

EXECUTIVE SUMMARY

OVERVIEW

The purpose of this *Denver Water Quality Management Plan* (Plan) is to advance a framework for better integrating stormwater management and water quality protection into planning, engineering, and infrastructure management for the City and County of Denver (Denver). This Plan will serve as a common authoritative reference identifying Denver's commitments, priorities, and strategies for protecting its rivers, streams, lakes, and wetlands from the adverse impacts of urban stormwater runoff. In addition, the Plan provides a practical initial strategy for managing stormwater runoff quality in the near term, while laying the groundwork for a long-term vision. This Plan is relevant to Denver staff, land developers undertaking new or redevelopment projects, other parties conducting activities that impact urban runoff, and citizens who want to support water quality protection in the Denver area. The primary goals of this Plan are identified in Exhibit ES.1. The remainder of this Executive Summary describes the project approach, stormwater quality Best Management Practice (BMP)¹ implementation guidelines, and recommendations resulting from the Plan.

EXHIBIT ES.1 PLAN GOALS

DEVELOP A FRAMEWORK AND SHARED VISION FOR MEETING DENVER'S STORMWATER QUALITY REQUIREMENTS AND GOALS

DEVELOP BMP STRATEGIES THAT WORK IN VARIOUS DENVER SETTINGS

DEVELOP A COMMON FOUNDATION FOR INTERDEPARTMENTAL UNDERSTANDING OF STORMWATER QUALITY REQUIREMENTS AND THEIR ROLE IN THE PLANNING PROCESS

DEVELOP A FRAMEWORK AND PRIORITIES FOR FUTURE WORK NEEDED TO MEET GOALS

APPROACH

This Plan has been developed using a multi-faceted approach to ensure that a practical and innovative strategy for addressing water quality is developed for Denver. Multiple interviews and meetings were conducted with key Denver staff to develop a Plan that will be beneficial to many Denver departments. Key aspects of the project approach include:

- ▶ **Extensive collaboration among multiple city departments.** Acceptance and use of this Plan across city departments is critical to its success. This document has been developed through close collaboration and frank discussion among multiple departments within

¹ Best Management Practices (BMPs) include a variety of both structural and non-structural techniques implemented to help minimize pollution of streams, rivers, lakes, and wetlands. BMPs are the foundation of stormwater quality management and regulation and are a key topic throughout this Plan. Representative examples of BMPs include source controls such as proper fertilizer use and structural BMPs such as water quality detention basins and porous landscape detention. See Chapter 6 of this Plan for more information.

Denver including Public Works, Parks and Recreation, Community Planning and Development, Environmental Health, and the City Attorney’s Office. By diligently working together to prepare this document, a more unified position and vision for stormwater quality management has emerged. Some of the opportunities and challenges identified during interviews and Advisory Committee meetings are summarized in Exhibit ES.2.

- ▶ **Identification and review of regulations and existing Denver planning documents affecting or interfacing with stormwater quality management strategies in Denver.** Many existing and proposed federal, state and local water quality regulations directly influence stormwater quality management in Denver. Key regulations were inventoried and described in order to provide a common basis for understanding stormwater quality management requirements. Similarly, Denver has many excellent planning documents and programs that help guide planning and watershed management decisions. In order to avoid reinventing the wheel, a review and summary of these key documents was completed.

- ▶ **Review of similar efforts in other communities with advanced stormwater programs.** Communities throughout the country are reassessing their approach to stormwater and watershed management. Early in development of this Plan, five communities with advanced stormwater programs were identified to explore their approaches, successes, and difficulties in addressing urban runoff. Interviews and review of key documents were conducted for these communities: Portland, Oregon; San Diego, California; Austin, Texas; Prince George’s County, Maryland; and Snohomish County, Washington. Findings from this research have been taken into account in development of this Plan with regard to general approach, as well as for recommendations for specific BMPs.

