



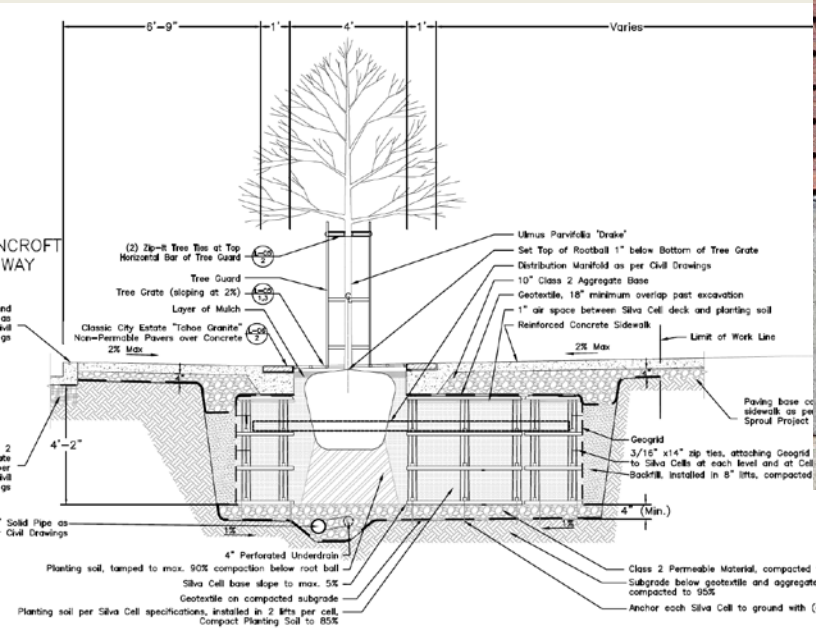
Source: CD+A, 2012



Source: CD+A, 2012



Achieving Green and Sustainable Streets – the latest techniques



**COMPASS
Technical
Workshop**
May 26, 2016

Phil Erickson



SILVA CELL – LATERAL CROSS-SECTION
SCALE: 1" = 2"
Note: 1'-3" spacing is required between Silva Cell Stacks (shown at 1')

Complete and Green Streets

- Combining two concepts for street design:
 - **Complete Streets + Green Streets**
- Create streets:
 - For all users
 - Reduce carbon footprint
 - Promote improved public health
 - Support economic vitality
 - Placemaking
 - Green infrastructure
 - Manage and improve stormwater quality



Source: outdoorchattanooga.com



Source: Green Infrastructure for Southwest Neighborhoods



Source: CD+A

What are Green Streets?

- In-street water management
 - Improve stormwater quality
 - Reduce stormwater flow
 - Use land efficiently
 - Embrace natural processes
 - Provide cost effective solutions
 - Reduce irrigation demand
- Beyond water management
 - Public health
 - Open space and recreation
 - Create unique and attractive places
 - Support for walking, biking, and transit
 - Reduce carbon footprint
 - Reduce urban heat island effect
 - Sea level rise



Photo: Greg Raisman – flickr.com/photos/gregraisman/



Source: DC Green Infrastructure

Why Green Streets?

Streets and Water Quality

- Collect and concentrate debris, sediment and contaminants
- Origin of higher concentrations of oils and pollutants
- Impact groundwater, waterways, and overall hydrologic



Sources: Upper- www.highpointnc.gov



Sources: <http://parkviewdc.files.wordpress.com>

Why Green Streets?

Streets and Water Flow

- Concentrated flow
- Increased flow volume
- Relationship to flooding



Source: www.abc-7.com



Source: CD+A, 2008

Green Streets

Improve Streets for All Users

- Street trees and other street landscape
 - Pedestrian comfort, safety, and interest
 - Vehicular & cyclist speed management and shade



Source: joyandphil.blogspot.com



Source: City of San Leandro



Source: City of San Leandro

Complete Streets

For All Users

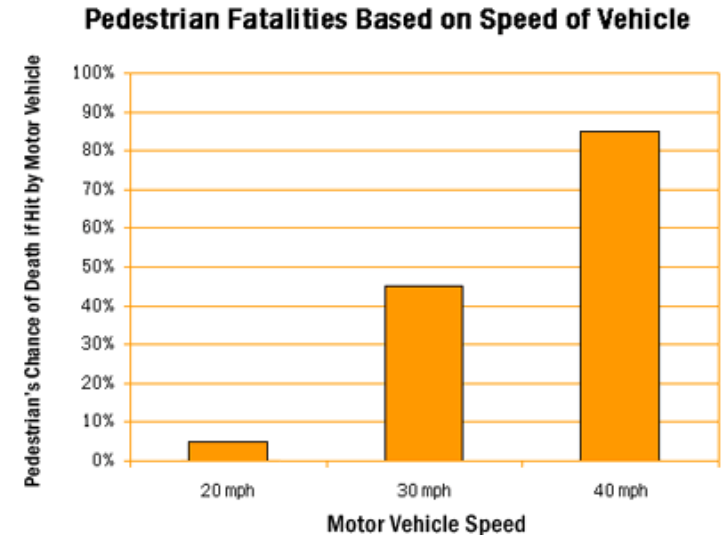
- Balancing Travel Needs and Purposes
 - Mobility
 - Access
 - Safety
 - Enjoyment



Complete and Green Streets

For All Users

- Manage Speed of Traffic for Safety
- Balancing Travel Needs and Purposes
 - Mobility



Source: <http://www.walkinginfo.org>

Hit at **40mph**
there's a 70% chance I'll die.

Hit at **30mph**
there's an 80% chance I'll live.

That's why it's 

*Approximate figures

Source: <http://mywheelsareturning.com>

Complete and Green Streets

Economic Vitality Benefits

- Street trees and walkable environments can positively impact retail sales & rents
 - 3-15% increase in home values
 - Polling of shoppers indicates
 - 9-12% more spending
 - Spend more time in treed district



Source: joyandphil.blogspot.com



Source: www.ca-ilg.org.com

1. *Public Response to the Urban Forest in Inner-City Business Districts* by Kathleen L. Wolf, *Journal of Arboriculture* 29(2), May 2003

- Improved worker

Complete and Green Streets

Economic Benefits

- Green infrastructure can have cost savings of 15-80% over conventional stormwater management, including construction and operations & maintenance^{1, 2, 3}



Source: www.annarbor.com



Source: CD+A,

1. *Managing Wet Weather with Green Infrastructure website: Philadelphia Case*, EPA
2. *SEA Street Precedent Design Study*, Washington State University, Wong and Stewart, 2008
3. *Downstream Economic Benefits of Conservation Development*, *Journal of Water Resources Planning and Management*, Johnston, Braden and Price, 2006

Why Green Streets?

Grey and Green Infrastructure Choice, Dayton, Ohio Case Study

PSSP #27 – Street View of Project Area

- Existing streets have brick with an asphalt overlay
- Curb height diminished by overlay/resurfacing
- Small set-backs with little grade change in front yards



Why Green Streets?

Grey and Green Infrastructure Choice, Dayton, Ohio Case Study Modeling Alternative Storm System Improvements

- **Grey Solutions:**
 - Increased Conveyance
 - Volume-storage
- **Grey-Green Solutions Combination:**
 - Conveyance with Retention
 - Conveyance with increased conveyance
- **Green Infrastructure Solutions**
 - BMP Toolbox (e.g., Pervious Pavements/
infiltration)
- **Tailored to City-region**

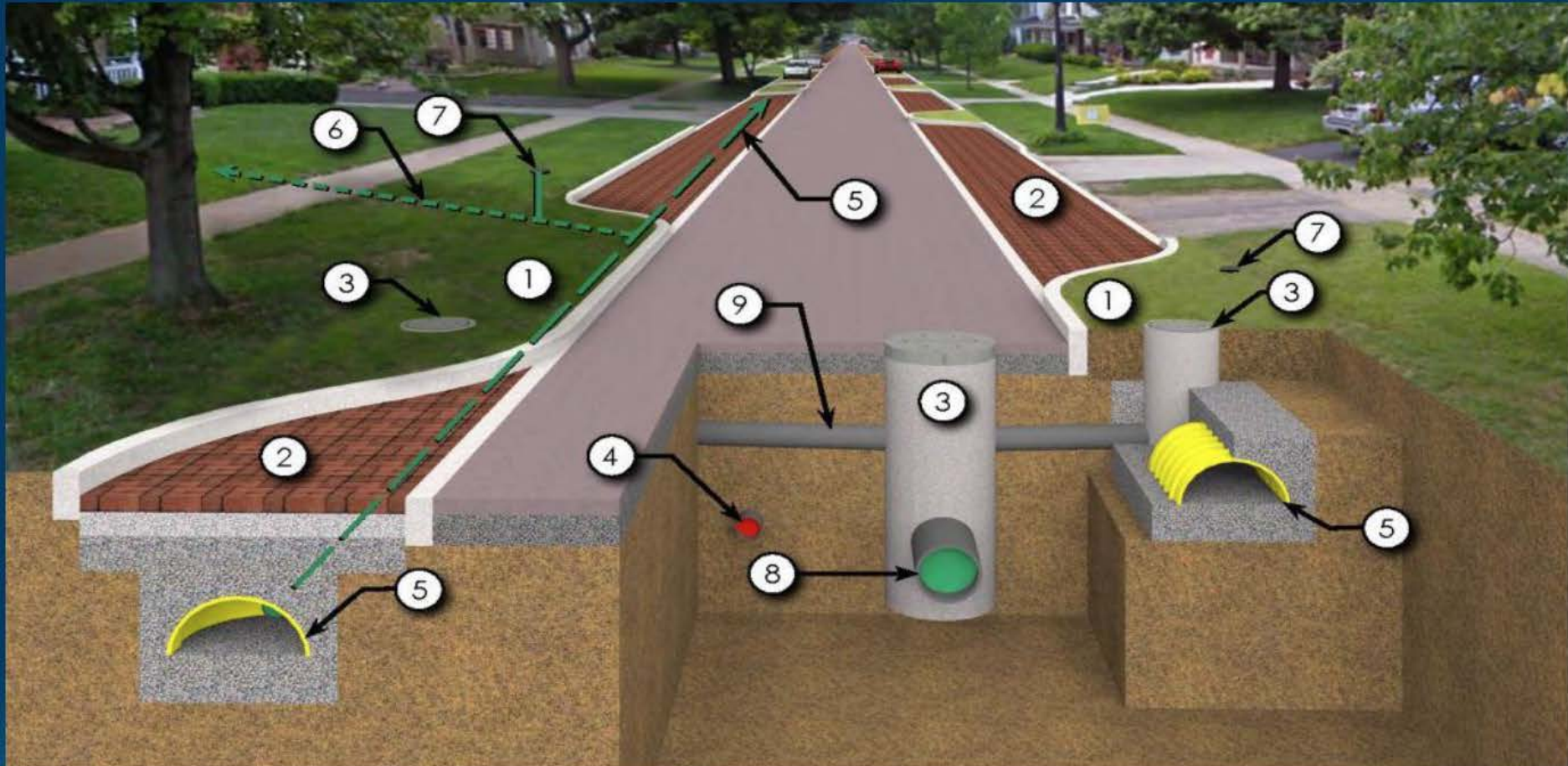


Why Green Streets?

