways to protect water quality is pollution prevention. To build an active, engaged community, the City provides a number of environmental stewardship and education programs. The education program was initiated in 1992 with a few dozen elementary students. Today, the program is conducted regionally through the Keep It Clean Partnership, which reaches more than 8,000 students each year. A number of programs have been adopted statewide.

School-Based Education:
Collaborating with teachers and school district administration, the City developed an engaging "Get to Know Your H2O" curriculum for K-12 students in the Boulder Valley and St. Vrain Valley school districts. The program includes teacher training to maximize the number of students reached. It also includes take-home materials so the message does not stop at the school-house door. The program reaches a large number of students through teacher and staff-led programs and at the annual Children's Water Festival.

Community Outreach: A limited budget for marketing efforts requires innovation in implementing the water quality outreach programs. The community is asked to help protect water quality through a wide range of materials, programs, and events. Websites, brochures, and stream tributary signs convey the broader message of water quality protection, while programs such as Stream Teams and Neighborhood Stewardship ask for action and commitment from individuals and smaller groups.

H_20 Jo and Flo - the mascot of the Boulder and Keep it Clean's Partnership water quality education program.

Investment Program

The WQSP is a five-year plan that will be implemented primarily by the WQES Group. The investment program is based on annual operating budgets for the WQES Group programs and does not include capital improvement projects.

A summary of the recommendations for funding levels is presented in Table 1. Implementation options are provided at three funding levels, according to the Fiscally Constrained, Action, and Vision plans.

Table 1 - Investment Program

Recommendation	**Fiscally Constrained Plan** The Fiscally Constrained Plan (Current Funding) is a prioritized, refocused service plan within existing budget targets.	**Action Plan** The Action Plan is the next step of service expansion or restoration that should be taken when funding is available either within current revenue sources or if new sources become available.	**Vision Plan** The Vision Plan is the complete set of services and facilities desired by the community and aligned with values and policies, with alternative proposals to fund them.
1. Adopt the strategic plan's water quality goals into the BVCP.	This recommendation will be fully implemented in the next BVCP update in 2010.	This recommendation will be fully implemented in the next BVCP update in 2010.	This recommendation will be fully implemented in the next BVCP update in 2010.
2. Incorporate water quality goals into citywide planning efforts and city regulations, polices and procedures.	**Five-year Implementation** Staffing restraints will limit implementation. Only plans or policies with updates initiated by other City departments will be analyzed.	**Three-year Implementation** Full implementation will be achieved within three years with **an additional $10,000 per year for three years** of consulting services.	**One-year Implementation** Full implementation will be achieved within one year with an **additional one-time fee of $40,000** for consulting services.
3. Develop annual work plans and water quality reports.	**Five-year Implementation** Annual work plans and water quality reports will be fully implemented within five years.	**Three-year Implementation** Full implementation will be achieved within three years with an **additional one-time fee of $20,000** for consulting services to develop a work plan and water quality report template.	**One-year Implementation** Full implementation will be achieved within one year with **an additional one time fee of $50,000** for consulting services to develop a template and draft of the work plan and water quality report.
4. Prepare for future water quality regulations.	**New Program Initiative** New and proposed regulations will be tracked and addressed to the extent possible within the existing budget.	**New Program Initiative** Partial implementation will be achieved with an **additional 0.5 FTE and $10,000 per year** for laboratory and consulting services. It requires an **annual adjustment to base of $47,000** for the 0.5 FTE annual salary and benefits.	**New Program Initiative** Full implementation will be achieved with an **additional 1.0 FTE and $10,000 per year** for laboratory and consulting services. It requires an **annual adjustment to base of $94,000** for the 1.0 FTE annual salary and benefits.
Total Investment	$0 beyond current budget	Requires a $50,000 one-time budget increase, a $57,000 ongoing adjustment to base, and an additional 0.5 full time equivalent staff member (FTE).	Requires a $50,000 one-time budget increase, a $104,000 ongoing adjustment to base, and an additional 1.0 full time equivalent staff member (FTE).

Next Steps

The most significant challenge the WQES Group faces is anticipating and preparing for new water quality regulations. The WQSP identifies the funding gap between the Fiscally Constrained Plan and the Action Plan.