**EXHIBIT ES.2
STORMWATER QUALITY
MANAGEMENT
OPPORTUNITIES AND CHALLENGES**

ADDRESS WATER QUALITY ISSUES (E.G., 303(D) LISTED SEGMENTS, STREAM STANDARDS)

IMPROVE INTERDEPARTMENTAL COOPERATION WITH REGARD TO INTEGRATING WATER QUALITY INTO SITE DEVELOPMENT

COORDINATE COMPATIBLE USES BETWEEN PARKS AND WATER QUALITY FACILITIES

ENHANCE COMPATIBILITY BETWEEN URBAN DESIGN GOALS AND WATER QUALITY FACILITIES

IMPLEMENT EFFECTIVE, SUSTAINABLE, ATTRACTIVE, MULTI-PURPOSE, SAFE AND WELL-DESIGNED BMPS

ENSURE LONG-TERM BMP OPERATION AND MAINTENANCE

DEVELOP FINANCING AND INSTITUTIONAL STRATEGIES FOR REGIONAL BMPS

- ▶ **Identification of stormwater BMPs that have been both successful and unsuccessful in the Denver area.** The Project Team spent several days in the field visiting BMP sites in Denver. The strengths and weaknesses observed at these sites have been incorporated into the recommendations and strategies identified in this Plan. Photographs of many of these BMP sites are interspersed throughout this document.
- ▶ **Review of new stormwater BMP technology and approaches for potential applicability to Denver.** Policy statements on new BMP technology such as underground proprietary treatment devices have been developed and provided in Chapter 6. Approaches that manage runoff close to the source and promote infiltration through landscape-based strategies are explored for more extensive application in the Denver area. Terms commonly used for these approaches include Minimizing Directly Connected Impervious Area, Smart Growth for Clean Water, and Low Impact Development. Circumstances under which new approaches may be considered are also identified.
- ▶ **Development of practical stormwater quality BMP implementation guidelines.** As a result of the initial project tasks described above, the most significant need identified was practical guidance for implementing and managing stormwater quality in Denver. Chapters 6 and 7 provide this guidance, with the Stormwater Quality BMP Implementation Guidelines further summarized below.
- ▶ **Accommodation of periodic updates and revisions.** Denver recognizes and intends that this Plan will be a “living” document that will need to be updated periodically to reflect changes in the Denver area, BMP technology, and various regulations and policy shifts. These updates will be posted on Denver’s web site, www.denvergov.org. The principles of adaptive management apply to this plan, as is the case for many related Denver planning documents.

STORMWATER QUALITY BMP IMPLEMENTATION GUIDELINES

A top priority identified through departmental interviews and Project Advisory Committee input was the need to provide clear guidance on how stormwater quality management could be effectively accomplished in a variety of development settings. To accomplish this task, the Project Team worked closely with the Project Advisory Committee to develop stormwater quality management strategies for seven common development types, including Ultra Urban, High Density Mixed Use, Campus, Industrial, Low Density Mixed Use, Residential, and Parks and Open Space Natural Areas. The Plan provides design recommendations for these development types addressing several factors:

1. Runoff reduction techniques to decrease runoff volume and reduce the Water Quality Capture Volume² requiring treatment.
2. BMPs to treat the Water Quality Capture Volume appropriate for the development type.
3. Flood detention methods to attenuate peak runoff from larger storm events on site.
4. More in depth guidance on specific aspects of BMP implementation.

Sketches and photographs showing how design recommendations can be implemented on typical development sites help to communicate effective stormwater management strategies for the various development types. The Plan's recommended strategies build upon the BMPs in the Urban Drainage and Flood Control District's (UDFCD's) *Urban Storm Drainage Criteria Manual, Volume 3*.

Stormwater quality BMP implementation guidelines for the various development types are further supplemented by implementation details for topics such as roof runoff treatment, stormwater management in parking lots, stormwater runoff distribution approaches, sediment removal traps and forebays, planting/vegetation considerations, and soils. BMP fact sheets describing grass buffers, grass swales, porous pavement, porous pavement detention, porous landscape detention, detention basins, and other approaches are also provided. Although detailed design guidance in the *Urban Storm Drainage Criteria Manual, Volume 3* (UDFCD 1999) is not reproduced in this Plan, the fact sheets provide practical supplemental information for the BMPs on topics such as typical applications, operation and maintenance considerations, landscape considerations, retaining walls, vehicular access, outlets, etc. The final portion of Chapter 6 provides suggestions for better integrating BMP maintenance into stormwater quality planning and provides specific recommendations for maintenance of various BMPs.