Grey and Green Infrastructure Choice,

Dayton, Ohio Case Study

Green Street System Elements



- | | | |
|-----------------------------|---|---------------------------------|
| 1. Proposed Curb Extension | 4. Existing Sanitary Sewer (Line Service
Laterals through R\W) | 6. Proposed Downspout Connector |
| 2. Proposed Pervious Pavers | 5. Proposed Underdrain (Stormtech) | 7. Proposed Cleanout |
| 3. Proposed Manhole | | 8. Existing Storm Sewer |
| | | 9. Proposed Storm Lateral |

Complete and Green S

Placemaking

- Mark gateways or special places
- Create opportunity for multiple activities and levels of engagement



Source: Pinterest, Denver Performing Arts Complex



Source: thetarnishedcrownblog.blogspot.com

Green Streets

Complement Urban Habitats and Open Spaces

- Part of urban forest
- Link and complement parks
- Reduce impacts to waterways
- Complement and protect



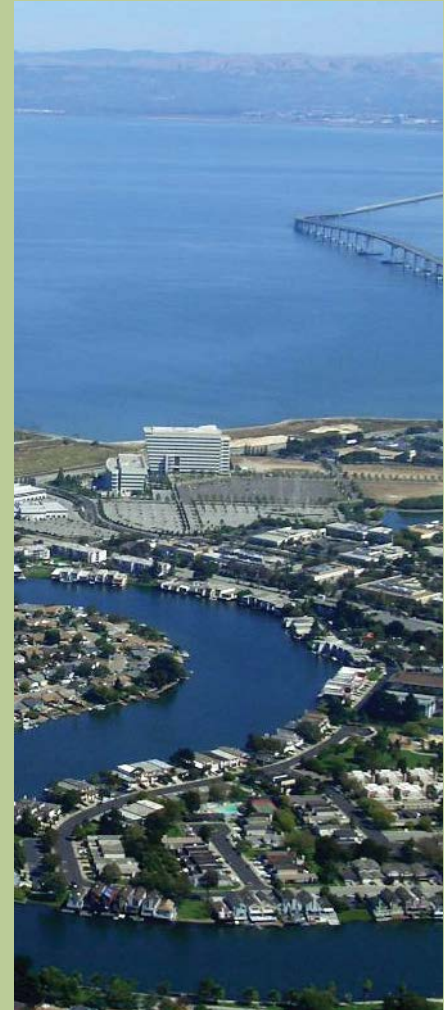
Source: www.aoinstitute.org



Source: www.sanlorenzopress.org



Source: Nevue Ngan Associates



Source: WWW.FlickR.CoM/ tELStAr LoGiStiCS / toDD LAPPin

Sustainable Streets Ne

Reduce Water Demand

- Water harvesting
 - Capturing water runoff to irrigate plants
- Select plant species specific to the place
 - Native or adaptive to climate and hydrology
 - Support habitat goals
 - Provide green infrastructure function



Source: Downloaded from www.djcoregon.com on 12.29.2012



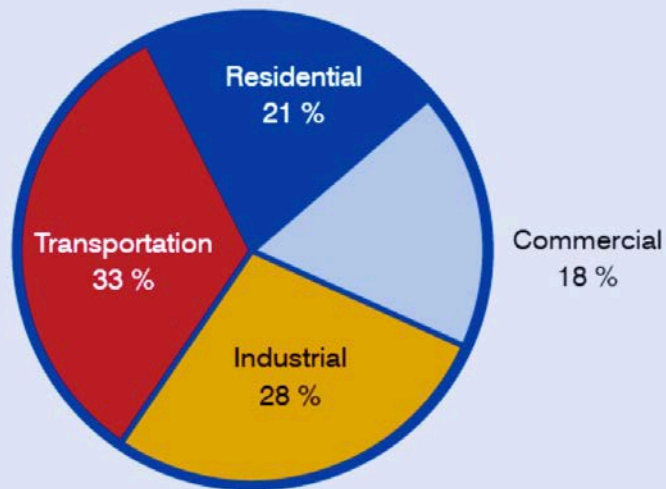
Source: Grant Road Improvement Plan, Tucson, AZ 2010

Sustainable Streets Network

Reduce Carbon Footprint

- Reduce need to drive as much
- Improve the urban forest

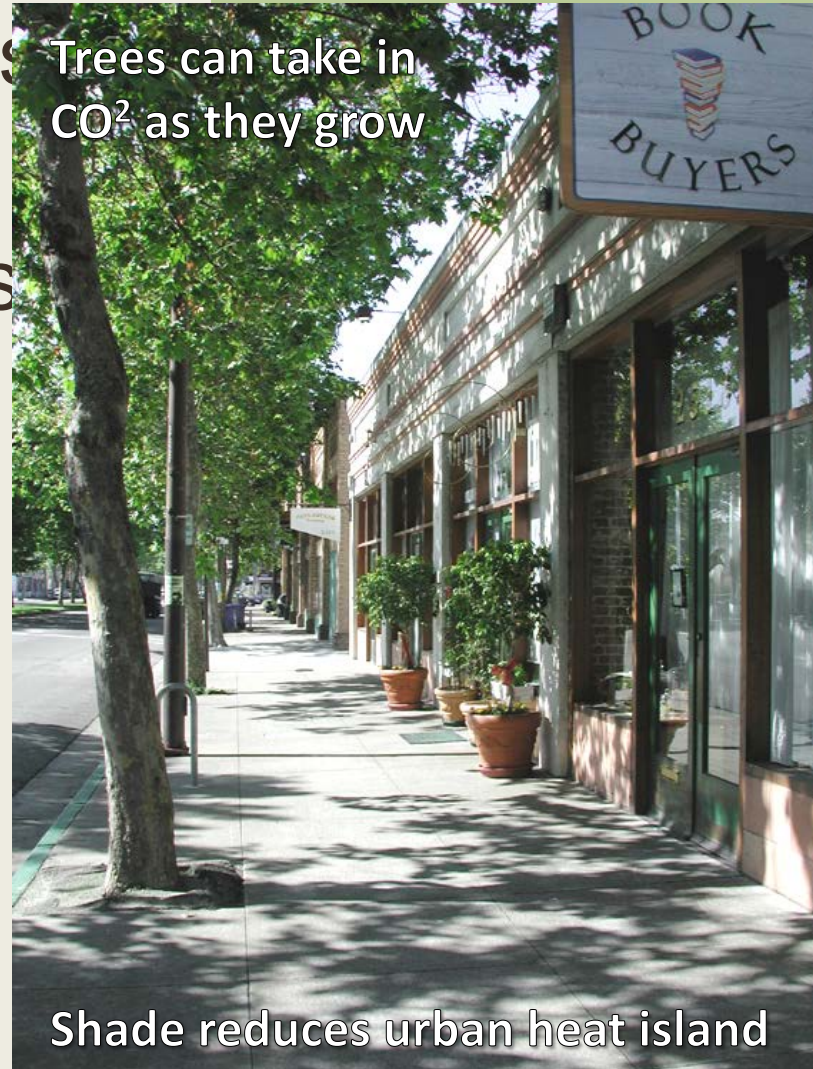
Exhibit 3-12. U.S. carbon emissions from fossil energy consumption by end-use sector in 2005



The chart shows that the transportation sector is the largest contributor of greenhouse gas emissions in the United States.

Source: Energy Information Administration

Trees can take in CO² as they grow



Shade reduces urban heat island

Complete and Green Streets

Public Health Benefits

- “Active Transportation” health benefits of walking and biking

An adult needs 150 min. of moderate activity per week to experience health benefits of physical activity

*“Physical Activity Guidelines for Americans”
USHHS, 2008*

- Less than 10% of



Source: blog.al.com



Source: CD+A

Green Design Elements

Plazas – Rain Gardens



Source: www.ann Arbor.com

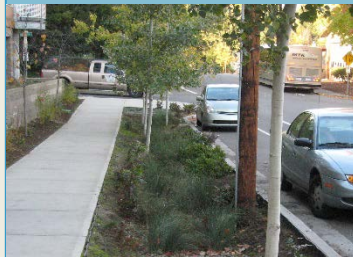


Source: www.sfbetterstreets.org

Planter Strips – Swales, Rain Gardens, Green Gutters, Trees



Source: sfbetterstreets2.szfpplanning.org



Curb Extensions – Rain Gardens



Source: www.myballard.org

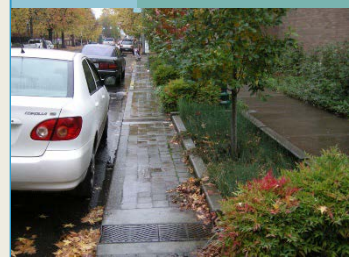


Source: www.blogspot.com on 3.7.2012

Linked Tree Wells/Curbed Planters



Source: blog.g8-life.com



Parking Lane – Permeable Paving, Rain Gardens



Source: www.cityofberkeley.info on 04.12.13



Source: www.extension.org

Green Streets Design Strategies Applicability

Green Streets Design Strategies	Stormwater Functions				
	Infiltration	Attenuation	Bioretention	Filtration (sediments)	Biofiltration (sediments & solutions)
Rain Garden	✓	✓	✓	✓	✓
Bioswale	✓	✓	✓	✓	✓
Green Gutters	✓	✓		✓	✓
Linked Tree Wells	✓	✓	✓	✓	✓
Permeable Pavement	✓	✓		✓	
Infiltration Trench/Basin/Well	✓	✓	✓	✓	✓
Detention Basin/Well	✓	✓		✓	
Trees		✓	✓	✓	✓
Rainwater Harvesting		✓	✓		

Green Streets Design Strategies Applicability

Green Streets Design Strategies	Complete Streets Elements						
	Travel Lane	Parking Lane	Curb Extension	Median / Planter Strip	Curbed or Raised Planter	Sidewalk	Adjacent Area
Rain Garden		✓	✓	✓			✓
Bioswale			✓	✓	✓		✓
Green Gutters	✓			✓	✓	✓	
Linked Tree Wells							
Permeable Pavement	✓	✓		✓		✓	✓
Infiltration Trench/Basin/Well		✓	✓	✓	✓		✓
Detention Basin/Well			✓	✓	✓		✓
Trees		✓	✓	✓	✓		✓
Rainwater Harvesting			✓	✓	✓		✓

