Edmonds Green Streets Guide

CITY OF EDMONDS
WASHINGTON

Prepared by: MIG

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Introduction to Green Streets

WHAT ARE GREEN STREETS?

Green streets are streets designed with nature in mind. They include features like trees, plants, and special pavements that help manage stormwater more naturally. Green streets improve our environment by reducing flooding, cleaning the air, and making our neighborhoods more enjoyable to walk and bike in.

Safe

Green Streets are places where all users feel comfortable.

Inclusive

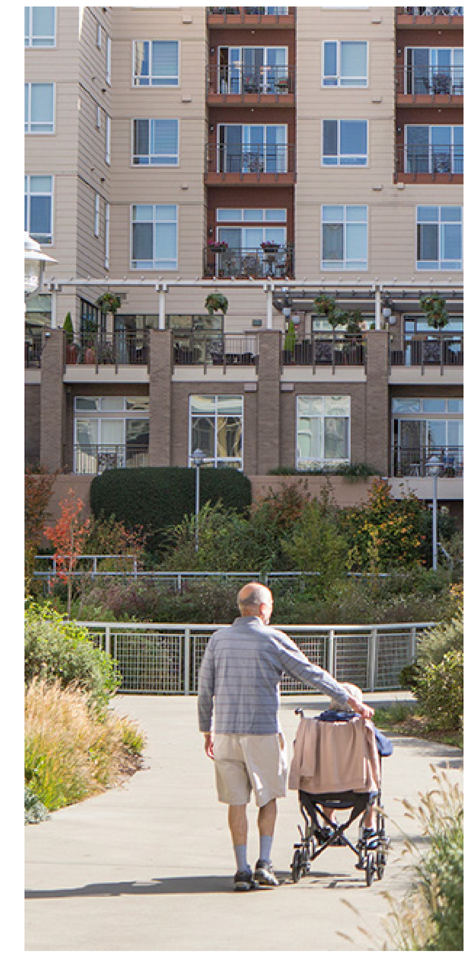
Green Streets are for people of all ages, abilities, races, cultures, genders, and income levels.

Healthy

Green Streets encourage healthy lifestyles for community members throughout the region.

Natural

Green Streets provide a healthy balance between the urban environment and the natural systems.



Accessible

Green Streets provide transportation and recreation access for all.

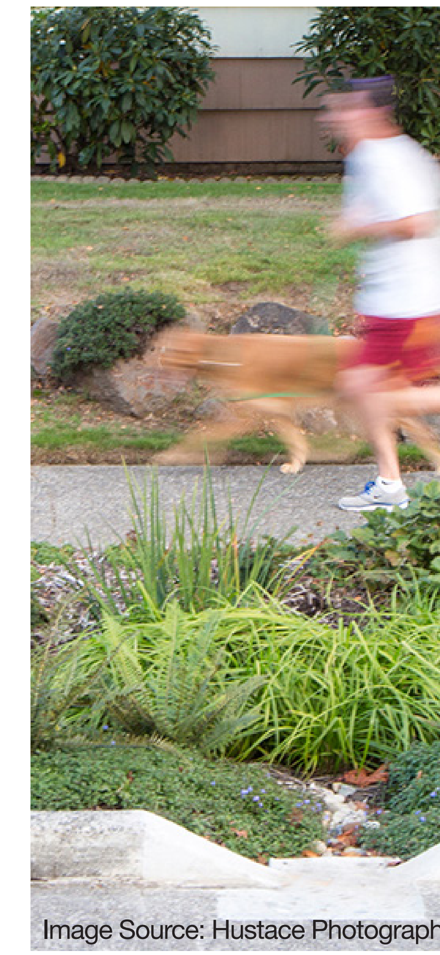


Image Source: Hustace Photography

Vibrant

Green Streets stimulate economic activities and sustainable, context-sensitive development.

WHAT ARE THE BENEFITS OF GREEN STREETS?

MULTIPLE SUSTAINABILITY GOALS WITH A SINGLE INVESTMENT

Environmental

Stormwater Management

Various strategies are used to manage stormwater runoff effectively and reduce the strain on existing drainage and sewer systems.

Water Quality

Strategies absorb and filter rainwater, reducing the burden on traditional drainage infrastructure and helping to replenish groundwater.

Urban Greening

Integrating vegetation and urban green spaces provides shade, reduces air pollution, reduces the heat island effect, supports urban biodiversity, and/or capture stormwater and provide biophysical processes for the treatment of it.

Transportation

Pedestrian-Oriented Design

Prioritize the safety and comfort of pedestrians. Accessible space for walking, cycling, and social interactions. Traffic-calming measures enhance safety.

Sustainable Transportation

Promote alternative modes of transportation such as walking, cycling, and public transit to reduce reliance on private vehicles.

Health

Active Lifestyle

Encourage active lifestyles and fun, healthy living by creating attractive, safe and accessible streets and green spaces.

Benefits of Nature

Provide improved air and water quality, reduced heat island effect, enhanced mental well-being, and increased opportunities for physical activity and social interaction.

Community & Development

Sense of Place

Foster a unique experience and identity along city streets to establish a sense of place for the community.

Community

Engaging community partners fosters a sense of ownership and pride in the green street.

Economic Development

Promote balanced development to create an inclusive and prosperous economy for the community. Proximity to green streets can boost property values, making neighborhoods more attractive.

Note: Section 502 of the Clean Water Act (CWA): "Green infrastructure means the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters."

Green Stormwater Infrastructure as a Foundation for Green Streets

BACKGROUND

Urbanization and land development have significantly altered natural hydrological processes. The removal of historic forests for development and extensive use of hard surfaces, like roads, parking lots, and rooftops, has disrupted the natural infiltration of rainwater into the ground, leading to increased stormwater runoff volumes and peak flows. This alteration of the hydrological cycle has resulted in more frequent and severe flooding events, accelerated erosion, and pollution into waterbodies.

Uncontrolled stormwater runoff can have significant consequences. Excessive runoff can lead to localized flooding, erosion of soils and stream banks, and the impairment of water quality in rivers, lakes, and coastal areas. Unmanaged stormwater can carry pollutants such as sediment, nutrients, chemicals, and bacteria, leading to adverse impacts on aquatic ecosystems and human health. Non-point source pollution is a significant contributor to water quality degradation, as it includes pollutants like sediments, fertilizers, pesticides, oil, and grease.

Additionally, rapid runoff can overwhelm stormwater and sewer systems, resulting in costly damage to roads, buildings, recreation, and livelihoods. Many older cities have combined sewer systems that collect both sanitary sewage and stormwater runoff in the same pipes. During heavy rain events, these systems can become overwhelmed, leading to combined sewer overflows (CSOs). CSOs discharge untreated sewage and stormwater directly into water bodies, posing significant health risks and degrading water quality.

Stormwater management is a crucial aspect of urban planning and development, with the goal of effectively managing rainfall and runoff to minimize negative impacts. Traditional stormwater management primarily focuses on quickly conveying runoff away from developed areas through piped systems, culverts, and detention basins. While these approaches can mitigate flooding to some extent, they often fail to address water quality concerns adequately. Moreover, traditional stormwater infrastructure alone is not designed to handle the increasing volume and intensity of rainfall associated with climate change.

Green stormwater infrastructure (GSI) refers to a range of stormwater management practices that mimic natural processes to effectively manage runoff. It includes features such as permeable pavement, bioretention cells, rain gardens, bioswales, green roofs, and urban forests. GSI promotes infiltration, captures and treats stormwater, and reduces runoff volume and peak flows. It helps to recharge groundwater, enhance water quality by filtering pollutants, and mitigate the impacts of urban heat islands. Additionally, GSI provides numerous co-benefits, including improved air quality, increased urban biodiversity, enhanced aesthetics, and community engagement.

Section 502 of the Clean Water Act (CWA) states "Green infrastructure means the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters."

By integrating GSI into urban landscapes, cities can achieve more sustainable stormwater management, reduce flooding risks, protect water resources, and create healthier, more resilient communities.

Excessive runoff can lead to localized flooding.
Image Source: The Daily Advisor

Rain events can overwhelm infrastructure, causing damage.
Image Source: WCHS News

Untreated sewage and stormwater flows into water bodies.
Image Source: iStock

Uncontrolled runoff can have many negative impacts.
Image Source: Jacob Fenston, WAMU

Case Studies

High Point Green Stormwater Infrastructure (Neighborhood)

Seattle Housing Authority's award-winning High Point redevelopment of 120 acres in the City of Seattle is a national example of urban neighborhood renewal and integration of GSI throughout all aspects of the redevelopment of streets and housing. The site was originally developed in the 1940s for housing during World War II, converted to subsidized housing units for SHA in the 1960s and then redeveloped in the 2000s from 716 housing units to mixed income community with 1,600 housing units, commercial, senior housing, community services, parks, and open space. Prior to redevelopment of the street grid and housing in the 2000s, there were limited drainage collection systems with no water quality or flow attenuation/detention stormwater systems prior to discharge into Longfellow Creek. Sidewalks were limited and traffic speeds along the street network were of concern for the residents. During heavy rain events, due to aging stormwater infrastructure, urban flooding would occur within the streets.

The High Point drainage basin is 8% of Seattle's Longfellow Creek Watershed and the Creek is a Coho salmon-bearing stream within the city. With the goal of having a net positive impact to the environment, MIG worked with Seattle Housing Authority (SHA) and Seattle Public Utilities (SPU) to develop a natural drainage system that runs through the entire development, helps manage the smaller rainstorms, improves the health of Longfellow Creek, and provides several community and environmental benefits.

The system is integrated into the housing sites and new street layout, creating a network of porous pavements, rain gardens, mature tree retention, two miles of vegetated and grass-lined bioretention swales underlain by amended soil that helps attenuate the impacts of small storm events on the Longfellow Creek basin and a 16-acre foot stormwater detention pond for flood control.

This neighborhood GSI project increases overall watershed health by intercepting stormwater through impervious surfaces, capturing and treating that stormwater, then infiltrating it back into the ground. This process also reduces the volume of water entering the sewer system by lowering runoff, promoting ground infiltration, and filtering pollutants to improve water quality. These collective benefits also minimize strain on the stormwater infrastructure.

In addition, the integration of GSI has enhanced the visual appeal and livability of the High Point neighborhood. Residents now enjoy the presence of vibrant rain gardens, and the ecological benefits of native plants and increased urban greenery.

The project demonstrates the transformative impact of GSI in urban environments. It displays the potential for sustainable stormwater management in addressing runoff challenges, while also creating healthier, more resilient communities that harmoniously coexist with their natural surroundings.

BEFORE GSI

BEFORE GSI

AFTER GSI

AFTER GSI

Winslow Way Street Planning, Design & Construction (Main Street)

The Winslow Way Street Planning, Design and Construction project in Bainbridge Island, Washington, highlights the successful integration of GSI into a vibrant downtown main street. Prior to the project, Winslow Way faced numerous challenges related to stormwater management, pedestrian safety, and overall streetscape quality.

Located in Bainbridge Island's commercial district, Winslow Way suffered from aging infrastructure, limited pedestrian amenities, and inadequate stormwater management systems. The area experienced issues with stormwater runoff, including localized flooding, water pollution, and strain on the existing infrastructure.

To address those challenges and revitalize the downtown area, the City of Bainbridge Island embarked on a comprehensive street planning, design, and construction project for Winslow Way. The project aimed to enhance pedestrian safety, improve the streetscape, and implement sustainable stormwater management practices to better reflect community values.

Working closely with the City of Bainbridge Island, MIG helped realize the City's vision of creating a vibrant pedestrian downtown environment that enhances multimodal and multiuse activity. The design program for this half-mile of roadway addressed the reconstruction of failing utility infrastructure (including water, sewer, and drainage), relocation of overhead utilities, intersection improvements, and the introduction of GSI systems. The design reflected community values by providing wider sidewalks, gathering areas, bike facilities and other site amenities while addressing overall accessibility. Since the design's completion, Dan Burden of the Walkable and Livable Communities Institute called Winslow Way "one of the best remade streets I've seen anywhere in America."

The GSI features installed along the project corridor consisted of stormwater planters, rain gardens, swales, permeable pavement, and new street trees with tree soil cells. The GSI intercepts runoff from impervious surfaces to capture and treat stormwater before discharging via underdrains to the existing storm drain system. The GSI facilities also provide flow attenuation by slowing the release of stormwater to the storm drain system.

In addition to the pedestrian amenities the project installed new street lighting (catenary and pedestrian) and public art installations further contributed to the aesthetic appeal and vibrancy of the area.

The project has had a transformative impact on the downtown area of Bainbridge Island. The integration of GSI and streetscape improvements have significantly improved stormwater management, enhanced landscaping in the public realm, created a safer and more inviting environment for people to walk, supported local businesses, and brought additional economic and social benefits to the community.

BEFORE GSI

AFTER GSI

Maynard Avenue Green Street (Sidewalk)

The Maynard Avenue Green Street project in Seattle, Washington, has successfully transformed a fully paved street from edge to edge. The project integrated the need to maximize parking and vehicular movement with a sustainable green connection that also effectively manages stormwater and enhances the overall pedestrian experience.

Prior to the implementation of green infrastructure, the area faced significant stormwater challenges and lacked adequate pedestrian amenities. Located in the heart of Seattle's International District, Maynard Avenue experienced regular flooding and poor water quality due to its outdated stormwater infrastructure and impervious surfaces. The conventional drainage systems were overwhelmed during heavy rainfall, leading to localized flooding and increased pollution in nearby water bodies.

Interim Community Development Association (ICDA) in partnership with the City of Seattle undertook the Maynard Avenue Green Street project to incorporate green infrastructure elements that would manage stormwater runoff, while improving both the overall aesthetic and functionality of the corridor. MIG was hired by ICDA for both civil engineering and landscape architecture services. The block-long project was funded in part through the Neighborhood Sidewalk Fund and several grants.

For the street retrofit, runoff from the roof of an adjacent building flows into a cistern at the top of the block. The water then flows into a series of stormwater planters, to be slowly filtered and detained before entering the municipal system. The sidewalk was also widened and seat walls with integrated art were created, which improves access and provides resting spots for pedestrians making the climb up the 16% street grade. Plantings were selected that blend with the character of the International District neighborhood's historical roots. MIG coordinated with the urban designer and several artists in developing the integrated site concept and art elements, which include photo tiles and a kiosk.

The implementation results of these green infrastructure and pedestrian enhancements include effectively managed stormwater runoff and a transformation of the corridor space connecting with the Danny Woo Garden. The project has revitalized Maynard Avenue as an attractive, pedestrian-friendly environment that encourages walkability. The widened sidewalks and added amenities have created a more comfortable and inviting atmosphere for residents, visitors, and businesses alike. The greening of the corridor has also contributed to the beautification of the neighborhood and enhanced the overall quality of life.

BEFORE GSI

AFTER GSI

How To Use This Document

Purpose of the Guide

The City of Edmonds Green Streets Guide is a set of recommendations to promote sustainable and environmentally-friendly urban development in the City of Edmonds. Developed in 2022-2023, this guide is part of the Reimagining Streets + Neighborhoods Initiative, which aims to enhance and expand public open space, and to create equitable connections within the city. Part of the initiative includes nine proposed street typologies (by others) that consider vehicle movement, as well as social, environmental, and economic needs and functions. This document provides information to help create streets and public spaces that prioritize sustainable stormwater management, pedestrian safety, promote sustainable transportation options, and enhance urban greenery. This guide intends to serve as a resource for the City of Edmonds to inform future planning, design, and construction of Green Streets within the city.

The guide has been developed in response to a request by the City of Edmonds, who had previously engaged MIG to develop a Citywide Green Streets Network Map (Figure 1, Pg. 14; Appendix, Pg. ii). This map identifies key areas appropriate for incorporating GSI into the urban fabric of the City to enhance pedestrian connectivity between the downtown core and surrounding neighborhoods.

Cars navigate a flooded Dayton Street in the City of Edmonds. Image Source: My Edmonds News

Heavy rains flooded the Harbor Square Business Complex in the City of Edmonds. Image Source: My Edmonds News

Creation of the Edmonds Green Streets Network

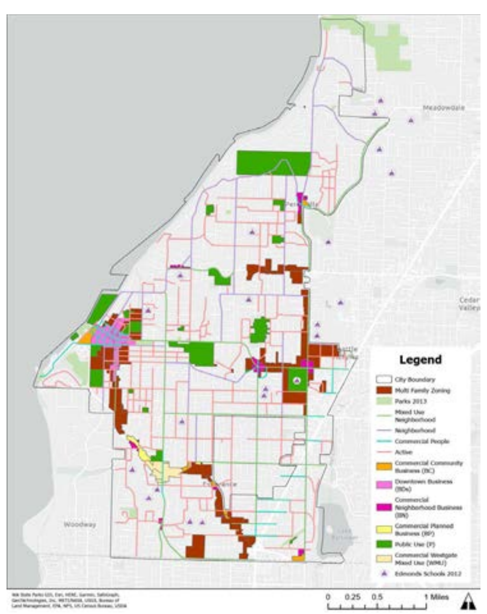
The objective of the Green Streets Network Map (GSN Map) is to establish a citywide map to identify streets suitable for implementing green stormwater solutions, with a focus on enhancing pedestrian connectivity between the downtown core, neighborhoods, and key community amenities. The GSN Map will assist the city to determine areas of the proposed street typologies to apply a Green Street overlay.

Creating the GSN Map involved gathering relevant data to establish criteria that would determine which street segments are included in the network. This included mapping streetscape typologies, zoning designations, locations of multi-family housing, slopes under 8%, proximity to schools and parks, watersheds feeding freshwater creeks and streams, urban tree canopy coverage, and available right-of-way for expanded pedestrian and green infrastructure elements.

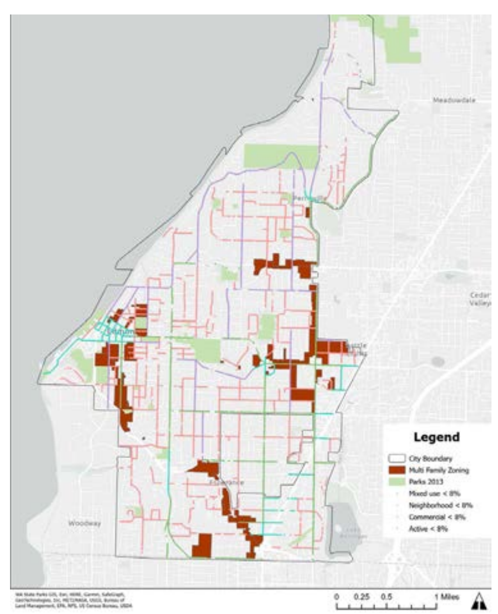
Locations were deemed suitable for green stormwater infrastructure through a process of overlaying and analyzing various layers of data listed in this section. The analysis identified gaps in the network where areas lacked urban canopy or pedestrian connections, such as between multi-family housing to parks and schools. The process excluded streets with slopes exceeding 8% due to potential issues with stormwater drainage and pedestrian accessibility.