RECOMMENDATIONS AND CONCLUSIONS

As is the case with cities throughout the country, Denver is faced with complex regulatory requirements with regard to water quality. Denver's Phase I Colorado Discharge Permit System (CDPS) permit specifies stringent requirements with which Denver must comply or face significant penalties. Fortunately, Denver already has many sound water quality requirements in place in the form of policies and regulations. Specific action items requiring additional work that are not currently included in existing Denver departmental programs are highlighted in Exhibit ES.3. An overall summary of recommendations for on-going and future water quality protection efforts by Denver follows.

² The Water Quality Capture Volume is the quantity of stormwater runoff that must be treated in stormwater quality BMPs in Denver. This volume is equivalent to the runoff from an 80th percentile storm, meaning that 80 percent of the most frequently occurring storms are fully captured and treated and larger events are partially treated. In simple terms, this quantity is about half of the runoff from a 2-year storm.

1. All new and redevelopment projects must address water quality in their development plans, complying with the stormwater policies and design criteria specified in the *Urban Storm Drainage Criteria Manual, Volumes 1-3* (UDFCD 1999, 2001) and in Denver’s CDPS permit. Particularly critical is the four-step BMP planning process that requires:

- ▶ Implementing stormwater runoff reduction practices.
- ▶ Providing treatment of the Water Quality Capture Volume.
- ▶ Implementing streambank and channel stabilization techniques for any drainageways within or adjacent to a project site.
- ▶ Providing additional treatment for pollution “hot spots.”

2. Under Denver’s CDPS permit, adverse impacts to receiving waters posed by urban stormwater discharges must be minimized to the “maximum extent practicable.”³ Examples of these adverse impacts can include increased pollutant loading, increased runoff rates and volumes, channel instability, modification of aquatic habitat and increased sediment loading, both during and after construction. It is essential to recognize that, despite the best efforts to control stormwater runoff, there will be some change in receiving water characteristics due to development; therefore, a “zero impact” policy is not realistic or attainable. As a result, Denver advocates management of stormwater through the implementation of BMPs designed in accordance with the guidelines established by UDFCD (UDFCD 1999, 2001), as summarized in #1, above.

**EXHIBIT ES.3
NEW ACTION ITEMS**

UPDATE DENVER’S *STORM DRAINAGE CRITERIA MANUAL* AND STORMWATER QUALITY CONTROL PLAN GUIDANCE TO REFLECT THE POLICIES, STRATEGIES AND RECOMMENDATIONS OF THIS PLAN

UPDATE DENVER’S STORM SEWER EASEMENT AND INDEMNITY AGREEMENT TO IDENTIFY SPECIFIC BMP MAINTENANCE REQUIREMENTS

EXPAND INTERDEPARTMENTAL AND CITYWIDE PUBLIC EDUCATION ON STORMWATER QUALITY MANAGEMENT

CONDUCT A FEASIBILITY STUDY OF POTENTIAL REGIONAL STORMWATER QUALITY FACILITY LOCATIONS

COMPLETE REGIONAL BMP FINANCING ALTERNATIVES ANALYSIS

CONDUCT WATERSHED-BY-WATERSHED WATER QUALITY ASSESSMENTS

DEVELOP EASY-TO-UNDERSTAND BMP MAINTENANCE GUIDANCE DOCUMENT(S)

SPONSOR PILOT-TESTING OF INNOVATIVE BMPS IN DENVER

³ See the Glossary for the regulatory definition of “maximum extent practicable.”