Green Infrastructure

Toolbox

- Street Trees & Conventional Landscaping
 - Capture rainfall before it becomes stormwater runoff
 - Provide shade and comfort during hot months
 - Enhance attractiveness and walkability of the street
 - Roots take up water



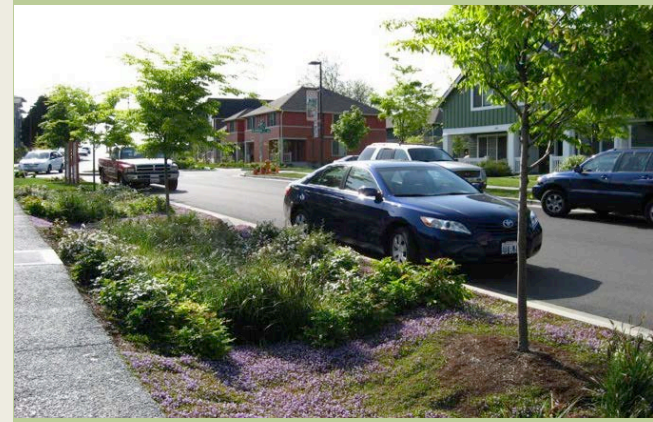
Green Infrastructure

Toolbox

- Bioswales
 - Linear landscape areas designed capture and manage stormwater runoff
 - Usually designed with long stretches of uninterrupted space and no on-street parking
 - Can support street trees
 - Can provide a buffer between traffic and people walking or cycling



Source: Green Infrastructure for Southwest Neighborhoods



Source: water.epa.gov



Source: sbetterstreets2.szfpplanning.org

Green Infrastructure

Toolbox

- Infiltration Trenches & Basins
 - Typically long and narrow
 - Recharge groundwater
 - Require pre-treatment such as landscaping to remove sediment
 - Can be used where adjacent to paved areas and to manage large water volumes



Source: Downloaded from www.ucsd.edu on 1.10.13



Source: Truckee Meadows LID Handbook, 2007

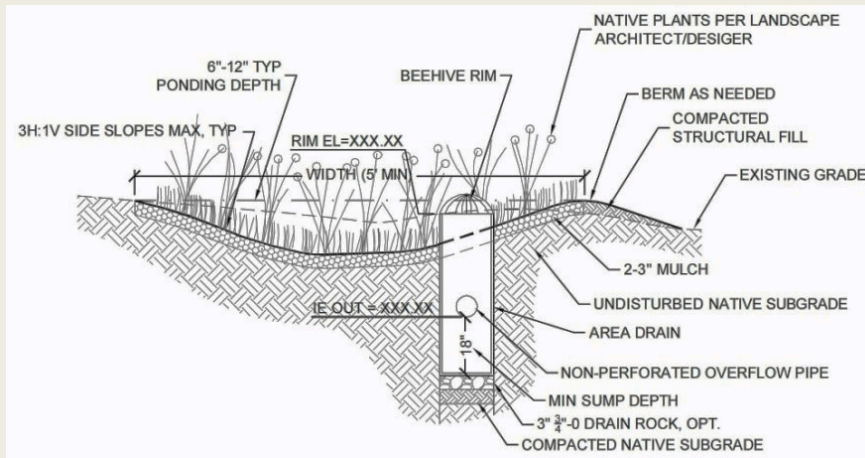
Green Infrastructure

Toolbox

- Rain Gardens
 - Landscape areas designed to capture and manage significant amounts of stormwater runoff
 - Come in all shapes and sizes



Source: Truckee Meadows LID Handbook, 2007



Source: www.greengirlpdx.com



Source: www.annarbor.com

Green Infrastructure

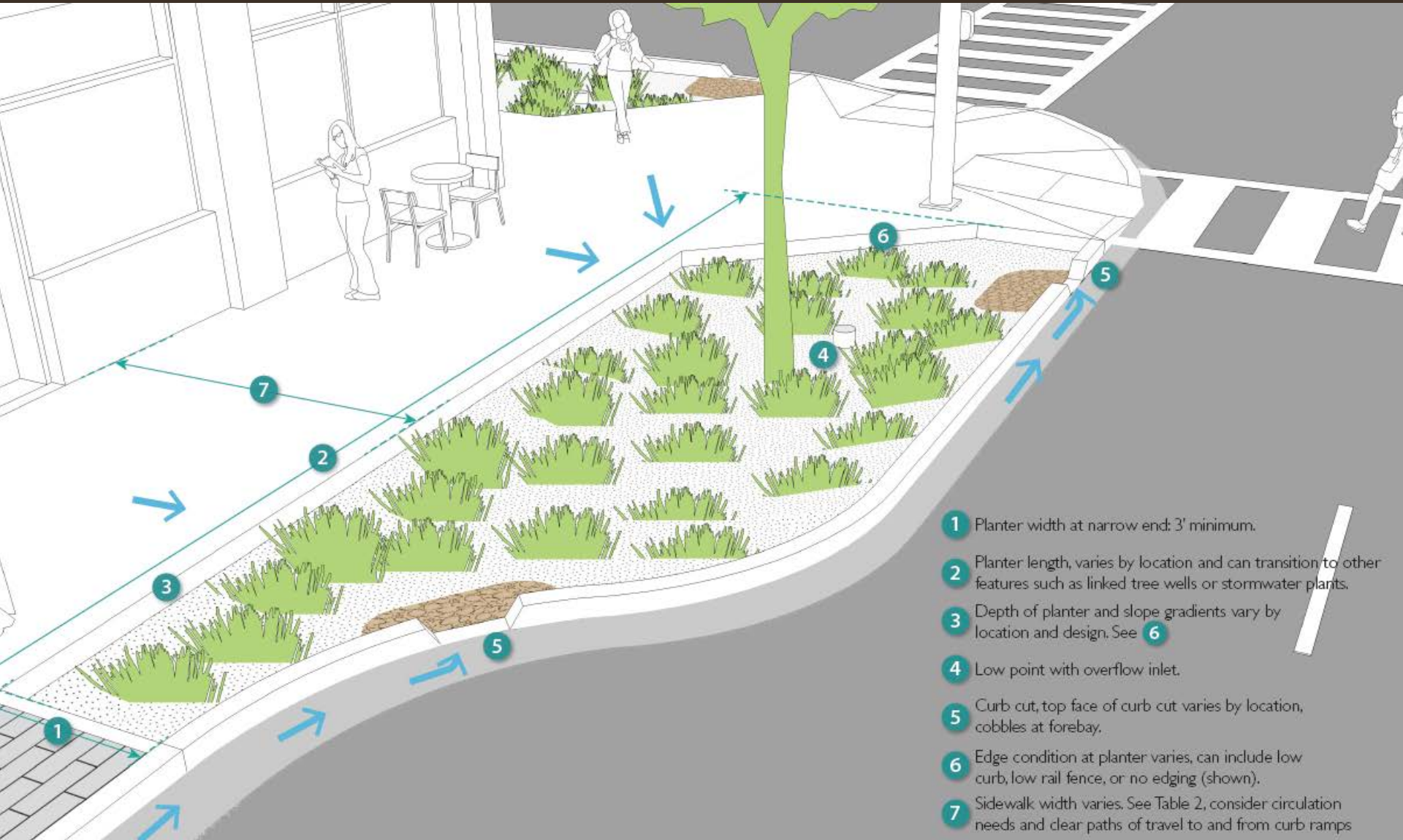
Toolbox

- Stormwater Curb Extensions
 - a complete streets rain garden
 - Landscape areas within a street's parking zone designed to capture and manage stormwater runoff
 - Shaped and sized to avoid utility conflicts
 - Help “green” overall appearance of the street and



Sustainable Streets Network

Stormwater Curb Extensions



- 1 Planter width at narrow end: 3' minimum.
- 2 Planter length, varies by location and can transition to other features such as linked tree wells or stormwater plants.
- 3 Depth of planter and slope gradients vary by location and design. See 6
- 4 Low point with overflow inlet.
- 5 Curb cut, top face of curb cut varies by location, cobbles at forebay.
- 6 Edge condition at planter varies, can include low curb, low rail fence, or no edging (shown).
- 7 Sidewalk width varies. See Table 2, consider circulation needs and clear paths of travel to and from curb ramps

Green Infrastructure

Toolbox

- Stormwater Planters
 - Contained and linear landscape areas designed to capture and manage stormwater runoff
 - They come in all shapes and sizes to help avoid utility conflicts
 - Can fit between the parking zone and sidewalk zone when there is adequate width
 - Can also support street trees when there is adequate width



Source: www.landscapeonline.com



Source: CD+A, 2012



Source: CD+A, 2012

Green Infrastructure

Toolbox

- Green Gutters
 - Narrow and shallow landscape areas designed to capture and manage stormwater runoff
 - Designed to be very linear and 3' wide or less
 - Can help provide a landscape separation between transportation modes and function as a stormwater facility



Source: CD+A

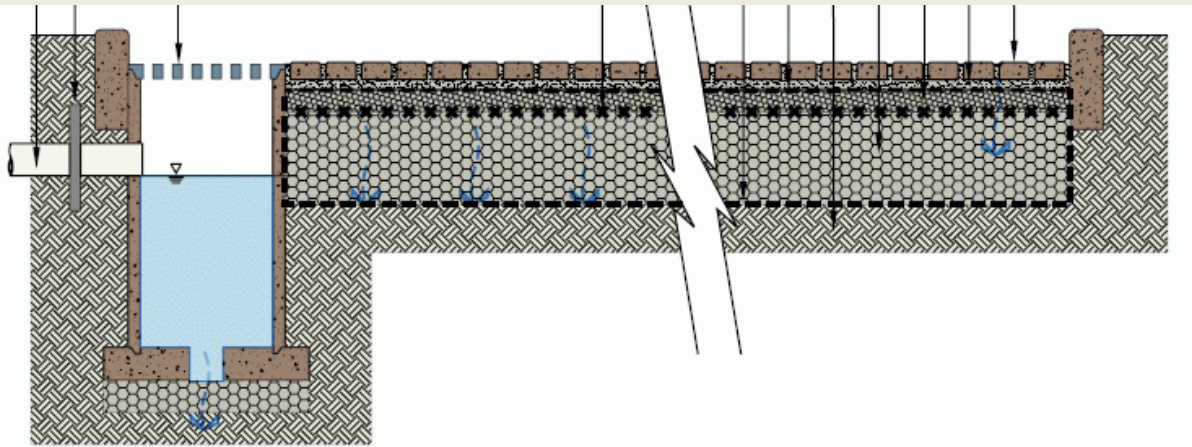


Source: Kevin Robert Perry

Green Infrastructure

Toolbox

- Pervious and Permeable Paving
 - Many different materials available
 - Remove fine particulates and allow infiltration



Green Infrastructure

Permeable, Pervious, and Porous Paving

Paving Material	Area of the Street									Description
	Frontage Zone and Pedestrian Through Zone	Street Furniture and Curb Zone	Curb Extensions	Bicycle Lane	Parking Lane	Travel Lane	Raised Medians	Alleys	Roundabouts	
Permeable Pavers	✘	■	■	✘	○	○	■	○	2	Permeable pavers are separated by joints filled with a crushed aggregate. Permeable pavers are different from pervious pavers in that rainwater passes through the joints only and not the paver itself.
Pervious Pavers	■ ¹	■ ¹	■ ¹	✘	○	○	■	○	2	Pervious pavers allow stormwater to percolate through the paver rather than through the permeable joints around the pavers. As water runs through the pavers some urban pollutants get filtered out.
Pervious Concrete	■	■	■	■	○	○	■	○	2	Pervious concrete is a concrete pavement with a large volume (about 20%) of interconnected voids. Like conventional concrete, pervious concrete is made from a mixture of cement, coarse aggregates, and water. However, it contains little or no sand, which results in a porous open-cell structure that allows water to pass through.
Porous Asphalt	✘	✘	✘	■	○	○	✘	○	2	Porous asphalt is the same as regular asphalt except that it is manufactured without the fine material, which leaves voids throughout the pavement allowing water to filter through and into a drainage bed of aggregate.