The mapping process primarily relied on GIS data; no field assessments or site visits were conducted. The following is a list of data provided by the City of Edmonds to develop the criteria for and inform the development of the GSN Map:

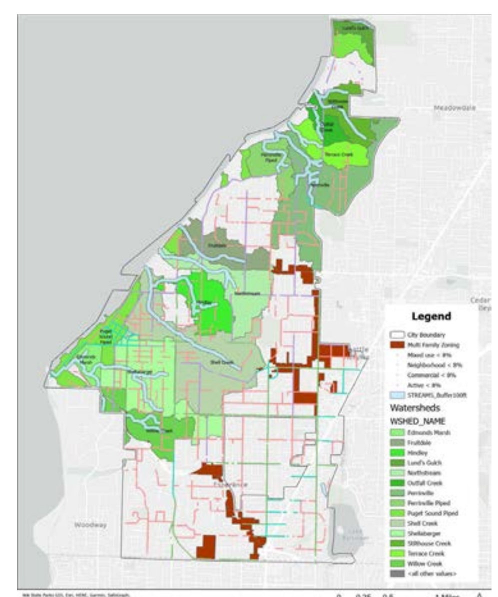
- Street Typologies: Part of the Reimagining Neighborhoods + Streets Initiative included nine proposed street typologies developed by others. Through coordination with city staff during the planning process, four typologies are included in the Network Map: Mixed Use Neighborhood Street, Commercial People Street, Neighborhood Street, and Active Street
- Zoning: The GSN Map prioritizes connections between commercial and business zones, multi-family zones, and priority destinations.
- Key Community Connections: Priority destinations include those that serve community such as schools, parks, and public use facilities.
- Watersheds: Stormwater runoff from roads can be a significant source of pollutants that are harmful to the aquatic habitat. Streets located in watersheds that feed freshwater creeks and streams are prioritized to slow and treat stormwater before it enters waterways.
- Urban Tree Canopy: Streets with less existing tree canopy are prioritized to expand the overall urban tree canopy in the City of Edmonds.
- Topography: Streets with a slope under 8% are prioritized to enhance the pedestrian environment and allow for a broader range of GSI best management practices and facilities.
- Excess Right-of-Way (ROW): The existing condition ROW for streets in the City of Edmonds are compared to the City's standard ROW dimensions (and proposed street typologies) to identify locations that support expanded pedestrian infrastructure and GSI elements.



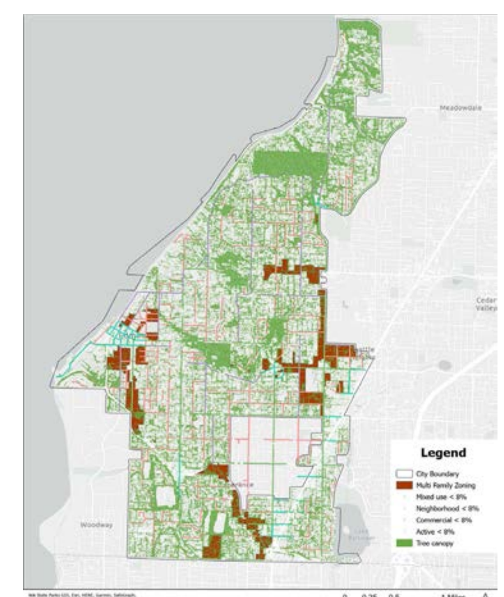
GIS Map: Street Typologies, Zoning & Destinations



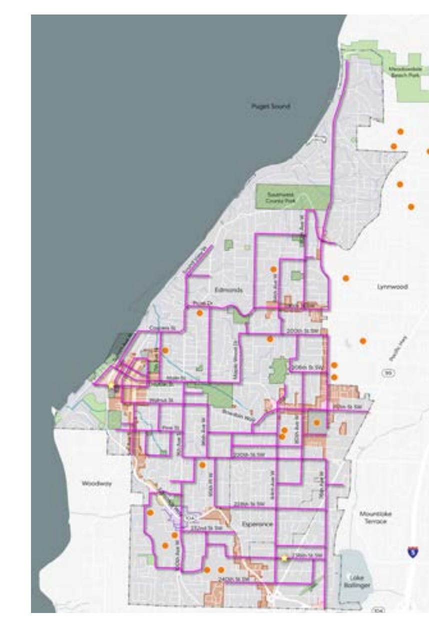
GIS Map: Street Typologies < 8% slope, Multi-Family Zoning & Destinations



GIS Map: Street Typologies < 8% slope, Multi-Family Zoning & Watersheds



GIS Map: Street Typologies < 8% slope, Multi-Family Zoning & Tree Canopy



Green Streets Network Map (see Appendix, Pg. ii, for full size map)

Elements of the Green Streets Network

The GSN identifies key areas appropriate for incorporating green infrastructure into the urban fabric of the city, enhancing pedestrian connectivity between the downtown core and surrounding neighborhoods.

The GSN Map includes:

- City of Edmonds Boundary
- Opportunity to enhance as a Green Street and evaluate for incorporation of GSI
    - » Based on mapping four street typologies (Mixed Use Neighborhood Street, Commercial People Street, Neighborhood Street, and Active Street), key community connections, land use zoning (see below), gaps in urban tree canopy, and slopes under 8%
- Opportunity to maximize ROW as part of Green Street development and evaluate for incorporation of GSI
    - » Based on mapping four street typologies (Mixed Use Neighborhood Street, Commercial People Street, Neighborhood Street, and Active Street), key community connections, land use zoning (see below), gaps in urban tree canopy, slopes under 8%, and excess right-of-way
- Edmonds Schools 2012
- Parks 2013
- Watershed Boundary - Watersheds that feed freshwater creeks and streams
- Edmonds Green Streets Demonstration Site - 10% Design
- Land Use Zoning - Includes the following:
    - » Multi-Family Zoning
    - » Commercial Community Business
    - » Downtown Business
    - » Commercial Neighborhood Business
    - » Commercial Planned Business
    - » Commercial Westgate Mixed Use
    - » Public Use

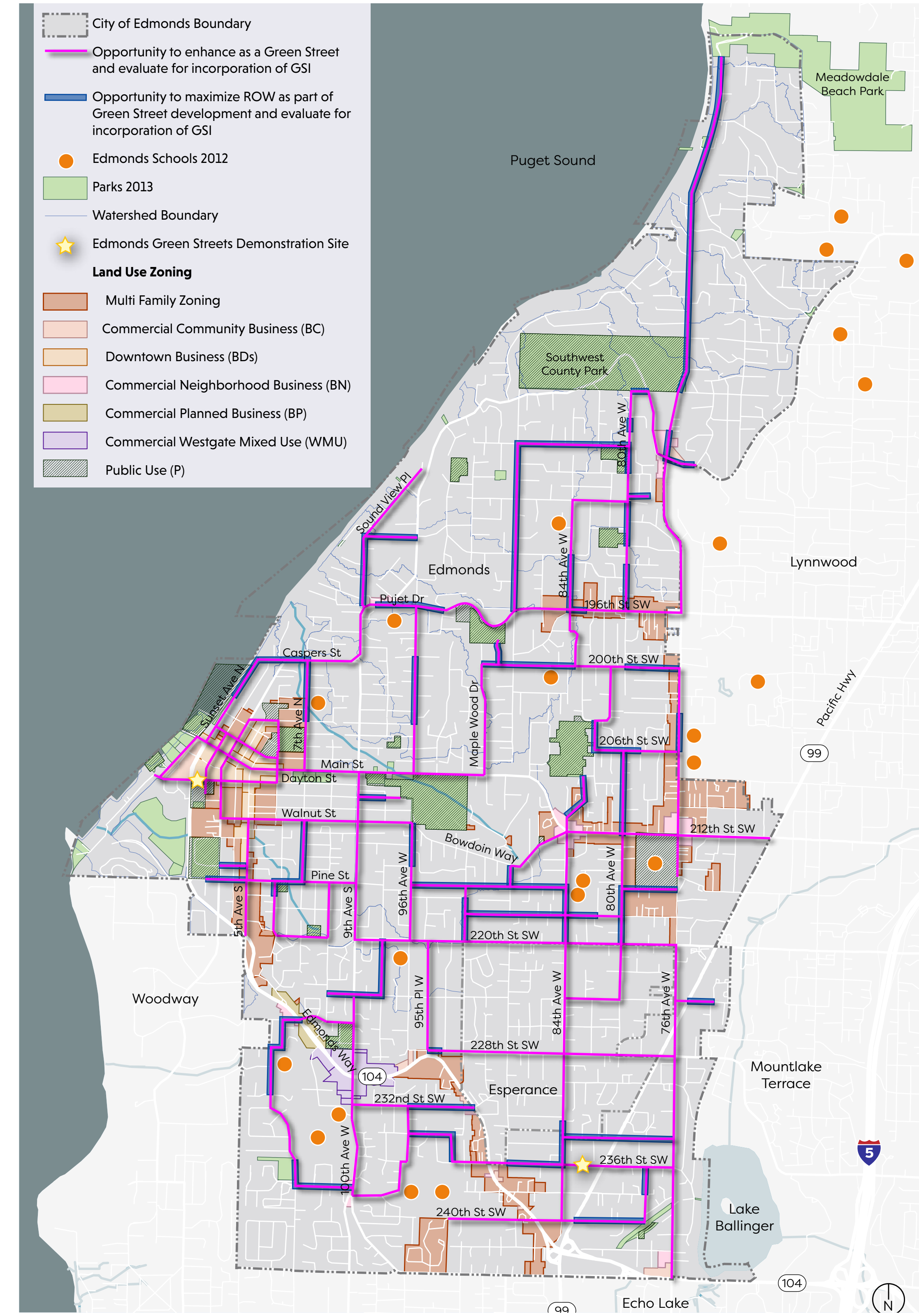


Figure 1: Green Street Network Map (see Appendix page ii for full sized map)

How to Implement the Benefits of Green Streets

Green Stormwater Infrastructure GSI offers flexibility in design and allows for modifications to accommodate various site conditions. Whenever possible, the design focuses on enabling stormwater runoff to infiltrate the ground, replenishing aquifers, and restoring base flows to local waterways. This approach effectively reduces the burden on the storm sewer system during minor storm events.

However, in densely populated urban areas where soil conditions are uncertain and utility conflicts arise, the feasibility and safety of infiltration may be limited. In such cases, GSI is designed to detain and gradually release stormwater runoff into the storm sewer system after the peak of the storm has passed. Both infiltration and detention/slow-release techniques are effective means of managing stormwater runoff during wet weather events.

To utilize the Green Streets Guide, designers, planners, developers, City officials, and property owners are encouraged to follow these steps:

- Review the Green Streets Network Map (Appendix, Pg. ii) and the Edmonds City Code and Community Development Code to understand where the proposed project fits within the network.
- Evaluate the location where the proposed project will be implemented. Consider factors such as existing infrastructure, drainage patterns, pedestrian and vehicle traffic, and any specific environmental considerations.
- Identify which interventions are appropriate to provide GSI and enhance the pedestrian experience at the proposed project site.

SITE CONSIDERATIONS

GSI interventions require careful consideration of site conditions to ensure their effectiveness and longevity.

Soil Infiltration: Conduct soil tests to assess the infiltration capacity.

Utilities: Consult with the city arborist and maintenance staff, to avoid conflicts with power lines and other utilities.

- For areas with overhead power lines, it is important to select street trees based on their mature size and growth habit. Maintain sightlines and provide clearance and setbacks of new street trees for both overhead and underground utilities.
- For areas without overhead power lines or underground power distribution, it may be possible to enhance biodiversity with a variety of tree species chosen based on their suitability to local soil and climate conditions after consultation with the city arborist and maintenance staff.

Right-of-way (ROW): Review the new street typologies introduced by the city to determine specific ROW dimensions for a proposed project location. Assess the ROW to ensure there is adequate and accessible space for all users, as well as GSI. Consider the needs of adjacent property owners and businesses to not negatively impact their operations.

Transit Corridors: Existing bus and bicycle routes should be prioritized.

Plant palettes for different conditions: Consult with city maintenance staff and select plants that are appropriate for the site conditions, including soil type, sun exposure, and moisture levels. Select plant palettes to provide year-round interest, habitat value, and stormwater benefits.

Topography: Assess the slope, elevation changes, and natural features to determine the appropriate stormwater management strategies. Topography influences stormwater flow, drainage patterns, and the feasibility of implementing GSI.

Zoning: Consider the City of Edmonds zoning requirements and restrictions when planning GSI. Zoning regulations play a significant role in determining land use, density, setbacks, and permitted activities within specific areas.

Associated Level of Cost

INDIVIDUAL GREEN STREET KIT OF PART ELEMENTS

The Green Streets Guide uses a three-level rating system to provide an associated level of cost for each Green Streets Kit of Parts element. In the associated level of cost rating system, each $ represents a specific cost range or price bracket, with $$$ indicating the highest or most expensive level. The system provides a simplified and standardized way to convey the expected expense associated with a particular item or experience. This rating system is designed to help planners gauge the relative cost and affordability of elements. An engineers final evaluation and review of existing site conditions will determine the most cost effective way to implement green street features and treat or handle the greatest amount of stormwater feasible.

\$

Signifies a lower cost or budget-friendly option.

Suggests affordability and may indicate that the product or service is more accessible to a wider range of consumers.

\$\$

Signifies a mid-range cost level.

Suggests a moderate expense and often represents a balance between price and quality. This option may provide decent value for money without reaching the highest levels of cost and function.

\$\$\$

Signifies a higher cost level compared to other options.

Suggests more intensive construction methods like cast-in-place concrete or more extensive improvements like tree cells that provide a step up in features and/or benefits.

EXAMPLE PROJECT BUDGET RANGES

The following project examples provide insight into the range of associated costs for various green street projects. When these individual green street elements are combined in a project, based on the site's specific requirements, the following cost ranges can be anticipated.

<\$1M

Pioneer Square East West Streets, Seattle

Year Constructed: 2023

Assumptions: Cost is based on a one block segment.

Project Elements:
- Expanded sidewalks
- Added street trees in renovated planters

\$1M TO \$3M

Yesler Terrace, Seattle

Year Constructed: Ongoing

Assumptions: Cost is based on a one block segment.

Project Elements:
- Bioretention swales
- Stormwater planters
- Stormwater planters with bike step out

> \$3M

Winslow Way, Bainbridge Island

Year Constructed: 2011

Assumptions: Cost is based on a one block segment.

Project Elements:
- Stormwater planters, rain gardens and bioretention swales
- Permeable pavement
- Street trees with soil cells

Edmonds Green Street Kit of Parts

Overview of Green Street Kit of Parts

The Edmonds Green Street Kit of Parts is a collection of GSI elements, strategies, and site amenities that can be customized and combined to suit the unique needs of various locations and street types within the City of Edmonds to mitigate the negative impacts of conventional stormwater management and to enhance the quality of life for residents.

The Kit of Parts is not a one-size-fits-all solution but rather a flexible framework that allows the City of Edmonds to adapt and apply sustainable design to their specific needs and local conditions. By incorporating these elements into street design and infrastructure projects, the City of Edmonds can promote sustainability, resilience, and livability while creating healthier and more vibrant environments.

Green infrastructure elements that will help to meet the long-term goals of the City of Edmonds Green Street Initiative are listed below.

Permeable pavement: Allows stormwater to infiltrate through the pavement surface and into the underlying soils, reducing runoff and improving water quality. Types of permeable pavement include pervious concrete, porous asphalt, permeable interlocking concrete pavement and grid pavement.

See Page: 19-20

Image Source: Alice Webb Land Perspectives

Vegetated bioretention facilities: Captures runoff from pollution-generating surfaces and filters pollutants through a combination of vegetation and amended/engineered soil medias.

These facilities include two main edge options: Natural edges and Concrete edges. Natural edge facilities are shallow landscape depressions with gentle side slopes, such as bioretention cells, bioretention swales, and rain gardens. Concrete edge facilities include stormwater planters and landscaped areas with curbs or sidewalls.

See Page: 21-23

Street trees: Trees provide numerous benefits, including reducing stormwater runoff by intercepting rainfall, improving air quality, reducing the effects of heat island, enhancing the streetscape character, and providing habitat/migration corridors in the urban environment.

See Page: 24-25

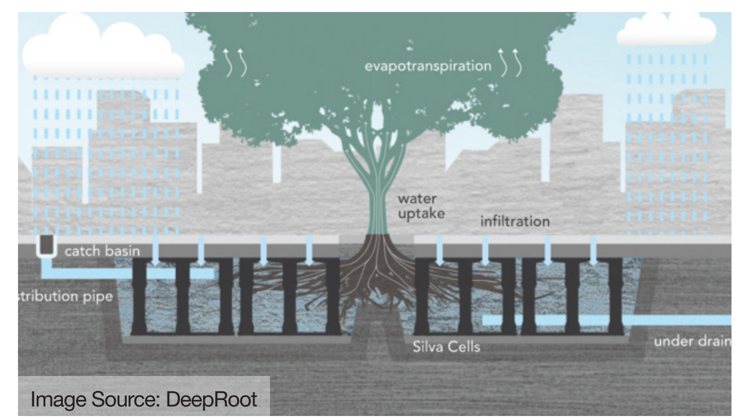


Image Source: DeepRoot

Modular soil cell systems: Underground structures that provide space for soil and tree roots to grow. Can also be designed to collect and treat stormwater runoff if used with engineered soil media.

See Page: 26-27

Pedestrian and bicycle amenities: Additional elements that encourage walking and bike riding by increasing comfort and safety.

See Pages: 28-29

Permeable Pavement

Permeable pavement offers an environmentally-sustainable approach, addresses water management challenges, and provides multiple benefits to communities and ecosystems. It allows stormwater to infiltrate through the pavement surface and into the underlying soils, reducing runoff and improving water quality. These systems may be used in place of conventional impervious paving. They are typically used more extensively on low-traffic streets, such as residential streets and pedestrian corridors, and for parking areas, driveways, sidewalks, and sport courts.

The following are site specific benefits of permeable pavement (Benefits of Green Streets are listed on page 5):

Stormwater management:

- Allows rainwater to infiltrate immediately to prevent runoff from flowing into storm drains.
- Alleviates the strain on drainage systems during heavy rain events, while promoting groundwater recharge and reducing the effects of flooding.
- Replenishing groundwater reserves helps sustain local ecosystems, supports plant growth, and maintains a stable water supply.
- Flow control is provided through detention in a reservoir base, providing flow attenuation prior to discharge downstream, while protecting wetlands and aquatic ecosystems.

Water Quality:

- Filters and removes pollutants and sediment from stormwater as it passes through the pavement layers and into the soil. Improves water quality by reducing the quantity of pollutants that reach streams, rivers, and other water bodies.