3. Denver will continue to advocate the use of multiple BMPs, including non-structural measures, source controls, and structural BMPs, to reduce stormwater pollution. Whenever practicable, combining BMPs in series can be very effective in reducing stormwater pollution.
4. The stormwater quality BMP implementation guidelines provided in Chapter 6 of this Plan will be shared with developers and city staff alike to promote better integration of water quality into site designs, including more substantial use of runoff reduction techniques.
5. Denver will work to ensure that water quality is addressed in the very beginning of the site development process so that stormwater quality BMPs are better and more cost effectively integrated into site designs. Various Denver departments (e.g., Public Works, Planning, Parks, Environmental Health) must work together with a shared vision of stormwater quality management to accomplish this goal.
6. Urban stormwater management must be an integral part of site design and take into consideration multiple objectives. As stated in the *Urban Storm Drainage Criteria Manual, Volume I* (UDFCD 2001), the many competing demands placed on space and resources require that stormwater management strategies take into account water quality enhancement, groundwater recharge, recreation, wildlife habitat, wetland protection, protection of landmarks/amenities, control of erosion and sediment deposition, and creation of open space. In addition, the appearance of BMPs is particularly important; Denver will expect to receive site development plans that feature attractive BMPs that will be viewed as assets by the community. Denver will encourage multi-purpose usage of BMPs; however, compatibility among uses must be demonstrated (e.g., compatibility between recreational areas and detention areas).
7. Planning for water quality must proceed hand-in-hand with drainage planning for quantity (rate and volume). In urban areas, these two planning efforts are inseparable. When these issues are addressed together and early in the site planning process, more efficient, economical and attractive land uses generally result.
8. Denver will continue to review BMP designs for public safety and maintenance accessibility, maintainability, documentation of maintenance requirements and schedule, and assured long-term funding for maintenance. Proper maintenance is fundamental to public safety and long-term effectiveness of stormwater BMPs; therefore, Denver will take these steps to promote better long-term maintenance of BMPs:
 - ▶ Require inclusion of a simple BMP maintenance plan as part of Denver's Stormwater Quality Control Plan submittal requirements.
 - ▶ Require a legally binding description of BMP maintenance requirements and arrangements as part of development plan approval.
 - ▶ Clearly identify BMP maintenance requirements in forthcoming updates to Denver's *Storm Drainage Criteria Manual*.

- ▶ Prepare easy-to-understand maintenance guidance documents and brochures for both public and private facility owners. These documents will be based on maintenance recommendations of UDFCD and the guidelines provided in Chapter 6 of this Plan.
9. The same stormwater quality management expectations and practices that apply to projects in the private sector also apply to projects that are the responsibility of Denver, such as buildings, parks, streets, utilities, etc. When Denver is preparing plans for any such projects or managing, maintaining and/or upgrading existing facilities, potential adverse stormwater quality effects must be evaluated and suitably mitigated.
 10. Denver will continue to actively participate in regional water quality management efforts such as those being conducted by South Platte Cooperative for Urban River Evaluation (CURE), the Cherry Creek Basin Stewardship Partners, and the Barr Lake-Milton Reservoir Watershed Group. These on-going efforts emphasize the importance of Denver partnering with neighboring communities to tackle difficult water quality issues. Denver must also stay abreast of forthcoming regulatory changes that affect management of the many lakes and streams within its boundaries.
 11. Denver's stormwater management strategies must be consistent with the principles, criteria, and priorities in its multiple planning and technical criteria documents, as described in Chapter 4.
 12. Denver will work to remove obstacles to innovative stormwater management approaches by reviewing regulations and codes and, where practical, modifying requirements that conflict with the principles of this Plan. For example, such conflicts may arise with regard to parking lot and curb and gutter design requirements relative to some Low Impact Development approaches.
 13. Denver will continue to promote managing and treating stormwater quality using aboveground facilities, rather than in subsurface, "vault-type" treatment devices. Nevertheless, Denver recognizes that there are some cases where the use of such facilities is necessary due to extreme space constraints in smaller redevelopment sites, such as those located in the downtown area.
 14. Denver will evaluate the feasibility of collaborating with UDFCD, a university, other local governments, and other organizations to pilot-test innovative BMPs. Denver will continue to actively partner with UDFCD to develop design guidance for "new" BMPs for the Denver area.
 15. Denver will continue to educate the public on stormwater quality issues. Additional opportunities for Denver's existing public education program include:
 - ▶ Provide additional educational brochures and water pollution prevention resources on the Denver website. For example, as discussed in Chapter 5, many of the national case studies provide extensive web resources.