Generally Appropriate



Appropriate If load and wear requirements can be met



Not Appropriate

NOTES:

- 1 Pervious pavers with a butt joint of 1/8" or less sand joint are appropriate for a pedestrian, an ADA compliant, surface.
- 2 Center of roundabout: see Raised Median; Apron: see Bicycle lane; Travel Lanes: see Travel Lanes
- 3 Apron and travel lanes only

Green Infrastructure

Permeable, Pervious, and Porous



Permeable Pavers



Source: CD+A

Pervious Pavers



Source: CD+A

Pervious Concrete



Green Infrastructure

Toolbox

- Tree Wells & Linked Tree Wells
 - Infiltration with limited retention
 - Roots take up water
 - Provide shade and cool during hot months
 - Enhance attractiveness and walkability of the street



Source: LID Carson Watershed



Source: <http://blog.g8-life.com>

Green Infrastructure

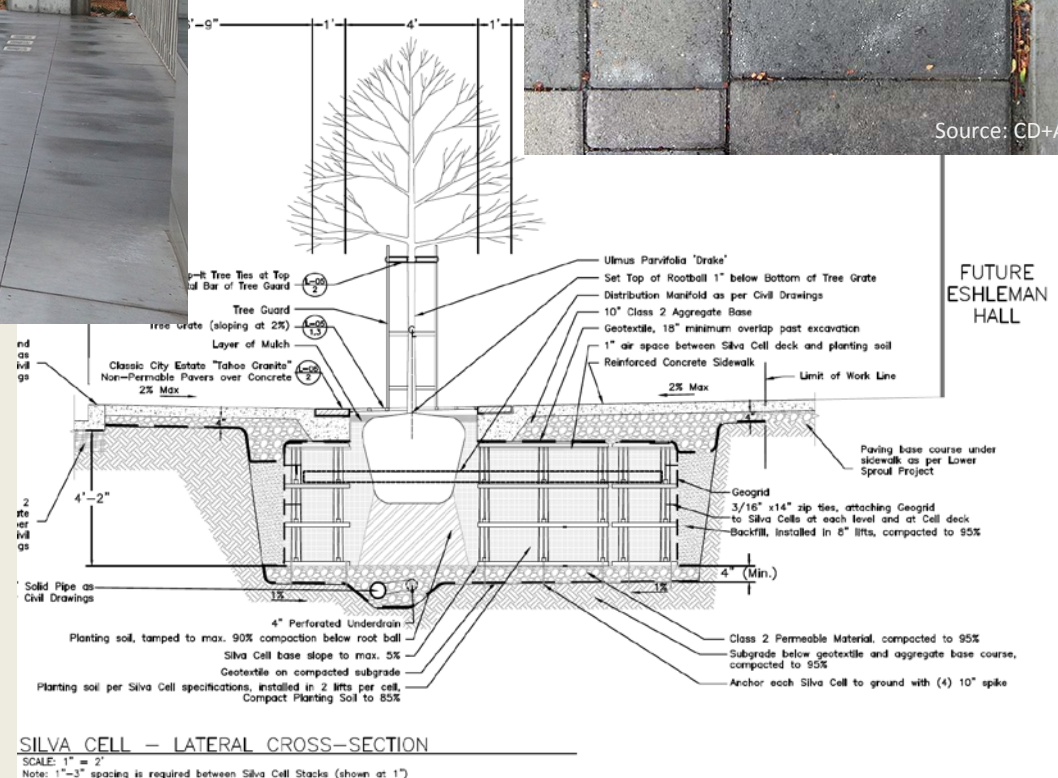
Linked Tree Wells



Source: CD+A



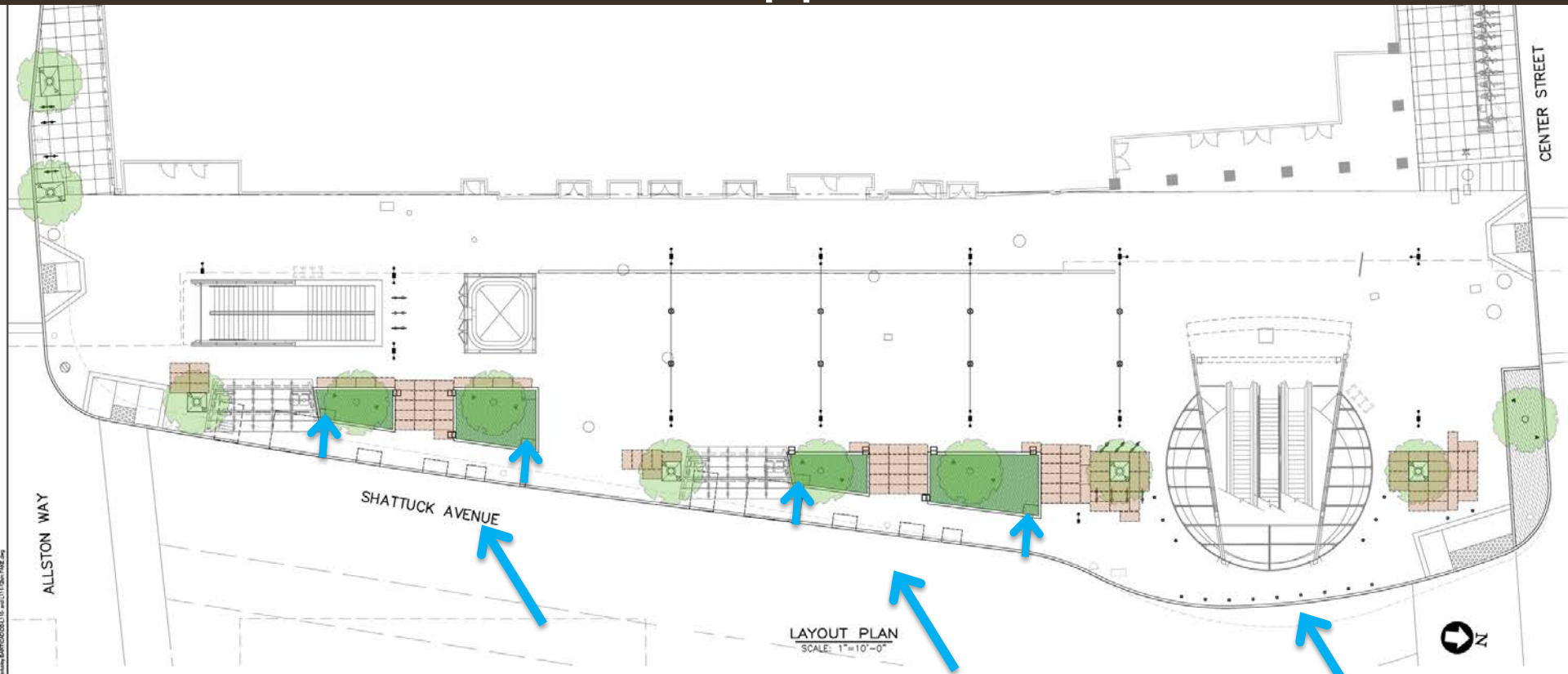
Source: CD+A



FUTURE ESHLEMAN HALL

Green Infrastructure

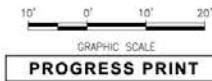
Modular Pavement Supports



LAYOUT PLAN
SCALE: 1"=10'-0"

LEGEND

- | | | | |
|---|-------------------|--|---|
| EXTENT OF MODULAR PAVEMENT SUPPORT SYSTEM | NEW TREE | PLANTING/ BIORETENTION AREA | TREE GRATE AND TREE GUARD, SEE DETAILS 2/L210 AND 3/L210 |
| BUS SHELTER | EXISTING CURBLINE | TRENCH DRAIN, SEE CIVIL ENGINEER'S DRAWINGS AND DETAILS 1/L211 | EXISTING RELOCATED SIGNAL POLE |
| | | GALVANIZED BIKE RACKS, ALLSTON WAY, SEE DETAIL L/210 | BOLLARD, SEE DETAIL 3/ L211 |
| | | STAINLESS STEEL BIKE RACKS, PLAZA, SEE DETAIL L/210 | TRASH COMPACTOR SYSTEM, NIC |
| | | | RELOCATED FIRE HYDRANT |
| | | | RELOCATED FIRE DEPARTMENT CONNECTION |
| | | | EXISTING RELOCATED STREET LIGHT PEDESTRIAN LIGHT POLE, L#, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |
| | | | PEDESTRIAN LIGHT POLE, L#, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |
| | | | CATENARY MOUNTED LIGHTS L#, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |
| | | | LIGHTED SEAT CUBE, L#, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |
| | | | TREE UPLIGHT AND POST L#, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |
| | | | TREE GRATE UPLIGHT, SEE STRUCTURAL AND ELECTRICAL DRAWINGS |



DESIGNED: P. ERICKSON		DRAWN: K. MAJEWSKI		CHECKED: C. COLLADE		APPROVED: P. ERICKSON		DATE: 20151015																					
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P	20151015			100% PROGRESS SET																									

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

COMMUNITY DESIGN + ARCHITECTURE

C O M M U N I T Y
D E S I G N + A R C H I T E C T U R E

1000 CALIFORNIA STREET
SAN FRANCISCO, CA 94109
415.774.4444

SUBMITTED

BART DOWNTOWN BERKELEY PLAZA IMPROVEMENT PROJECT

BAY AREA RAPID TRANSIT DISTRICT

PLAZA LAYOUT PLAN

APPROVED

CAAD FILENAME: DB-L110-A.dwg	REV. P
SIZE SCALE: 1" = 10'-0"	REV. P
CONTRACT NO. 05EA-110	CONTRACT SHEET NO. L110
PAGE NO.	PAGE NO.