Reduced heat island effect:

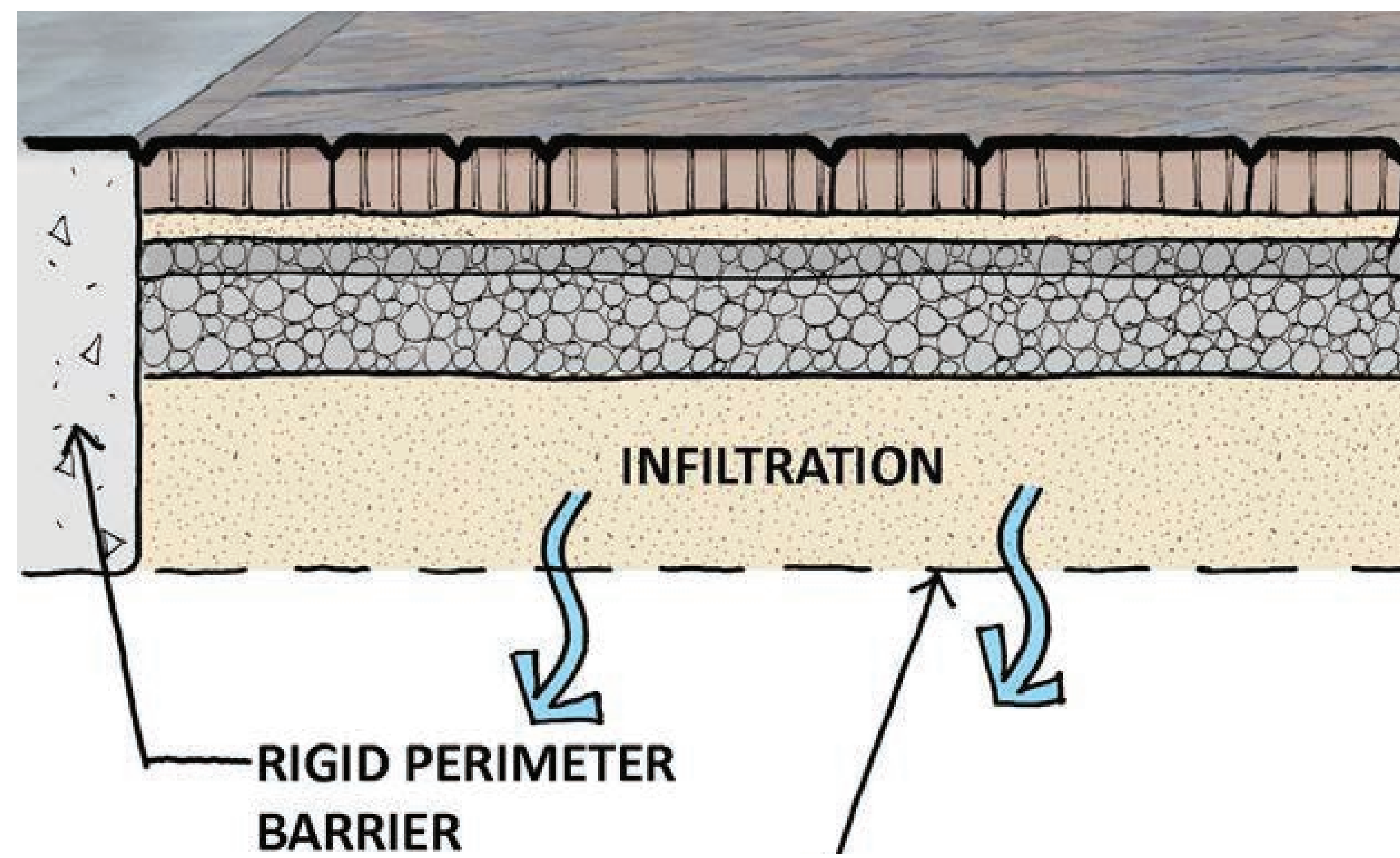
- Compared to traditional impervious surfaces, permeable pavements absorb less heat and can help to lower ambient temperatures in urban areas.

Improved pedestrian connectivity:

- Offers some sound absorption for the environment through the voids in the pavement system, which improves the pedestrian and residential experience.
- Prevents surface water accumulation, reducing the potential for puddles forming along walkways.

Long-term cost savings:

- Reduces reliance on costly traditional stormwater infrastructure, such as extensive drainage systems, catch basins, and pipes. This can lead to long-term cost savings related to construction, maintenance, and management of stormwater.



The permeable pavement section illustrates the system's layers and water infiltration. Image Source: City of Fort Collins LID Implementation Manual

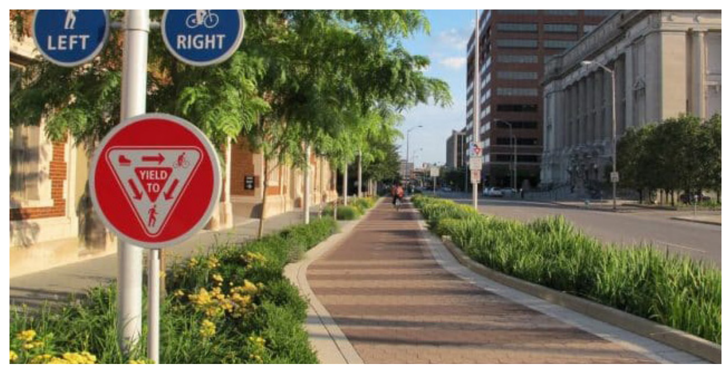
Permeable Pavement (CONT.)

Types of permeable pavement include pervious concrete, porous asphalt, permeable interlocking concrete pavements, and open grid paving systems.

Permeable interlocking concrete pavement infiltrates stormwater and maintains the appearance and functionality of the asphalt street. Image Source: Mutual Materials

Porous asphalt for a park trail manages stormwater and provides a comfortable and safe user experience. Image Source: City of Bellingham, WA

Pervious concrete infiltrates stormwater, reduces runoff, and maintains appearance and functionality of the street. Image Source: Bay Area Pervious Concrete



Permeable interlocking concrete pavement and planters manage stormwater runoff, while promoting active transportation. Image Source: Indianapolis Cultural Trail

Permeable interlocking concrete pavement allows for efficient stormwater management, while creating an accessible environment. Image Source: City of Kirkland, WA

Open grid paving systems filled with grass allow for effective stormwater infiltration and a natural aesthetic. Image Source: GrassConcrete

OPPORTUNITIES TO USE PERMEABLE PAVEMENT

Consider permeable pavement when space is constricted, but pedestrian improvements are desired. Permeable pavement can be used in place of conventional impervious pavement in almost any location. Permeable pavements are typically used more extensively on low-traffic streets, such as residential streets, parking areas, driveways, sidewalks, multi-use trails, and sport courts.

Additional Design Considerations:

- Proximity of permeable pavement to structures and land use will influence whether the system is suitable. Refer to City code for requirements.
- Volume of traffic on the pavement will determine which, if any, permeable pavement is appropriate.
- Site topography should generally be at <5% grades for optimal stormwater infiltration.
- Soil infiltration should be evaluated, as not all native soils are able to infiltrate runoff at acceptable rates.
- Depth to water table, bedrock or other impermeable layer impacts whether infiltration is possible or appropriate. If the water table is too high, it may not be possible to fully treat runoff before it reaches groundwater aquifers.
- Installation requires installers trained and experienced in permeable pavement installation.
- To reduce costs, permeable pavement can be installed in smaller locations to collect run-on from a larger drainage area (e.g., install permeable pavement in parking stalls to collect run-on from the street travel lanes).

Operations & Maintenance Considerations:

- Maintenance may include regular site inspection, trash and debris removal, routine vacuuming, pressure washing, restorative vacuuming, and/or other maintenance practices to clean out void spaces.
- Irrigation should be included for the first two growing seasons to support plant establishment.

Associated Level of Cost: $$$

Vegetated Bioretention Facilities

Vegetated bioretention facilities are GSI systems designed using vegetation and natural processes to manage stormwater runoff. These facilities are specifically designed to mimic the natural water cycle and help mitigate the negative impacts of urbanization on water quality and quantity. By using vegetated bioretention facilities, cities can create more sustainable and resilient public spaces that benefit both people and the environment.

There are several types of GSI that can be integrated into Green Streets. The following are suited to planning and implementation for the City of Edmonds Green Streets:

- Bioretention cells, bioretention swales, and rain gardens (page 22)
- Stormwater planters (page 23)

While they can have similar functions, there are distinct differences as noted in each section.

General Bioretention System Design Considerations:

- Site topography: Runoff flow patterns and land use will determine which type of bioretention system will be most appropriate.
- Soil infiltration: In places where infiltration is not viable, bioretention systems may need to be lined and/or include an overflow system to convey high volumes to the public storm drain.
- Depth to Water Table, Bedrock or Other Impermeable Layer: Impacts whether infiltration is possible or appropriate. If the water table is too high, it may not be possible to fully treat runoff before it reaches groundwater aquifers.
- Site Context: Site proximity to streams or other critical areas will influence design.
- Plant selection: Plants must handle ponding water, in addition to drought conditions. Visual interest and character are also important considerations.

Vegetated bioretention facilities offer several benefits, both environmentally and functionally. The following are site specific benefits of stormwater planters (Benefits of Green Streets are listed on page 5):

Water Quality:

- Function as natural filtration systems, removing pollutants such as sediment, heavy metals and nutrients from the water before it enters the stormwater system or nearby water bodies. This helps to reduce water pollution and improve overall water quality.

Stormwater management:

- Allows stormwater to either infiltrate the ground instead of flowing into storm drains and/or slow the volume being released into the system, which helps to control the volume and rate of runoff during heavy rainfall events. This alleviates the strain on the city's drainage systems during heavy rain events.
- Promotes groundwater recharge and reduces the risk of flooding. Replenishing groundwater reserves helps sustain local ecosystems, supports plant growth, and maintains a stable water supply.
- Flow control provided through reduction of impervious surface area and runoff, detention, and flow attenuation through infiltration, plant interception of rainfall, evapotranspiration, and the biological processes of plants and soil fauna.

Reduced heat island effect:

- Plants help to cool the surrounding air through evapotranspiration. This can reduce the ambient temperature, making the urban environment more comfortable and reducing the energy demand for air conditioning.

Improved air quality:

- Plants help filter and trap airborne pollutants, such as dust and particulate matter, thereby improving local air quality.

Increased Biodiversity:

- Provides opportunities to add plants that provide habitats for birds, butterflies, and other beneficial insects.

Community engagement and education:

- Vegetated bioretention facilities can serve as educational tools to raise awareness about stormwater management, water conservation, and sustainable urban design.

Sense of place:

- Can be designed to be visually appealing, providing an attractive and engaging public space for the community.

Property Value and Development Costs:

- Enhances the visual appeal of streetscapes by introducing greenery and natural elements into urban environments, increasing property values.
- Reduces development costs by reducing the need for traditional stormwater infrastructure and is less expensive than more structured interventions, however they require more space.

Vegetated Bioretention Facilities (CONT.)

BIORETENTION CELLS, SWALES AND RAIN GARDENS

Bioretention cells, also called bioretention swales or rain gardens, are a type of GSI characterized by sloped sides, a flat bottom area, and water storage capacity. In the right-of-way, they are typically bounded on one side by the edge of road or parking area and a sidewalk on the other side to accept sheet flow runoff from both sides. They can also be at streets curbs using curb cuts to accept point runoff or placed with curb bulbs. The key differences between them are:

- **Bioretention cells** are engineered to capture, slow, treat, and slow discharge to the main storm drainage system and/or infiltrate stormwater where feasible.
- **Bioretention swales** collect, convey, slow, treat, and infiltrate stormwater as it moves downstream. Planting typically contains native grasses, forbs, and ground cover rather than more shrubby planting.
- **Rain gardens** are often located in landscaped areas, such as on properties, parks or right-of-ways with large open landscape areas, and are designed to capture and temporarily hold stormwater runoff, allowing it to slowly infiltrate into the soil. Planting typically contains native grasses, forbs, ground cover, and shrubs.

OPPORTUNITIES TO USE BIORETENTION CELLS

Consider bioretention cells, swales, or rain gardens where space allows and subsurface material is infiltrative. Each of these bioretention cell types are useful strategies for managing stormwater in areas adjacent to parking, such as within tree islands, along pedestrian zones, in center roadway medians, and in unused open space, including front yards. Depending upon the underlying soil characteristics, water may fully infiltrate or overflow into an underdrain system to a designated discharge facility.

Additional Design Considerations:

- Available space must be wide enough to develop adequately graded side slopes and create a flat bottom for infiltration.
- Depending on the subsurface material, bioretention swales can be designed to allow stormwater infiltration and groundwater recharge or may simply reduce immediate runoff through absorption in surface soils and evapotranspiration. Where infiltration cannot be accomplished, planters can be designed with an impermeable base and an underdrain (perforated) pipe.
- Bioretention cell size depends on the stormwater management goals for the GSI and the space available in the right-of-way.
- Must be located a minimum of 5' from any buildings without basements and 10' from buildings with basements.
- Typically, there is increased cost when infiltration is not feasible and additional infrastructure capacity is needed to convey to storm drainage system.

Operations & Maintenance Considerations:

- Regular ongoing maintenance includes trash and debris removal, weeding and pruning vegetation, sediment removal, minor erosion control and repair, clearing inlets, outlets and overflows, and mulching.
- Irrigation should be included for the first two growing seasons for plant establishment.

Associated Level of Cost: $-$$

Vegetated Bioretention Facilities (CONT.)

STORMWATER PLANTERS

Stormwater planters, also known as bioretention planters, are a type of GSI characterized by cast-in-place concrete walled vertical sides, a flat bottom area, and water storage capacity. The planters can be adapted to diverse urban street areas and allow for flexible depth, edge construction, and vegetation choices. Stormwater planters are particularly useful in areas where right-of-way width is limited or there is a need to accommodate multiple modes of transportation.

The concrete edges of stormwater planters provide a distinct separation between the bioretention cell and surrounding areas, making it easier to contain and control the flow of water. These edges offer stability and durability, ensuring that the bioretention cell retains its shape over time. They can also facilitate maintenance activities, such as mowing, by providing a clear distinction between the bioretention cell and the surrounding landscape.

Stormwater planters efficiently capture and treat stormwater runoff while adding aesthetic value to an urban setting. The planted vegetation and engineered soil enhance water infiltration, mitigate pollution, and contribute to a more sustainable and resilient urban ecosystem. Image Source (Bottom): City of Portland, Bureau of Environmental Services

OPPORTUNITIES TO USE STORMWATER PLANTERS

Consider stormwater planters when space is constricted, but plants are desired.

Additional Design Considerations:

- The planters can be implemented in various locations within the right-of-way, where space is constrained in narrow planting strips of the ROW.
- Where infiltration cannot be accomplished, planters can be designed with an impermeable base and an underdrain (perforated) pipe. This solution still allows for biofiltration and reduction in the rate of runoff during heavy rainfall events. Stormwater planter size depends on the stormwater management goals for the GSI and the space available in the right-of-way.
- Length-width-height dimensions determine capacity for temporarily storing stormwater.
- Concrete edges create a physical barrier that can limit the natural movement of organisms, potentially reducing the biodiversity within the bioretention cell.

Operations & Maintenance Considerations:

- Regular ongoing maintenance includes trash and debris removal, weeding and pruning vegetation, sediment removal, minor erosion control and repair, clearing inlets, outlets and overflows, and mulching.
- Irrigation should be included for the first two growing seasons for plant establishment.

Associated Level of Cost: $$

Street Trees

Street trees offer numerous benefits to both the environment and the community. A robust tree canopy is one of the great contributors to a healthy and livable urban landscape. Note: Benefits may vary depending on the specific tree species, location, and urban context. Proper planning, selection, and maintenance of trees are crucial for maximizing these benefits. The following are site specific benefits of street trees (Benefits of Green Streets are listed on page 5):

Stormwater Management:

- Trees intercept rainwater, reducing stormwater runoff and the strain on stormwater management systems. Their roots also help to absorb and filter water into the ground.

Urban Greening:

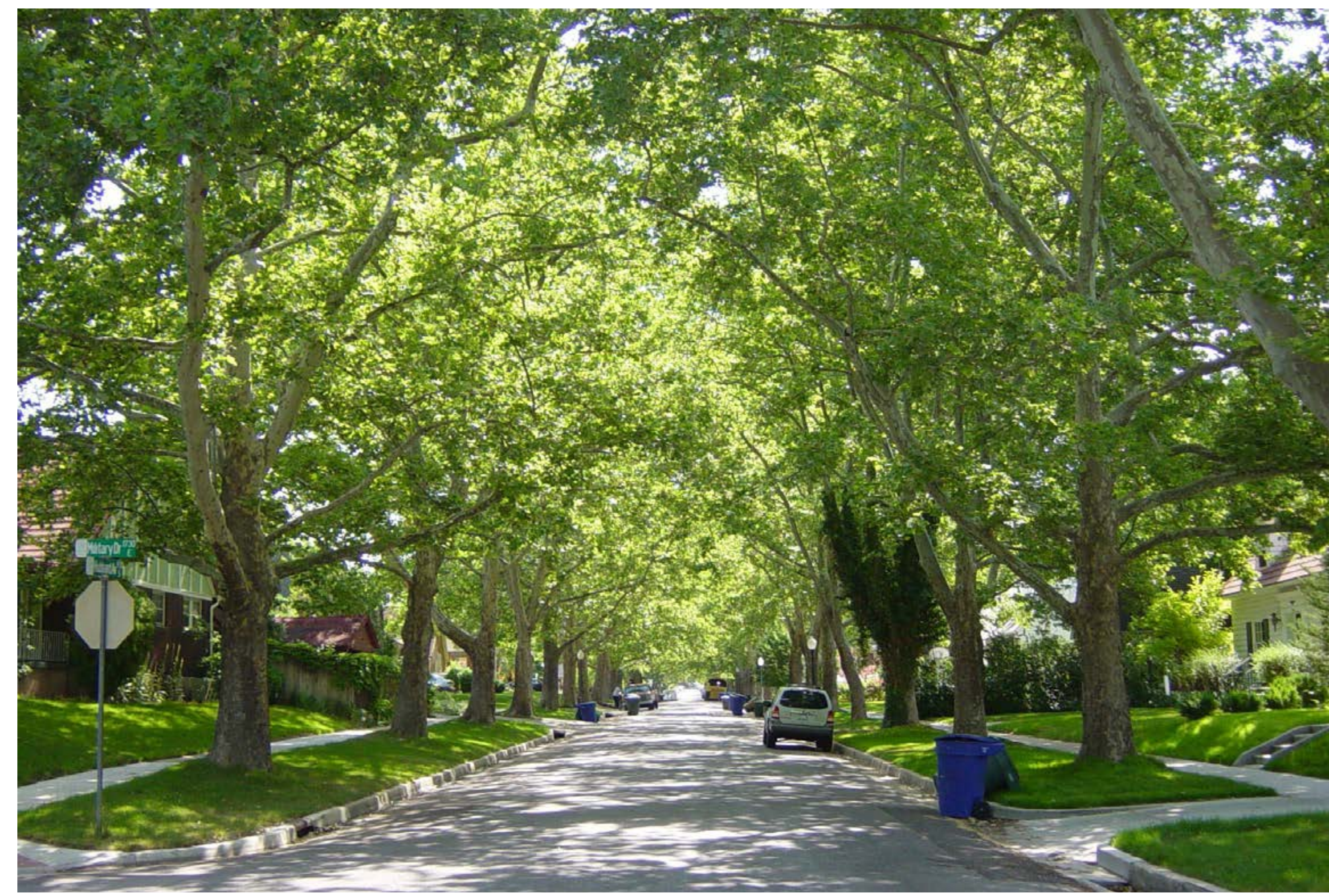
- Improved soil quality allows tree roots to help to stabilize soil, prevent erosion, and enhance soil fertility, which contributes to healthier urban ecosystems.
- Provides habitat for birds, insects, and other urban wildlife, which collectively supports biodiversity in urban environments.
- Trees filter and purify the air by absorbing harmful pollutants, such as carbon dioxide, nitrogen dioxide, and particulate matter.
- Trees provide climate regulation by providing shade, which reduces the urban heat island effect and lowers temperatures in urban areas. They also release moisture through transpiration, which cools the surrounding air.
- Street trees can serve as green corridors, connecting larger green spaces and promoting wildlife habitat and movement through urban areas.