Implementation of the WQSP will be based, in part, on the funding level. At every funding level, the WQSP calls for the City to commit to adopting the five water quality goals and the recommendations.

The WQSP is a five year plan and will be updated in 2014.

Appendix A ~ Understanding Water Quality Regulations

The Colorado Water Quality Control Division (Division) regulates the discharge of pollutants into the state's surface and ground waters and enforces the Colorado Primary Drinking Water Regulations. The Division is the administrative agency responsible for developing specific state water quality policies related to those specified in the Colorado Water Quality Control Act. The Colorado Water Quality Control Commission (Commission) adopts water quality classifications and standards for surface and ground waters of the state, as well as various regulations aimed at achieving compliance with those classifications and standards. Standards have three components: designated use classification, water quality criteria, and anti--degradation policies. The following outlines each of these components:

Designated Uses. Designated uses are human and ecological uses that are officially recognized and protected. Colorado's designated use categories are:

Recreation:

Class 1 – Primary Contact: Waters suitable for recreational activities when ingestion of water is likely, such as swimming, kayaking and tubing. There are two subcategories: Class 1E (existing use) and Class 1P (potential use).

Class 2 – Secondary Contact: Waters not suitable for primary contact, but suitable for recreational uses such as wading and fishing.

Agriculture:

Waters suitable or intended to be suitable for crop irrigation and for livestock watering.

Aquatic Life:

Class 1: Waters capable of sustaining a wide variety of aquatic life, including sensitive species. There are two subcategories: Cold Water and Warm Water

Class 2: Waters not capable of sustaining a wide variety of cold or warm water aquatic life, including sensitive species, due to physical habitat, water flows, or uncorrectable water quality conditions. There are two subcategories: Cold Water and Warm Water

Domestic Water Supply:

Surface waters suitable or intended to be suitable for drinking water supplies. After standard treatment, these waters will meet Colorado drinking water regulations.

Surface waters within a watershed are divided into segments, which are then assigned designated uses based on how the water is currently used and what uses are desired for the future. Several designated uses have been applied to waters in the Boulder Creek watershed. All of the waters have been classified for Recreation 1A and agricultural use, and all except for parts of Coal Creek have been classified for domestic water supply. Aquatic life use classifications vary depending on water temperature and flow.

Water Quality Criteria. Water quality criteria are descriptions of the chemical, physical, and biological conditions necessary to achieve and protect a water body's designated uses. For waters with multiple designations, the criteria must support the most sensitive use. There are both narrative and numeric criteria. Narrative criteria describe water quality goals and provide protection against contaminants that do not have specific numeric standards. Numeric criteria set an acceptable concentration of a specific contaminant in a surface water or groundwater.

Anti-degradation Policies. Anti--degradation policies are used to protect water quality. The Division's guidance on anti--degradation identifies three levels of classification: 1) outstanding waters, for which no degradation is allowed; 2) use-protected waters, where degradation is allowed as long as water quality criteria are met; and 3) reviewable waters, where limited degradation is allowed if no reasonable alternatives are available and water quality standards are still met. In the Boulder Creek watershed, all of the tributaries within the Indian Peaks Wilderness Area are designated as outstanding waters. In general, Boulder Creek and other tributaries in the mountains are reviewable waters, where segments on the plains are mostly use-protected. Segment 9 of Boulder Creek, which is the reach of Boulder Creek that receives treated effluent from the city of Boulder N 75th Street WWTF, is a reviewable water and requires more stringent effluent limits for some constituents.

Compliance with Water Quality Criteria. States are required by section 305(b) of the Clean Water Act to assess and report on the quality of the state's waters to Congress through the U.S EPA. The state's current (2008) 305(b) report describes the ways the state measures water quality, the quality of water bodies, and pollution control programs. The State of Colorado 305(b) report, titled Status of Water Quality in Colorado, is available from Colorado Department of Public Health and Environment, at the following link: http://www.cdphe.state.co.us/op/wqcc/Resources/waterstatus_305_b/305bUpdate08.pdf

In addition to the 305(b) Report, Section 303(d) of the Clean Water Act requires states to develop a list of impaired water bodies, called the 303(d) list. When credible data indicate that a water quality standard is not met, the state is required to propose that the stream segment be placed on the 303(d) list with information pertaining to the constituent(s) that do not meet water quality standards and an assessment of what is causing the impairment. In Colorado, the Colorado Water Quality Control Division develops the 303(d) list every two years and submits the list to the Colorado Water Quality Control Commission for a public hearing. Once the 303(d) list is approved, it is provided to U.S EPA Region 8 for review and approval. In the Boulder Creek Watershed, segments of Boulder Creek and Coal Creek have been listed as impaired for ammonia and/or E. coli, requiring the development of a total maximum daily load (TMDL) assessment (see Figure A-1).