Green Infrastructure

Modular Pavement Supports

- Marquette & 2nd Avenue, Minneapolis MN



Silva Cells accommodate new and existing utilities.

Source: Deeproot.com



A bioinfiltration soil mix is used to fill the system.



Pervious pavers route stormwater into the Silva Cell system.

Green Infrastructure

Green Streets + Complete Streets = Sustainable Streets

- Create attractive places
- Provide safe and comfortable places to walk and bike
- Integrate infrastructure into other facilities to manage and treat stormwater runoff
- Support economic vitality
- Secondary benefits related to public health,



Green Infrastructure Guidance

Range of Guidance Documents – still evolving best practices

- San Mateo County *Sustainable Green Streets and Parking Lots Design Guidebook*
- City of San Mateo *Sustainable Streets Guidelines*
- Chicago Sustainable Urban Infrastructure Guidelines, Parts 1 and 2
- Philadelphia Guidance Manual 3.0
- Minnesota Stormwater Manual
- San Francisco has new set of

San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook

First Edition | January 2009



© San Mateo Countywide Water Pollution Prevention Program 2009. All rights reserved.



**SUSTAINABLE
STREETS**
CITY OF SAN MATEO
Design Guidelines January 2015

Green Infrastructure Guidance

Philadelphia Case Study

Stormwater Planter



Columbus Square



The Philadelphia Navy Yard

Overview

A stormwater planter is a specialized, landscaped planter installed in the sidewalk area and designed to manage stormwater runoff. Runoff is routed to the planter by setting the top of the planting media in the planter lower than the street's gutter elevation and connecting the planter to one or more inlets (types vary), allowing stormwater runoff from the street to flow into the planter. Runoff from the adjacent sidewalk can flow directly into the stormwater planter from the surface. Plantings are incorporated within the facility to provide uptake of water and pollutants. Though stormwater planters can be designed in a variety of shapes and sizes, they are typically rectangular in form with vertical sidewalls on all four sides and an open bottom.

Benefits

- Water filters through the planting soil, improving water quality.
- Provides a physical buffer between pedestrians and the street.
- Creates aesthetic improvements to streetscape.
- Can be sized and placed to fit between existing surface features such as driveways, signs, street furnishings, and street trees.
- Provides an area within the right-of-way for smaller plantings in addition to street trees.

Potential Constraints and Considerations

- Requires adequate sidewalk width to accommodate both the planter and pedestrian circulation; refer to the Complete Streets Design Handbook, Section 4.3.2
- Can sometimes be challenging to limit interior depth of planter depending on surrounding surface grades.
- Must consider step-out areas for on-street parking or vehicle stopping.

Interaction with Bicyclists and Pedestrians

- Provides a separation between pedestrians and moving traffic.
- May intrude into the walking zone a maximum width of two feet, maximum length of 10 feet, and a minimum spacing of 30 feet. Refer to the Complete Streets Design Handbook, Section 4.3.2.

Urban Design Context

- Provides a formal streetscape element.
- Edge treatment may contribute to streetscape design (i.e., a perimeter wall could be designed to function as a seat wall, a perimeter fence could be an aesthetic feature, or the edging may include artistic elements).
- Stormwater Planters are designated as a priority design treatment for all street types by the Complete Streets Design Handbook.

Maintenance

- Routine landscape maintenance needed, such as trimming, watering during droughts, weeding, and litter removal, etc.
- Routine cleaning of inlets and pipes is required.

Examples

- Columbus Square
- The Philadelphia Navy Yard

Green Infrastructure Guidance

Philadelphia Case Study



Green Streets Opportunities

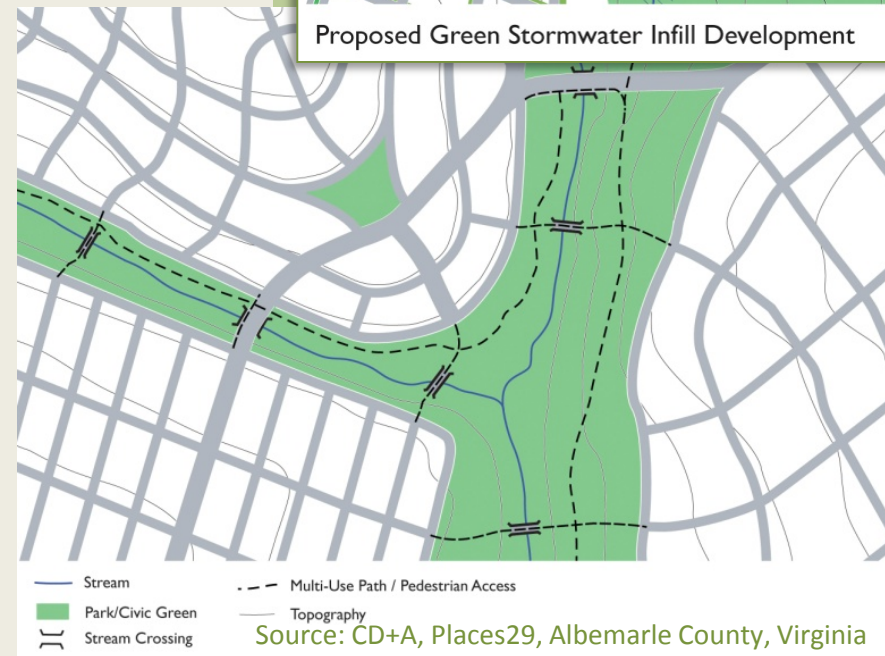
Designing networks

- Green streets and open spaces provides
 - Interconnected access



Proposed Green Stormwater Infill Development

Infrastructure



Source: CD+A, Places29, Albemarle County, Virginia

Green Streets Opportunities

Designing for Context

- Downtowns
- Mixed Use Corridors
- Residential Neighborhoods
- And others...



Source: CD+A, 2011



Source: www.dot.ca.gov



Source: CD+A, 2013



Source: CD+A, 2012



Source: CD+A, 2014

Green Streets Opportunities

Public-Private Partnerships to Support Efficient Smart Growth

- Fort Collins, CO Case Study

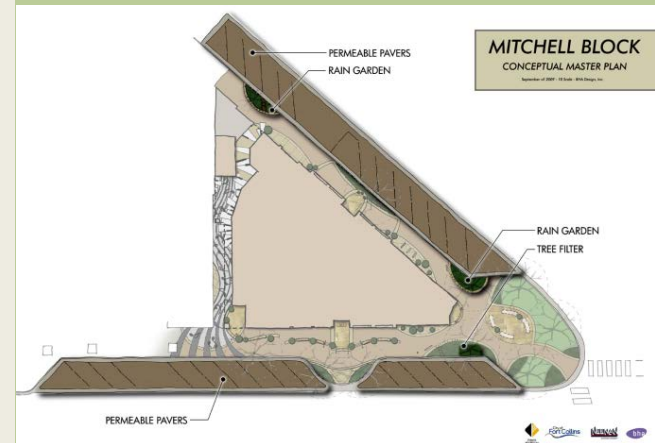
- Developers required to treat adjacent right of way

- Private and public storm runoff treated in drainage facilities within right-of-way using

- permeable pavers in parking areas

- rain gardens and tree filters in parkway

- Roof drainage treated by rain



Source: City of Fort Collins, CO, Basil Hamdan

Green Streets Opportunities

Public-Private Partnerships to Support Efficient Smart Growth

- Fort Collins, CO Case Study
 - City subsidized some construction costs
 - Developer indemnified city from most storm drainage related claims
 - Building owner maintains landscape, roof drains under sidewalk and all subdrains
 - City maintains rest and is responsible for long-term replacement as needed