Health and Well-being:

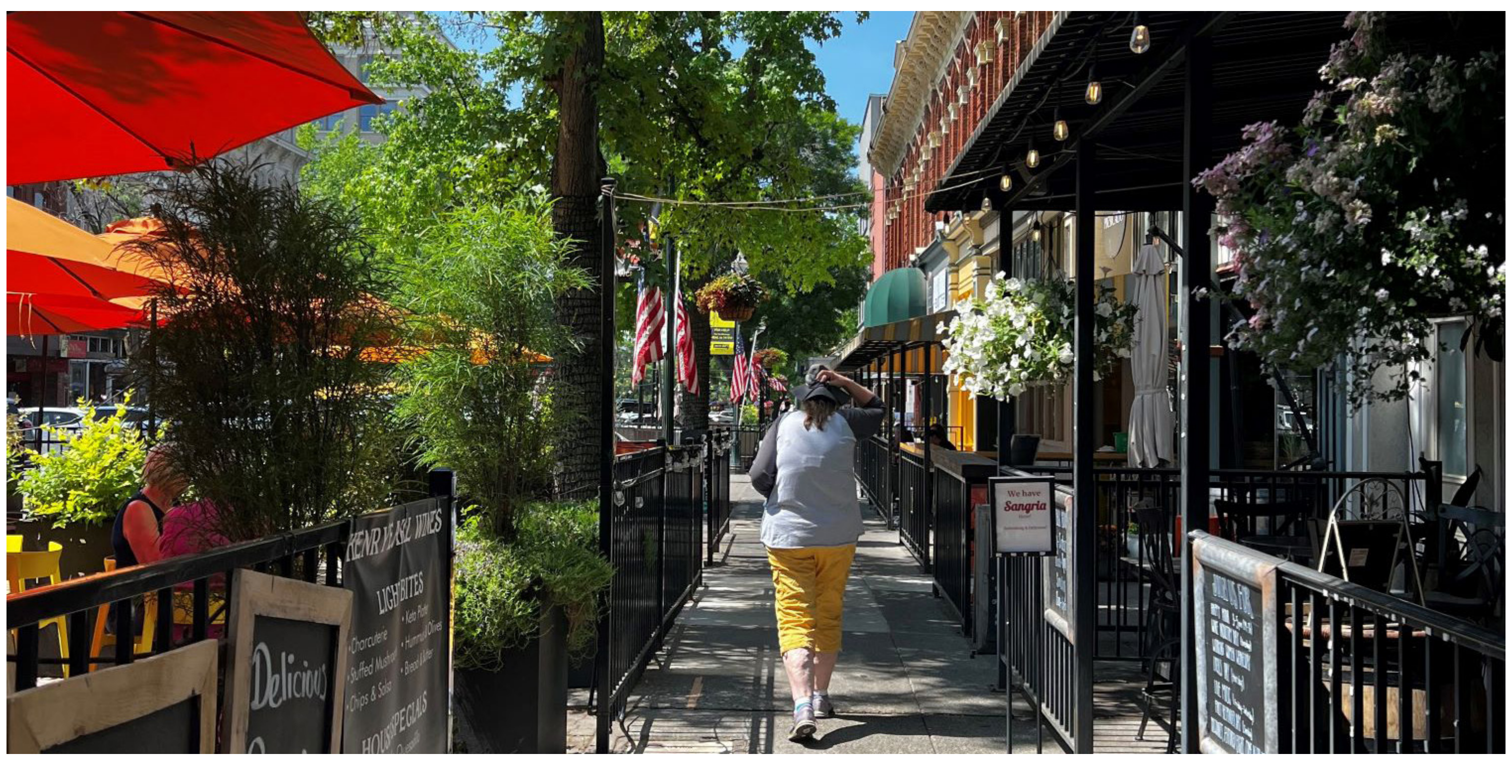
- Street trees create a more pleasant and inviting environment, promoting physical activity, reducing stress, and improving mental health and well-being.
- Street trees provide shade and shelter, making sidewalks more comfortable for people and encouraging pedestrian movement. This helps promote healthier lifestyles and reduces car dependency.

Economic Development:

- Streets lined with trees have been shown to increase property values, making them more desirable places to live, work, and visit.
- Preserving existing mature trees provides continued and substantial environmental, social, and economic benefits.



Street Trees (CONT.)



Street trees provide numerous benefits, such as shade, improved air quality, aesthetic appeal, and a welcoming and pedestrian-friendly atmosphere. Carefully selected tree species and strategic placement enhance the streetscape, fostering a sense of community and contributing to a greener, healthier urban ecosystem. Image Source: (Top) City of Edmonds

OPPORTUNITIES TO USE STREET TREES

Street trees are appropriate for any urban condition in which there is adequate space. For constrained conditions, consider the use of soil cells to maximize tree health and stormwater management.

Additional Design Considerations:

- Tree Protection Zone: Tree critical root zone or drip line, whichever is wider. No construction or related activities (storage, equipment movement, etc.) should occur within it, earthwork should be prohibited or minimized, and irrigation systems should not trench through it.
- Species: Broadleaf evergreens and conifers provide the most stormwater benefit due to their greater year-round leaf surface area. Native trees provide greater habitat value and can reduce irrigation needs and other maintenance requirements.
- Size: Trees with larger canopies and greater height provide more benefits.
- Location: Sun and wind exposure, rainfall, drought and wind patterns, and soil characteristics will influence tree selection. Proximity to built structures will influence tree selection and growth habits. Certain tree species can cause sidewalk or utility damage. A tree located within a 12’ wide planting strip next to a sidewalk will provide greater benefits than a tree located within a narrower planting strip. Layout of impervious surfaces should include space for planting adjacent trees. Refer to City of Edmonds code requirements for minimum separation requirements for sanitary sewer, water mains and other infrastructure.
- Treatment: Existing trees need irrigation during construction and will benefit from some irrigation in the 3 years after construction. New trees need irrigation in the first 3 years for establishment.
- Underplanting: Limited to 4” pots planted by hand and should occur only within areas that can be reached by irrigation heads located outside the Tree Protection Zone.
- Maintenance: Needs vary across species.

Associated Level of Cost: $

Modular Soil Cell Systems

Modular soil cell (MSC) systems, sometimes called soil cells or tree trenches, are underground structures designed to support healthy tree growth and manage stormwater in urban environments. MSC systems differ from structural soil systems in the amount of soil and void space a tree is provided. MSC systems provide more soil and void space for air, water, and tree root development. MSC systems offer many benefits when applied to urban landscapes:

Stormwater management:

- MSC systems provide a stormwater treatment function. Runoff can enter the system through pervious paving, drains, catch basins, and the opening around the tree trunk.
- The increased soil volume in soil cells can accommodate stormwater, allowing it to infiltrate into the ground more effectively.

Improved Tree Health:

- MSC systems provide opportunities to increase soil volume for promoting healthy root systems for large street trees that can mature, grow, and thrive in heavily paved urban areas.
- Load-bearing modules form a skeletal matrix that is filled with soil to provide uncompacted rooting volume for trees.

Reduced Heat Island Effect:

- Soil cells can help mitigate this effect by providing space for larger tree canopies. Trees provide shade, which reduces surface temperatures and cools the surrounding air through evapotranspiration.

Air Quality Improvement:

- By acting as natural air filters, trees help reduce air pollution levels to make the surrounding environment healthier for residents.

Aesthetic and Psychological Benefits:

- Studies have shown that exposure to green spaces and nature has psychological benefits, reducing stress levels and improving overall well-being. Streets with well-maintained trees and vegetation have a positive visual impact on urban areas.

OPPORTUNITIES TO USE SOIL CELLS

Consider using soil cells when land is at a premium but prioritizing both GSI and accessible public space is desired. Because they allow tree roots to expand without damaging concrete, they can reduce maintenance associated with poor tree health and pavement uplift.

Additional Design Considerations:

- Suited for narrow pedestrian ROW with little to no room for additional planting.
- Not suitable in areas with dense underground utilities. If used in such space, utility purveyor may require utilities to be sleeved or relocated for ease of future maintenance. Drainage patterns: identifying areas prone to water accumulation or runoff. Consideration includes the direction and topography, and existing drainage infrastructure.
- Soil conditions: each site has specific soil characteristics that play a vital role in determining the placement of stormwater planters. Each site should be tested to assess soil composition and infiltration rates.
- Consult with manufacturer to provide sufficient soil volume for specific tree species.
- Existing vegetation and landscaping: Assessing the location of existing trees and other vegetation can help determine where planters can be placed without disturbing mature existing trees and vegetation.

Operations & Maintenance Considerations:

- Locate planters in areas that are easily accessible for maintenance activities such as regular inspections, cleaning and vegetation management.
- Provide access for inspections and filter material replacement.
- Irrigation for the first two growing seasons for plant establishment.

Associated Level of Cost: $$$

Modular Soil Cell Systems (CONT.)

MSCs offer a sustainable and environmentally friendly approach, addresses water management challenges, and provide multiple benefits to communities and ecosystems.

Visualization showing a modular soil cell underneath a tree planting.
Image Source: GreenBlue Urban

Modular soil cells during installation.
Image Source: DeepRoot

Visualization showing root growth within a modular soil cell.
Image Source: Citygreen Urban Landscape Solutions

Pedestrian Amenities

FEATURES TO MAKE A STREET FEEL SAFE & WELCOMING TO PEDESTRIANS

In addition to sustainably managing stormwater, Green Street projects can enhance the pedestrian experience and accommodate multiple modes of transportation. Pedestrian amenities such as accessible sidewalks, seating, lighting, and public art add vibrancy to streets and create a welcoming environment for all.

Pedestrian amenities include:

Sidewalks: Increasing the width of sidewalks provides more space for pedestrians, allowing them to walk comfortably and safely. Creating physical separation between the sidewalk and the roadway, such as through curbs, planters, or bollards, enhances pedestrian safety by reducing the risk of vehicle encroachment.

Image Source: Hustace Photography

Seating: Benches, seat walls, and other seating options along the street encourage people to take a break, socialize, and enjoy the surroundings.

Image Source: City of Hoboken, NJ

Curb Extensions: Provide opportunities for landscaping and GSI, and improve pedestrian safety by slowing traffic and reducing the distance of a crosswalk.

Public Art and Placemaking: Integrating public art along the street adds an element of creativity and cultural significance to the project. Working with city staff, local artists and the community can identify appropriate opportunities for public art installations.

Image Source: Hustace Photography

Crosswalks: Clearly marked crosswalks help pedestrians navigate intersections and signal to drivers that pedestrians have the right of way. Techniques such as zebra crossings, raised crosswalks, and high-visibility markings improve safety and visibility.

Energy-Efficient Lighting: Energy-efficient LED streetlights help reduce energy consumption and light pollution while ensuring safe and well-lit streets at night.

Bicycle Amenities

FEATURES TO MAKE A STREET FEEL SAFE & WELCOMING TO BICYCLISTS

In addition to sustainably managing stormwater, Green Street projects can enhance the bicyclists' experience and accommodate multiple modes of transportation. Bicycle amenities such as bike lanes, bike parking, and signage add vibrancy to streets and create a welcoming environment for all.

Bicycle amenities include:


Image Source: Shutterstock

Bicycle Lanes: Bike lanes active transportation, reduce vehicle reliance, and promote a healthier lifestyle.


Image Source: Shutterstock

Bicycle and Pedestrian Signs: These signs specifically cater to the needs of cyclists and pedestrians on streets. They include bicycle route markers, pedestrian crossing signs, and shared-use path signs.

Protected Bicycle Lanes: These lanes have physical barriers, such as curbs or bollards, separating cyclists from vehicle traffic. Protected bike lanes offer enhanced safety by providing a physical buffer between cyclists and vehicles, reducing the risk of accidents and injuries.


Image Source: Saris

Bicycle Repair Stations: Installing bicycle repair stations offers cyclists a convenient place to perform minor repairs or maintenance tasks. These stations typically include tools, air pumps, and instructions, allowing riders to keep their bikes in good condition and address minor issues on the go.

Bicycle Parking: Providing secure and convenient bicycle parking facilities encourages people to choose cycling for their commutes or daily activities. Bike racks, lockers, or covered parking areas near key destinations like workplaces, promote accessibility and convenience.


Image Source: Seattle Dept. of Transportation

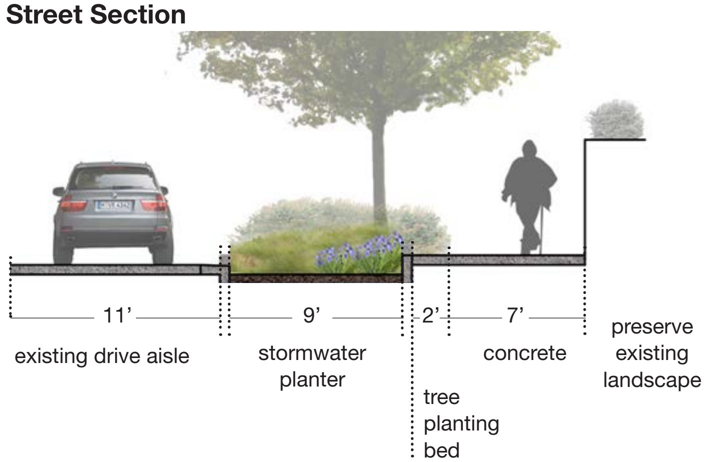
Bike Share Programs: Implementing bike share programs enables people to access bicycles for short-term use. These systems often have docking stations strategically placed throughout the community, allowing users to pick up and drop off bicycles at different locations.

Green Streets Applied

Application in Downtown Mixed Residential Zoning

Existing Conditions (view west Dayton Street)

Street Section

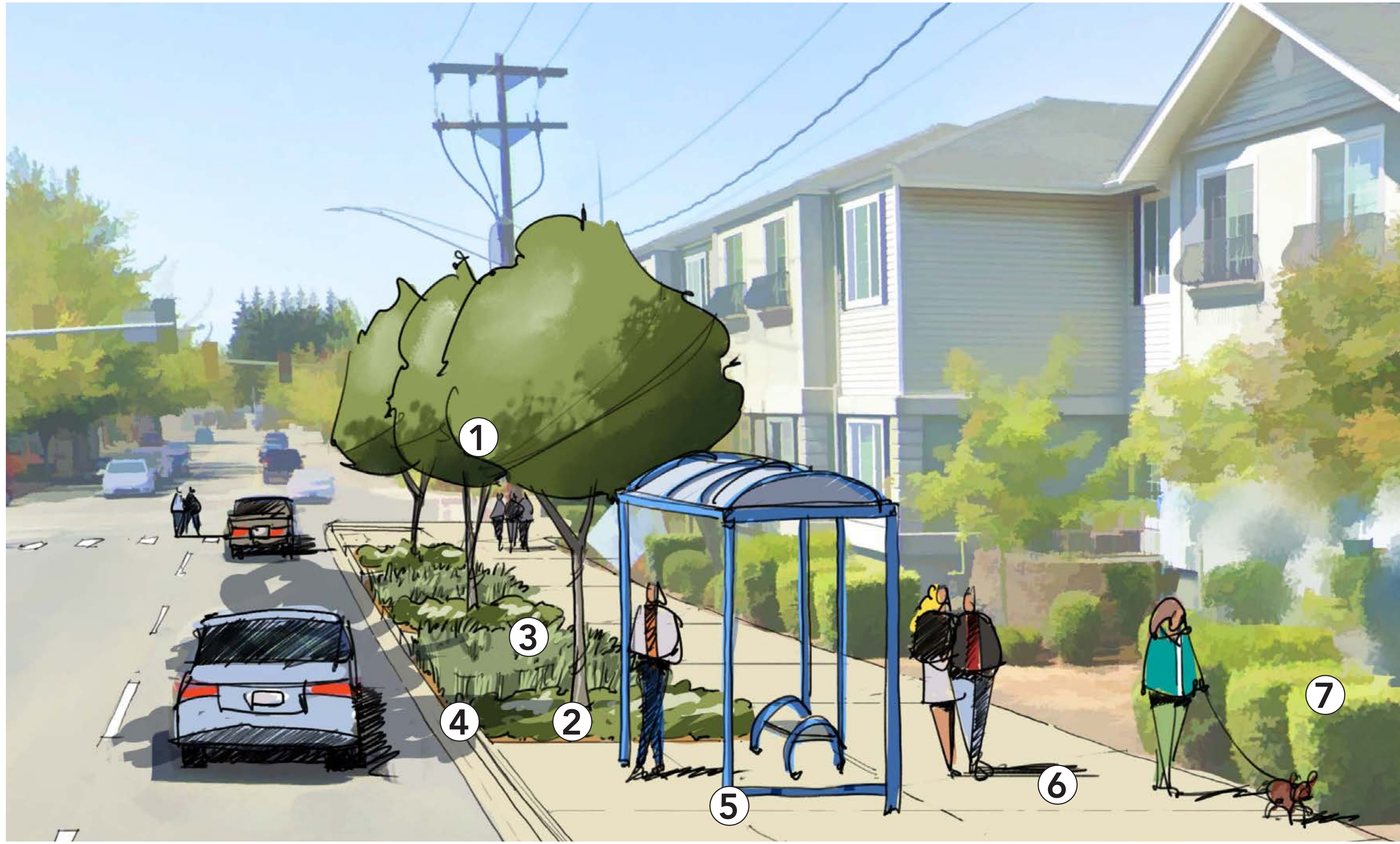


Legend

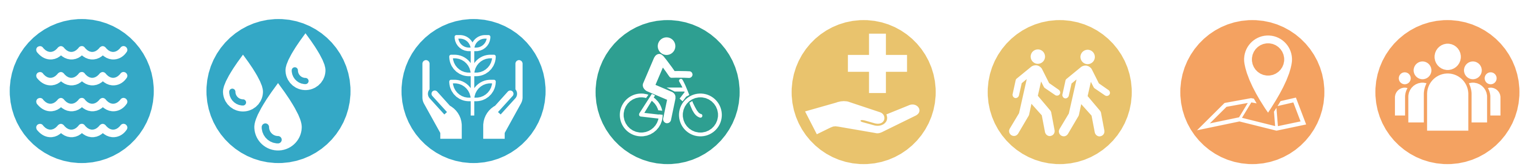
1. Trees in standard landscape beds alternate at regular intervals with stormwater planters
2. Standard landscape beds
3. Stormwater planter to collect sidewalk and roadway runoff
4. Curb extension
5. Accessible bus stop and shelter
6. Accessible concrete sidewalk (7'-9' wide)
7. Landscape buffer

Perspective Illustration (view west Dayton Street)

For illustrative purposes only



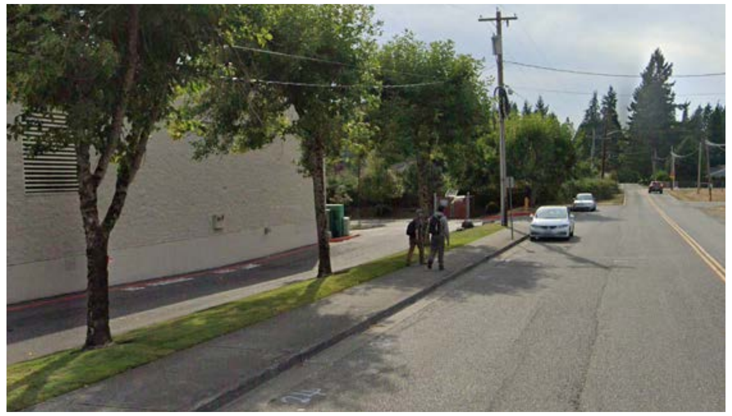
Design Example Benefits



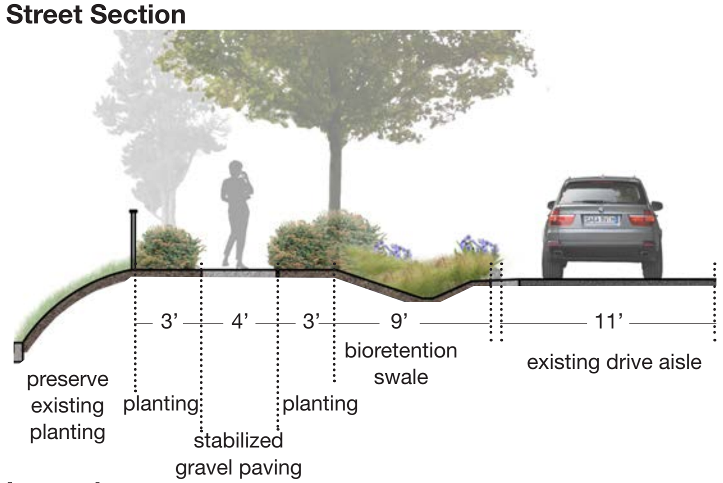
See page v - xii of the Appendix for full 10% design consideration for Dayton Street.