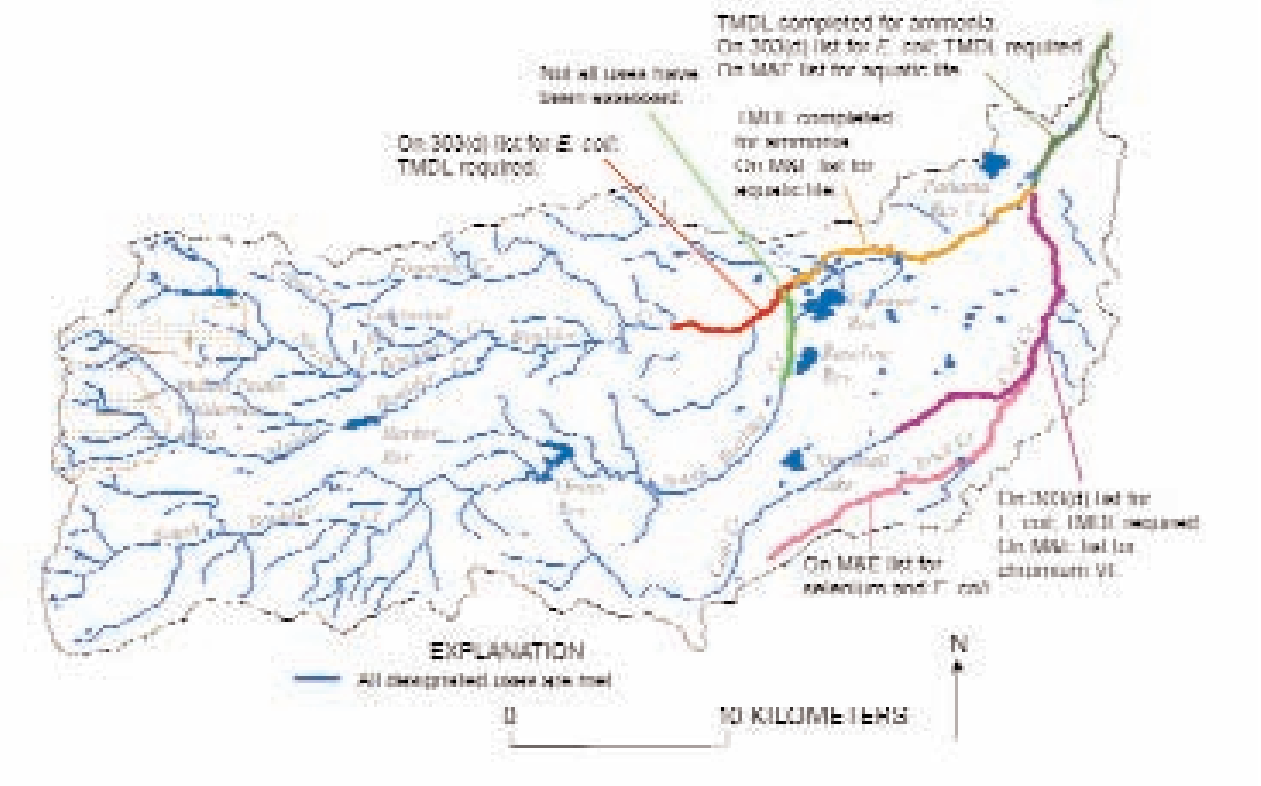

Figure A-1 Listing of Impaired Waters in the Boulder Creek Watershed

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Appendix B ~ Emerging Water Quality Issues

To prepare for future water quality regulations, the Water Quality and Environmental Services (WQES) Group within the city of Boulder (City) Public Works Department, Utilities Division, developed the following synopsis of emerging water quality issues faced by the City and other municipalities throughout Colorado:

Pending or Proposed Water Quality Regulations and Emerging Issues or Concerns

- **Wastewater:** temperature and the presence of mercury, ammonia, nitrogen, phosphorus nonylphenol, and emerging contaminants, such as pharmaceuticals, personal care products, and endocrine disrupting compounds
- **Drinking Water:** Revised regulations for lead and copper will be finalized in 2009 and implemented in 2010. Revisions to the Total Coliform Rule will be proposed by USEPA in 2010. Occurrence monitoring for Contaminant Candidate List 2 (25 contaminants) will be completed in 2009 with review and regulatory determinations made in 2011. Contaminant Candidate List 3 (93 chemicals and 11 microbiological contaminants) will be evaluated for occurence monitoring to begin in 2012 with revew and regulatory determinations made in 2014. Other potential contaminants such as endocrine disrupting compounds are being studied or monitored to determine whether regulation may be warranted.
- **Stormwater:** airborne contaminants, pathogen (E. coli) TMDLs, and sediment criteria
- **Stream Standards and Total Maximum Daily Loads (TMDL):** standards changes including sediment criteria, nutrient criteria, aquatic life criteria, and pathogens (E. coli), plus TMDLs, or calculations of the maximum amount of pollutants that a waterbody can receive and still safely meet water quality standards, for E. coli.
- **Other:** climate change impacts

WASTEWATER ISSUES

Emerging Contaminants. Increasingly sensitive chemical analytical technologies have revealed previously unmeasurable microconstituents in the water. These microconstituents (emerging contaminents of concern (ECCs)) include endocrine disrupting compounds (EDCs), and pharmaceuticals and personal care products (PPCPs). ECCs represent a variety of compounds including prescription and over-the-counter veterinary and human medicines, household and industrial cleaning products, herbicides and pesticides, and intermediary manufacturing chemicals. ECCs can be synthetic or natural, such as estrogenic compounds produced by plants like soy.

Recognizing the need to address potential health and environmental concerns, the City's WQES staff has done research and followed developments in this new discipline. The City participates in the Consortium for Research and Education on Emerging Contaminants (CREEC), an interagency organization. The City recently joined the Water Research Foundation taking an active role in research that will enable utilities to characterize occurrence and potential public health risks of ECCs and address them proactively.

The Drinking Water Program has initiated screening of source water and treated drinking water for a wide range of ECCs for which established analytical technology exists. Preliminary results indicate the presence of some ECCs in both source and treated water. Future monitoring will depend on availability of additional funds.

Endocrine Disrupting Compounds (EDCs). EDCs are natural and synthetic molecules that can interfere with hormone systems in the bodies of animals. EDCs such as estrogenic pesticides and pharmaceuticals (xenoestrogens) can have adverse impacts on wildlife, domestic animals, and humans.

Fish Exposure Mobile
Research trailer used by CU and USGS to evaluate impacts of Endocrine Disrupting Compounds.

Fish Exposure Mobile Aquaria
Aquaria inside the research trailer used by CU and USGS to evaluate impacts of Endocrine Disrupting Compounds.

Boulder recently received national attention related to EDCs detected during research on Boulder Creek by the University of Colorado (CU), Boulder, and the U.S. Geological Survey (USGS). The research is evaluating low-level contaminants that act as endocrine disruptors and have led to a predominance of female fish in the study area.
Although research focused on Boulder Creek, primarily downstream of the City's N 75th Street WWTF, Boulder is not alone in dealing with the effects of these chemicals on the environment.

Little is know about the removal of EDCs in the drinking water and wastewater treatment processes, or the impact these chemicals may have on human health. The City, in conjunction with the USGS and CU, has initiated monitoring to evaluate the level of treatment required for specific emerging contaminants at the N 75th Street WWTF and to measure the effects of these contaminants on Boulder Creek. Evaluation of the effectiveness of treatment at the WWTF and the impacts on Boulder Creek should continue through cooperation with the USGS and CU. These cooperative efforts could be expanded to assess potential emerging contaminant impacts on the City's raw and treated drinking water. Prevention measures will be a key component of any control strategy. In 2008, the City completed a one-day pharmaceutical take-back program with the Boulder County Health Department. The program attracted approximately 300 county residents, who turned in approximately 300 pounds of pharmaceuticals. These efforts help prevent pharmaceuticals from entering the City's wastewater treatment facility through the sanitary sewer system and also eliminate improper disposal or use of excess or expired pharmaceuticals.