Source: City of Fort Collins, CO, Basil Hamdan



Missed Opportunities

Oregon District – 5th Street, Dayton, Ohio



Missed Opportunities

Oregon District – 5th Street, Dayton, Ohio

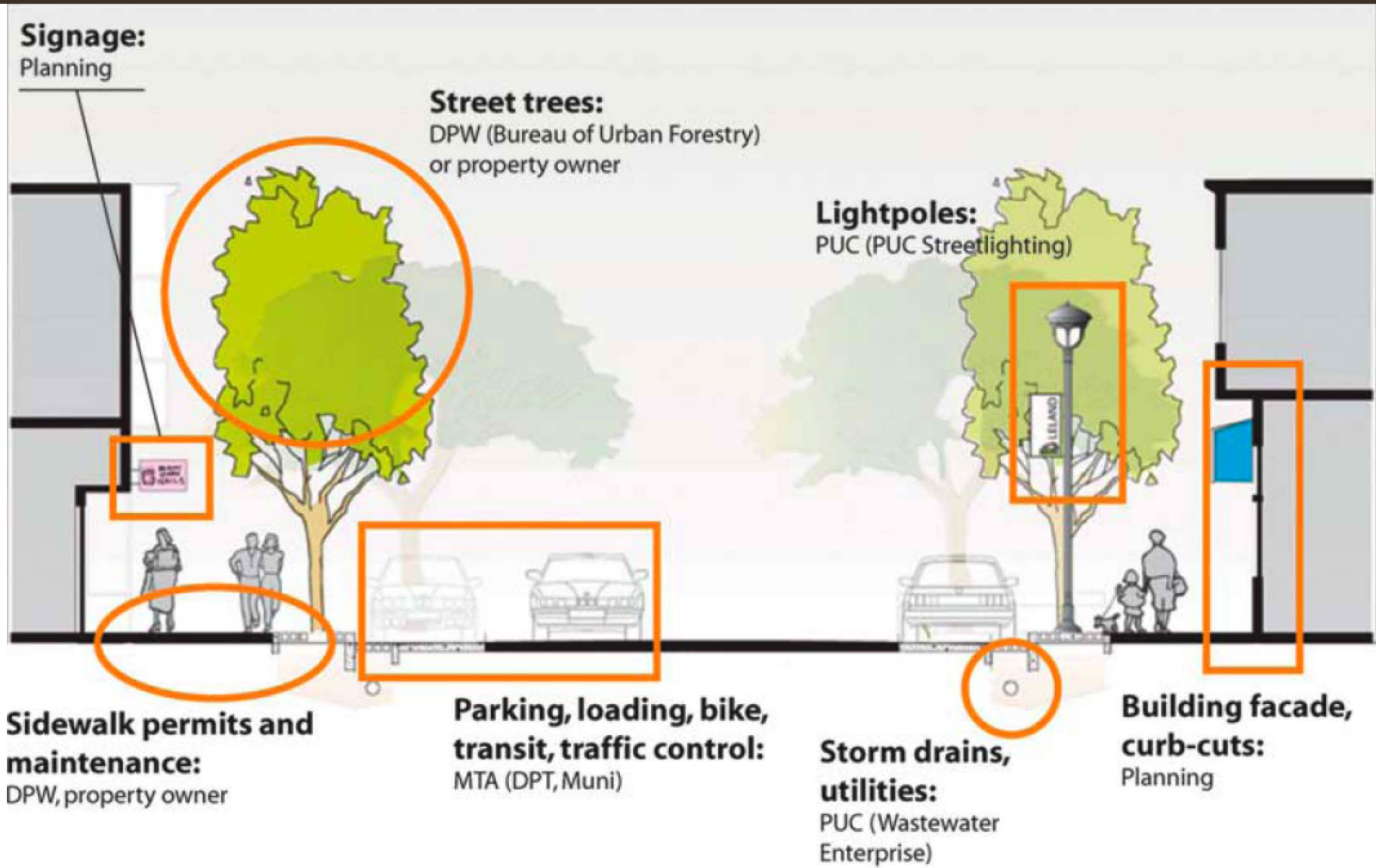


Missed Opportunities

Oregon District – 5th Street, Dayton, Ohio

Agency Implementation, Operations, & Maintenance

Need for Agency Coordination



Operations and Maintenance

Challenges and Opportunities

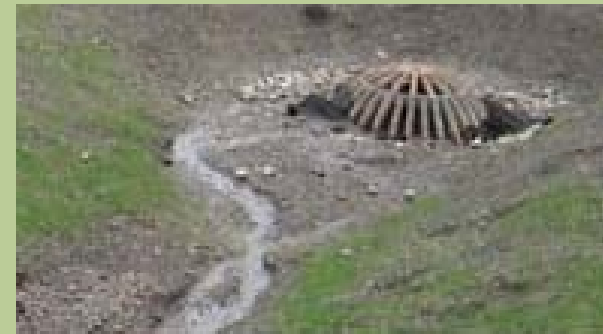
- Establish Green Street Working Group
- Multifunctional aspects can challenge existing practices
 - Responsibilities can overlap departments
 - Departmental/Divisional funding may need to be redistributed
 - Potential labor and union work rule issues
- Opportunities
 - Examine current practices
 - Establish an O&M strategy and funding plan
 - Monitor and adapt
 - Stormwater districts



Operations and Maintenance

Policy and Standards Framework

- Identify related policies & standards and potential conflicts
 - Streets
 - Transit
 - Utilities
 - Landscape
 - Snow
 - Private responsibilities



Source: City of Bellevue, WA, Storm and Surface Water Maintenance Standards, February, 2010.

Operations and Maintenance

Maximize Efficiency of Implementation & Maintenance

- Determine who is responsible for what aspect
- Coordinate responsibilities, timing, requirements, funding, etc.
- Inspect on a regular basis to identify problems early
- Monitor for performance
- Utilize public/private partnerships and volunteer



Source: Portlandoregon.gov/bse (City of Portland, Environmental Services Report).



Source: www.portlandoregon.gov

Operations and Maintenance

Snow and Ice Related Issues and Practices

- Extreme temperatures
 - Utilize locally adaptive plants
- Snow melt and removal
 - Potential issues from application of salt
- Avoid unwanted sediment infiltration
 - Pile snow adjacent to swales and away from permeable pavements
 - Utilize sloped splash pads to



Source: Dustin Racioppi, downloaded from:
www.redbankgreen.com



Source: www.gardeninginfozone.com

Operations and Maintenance

Snow and Ice Related Issues and Practices

- De-icing Concerns
 - On street with green infrastructure
 - Reduce salt usage
 - Explore alternative methods or additives to salt for ice control (BUT no urea, nitrogen, or phosphorus)
 - Washington DC DOT notes that spring rains flush salts from soil and does not affect plants as long as they are dormant
- Porous Paving Considerations
 - Use plastic/rubber blades
 - Experience has shown ground



Source: Downloaded from
<http://cdn.c.photoshelter.com/>, 04-10-13

Operations and Maintenance

Develop an O&M Plan

- Convene and empower a Project Team of key departments / agencies (possibly other stakeholders)
- Define practices, responsibilities, costs, and reporting procedures for different types of Green Streets improvements
- Consider requiring special O&M Plans for major projects



Source: [Portlandoregon.gov/bse](http://portlandoregon.gov/bse), April 2005.



Source: Downloaded from oregongreenjobsnow.blogspot.com

Operations and Maintenance

Maintenance Program Approach

- Maintenance Program approach:
 - Identify equipment and skill needs
 - Coordinate across departments to access most appropriate labor and equipment
 - O&M practices
 - Identify frequency and specific practices
 - Identify budgeting across departments
 - Establish maintenance agreements and enforcement for



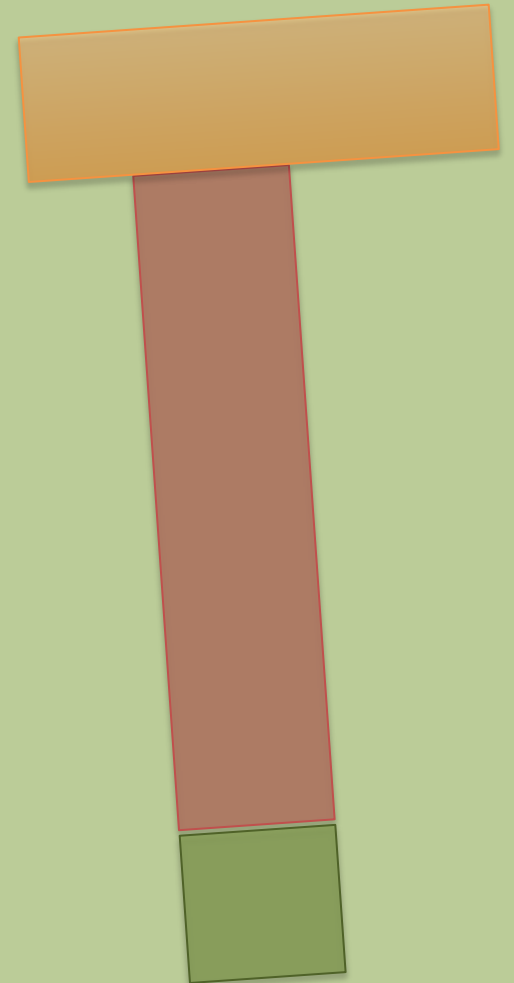
Source: Portlandoregon.gov/bse, April 2005.



Source: Downloaded from oregongreenjobsnow.blogspot.com

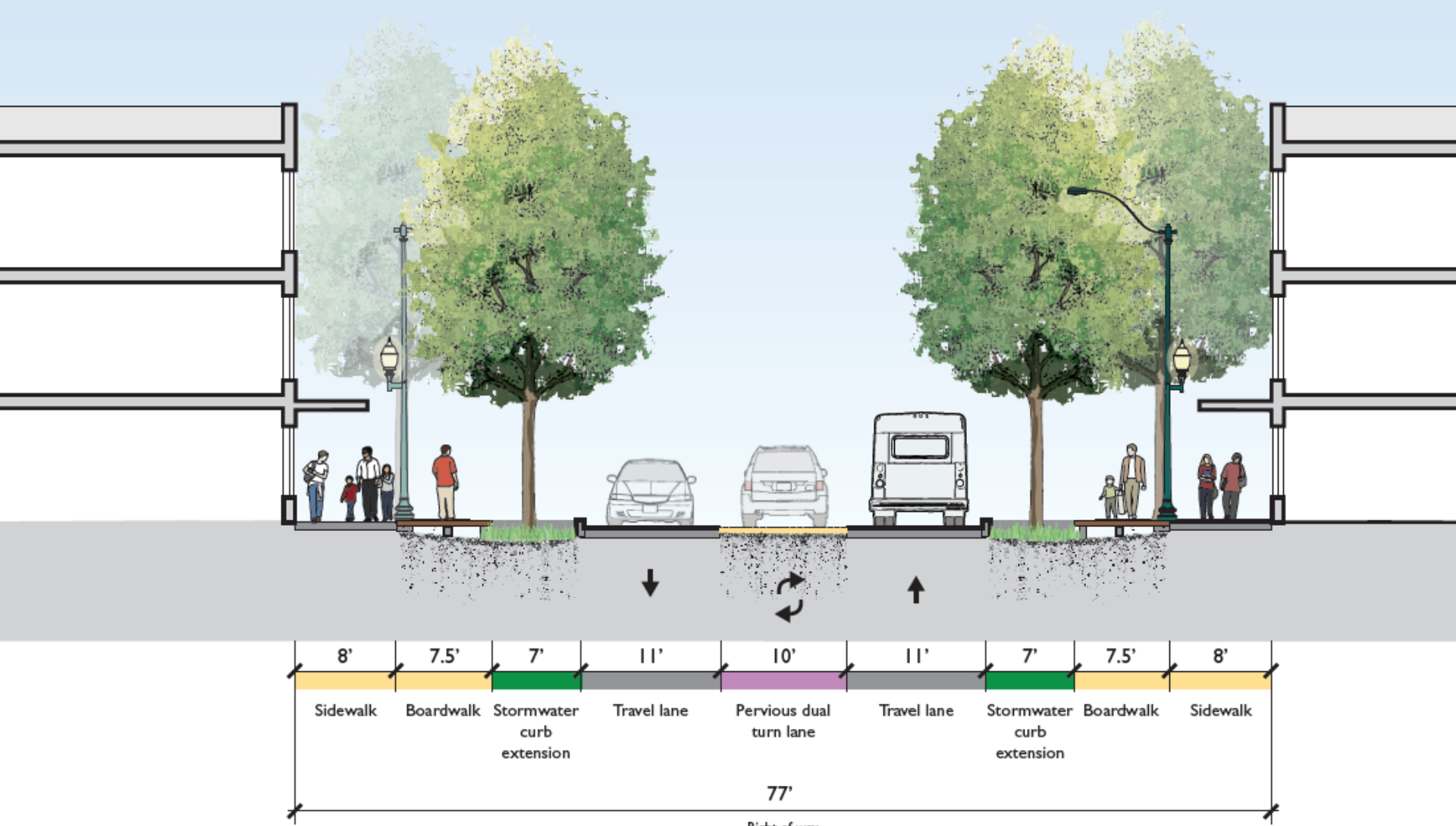
Core Downtown Main Street

- Enable downtown's main street
- Maintain on-street parking
- Enhance pedestrian space
- Opportunities on cross streets
- Layered approach to green infrastructure given space constraints