Application in Commercial & Residential Zoning

Existing Conditions (view west 236th Street)



Street Section



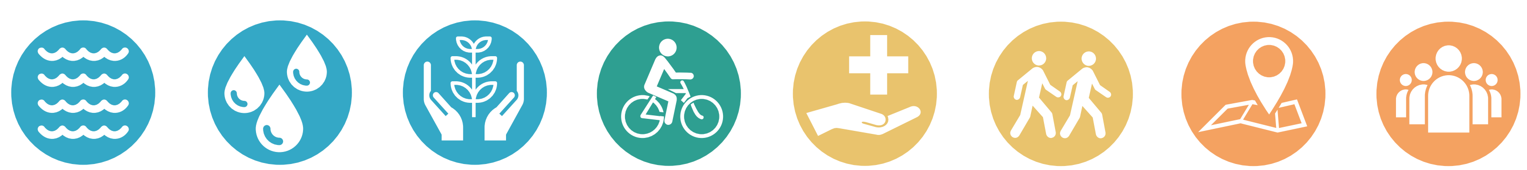
Legend

1. Meandering informal stabilized gravel path
2. Vegetative buffer planting at back of sidewalk to provide screening of Aurora Marketplace wall
3. Bioretention swales to collect runoff from the road through curb cuts
4. Curb extension
5. Trees planted on high point of bioretention swale
6. 3' guardrail

Perspective Illustration (view west 236th Street)

For illustrative purposes only

Design Example Benefits

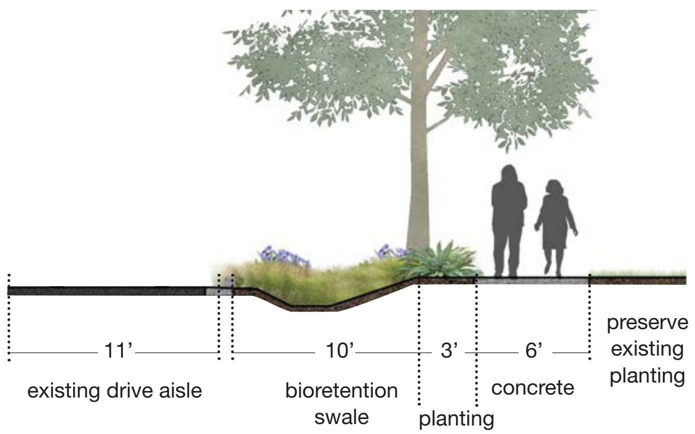


See page xiii - xvii of the Appendix for full 10% design consideration for 236th Street.

Application in Commercial & Residential Zoning

Existing Conditions (view west 236th Street)

Street Section

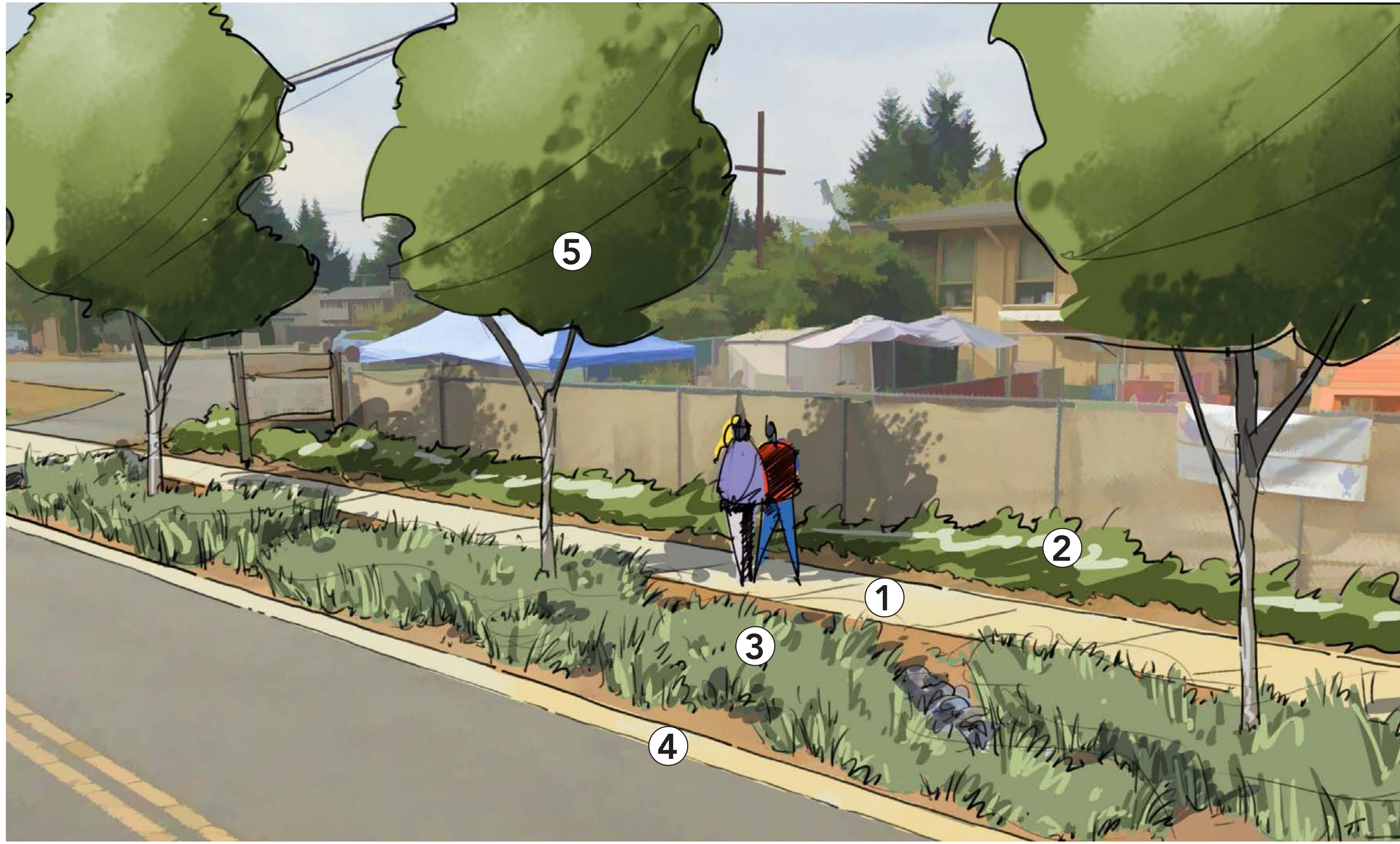


Legend

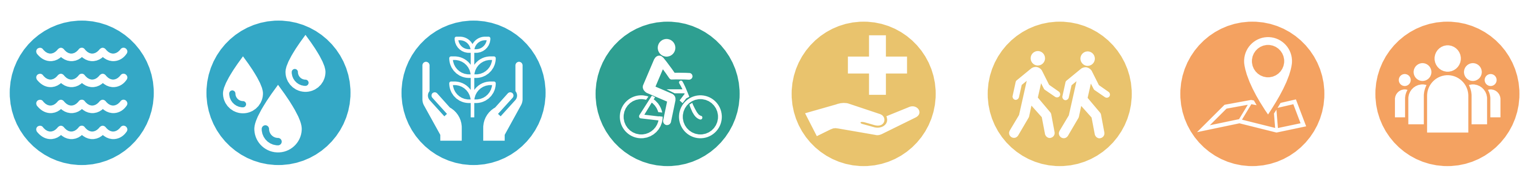
1. Accessible concrete sidewalk (6' wide)
2. Vegetative buffer planting between the sidewalk and learning center
3. Bioretention swales to collect runoff from the sidewalk and the road through curb cuts
4. Curb extension
5. Trees planted on high point of bioretention swale

Perspective Illustration (view west 236th Street)

For illustrative purposes only



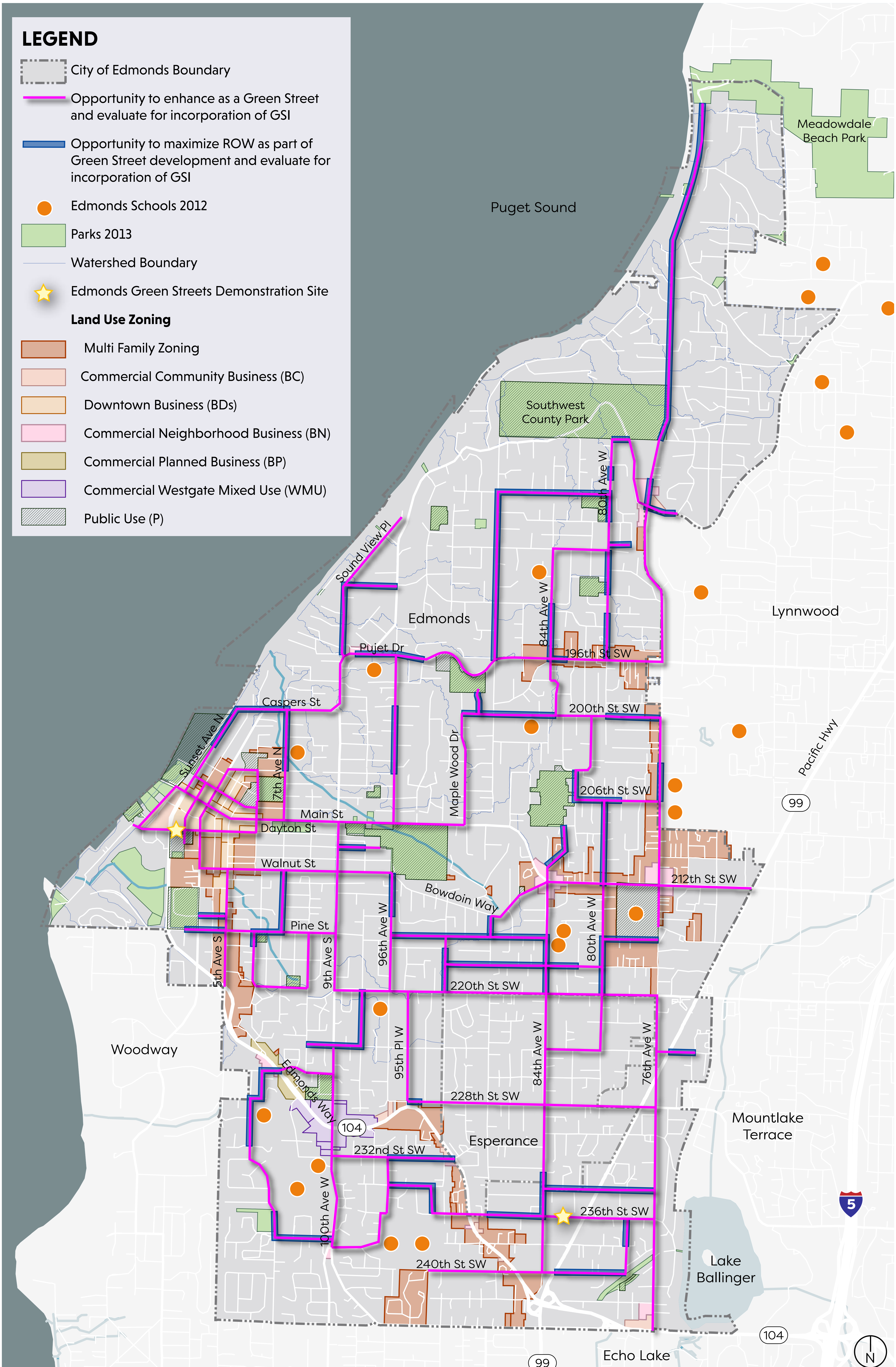
Design Example Benefits



See page xiii - xvii of the Appendix for full 10% design consideration for 236th Street.

Appendix

Green Streets Network Map



Glossary

Best Management Practices (BMPs): Techniques, methods, or measures designed to effectively manage and control various environmental impacts, particularly related to stormwater management, erosion control, and water pollution prevention. These practices are implemented to mitigate adverse effects and promote sustainable and environmentally friendly approaches (Source: US EPA)

Bioretention BMPs: Techniques or measures used to manage stormwater runoff and improve water quality by allowing it to infiltrate into the soil and be treated by vegetation and engineered media in bioretention areas. These practices typically involve the use of specially designed vegetated basins or cells that capture, store, and treat stormwater runoff (Source: US EPA)

Green Streets: Streets designed with nature in mind. They include features like trees, plants, and special pavements that help manage stormwater more naturally. Green streets improve our environment by reducing flooding, cleaning the air, and making our neighborhoods more enjoyable to walk and bike in.

Green Stormwater Infrastructure (GSIs): A collection of sustainable practices and systems that mimic natural hydrological processes to manage stormwater runoff. It involves the use of vegetated features, permeable surfaces, and engineered techniques to capture, treat, and store stormwater, promoting its infiltration, evaporation, or reuse while providing additional environmental and social benefits (Source: US EPA)

Low Impact Development (LID): An approach to land development and stormwater management techniques that mimic natural hydrological processes, reduce stormwater runoff, and promote on-site infiltration, filtration, and reuse of water. LID strategies emphasize the preservation and restoration of natural features and the use of decentralized, distributed, and integrated stormwater management practices (Source: US EPA)

LID Best Management Practices (BMPs): Techniques and measures employed within LID strategies to manage stormwater runoff and reduce its impact on the environment (Source: US EPA)

LID Principles: Principles that aim to mitigate the negative impacts of urban development on the natural water cycle and include strategies such as preserving natural features, minimizing impervious surfaces, managing stormwater close to its source, promoting infiltration and filtration, and integrating multiple GSI practices (Source: US EPA)

Maintenance: Regular inspection, cleaning, repair, and management activities undertaken to ensure the proper functioning and longevity of stormwater management systems and practices. It involves activities such as sediment removal, vegetation management, infrastructure repairs, and monitoring to prevent system failures, improve water quality, and sustain the effectiveness of stormwater management measures (Source: Green Infrastructure Maintenance Guidebook)

Non-Point Source Pollution: The contamination or introduction of pollutants into the environment from diffuse sources, rather than from a single identifiable point of discharge. It occurs when rainfall or snowmelt carries pollutants from various sources, such as agricultural lands, urban areas, construction sites, or natural landscapes, and transports them into bodies of water or groundwater (Source: US EPA)

Pervious Surface: Also known as a porous or permeable surface, refers to a type of surface material that allows water to infiltrate through it into the underlying soil or drainage system. Pervious surfaces are designed to facilitate stormwater management by reducing runoff, promoting groundwater recharge, and minimizing the concentration of pollutants (Source: Federal Highway Administration)

Point Source Pollution: The contamination or introduction of pollutants into the environment from a discrete and identifiable source, such as a pipe, channel, or specific outlet. It involves the direct discharge of pollutants from a single point of origin into bodies of water or onto land surfaces (Source: US EPA)

Pollution-Generating Pervious Surfaces (PGPS): Pervious surfaces that are regularly subject to vehicular use, industrial activities, or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall (Source: Snohomish County)

Roadway: A route designed for vehicular travel, typically consisting of a prepared surface and designated for the movement of vehicles. It includes the main driving lanes, as well as any accompanying lanes, shoulders, or additional features intended for safe and efficient transportation (Source: Federal Highway Administration)

Runoff: Refers to the flow of water, typically from precipitation, over the land surface, eventually collecting in streams, rivers, lakes, or other water bodies. It occurs when the amount of water exceeds the capacity of the soil to absorb it, resulting in the excess water moving across the surface (Source: US EPA)

Run-on: Stormwater runoff from another property that is entering a site (Source: Stormwater Hawaii)

Slope: Refers to the measure of steepness or inclination of a surface or landform, indicating the rate of change in elevation over a given horizontal distance. It is typically expressed as a ratio or percentage, representing the vertical rise divided by the horizontal run (Source: US EPA)

Stormwater Treatment and Flow Control BMPs/Facilities: Techniques and infrastructure designed to manage stormwater runoff by effectively treating and controlling its flow. These BMPs/facilities aim to remove pollutants, promote sedimentation, provide filtration, enhance water quality, and regulate the volume and rate of stormwater discharge into receiving water bodies or the local drainage system (Source: US EPA)

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10% Design Examples

10% design studies can support future Green Streets projects as examples of responding to site conditions to develop appropriate Green Streets design approaches.

MIG provided a conceptual 10% design and rough order of magnitude (ROM) cost estimate for incorporating GSI and streetscape enhancements at two city locations: Dayton Street and 236th Street SW. The project locations are adjacent to a variety of land uses, such as residential, commercial, institutional, and open space. The proposed designs build upon the City of Edmonds' vision to integrate GSI to create a more sustainable and livable community. Each design included before-and-after plans and sections, a design narrative, and a plant list. The ROM cost estimates provide a preliminary understanding of the potential construction costs associated with each proposed design, and are intended to serve as a tool to help guide decision-making through the planning, budgeting and early design process. The 10% designs and ROM cost estimates provided the City of Edmonds with a comprehensive understanding of the design opportunities and costs associated with incorporating GSI and enhancing the streetscape on Dayton Street.

Both pilot project locations represent opportunities for the City of Edmonds to improve water quality, reduce stormwater runoff, and create a more sustainable and livable community. The project also has the potential to enhance the safety, accessibility, and aesthetic appeal of the street, improving the quality of life for residents and visitors alike.

DAYTON STREET

Dayton Street is in the commercial core of Downtown Edmonds. There are two design examples. One of them exemplifies a streetscape condition in which the adjacent buildings abut the ROW and pedestrian space is at a premium.

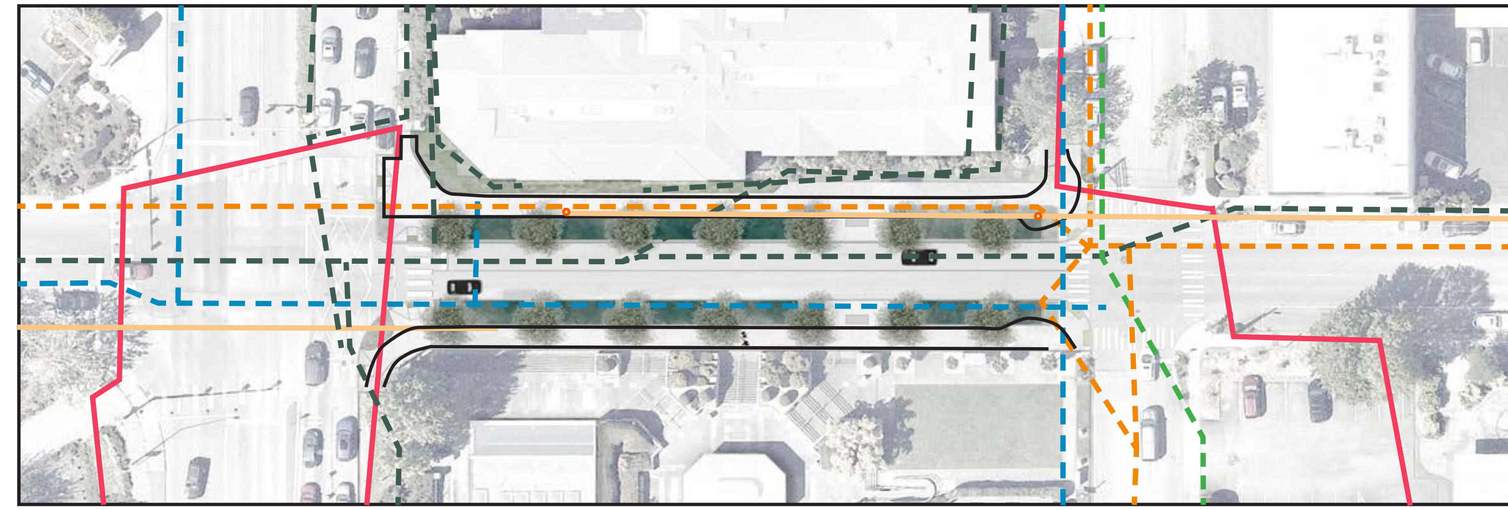
This site condition is characterized by the need to accommodate existing infrastructure, a constrained sidewalk zone and limited topography.