Temperature Standard: In 2006, the Colorado Water Quality Control Division (Division) Department of Public Health and Environment (CDPHE) proposed changes to statewide water temperature standards. A more restrictive and complex set of temperature standards were adopted in the Colorado Basic Standards and Methodologies for Surface Water. The Division will evaluate receiving water temperature data and determine whether discharges, such as treated effluent from wastewater treatment facilities, should have a lower effluent temperature to protect aquatic life (recognizing that temperature variations result from natural conditions and irreversible human impacts). Possible implications for the City include the need for cooling towers or refrigerated chillers to cool effluent from the N 75th Street WWTF.

Mercury Standard: The current mercury water quality standards for the protection of aquatic life are 1.4 ug/L for acute conditions and 0.01 ug/L for chronic conditions, measured as a water column concentration. The N 75th Street WWTF

effluent limit is set at 0.012 ug/L.

The U.S. Environmental Protection Agency (EPA) recently has focused on revisions to the mercury criteria to better address the bioaccumulation of mercury in fish tissue. EPA is revising criteria for the protection of human health from a form of mercury called methylmercury. Other criteria being developed by EPA is the study of the relationship between fish tissue mercury accumulation and water column concentrations. This relationship is important in determining how compliance with mercury levels will be measured.

The Division has included mercury criteria in the list of constituents to be addressed through the Standards Framework Work Group process. The Work Group meets bimonthly and the City will remain a member of the Work Group through the 2010 Basic Standards Hearing.

Ammonia Standard. As part of the N 75th Street WWTF Colorado Discharge Permit System (CDPS) permit renewal process in 2002, the Division required an ammonia TMDL be completed for Boulder Creek and the St. Vrain Creek basin to address elevated ammonia concentrations. The TMDL was completed in 2003, and ammonia effluent limits were incorporated into the CDPS discharge permit.

In 2007 the Colorado Water Quality Control Commission (Commission) adopted more restrictive ammonia water quality standards and implemented a new model to calculate WWTF effluent limits for ammonia. Substantial improvements at the N 75th Street WWTF were implemented to prepare for the new ammonia standard, and the possible implementation of nitrate and nutrient standards.

Additional Boulder Creek ammonia and nitrogen evaluations were completed in 2008 and submitted to the Division. Preliminary results of the modeling indicate that monthly ammonia effluent limits are substantially lower for specific months and require enhanced nitrogen removal at the N 75th Street WWTF. Implementation of lower ammonia effluent limits will be part of the CDPS permit renewal process, which is expected to occur in 2010. Boulder will need to evaluate further the technical basis used to calculate the low ammonia limits to ensure they are accurate.

Nonylphenol Standard. In 2006, EPA published final aquatic-life chronic criteria for nonylphenol, an organic compound that is a product of industrial synthesis, particularly in making detergents. The EPA freshwater criteria specified 6.6 ug/L and an acute criteria of 28 ug/L. As part of the 2007 Commission hearing on Consideration of Revisions to Statewide Organic Chemical Standards in the Basic Standards and Methodologies for Surface Water, Regulation #31 and in the Basic Standards for Groundwater, Regulation #41, as well as other proposed revisions to Regulation #41, the Commission adopted the EPA nonylphenol criteria.

As part of the Commission hearing process, meeting these standards was deferred through 2009 to allow dischargers time to evaluate the following: approvable analytical procedures for measuring nonlyphenol and its parent compounds; sources of nonylphenol; ability to limit nonylphenol sources; and, measure the level of nonylphenol in WWTF effluent to determine the ability to comply with the adopted criteria.

The City is in the process of collecting data on nonylphenol and its parent compounds to characterize sources. The City has been an active participant with other dischargers on developing an approval analytical method for nonylphenol. These efforts will need to continue through 2009.

Nutrient Standards. In 2002 the Division released their Nutrient Criteria Development Plan for the development and implementation of nutrient criteria in Colorado. Over the past six years the Division has been working towards developing nutrient criteria for nitrogen, phosphorus and chlorophyll *a*. Algae, measured as chlorophyll *a*, has been identified as the primary indicator for evaluating the health of lakes and reservoirs. The Division is also evaluating the relationship between chlorophyll *a* and nitrogen and phosphorus concentrations. If impairment due to elevated chlorophyll *a* levels is identified some level of control for nitrogen and/or phosphorus contributions, from point and non-point sources, will be required by the Division. For streams and rivers, the Division is focusing on controlling nitrogen and/or phosphorus

contributions based on the health of the aquatic community, specifically macroinvertebrates. This process looks at the relationship between nutrient concentrations and macroinvertebrate populations and diversity.