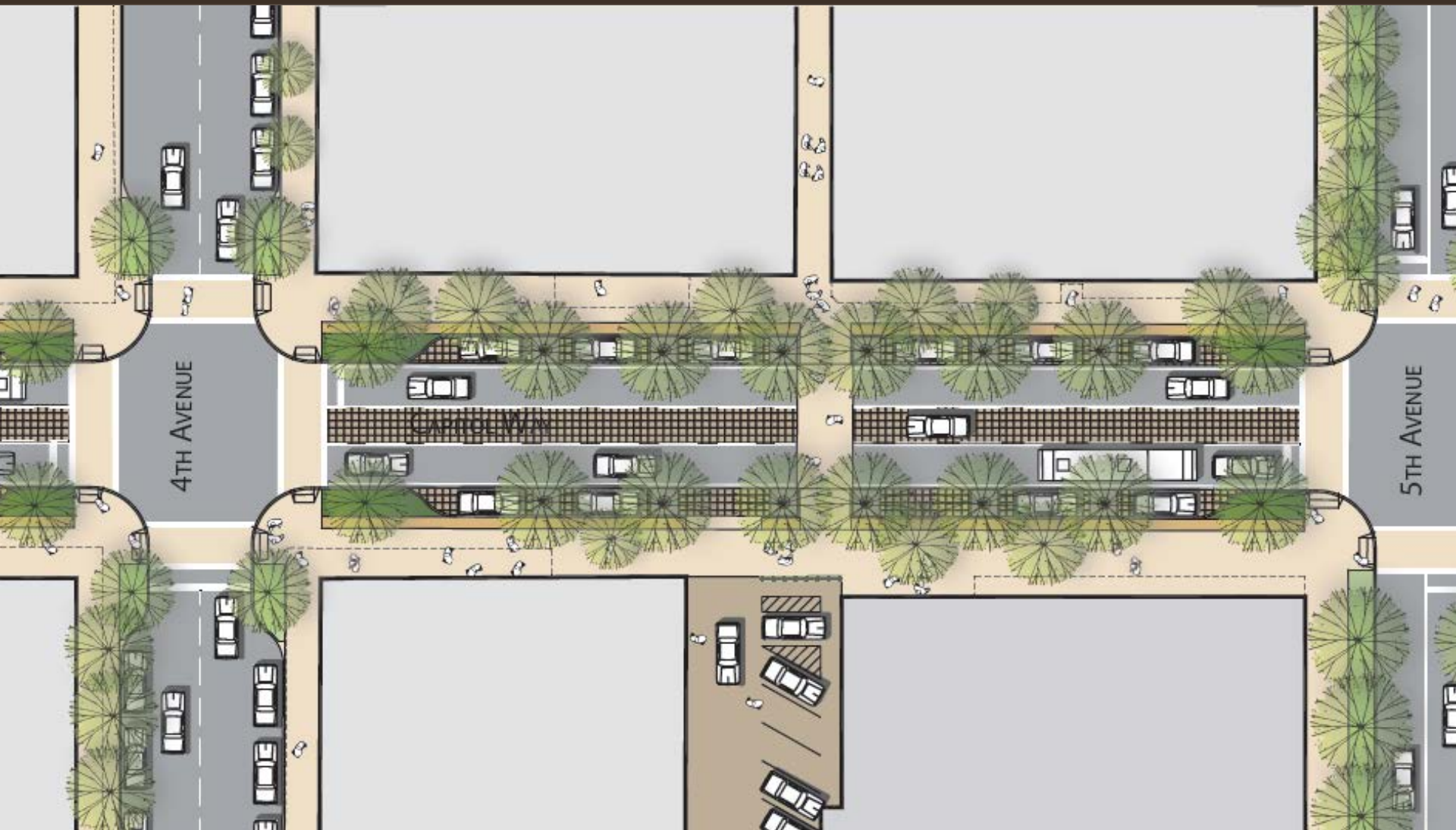
Core Downtown Main Streets

Reallocation of space in street cross section



Core Downtown Main Streets

Reallocation of space – 4th to Legion



Core Downtown Main Streets

Reallocation of space between 5th and Legion

- Before



Core Downtown Main Streets

Reallocation of space between 5th and Legion

- After



Core Downtown Main Streets

Combining Green Infrastructure and Hardscape

- Boardwalks, grates, and pathways



Source: CD+A



Source: Urban Rain Design



Source: Urban Rain Design

Greening America's Capitals – Carson City Nevada

Site 2: E. William Street – N. Saliman Road to
Rand Ave.

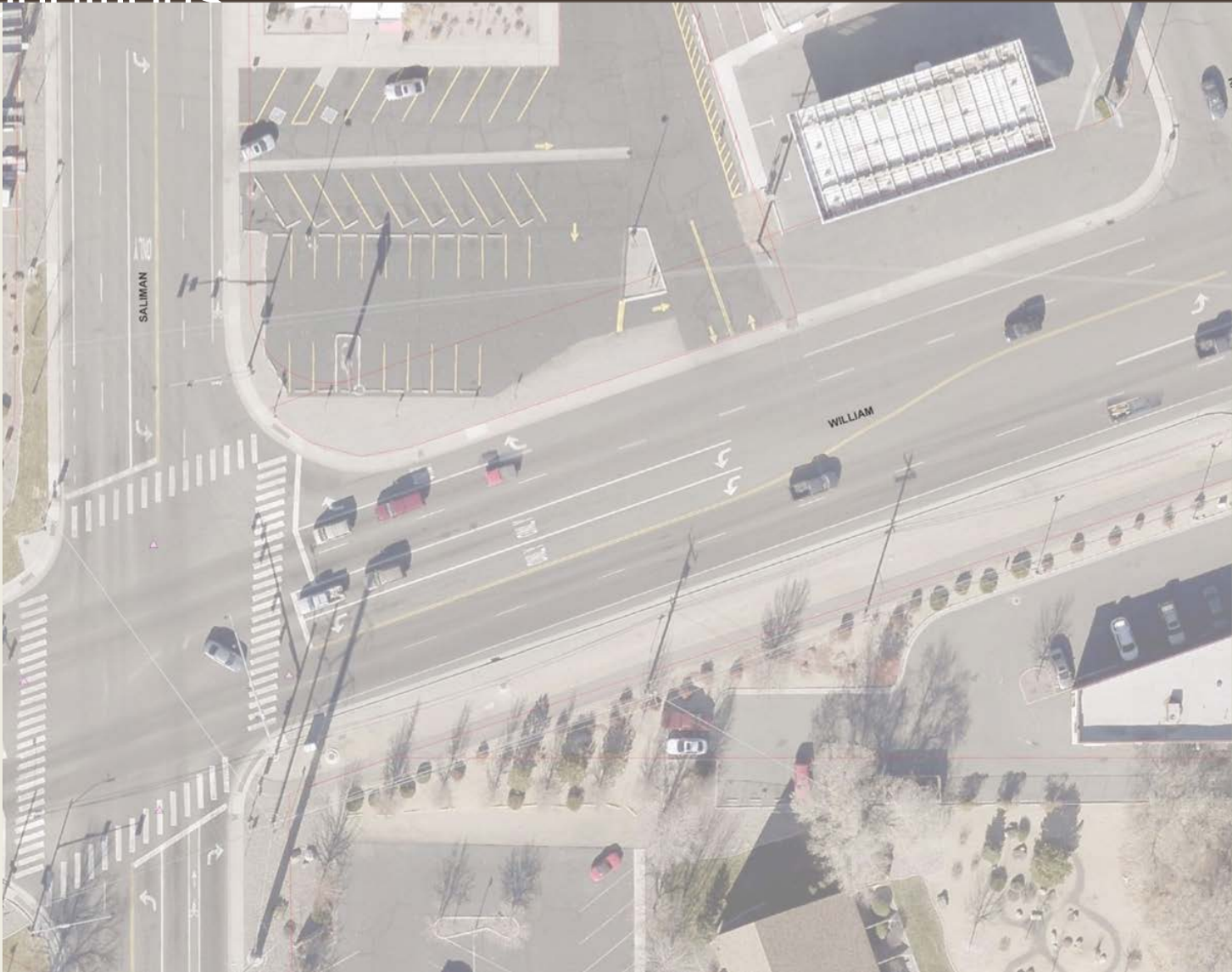
- Poor pedestrian environment
 - No buffering from traffic
 - Buildings set back from street
 - Narrow or missing sidewalks
 - Numerous driveways and long continuous



Greening America's Capitals –

Carson City Nevada

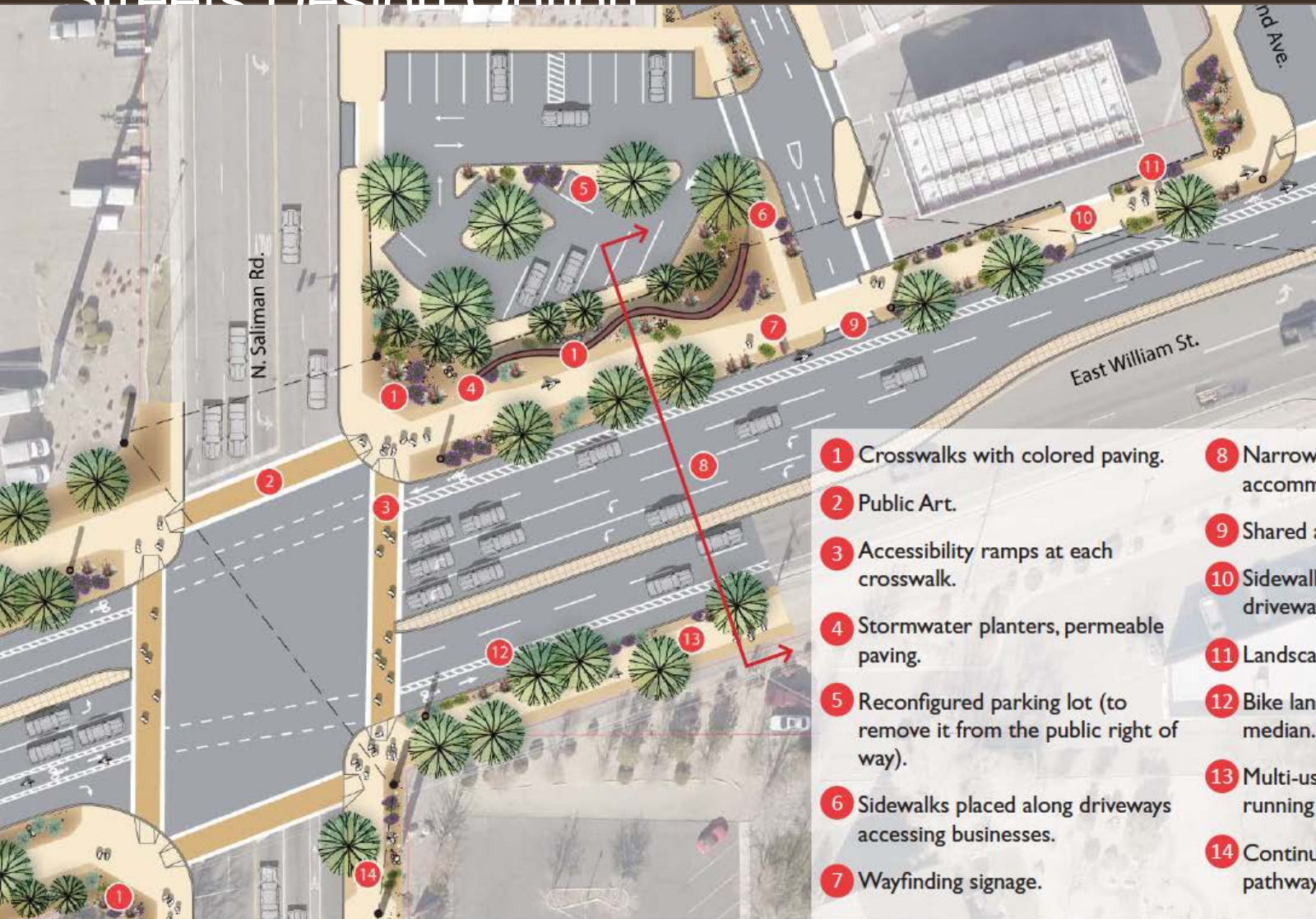
Site 2: Saliman Road to Rand Avenue – Existing Conditions