236TH STREET SW

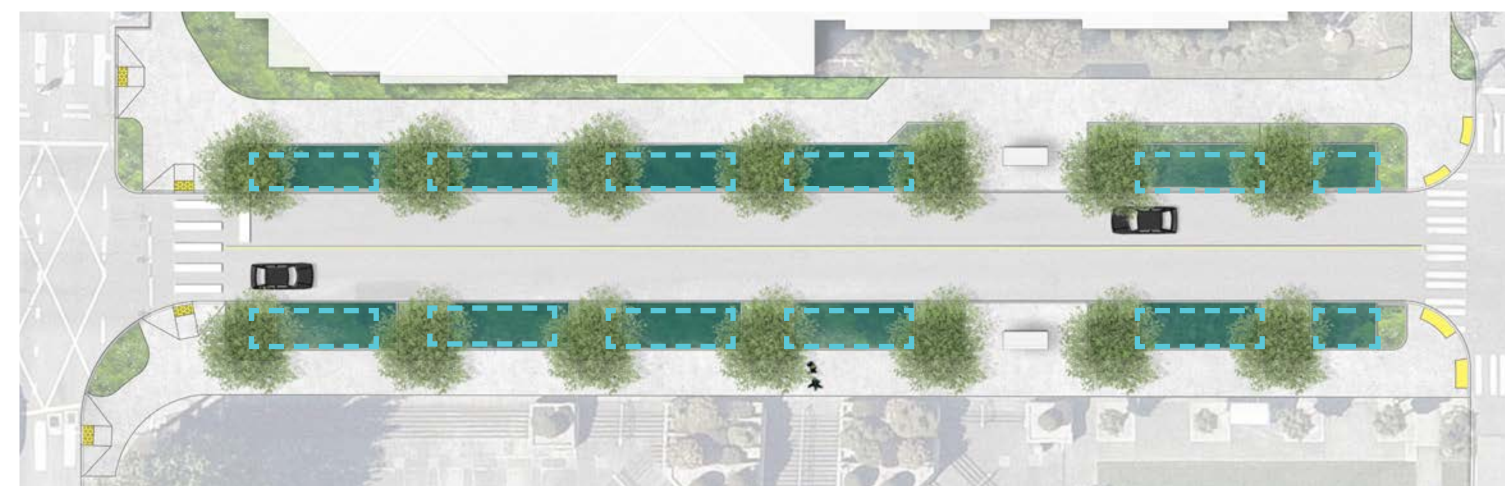
236th Street SW is currently in the midst of development. The design example in this block considers how both the City and developers working on streets with a poorly defined ROW and no preexisting sidewalk can contribute to the Green Streets Network and a consistent experience for pedestrians and bicyclists.

This site is characterized by a more expansive ROW zone allowing for larger scale interventions, steeper topography and less existing infrastructure.

Existing Conditions



Plan View



Sections

Dayton Street | 10% Design Example

This section is to use the two example projects to show how elements were selected to create a green street on this specific street typology. The project is located on Dayton Street between Highway 104 and 2nd Avenue South. The primary goals in this example are to reduce stormwater runoff and improve water quality, enhance the streetscape character, and provide safe and accessible pedestrian and bicycle accommodations. To achieve these goals, a range of design strategies and opportunities were considered, including GSI techniques, planting strategies, traffic calming measures, and pedestrian-oriented streetscape elements.

CONNECTION TO THE GREEN STREETS NETWORK

The site ties into the Green Streets Network in the downtown area, connecting pedestrians and cyclists with local businesses and, enhancing the streetscape experience for tourists and reducing contaminated runoff into the Puget Sound

SITE CONSIDERATIONS

- Utilities: Trees are offset from stormwater and sewer lines on the north side of the block and the water line on the south side of the block
- Overhead power lines: Smaller tree species are recommended for this block due to overhead electric lines on both sides of the street.
- ROW dimensions: The current streetscape infrastructure takes up the entire ROW.
- Conditions informing plant palette development: Since many people pass through this area with their pets, dog tolerant plants are recommended.

GREEN STORMWATER INFRASTRUCTURE

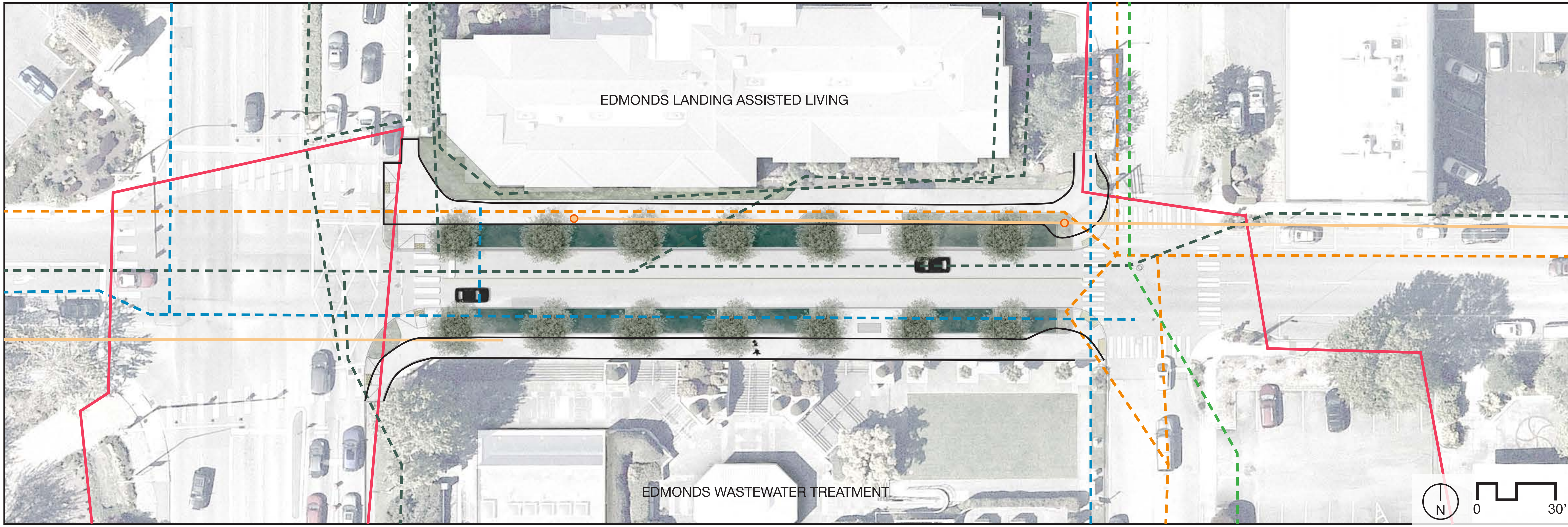
- Stormwater planters: Are used on both sides of the street to capture and infiltrate stormwater runoff from the street and sidewalk.
- Street trees: Street trees are used on both sides of the street to reduce stormwater runoff through uptake and evapotranspiration as well as intercepting rainfall. Additionally, they provide shade to reduce Urban Heat Island Effect and improve air quality.

PEDESTRIAN ENHANCEMENTS

- Sidewalk enhancements: The existing pedestrian travel zone is maintained, with proposed trees and stormwater planters acting as a buffer to separate pedestrians from vehicular traffic.

PROJECT LOCATION - MAP NOT TO SCALE

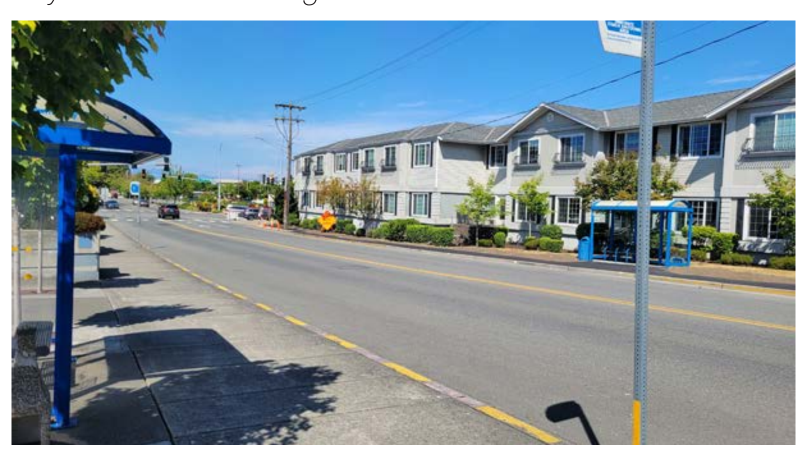
Dayton Street Option 1 | Existing Conditions



Existing Site Photos

Dayton St: view looking east

Dayton St: view looking west



Legend

- Existing sidewalk

EXISTING ABOVE GROUND UTILITIES

- Fiber optic communication line
- Electric
- Utility pole

EXISTING UNDERGROUND UTILITIES

- Sewer
- Stormwater
- Water

Note: Trees to be placed with 5' offset from utility lines.

Project location

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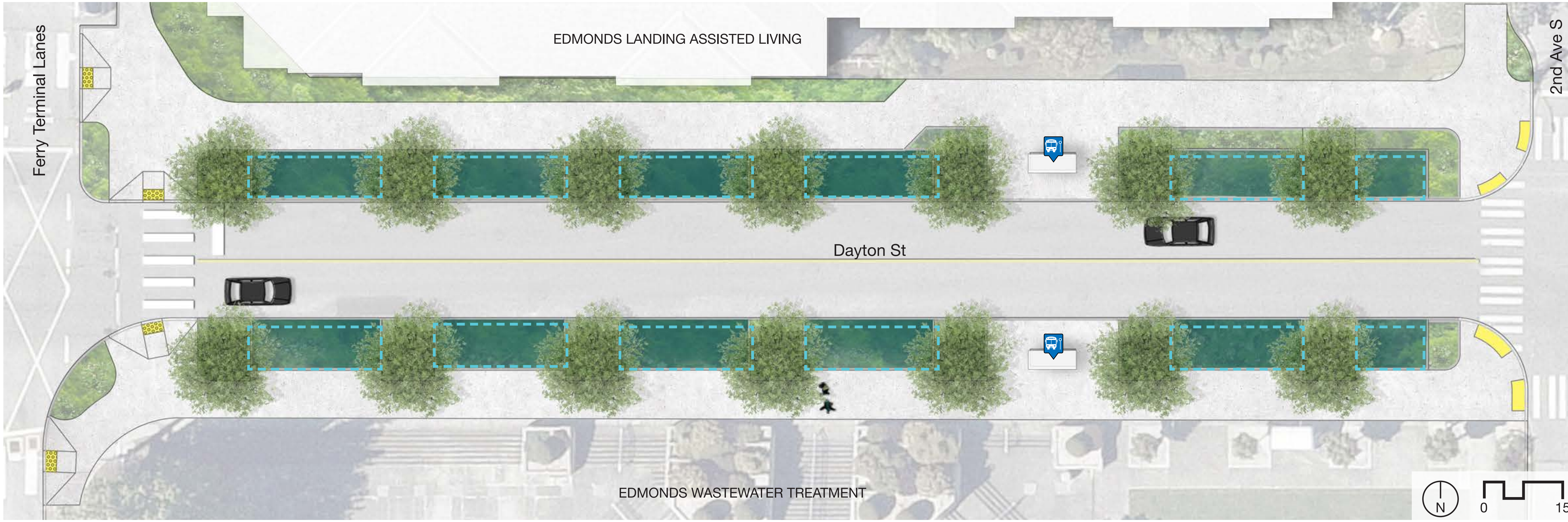
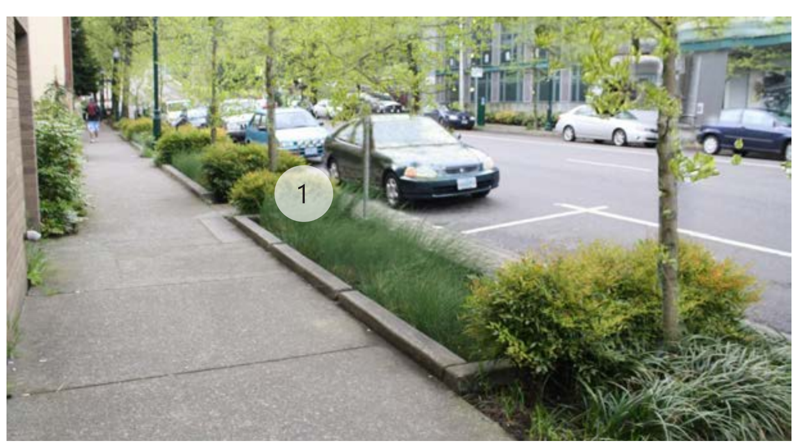
Utilities are diagrammatic and are approximate locations based on City of Edmonds Web Map Data

Dayton Street Option 1 | Plan View



Precedent Images

Portland, OR



Portland, OR

Legend

- Street trees
- Stnd. landscape beds
- Stormwater planter
- Concrete pavement
- Bus shelter

Notes

1. Trees in standard landscape beds alternate at regular intervals with bioretention planters
2. Stormwater planter collecting sidewalk and roadway runoff

Project location

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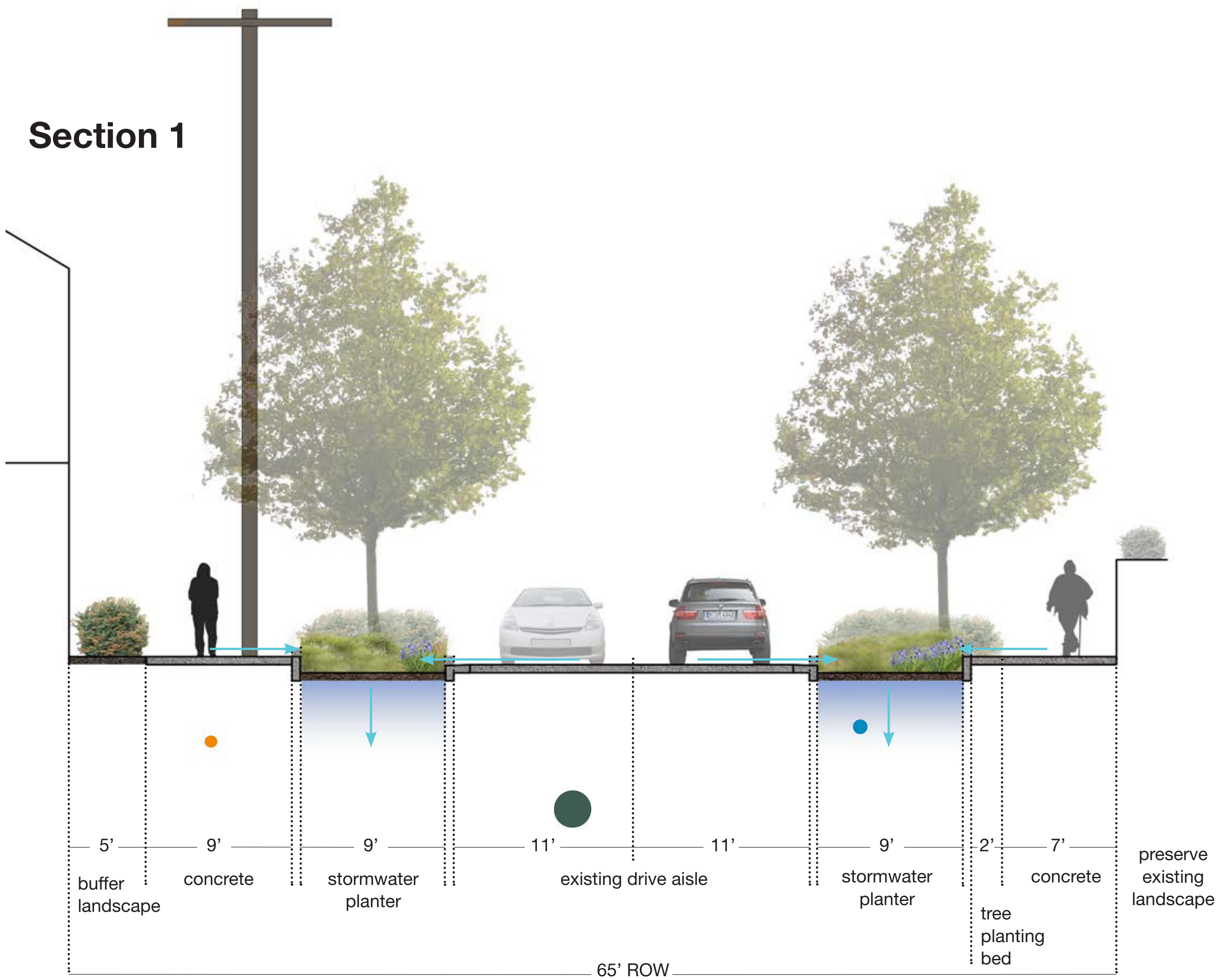
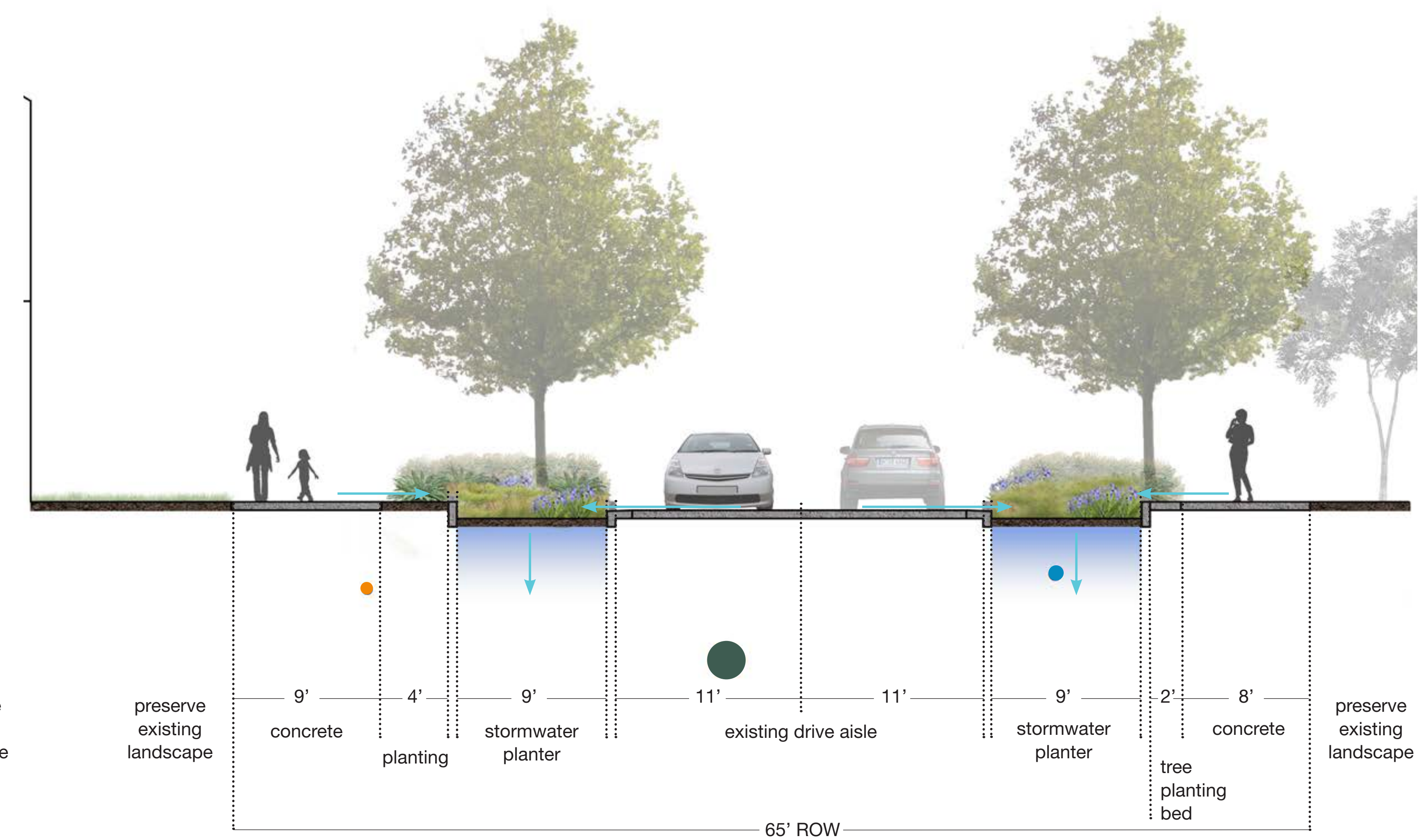
Dayton Street Option 1 | Sections

Key Map

Section 1



Section 2



Legend

- Sewer
- Stormwater
- Water
- Stormwater runoff

Note: Trees to be placed with 5' offset from utility lines.

