

# 1. INTRODUCTION

## 1.1 PROJECT PURPOSE

The City and County of Denver is making green infrastructure a fundamental part of the city's long-term stormwater management strategy by looking at ways to incorporate large-scale green infrastructure with small or site-scale green infrastructure. On a large-scale, green infrastructure refers to a network of parks, open spaces, drainageways, and floodplains which help mitigate the impacts caused by impervious (hard) surfaces. Impervious surfaces disrupt the natural infiltration of water and increase both the volume and peak rate of stormwater runoff which leave urban watersheds prone to flooding, erosion, and increased pollution levels.

Site-scale green infrastructure refers to smaller, engineered, structural practices which are necessary to mitigate the impacts urbanization has on the hydrologic cycle. These systems mimic larger natural systems and use vegetation, soils, and roots to slow and filter stormwater runoff. Site-scale green infrastructure best management practices (BMPs) are the focus of these guidelines and fact sheets for streetside stormwater planters, bumpout stormwater planters, green gutters, green alleys, and tree pit/tree trenches are discussed. The fact sheets and conceptual construction details herein provide the user with technical guidance for designing, installing, and maintaining site-scale green infrastructure. Benefits of green infrastructure, regardless of scale, include improved air and water quality, reduced flooding risks, urban heat island effect mitigation, reduced energy demands, climate change resiliency, and enhanced community livability.

Each practice within these guidelines has been chosen for its suitability in Denver's ultra-urban environment and in particular for use in the right-of-way (ROW). Treating street runoff is critical to improving the health of Denver's urban waterways. Not only are streets a major source of stormwater runoff, they also represent the largest source of urban pollutants including sediment, heavy metals, automotive fluids, nutrients, and trash. As part of the stormwater conveyance system, roads collect and carry runoff directly to the underground storm drain

network which then pipes these pollutants directly to receiving waterways, often without treatment. While the road network represents one of the largest urban pollution and runoff sources, it also represents one of the best opportunities for the use of site-scale green infrastructure. These practices can be used on new streets and during repaving or reconstruction of streets, alleys, medians, and parking lots.

Each practice in this guide is also suitable for use on ultra-urban private residential and commercial development and redevelopment. Green infrastructure can enhance the livability of a space, increase property values and retail sales when integrated seamlessly into courtyards, plazas, and other public spaces.

## 1.2 AUDIENCE

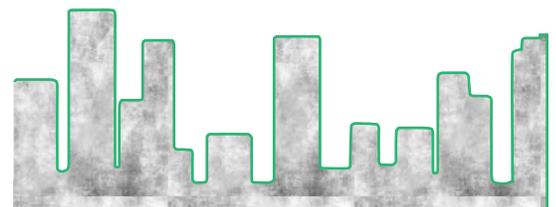
The practices illustrated in these guidelines build upon the practices discussed in Urban Drainage and Flood Control District's (UDFCD) Urban Storm Drainage Criteria Manual, Volume 3 (USDCM's Vol. 3) and were created to provide guidance for city staff, engineers, planners, landscape architects, and developers for use on both public and private projects where space is limited. These guidelines provide details that have not been previously approved in Denver and thus is intended to expedite the review and approval process when choosing these practices. Investment from both the public and private sector is needed to achieve the economic and environmental benefits of a green infrastructure program.

## 1.3 REGIONAL CONSIDERATIONS

Special consideration has been given to providing guidance suitable for Denver's semi-arid climate and unique system of administering surface water rights.

### SEMI ARID CLIMATE

Denver's semi-arid climate requires modifying green infrastructure practices adopted from other U.S. locations. Stormwater controls typically must be xeriscaped with a focus



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on native plants, because they use less water and perform better in the semi-arid environment. A mix of North American natives can be utilized to develop a plant palette that will tolerate both periodic flooding and drought. Though native species will likely need supplemental irrigation during establishment, nonnative plants generally will not survive without irrigation (WEF 2014).

Additionally, rain events in Denver tend to be high intensity and infrequent, resulting in a water quality event that is heavy with sediments and other pollutants that have accumulated since the previous storm. As a result, forebays, presedimentation basins or other forms of pretreatment are recommended to remove some of the particulate matter before it reaches the green infrastructure facility.

### **SURFACE WATER RIGHTS**

Surface water in Colorado is administered through a priority system, the Doctrine of Appropriation, where “first in time” equals “first in right.” Water users with earlier water rights decrees (senior rights) have first right in times of short supply and can fill their needs before the junior rights users can begin to use water. The Colorado Division of Water Resources (DWR) administers this program and in 2011 circulated a memorandum titled “Administrative Approach for Storm Water Management.” This document details what administrative allowances the State is currently willing to make to accommodate detention and infiltration as stormwater management activities. Specific limitations state that stormwater detention and infiltration areas must release all the water detained from the site within 72 hours of the end of the precipitation event, should be designed to release the water from the site as quickly as downstream conditions allow, and must be designed to minimize consumption from vegetation.