- ▶ Develop pollution prevention programs for specific industries that require further attention and/or partner with entities providing existing programs. For example, the City of Boulder’s Partners for a Clean Environment (PACE) program targets and provides educational information to specific industry segments including auto repair, auto body, green building, dental offices, dry cleaning, landscaping, manufacturing, printing, restaurant, and retail sectors. The City of Portland has a similar program. As an alternative to independently developing such programs, Denver can partner with professional organizations and industry groups to support their efforts in this type of training.
 - ▶ Educate developers and Denver staff on the benefits of land management strategies such as open space/natural areas preservation and/or restoration, riparian buffer zone protection, Smart Growth, Green Development, and Low Impact Development strategies.
 - ▶ Continue educational campaigns on specific measures to minimize pollution at its source. These efforts will include a multi-faceted approach directed to the public, Denver staff and elected officials, and neighboring communities.
16. Based on an initial reconnaissance level evaluation (as described in Chapter 8), there are promising opportunities for regional water quality BMPs, including large retention basins and wetlands, that could reduce impacts to downstream receiving waters. Methods to finance the development and maintenance of these facilities are urgently needed. In addition, Denver will proceed with more detailed citywide planning to identify and prioritize regional BMP alternatives. As a part of any regional facility evaluation, it will be important to clearly define under what circumstances a developer can have their requirement for onsite water quality treatment waived (e.g., paying a fee-in-lieu-of treatment) due to regional treatment facilities.
17. Closely related to regional water quality facilities is the need to conduct a watershed-by-watershed evaluation of current stream and lake conditions, including steps that are necessary to improve the status quo. The purpose of such an evaluation is to identify watershed-specific goals, priorities, data gaps and practicable mitigation measures that could be developed to strategically improve conditions. It is logical to focus initially on 303(d)-listed streams (i.e., those that are considered to be “impaired” for one or more pollutants) and to work closely with existing efforts such as those of South Platte CURE, the Barr-Milton Watershed Group, and Denver Public Works and Environmental Health.
18. Denver will continue to monitor approaches used throughout the country related to stormwater and watershed management. Lessons learned from case studies evaluated in this Plan will be kept in mind during decision-making and planning for Denver. Examples of common themes from communities with advanced stormwater programs include:
- ▶ Comprehensive approaches are being used to address drainage, flooding, erosion, aquatic life, native habitat, and water quality in an integrated manner.

- ▶ Watershed-based approaches are being used for planning and problem solving.
- ▶ Geographic Information System (GIS) tools are being used effectively to prioritize stormwater improvements and to more effectively communicate to citizens, staff, and developers.
- ▶ Storm runoff volume reduction practices are being used in many of these communities. These practices include a variety of runoff reduction techniques such as grass buffers and swales, green roofs, and other landscape-based approaches.
- ▶ The importance of sound long-term maintenance of BMPs is widely recognized, as is the need to provide public safety at drainage facilities.
- ▶ Strong public education and outreach campaigns in combination with extensive web sites are substantive components of these programs. Education is being aggressively used as a key strategy to improve runoff quality.
- ▶ Significant financial investments, often measured in millions of dollars, have been required for many communities to conduct their stormwater quality planning efforts. These communities recognize that comparable future expenditures will be required to implement their plans, and are implementing suitable methods of financing.

19. Because the water quality challenges facing Denver will require significant funding, new and potentially innovative financing strategies that capitalize on public/private partnerships will be investigated.

20. Although this Plan provides a solid framework and foundation for effective stormwater quality management in Denver, follow-up implementation measures are needed to ensure that the principles and practices set forth in this Plan are implemented throughout Denver. An initial implementation plan specifying target timeframe, activities, responsible departments, and approximate costs has been developed in Chapter 9 of this Plan.

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