0 5' 10'

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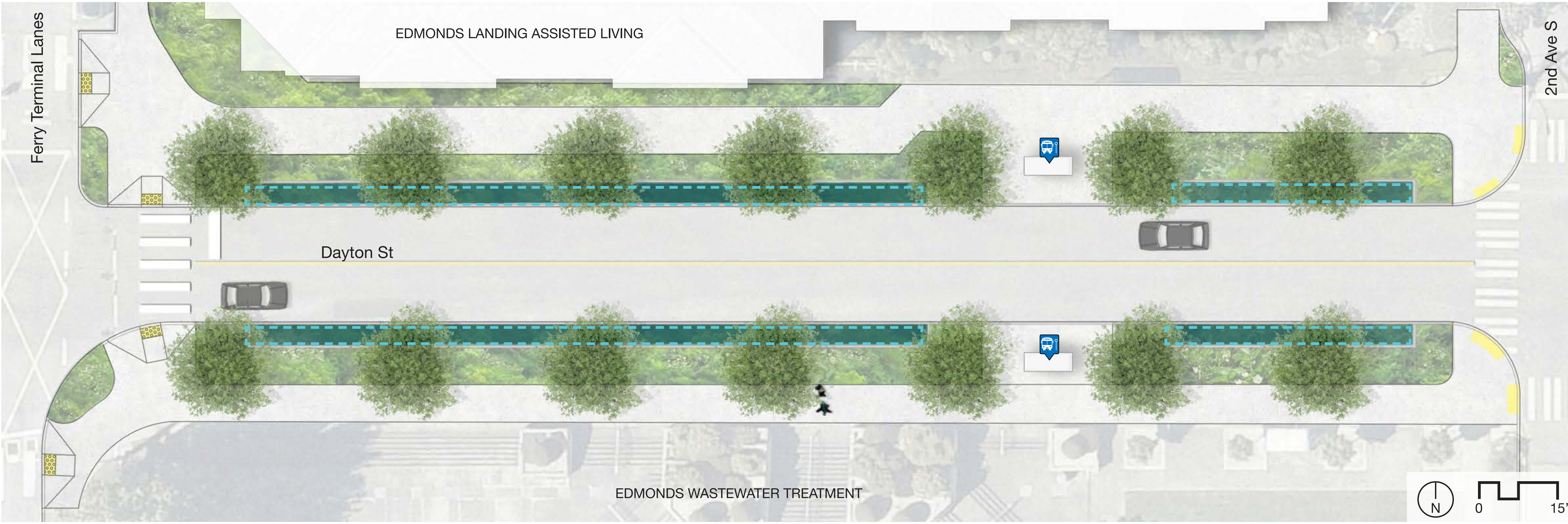
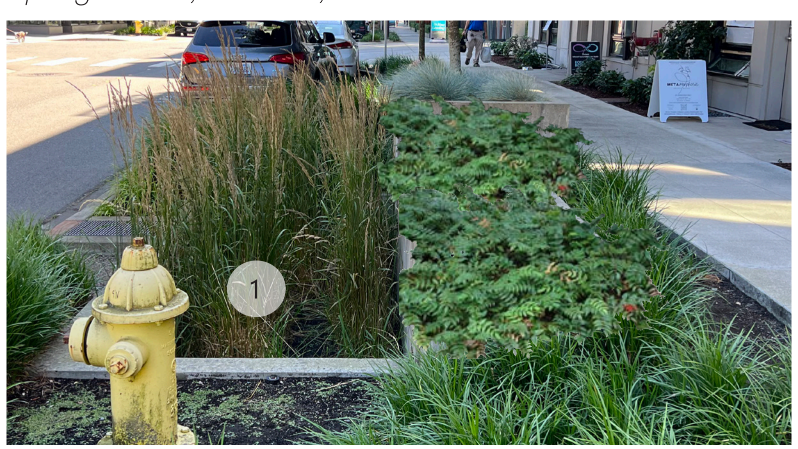
Dayton Street Option 2 | Plan View



Precedent Images

Spring District, Bellevue, WA



Legend

Street trees

Stnd. landscape beds

Stormwater planter

Concrete pavement

Bus shelter

Notes

1. Stormwater planter collecting runoff from the road
2. Standard landscape beds adjacent to stormwater planter picking up sidewalk runoff, overflows to stormwater planter.

Project location

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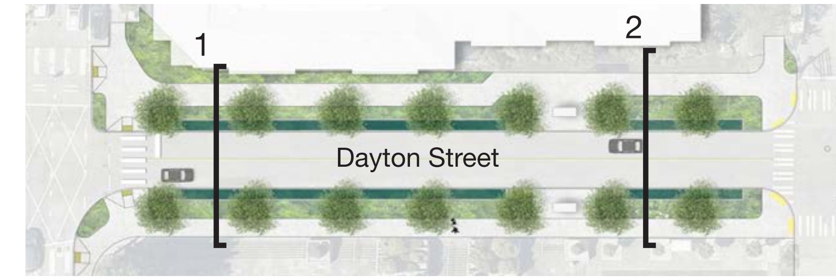
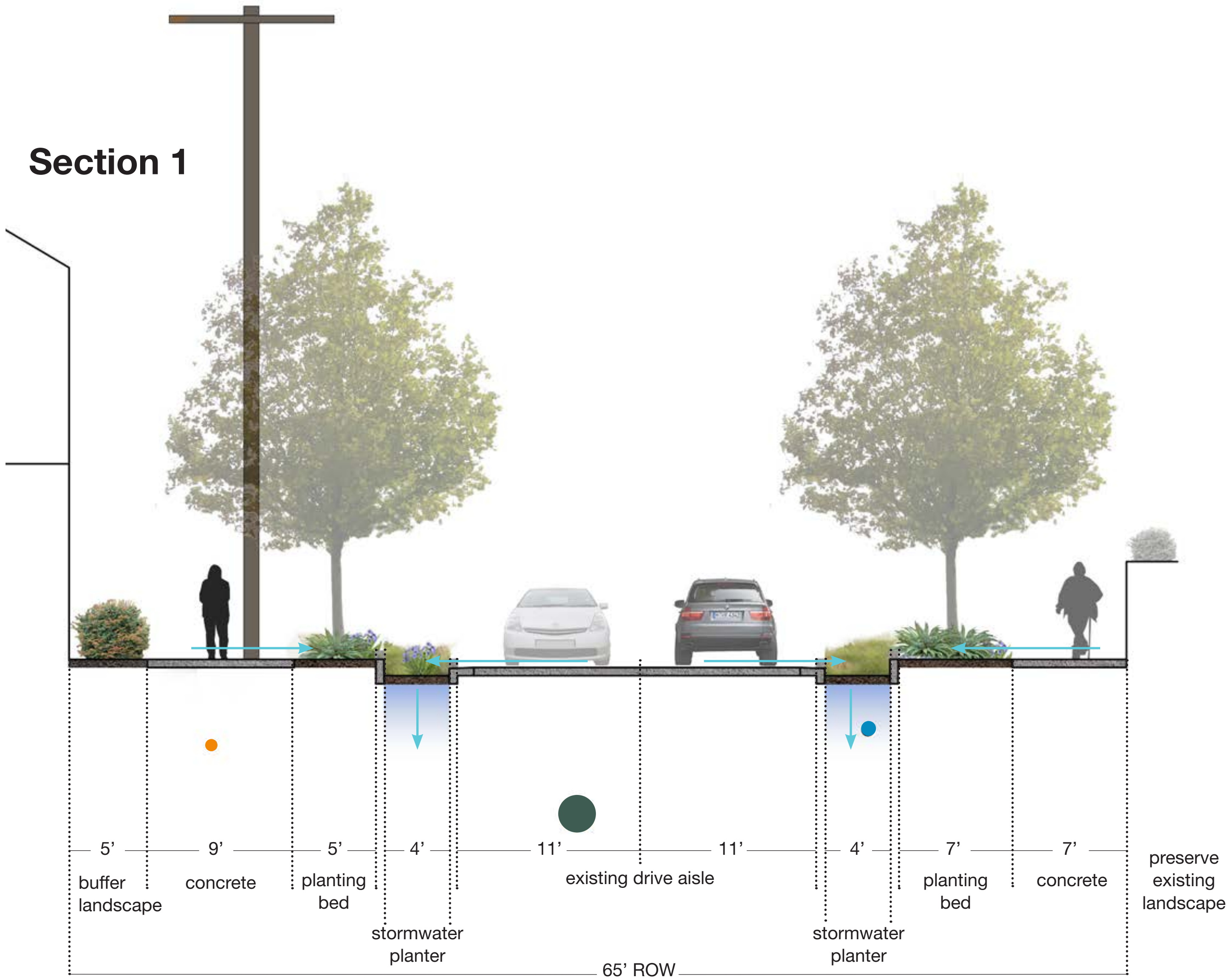
Dayton Street Option 2 | Sections

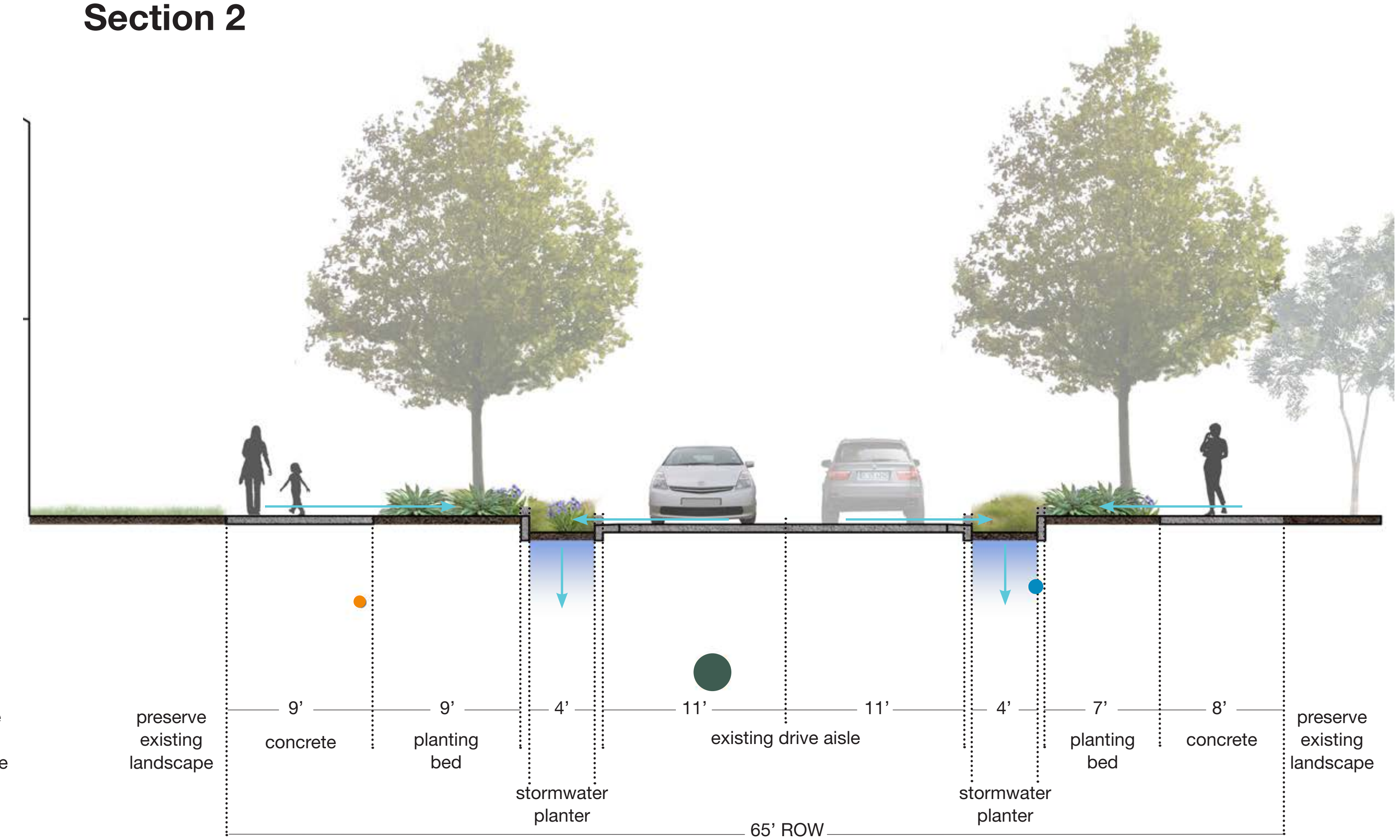
Key Map



Section 1



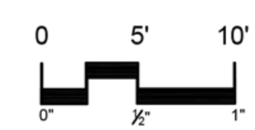
Section 2



Legend

- Sewer
- Stormwater
- Water
- Stormwater runoff

Note: Trees to be placed with 5' offset from utility lines.



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Dayton Street | Plant Palette and Details

Plant Palette

Trees

Loebner Magnolia

Orange Bark Stewartia

Planting beds

Dwarf Cranberry Bush

Dog Tolerant Plants

Sword Fern, Japanese Holly Fern

Mexican Sage

Silver Carpet

Bioretention Cell Plantings

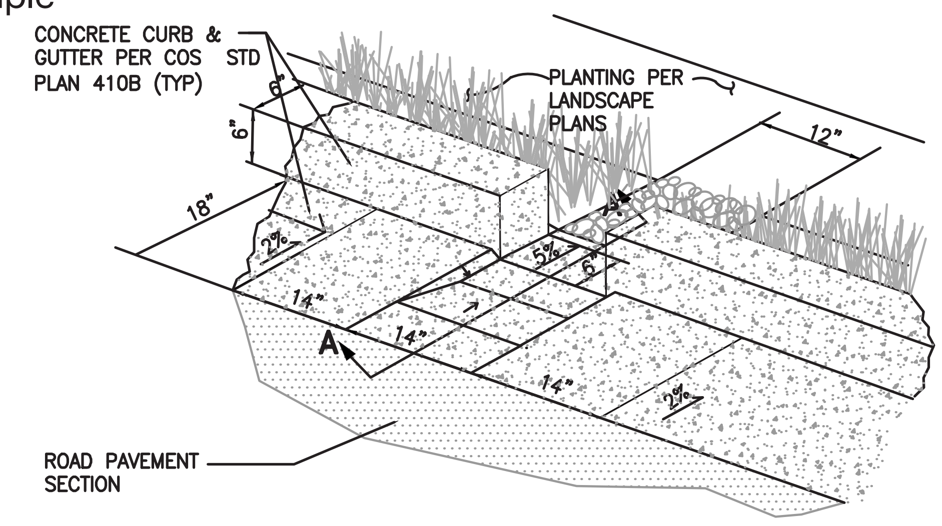
Kelsey Dogwood

Orange New Zealand Sedge

Oregon Iris w/ Slough Sedge

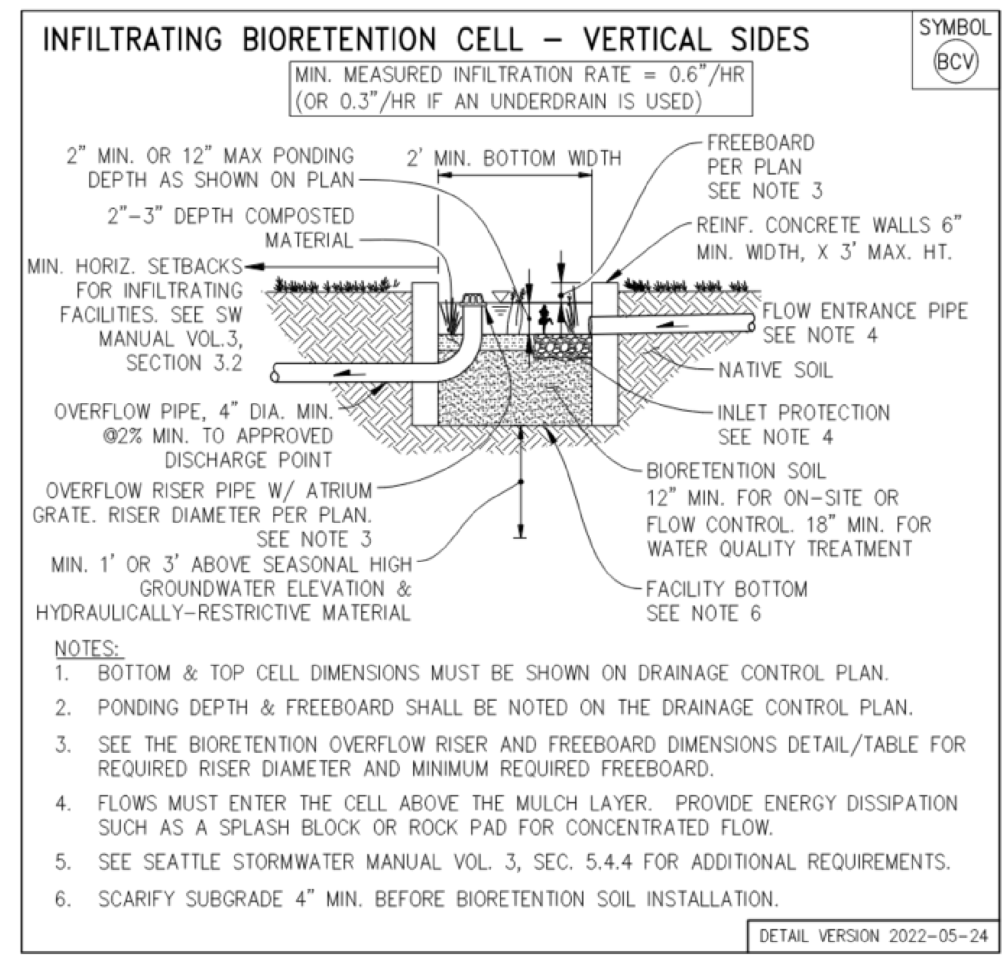
Typical Details

Curb cut example



VIEW FROM GUTTER SIDE

Stormwater planter example



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236th Street SW | 10% Design Example

The primary goals of the design are to improve water quality, reduce stormwater runoff, enhance pedestrian and bicycle accommodations, and create an inviting and safe streetscape character. To achieve these goals, a range of design strategies were considered, including GSI techniques, planting strategies, traffic calming measures, and pedestrian-oriented streetscape elements and sections, a design narrative, and a plant list.

CONNECTION TO THE GREEN STREETS NETWORK

The site ties into the Green Streets Network adjacent to a grocery store and multifamily housing, connecting shoppers and residents to the Green Streets Network extending from Lake Ballinger to destinations throughout the City of Edmonds including Downtown, schools, other businesses and open spaces.

SITE CONSIDERATIONS

- Utilities: Trees are offset from known underground utilities.
- Overhead power lines: Currently, there are overhead utilities on both sides of the street. This design proposes undergrounding the communication lines on the north side of the street to allow for taller trees. On the south side, shorter varieties are utilized to account for power lines.
- ROW dimensions: The ROW in this area allows for an expanded pedestrian zone including new sidewalks as well as bioretention swales.
- Conditions informing plant palette development: The expansive space and more informal nature of this block of 236th is reflected in a naturalistic, primarily PNW native plant palette.
- Topography: The project area's steeper topography presents additional challenges, requiring creative solutions to manage stormwater runoff and provide safe and accessible pedestrian and bicycle connections.