The Division will propose state-wide nutrient criteria to the Commission at the 2010 Basic Standards Hearing. Nutrient criteria development Work Group meetings will continue through 2009 and in to early 2010 in preparation for the Hearing. The City is actively participating in the Work Group meetings and will need to decide in late 2009 whether there is a need to testify at the 2010 Basic Standards Hearing.

Copper Water Quality Standard. The Division is in the process of evaluating methods to develop site-specific copper standards in Colorado to address the over-conservative nature of the existing copper standards. The Division is evaluating the use of a Translator following EPA Guidance, plus the use of the Biotic Ligand Model (BLM) to more accurately reflect site-specific water quality conditions that reduce the level of copper toxicity in natural waters. The Division may provide a proposal for the 2010 Basic Standards Hearing on which method, or combination of both methods, may be used in Colorado to develop copper water quality standards. Either method will require additional data collection to support site specific copper criteria development.

Aquatic Life Standard. The Division initiated the Aquatic Life Work Group in 2000 as part of their process of developing aquatic life water quality standards, which are expressed as biocriteria. The primary function of biocriteria is to describe the biological condition that is necessary to support the designated use of the water body, including lakes, reservoirs, rivers and streams. Bioassessment tools are being developed to quantify the biological condition of an aquatic community. The primary intent of biocriteria is not to set a regulatory standard, but will be used to detect impairment in aquatic life and identifying probable causes of the impairment.

To date, the approach to developing biocriteria has focused on using macroinvertebrate population data, habitat assessments (physical features) and fish population data. One of the main challenges in developing biocriteria is determining "expected conditions". The expected condition will reflect a range of biological characteristics that are considered "normal" or "healthy" for a waterbody. Impairment of a waterbody will be based on the comparison of the expected condition to the actual condition, based on collected data. To date, the City has not been an active participant in the Aquatic Life Work Group due to limited resources.

STORMWATER ISSUES

Urbanization. As Boulder becomes more urban, much of the land surface becomes covered by buildings and pavement. These impervious surfaces do not allow rain and snowmelt to soak into the ground. Instead, stormwater runoff is carried into nearby waterways. The stormwater runoff may carry pollutants such as oil, dirt, chemicals, and lawn fertilizers into streams and rivers, impacting water quality.

Additional impacts from runoff in urban areas include:

- Stream bank erosion and increased sedimentation
- Loss or degradation of riparian habitat
- Pollution from runoff, including from nitrogen, phosphorus, pathogens, toxic metals, and pesticides
- Loss of aquatic and riparian dependent species
- Reduction in groundwater recharge

The City addresses a number of urban water quality impacts through the Water Quality and Environmental Services Stormwater Quality Program. The City is regulated by a Municipal Separate Storm Sewer System (MS4) Permit that requires implementation of stormwater program elements to control runoff and implement prevention strategies. The City's Greenways and Wetlands protection programs provide for the protection and restoration of wetlands and riparian areas, which

help to mitigate the effects of increased runoff in urban areas.

The City's stormwater and associated programs address basic problems associated with urban runoff, such as runoff volume control and pollution prevention. However, a number of emerging stormwater issues will make it more difficult to meet the City's water quality goals in the future. These issues include:

Air-born contaminants: The U.S. Geological Survey's National Water Quality Assessment program included the first comprehensive evaluation of waterways in the U.S. The study identified air-born contaminants as a source of hydrocarbon pollutants in a surface water, stormwater, and groundwater. These contaminants were likely formed by the burning of fossil fuels. EPA has indicated that these contaminants will be regulated in the future.

Pathogens: Pathogens are another type of pollutant regulated to improve water quality and protect public health. Currently, E. coli is used as an indicator of contamination by pathogens. Boulder Creek has been listed as impaired because of level of E. coli. This is discussed in further details in the TMDL section below.