GREEN STORMWATER INFRASTRUCTURE

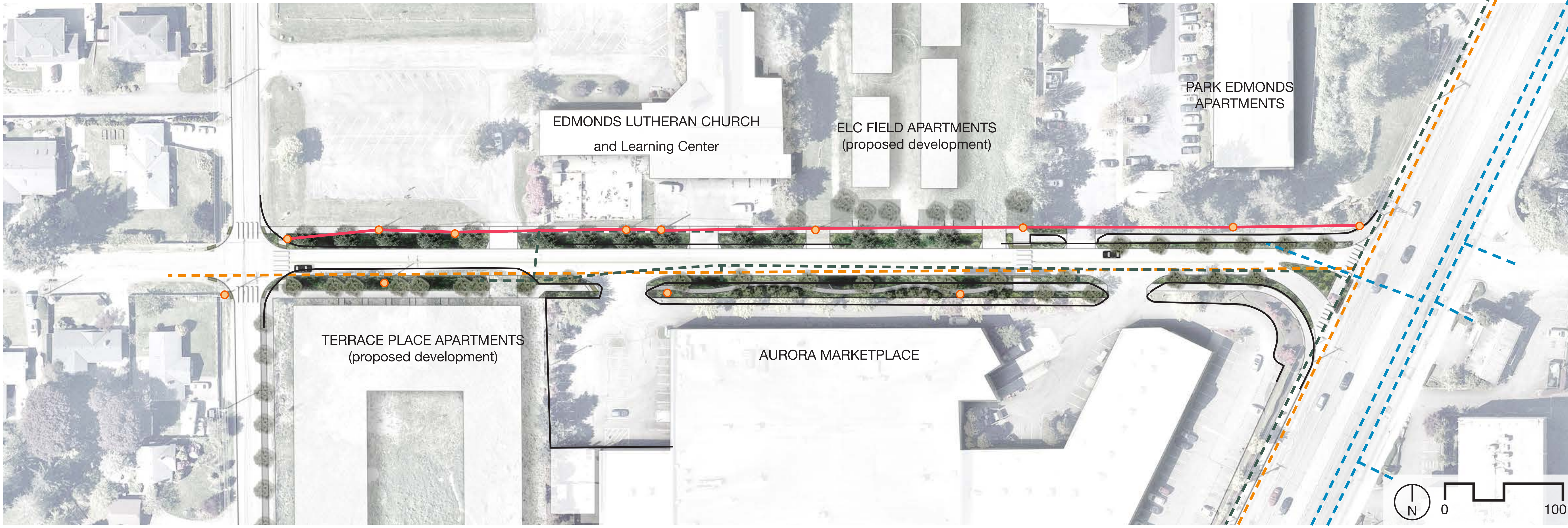
- Bioretention swales: Bioretention swales are used on both sides of the street to capture and infiltrate stormwater runoff from the street and sidewalk.
- Street trees: Street trees are used on both sides of the street to reduce stormwater runoff through uptake and evapotranspiration as well as intercepting rainfall. Additionally, they provide shade to reduce Urban Heat Island Effect and improve air quality.

PEDESTRIAN ENHANCEMENTS

- Sidewalk enhancements: This block currently has occasional, discontinuous sidewalks. The proposed design creates a continuous pedestrian zone, separated from the roadway by a planted buffer.

PROJECT LOCATION - MAP NOT TO SCALE

236th Street SW | Existing Conditions



Existing Site Photos

236th St SW: view looking east

236th St SW: view looking west

Legend

- Existing sidewalk

EXISTING ABOVE GROUND UTILITIES

- Fiber optic communication line
- Electric
- Utility pole

EXISTING UNDERGROUND UTILITIES

- Sewer
- Stormwater
- Water

Note: Trees to be placed with 5' offset from utility lines.

Project location

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236th Street SW | Plan View

Precedent Images

Portland, OR

Image: City of Portland

S.E.A. Street, Seattle, WA

Legend

- Street trees
- Planting beds
- Bioretention swales
- Concrete pavement
- Stabilized gravel paving
- Utility pole
- 3' Guardrail
- Stormwater pipe (proposed)

Notes

1. Meandering informal stabilized gravel path
2. Vegetative buffer planting at back of sidewalk to provide screening of Aurora Marketplace wall
3. Connection to existing storm
4. Bioretention swales collect runoff from road through curb cuts
5. Bioretention swales collect runoff directly from sidewalks

Project location

Image: Google Maps

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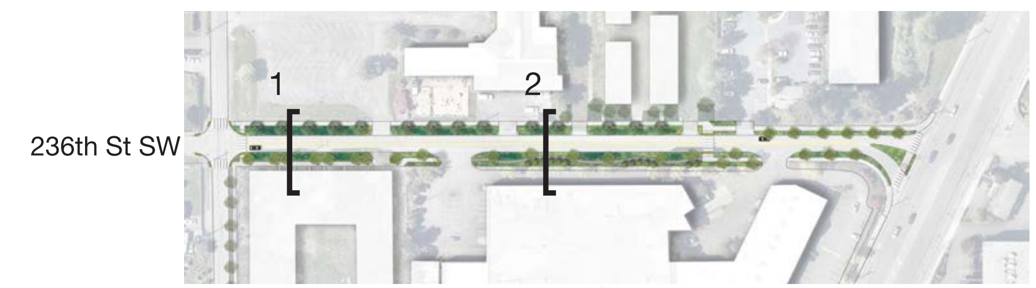
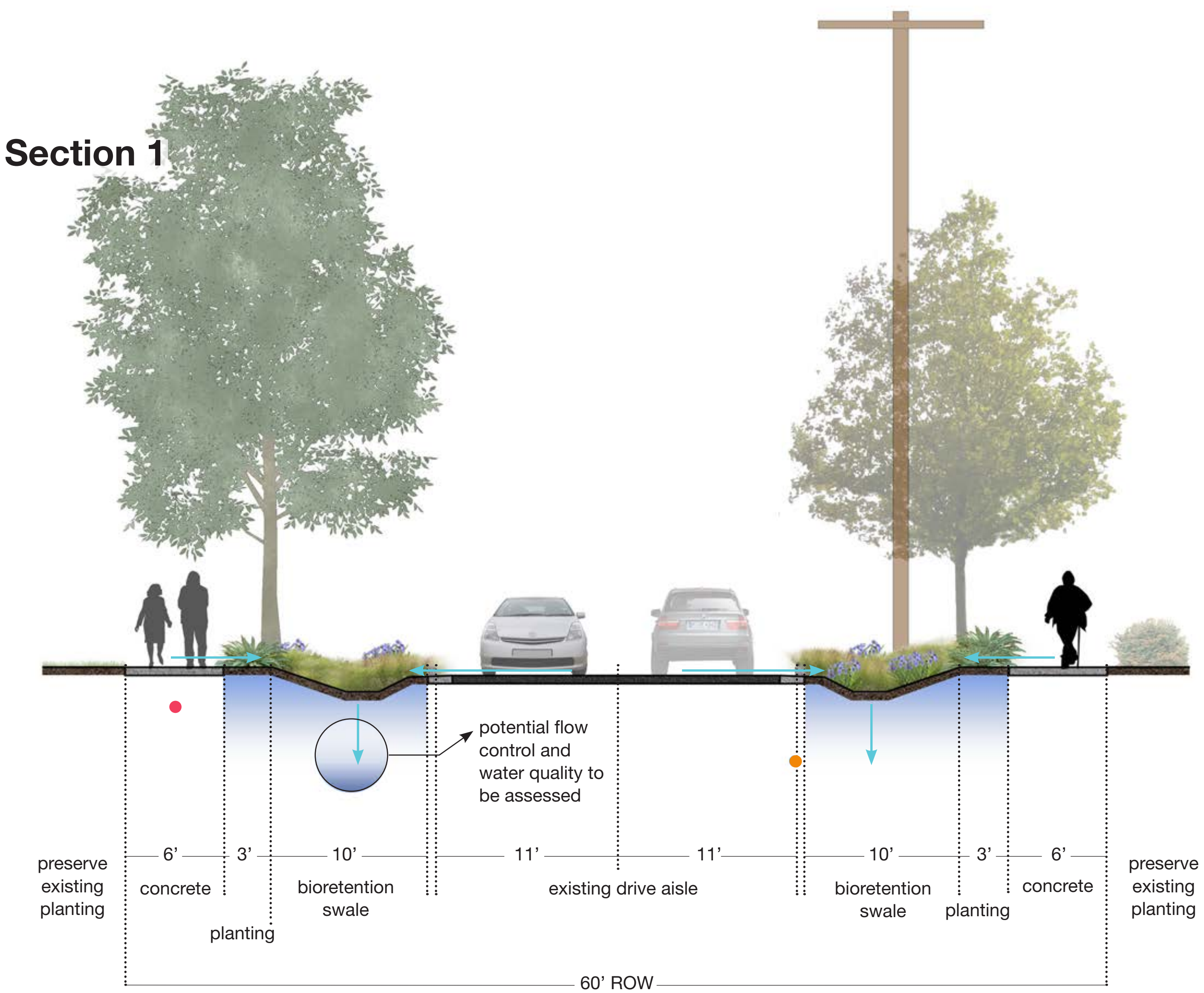
236th Street SW | Sections

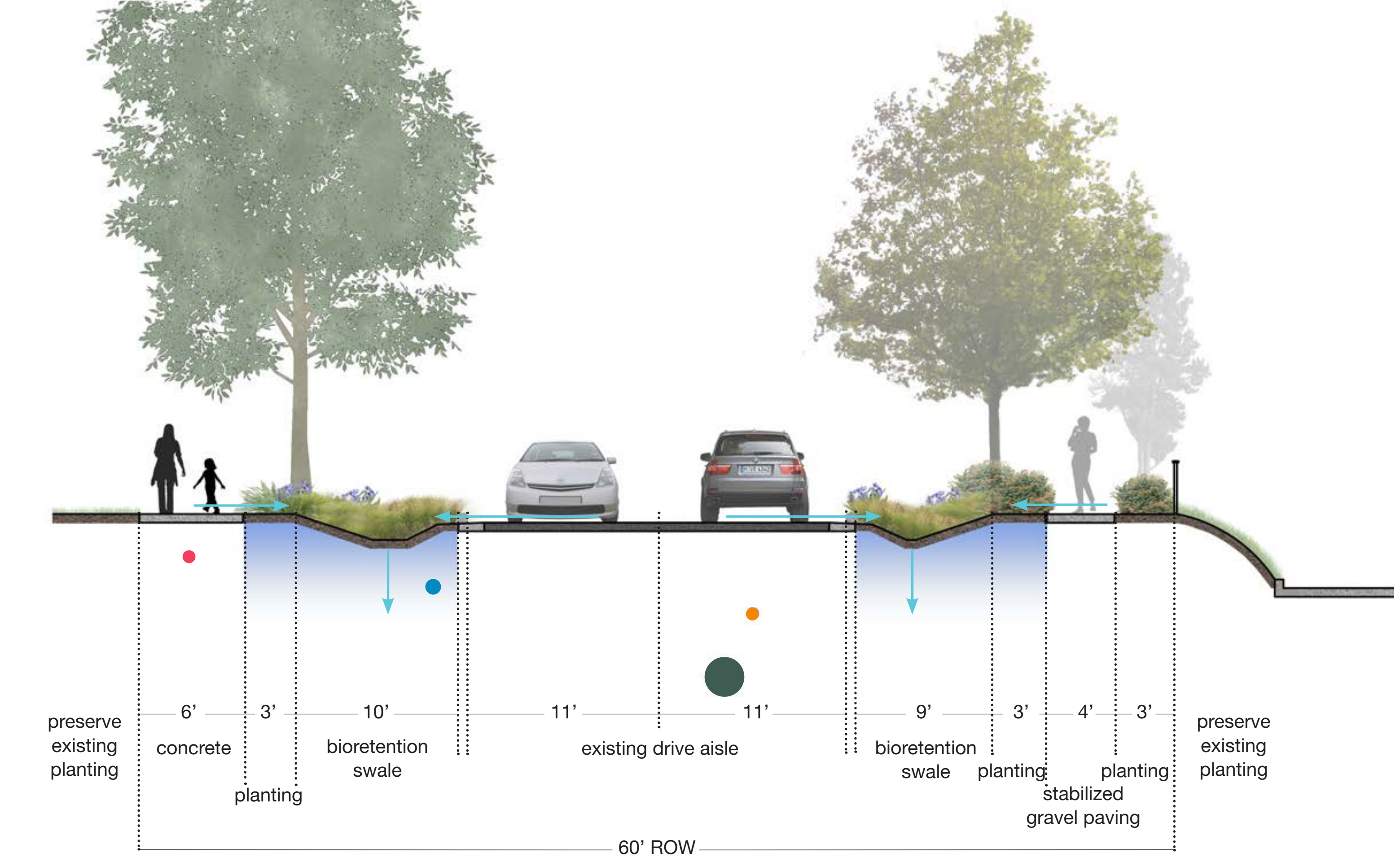
Key Map



Section 1



Section 2



Legend

- Sewer
- Stormwater
- Water
- Proposed under-grounding of Fiber optic communication line
- Stormwater runoff

Note: Trees to be placed with 5' offset from utility lines.

0 5' 10'
0" ½" 1"

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236th Street SW | Plant Palette and Details

Plant Palette

Trees

Western Red Cedar

Eddies White Wonder Dogwood

Large Shrubs

Hinoki Cypress

Planting beds

Dwarf Cranberry Bush

Tall Oregon Grape

Sword Fern

Bioretention Swale Plantings

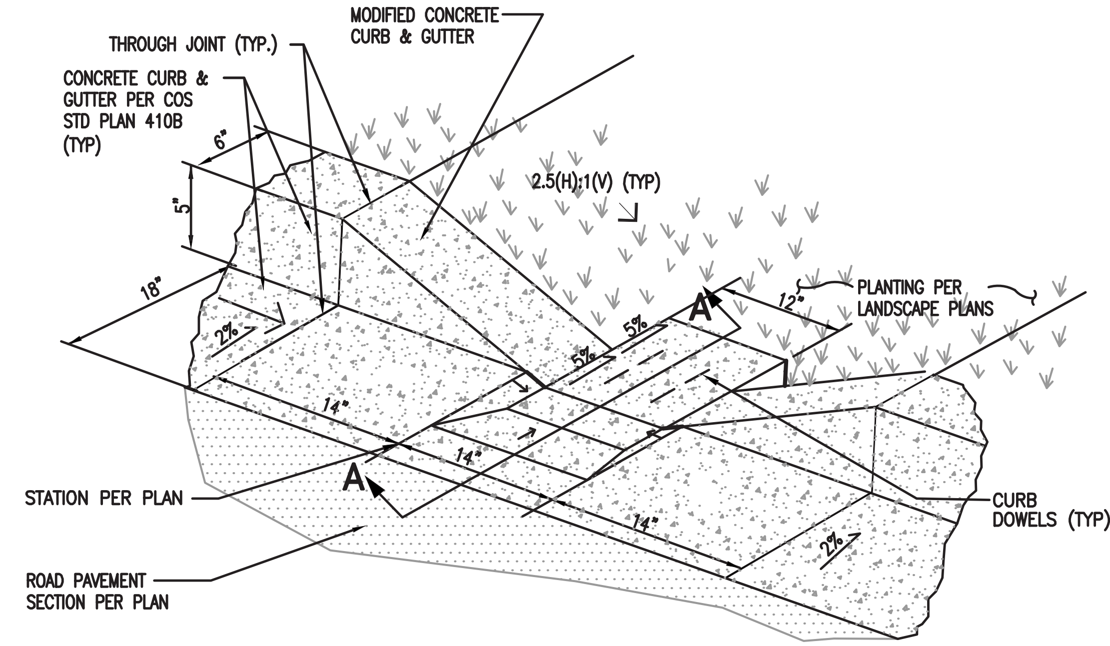
Kelsey Dogwood

Orange New Zealand Sedge

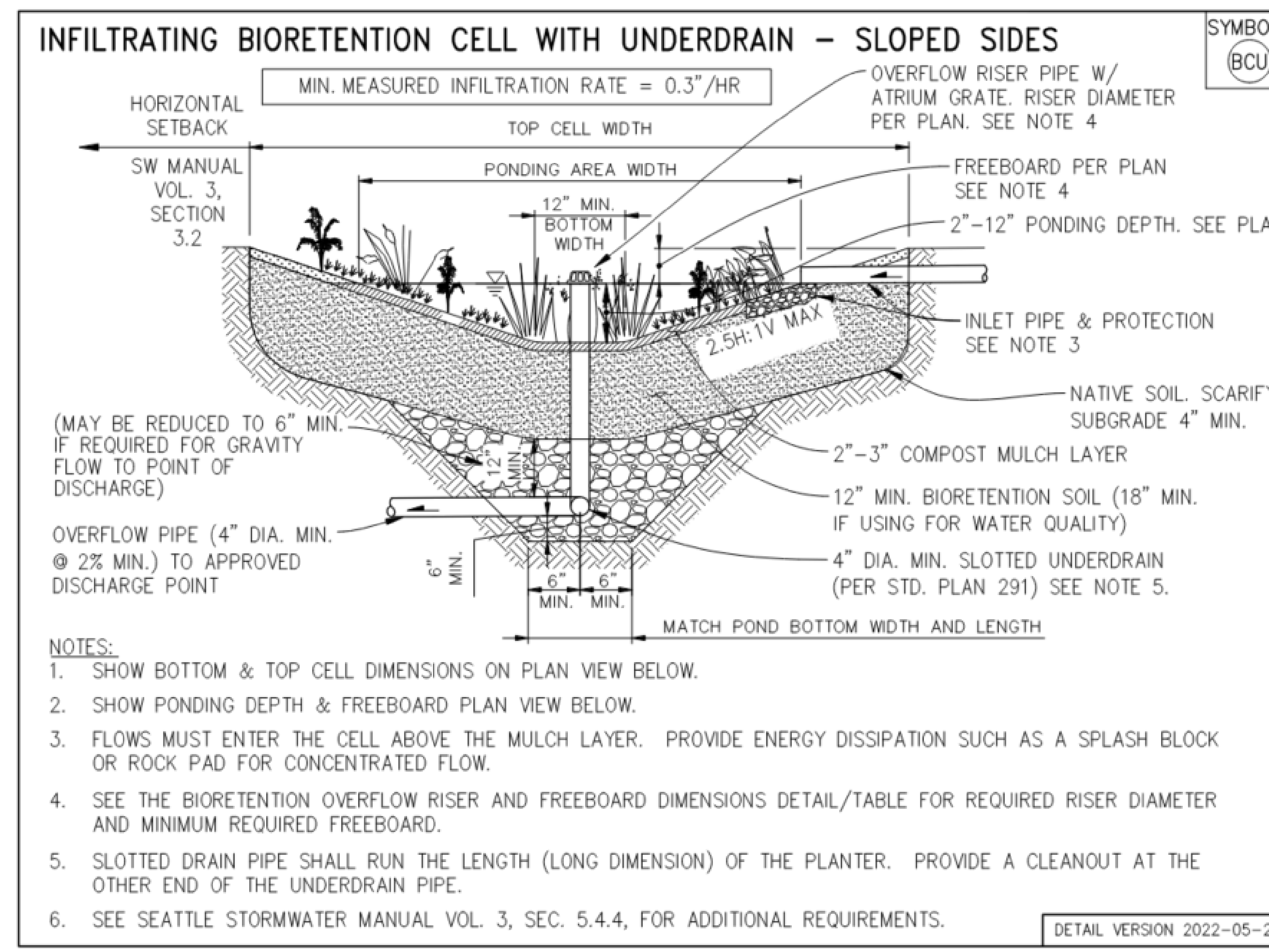
Oregon Iris w/ Slough Sedge

Typical Details

Curb cut example



Bioretention Swale example



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