Sediment: The Commission has adopted guidance concerning sediment deposition impacts to aquatic life in streams and rivers. The guidance document, Provisional Implementation Guidance for Determining Sediment Deposition Impacts to Aquatic Life in Streams and Rivers" focuses on the application of "expected conditions" with respect to aquatic life classification, nutrient criteria, and narrative sediment standard issues. The Commission is currently developing sediment regulations, which are expected to be completed by 2011.

TMDL Requirements. The Clean Water Act requires that states develop streams standards for waterways within their jurisdictions. These stream standards are based on "beneficial uses" of stream segments and include recreation, drinking water, agricultural and aquatic life standards. New stream standards are often developed to provide additional or improved water quality protection. The Division is proposing several new stream standards, including those on nutrients, sediment, aquatic life, and temperature. These standards can affect the N 75th Street WWTF by requiring additional treatment and the City's stormwater quality program by requiring additional best management practices (BMPs). States also are required to assess water quality to determine compliance with all water quality standards. The Clean Water Act requires states to develop a list of impaired waters, commonly referred to as the "303(d) list." A water body is considered impaired if: a) the current water quality does not meet the numeric or narrative stream standard; or, b) the designated use that is not being achieved. Once a waterbody is listed, the state must work with dischargers to those stream segments to develop a TMDL analysis.

Pathogen (E. coli) TMDL. In 2006, some segments of Boulder Creek were listed on the state's 303(d) list as impaired due to exceeding the E. coli stream standards. Escherichia coli (E. coli) is a bacteria used as indicators of the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoa from sewage contamination. Since it is difficult, time-consuming, and expensive to test directly for the presence of a large variety of pathogens, water is tested for E. coli instead. However, recent studies have indicated that E. coli may not be a good indicator of pathogens, because a number of strains thrive in the environment of soils and natural waterways, unlike the pathogens they indicate.

Monitoring by the City has shown high concentrations of E. coli in some segments of Boulder Creek. The City is working with the state to identify the sources of E. coli and other indicators to determine the relative health risk in Boulder Creek.

DRINKING WATER ISSUES

The WQES Drinking Water Program addresses water quality issues from the source water through the distribution system.

The source water management programs typically are invaluable in understanding water quality for treatment and protecting the City water supplies, rather than in meeting specific regulatory reporting requirements. This includes tracking emerging water quality issues, of which water customers are increasingly more aware. Treatment and distribution system monitoring typically is more focused on regulatory reporting but also provides information on water quality after it leaves the treatment facilities and when it reaches the City's customers.

Changes to drinking water regulations will continue to affect the City through monitoring, treatment, reporting, and customer awareness. The EPA must revisit drinking water regulations to address new developments in research related to human health effects and analytical methods. The trends in drinking water regulations include more complex rules, more emphasis on treatment techniques, and more complex methods for determining compliance. There also may be changes in how regulations are determined, such as health endpoints and acute and chronic health effects. In the past two years, the Division has adopted revisions to significant drinking water regulations related to federal Long-Term 2 Enhanced Surface Water Treatment Rule and Stage 2 Disinfectants/Disinfection By-Products Rule, and the Groundwater Rule. In the coming year, the Division also will be required to adopt the Lead and Copper Rule revisions.

The following provides a summary of current and developing changes in drinking water quality management issues:

Backflow Prevention. The Division will be considering revisions to Article 12 of the Colorado Primary Drinking Water Regulations in 2009. Article 12 governs the installation, maintenance, and annual testing of backflow prevention assemblies. Potential changes that could affect the City include: 1) greater inclusion of backflow prevention requirements during a Sanitary Survey; 2) increased tracking and reporting by the Backflow Prevention Program; 3) inclusion of an educational component to the Backflow Prevention Program; and 4) more accountability for annual testing/compliance and reporting.

Lead and Copper Rule. The Division will adopt revisions for implementation in 2010. Recent revisions to the Lead and Copper Rule enhance implementation of monitoring, treatment, and customer awareness and impose additional reporting requirements. The City is participating in the rule-making process.

Total Coliform Rule. Revisions to the Total Coliform Rule to be proposed by EPA in 2010 will apply treatment technique concepts implemented in the Long Term 2 Enhanced Surface Water Treatment Rule to treatment and distribution system operations. Detecting total coliforms as an indicator will trigger assessment requirements including action to correct sanitary defects. The Total Coliform Rule Distribution System Advisory Committee defined sanitary defects, for the purpose of revising the rule, as: "a defect that could provide a pathway of entry for microbial contamination into the distribution system or that is indicative of a failure or imminent failure in a barrier that is already in place." The Advisory Committee also recommended additional research and information sharing about cross connections and backflow, contamination risk involving storage and distribution design, operation and maintenance, biofilm and microbial growth and accumulation and release of contaminants accumulated in distribution system scales and sediments.

Long-term 2 Enhanced Surface Water Treatment Rule. This rule set a Maximum Contaminant Level Goal of zero for Cryptosporidium and established treatment technique requirements for all public water suppliers. Additional treatment requirements will be based on Cryptosporidium occurrence in source water. The City's treatment requirements will be determined in 2009 but is already meeting expected additional treatment and monitoring requirements under this rule.

Stage 2 Disinfection/Disinfectant Byproduct Rule. This rule retargets monitoring to identify areas of highest exposure risk to disinfection byproducts and applies more stringent compliance standards. MCLs for disinfection byproducts remain the same but are calculated on the basis of a location-specific running annual average instead of system-wide averages. If any one location exceeds the MCL the entire system is considered to be noncompliant. The city identified new monitoring lo-

cations by modeling water age and conducting additional DBP monitoring. The city must demonstrate compliance in 2012.

Regularly Scheduled Rule Reviews. EPA is required to review each drinking water rule at least every six years to determine its effectiveness in protecting public health and whether revisions may improve drinking water safety.

Presence of Invasive Species in Carter Lake Watershed. In 2008, Quagga and Zebra Mussels were detected in Colorado reservoirs, including west slope reservoirs that feed Boulder Reservoir. The state of Colorado initiated an extensive monitoring and education program related to the invasive species. The City's Utilities, Parks and Recreation and Open Space and Mountain Parks Departments have been developing responses to minimize the introduction of the species into Boulder Reservoir. The City also has as begun planning efforts to eliminate or limit the transport of mussels into Boulder Reservoir by boats. In addition, the City has initiated planning efforts to respond to potential impacts to infrastructure.

Emerging Contaminants. Increasingly sensitive chemical analytical technologies have revealed previously unmeasurable microconstituents in the water. These microconstituents include endocrine disrupting compounds (EDCs), and pharmaceuticals and personal care products (PPCPs). ECCs represent a variety of compounds including prescription and over-the-counter veterinary and human medicines, household and industrial cleaning products, herbicides and pesticides, and intermediary manufacturing chemicals. ECCs can be synthetic or natural, such as estrogenic compounds produced by plants like soy.

Recognizing the need to address potential health and environmental concerns, the city's WQES staff has done research and followed developments in this new discipline. Boulder participates in the Consortium for Research and Education on Emerging Contaminants (CREEC), an interagency organization. The city recently joined the Water Research Foundation taking an active role in research that will enable utilities to characterize occurrence and potential public health risks of ECCs and address them proactively.

The Drinking Water Program has initiated screening of source water and treated drinking water for a wide range of ECCs for which established analytical technology exists. Preliminary results indicate the presence of some ECCs in both source and treated water. Future monitoring will depend on availability of additional funds.

Over the past six years, the city has participated in joint research with CU and USGS in evaluating EDCs in Boulder Creek below the N 75th Street wastewater treatment facility. The location of this work is downstream of the city's drinking water sources but is contributing importantly to developing research methods that may improve understanding of the effects of EDCs in source waters.

CLIMATE CHANGE

One of the biggest factors impacting water quality is the modification of stream flows and groundwater levels. These modifications are due in a large part to increased runoff from urban areas and to diversions and return flows from agricultural and municipal water demands. This hydrologic modification of the natural stream system leaves little water in the creek to provide dilution of pollutants, or to maintain habitat and the natural stream channel. These hydrologic conditions may be further affected by climate change.

In a recent study completed by University of Colorado for the City's Water Resources Group, researchers predict drier winters, wetter springs with an earlier mountain snow runoff period. These conditions could lead to depleted stream flows in the winter, threatening aquatic life; and more frequent and severe flooding in the spring, which could lead to accelerated stream bank erosion and degradation of aquatic and riparian habitat. Both conditions could lead to degraded water quality.