Greening America's Capitals –

Carson City Nevada

Site 2: Saliman Road to Rand Avenue – Sustainable Streets Design Option

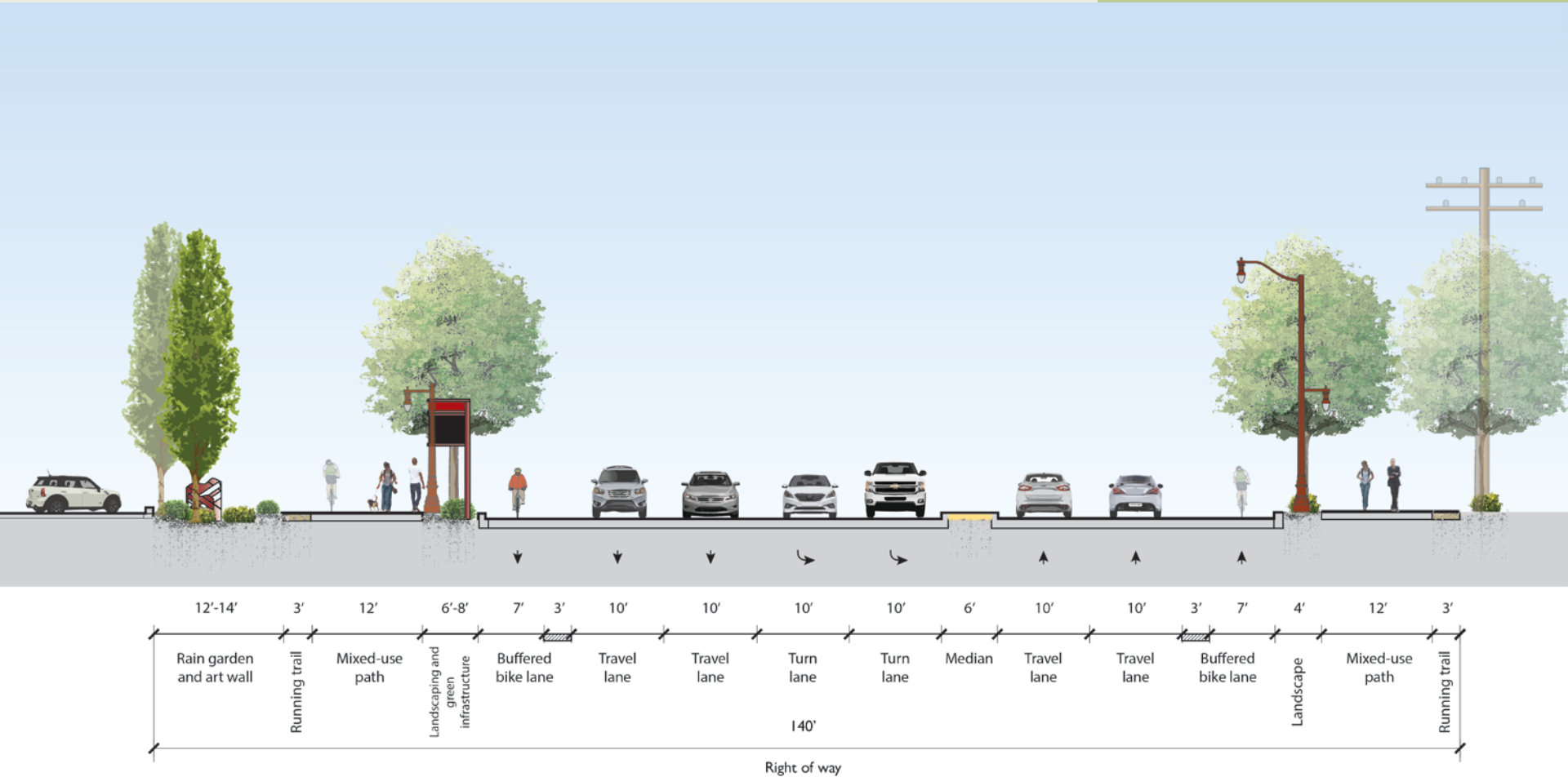


- 1 Crosswalks with colored paving.
- 2 Public Art.
- 3 Accessibility ramps at each crosswalk.
- 4 Stormwater planters, permeable paving.
- 5 Reconfigured parking lot (to remove it from the public right of way).
- 6 Sidewalks placed along driveways accessing businesses.
- 7 Wayfinding signage.
- 8 Narrowed travel lanes (to accommodate bike lanes).
- 9 Shared and consolidated driveway.
- 10 Sidewalk level maintained at driveways.
- 11 Landscape screening.
- 12 Bike lanes with striped buffer median.
- 13 Multi-use pathway with adjacent running trail.
- 14 Continuation of a multi-use pathway to Carson High School.

Greening America's Capitals –

Carson City, Nevada

Site 2: Saliman Road to Rand Avenue – Sustainable Streets Design Option



Greening America's Capitals –

Carson City Nevada

Site 2: Saliman Road to Rand Avenue – Existing Conditions



Greening America's Capitals –

Carson City Nevada

Site 2: Saliman Road to Rand Avenue – Sustainable Streets Design Option



Greening America's Capitals –

Carson City Nevada

Site 5: E. William Street – N. Carson Street to Stewart Street

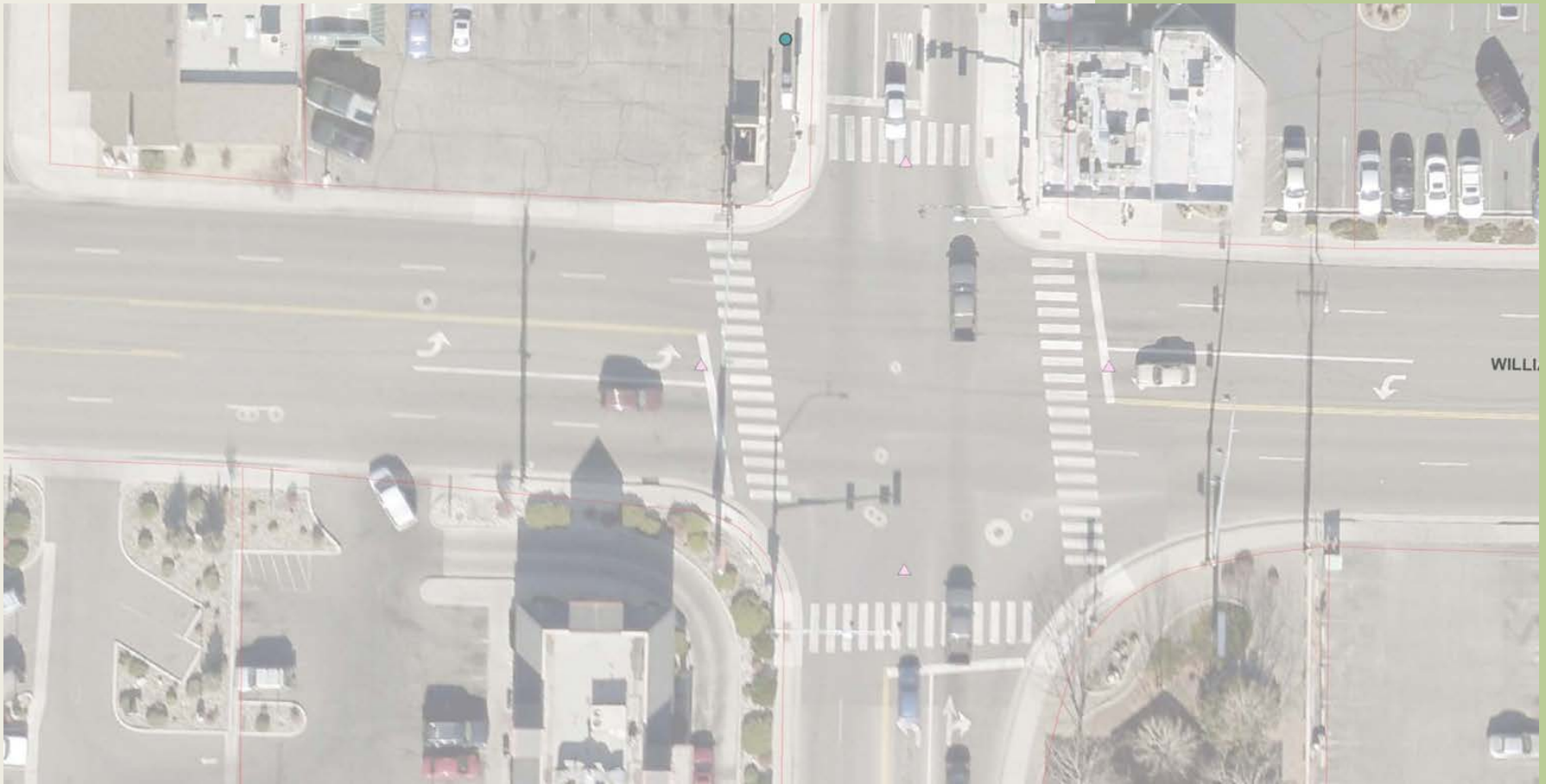
- Gateway to downtown
- Dominated by auto use
- Narrowest right of way along East William
- Many pedestrian & vehicle conflicts
- Poor pedestrian facilities
 - narrow,
 - lack of defined walkway
 - not accessible
- No bike facilities



Greening America's Capitals –

Carson City Nevada

Site 5: N. Stewart Street Intersection – Existing Conditions



Greening America's Capitals –

Carson City Nevada

Site 5: N. Stewart Street Intersection – Sustainable Streets Design Option

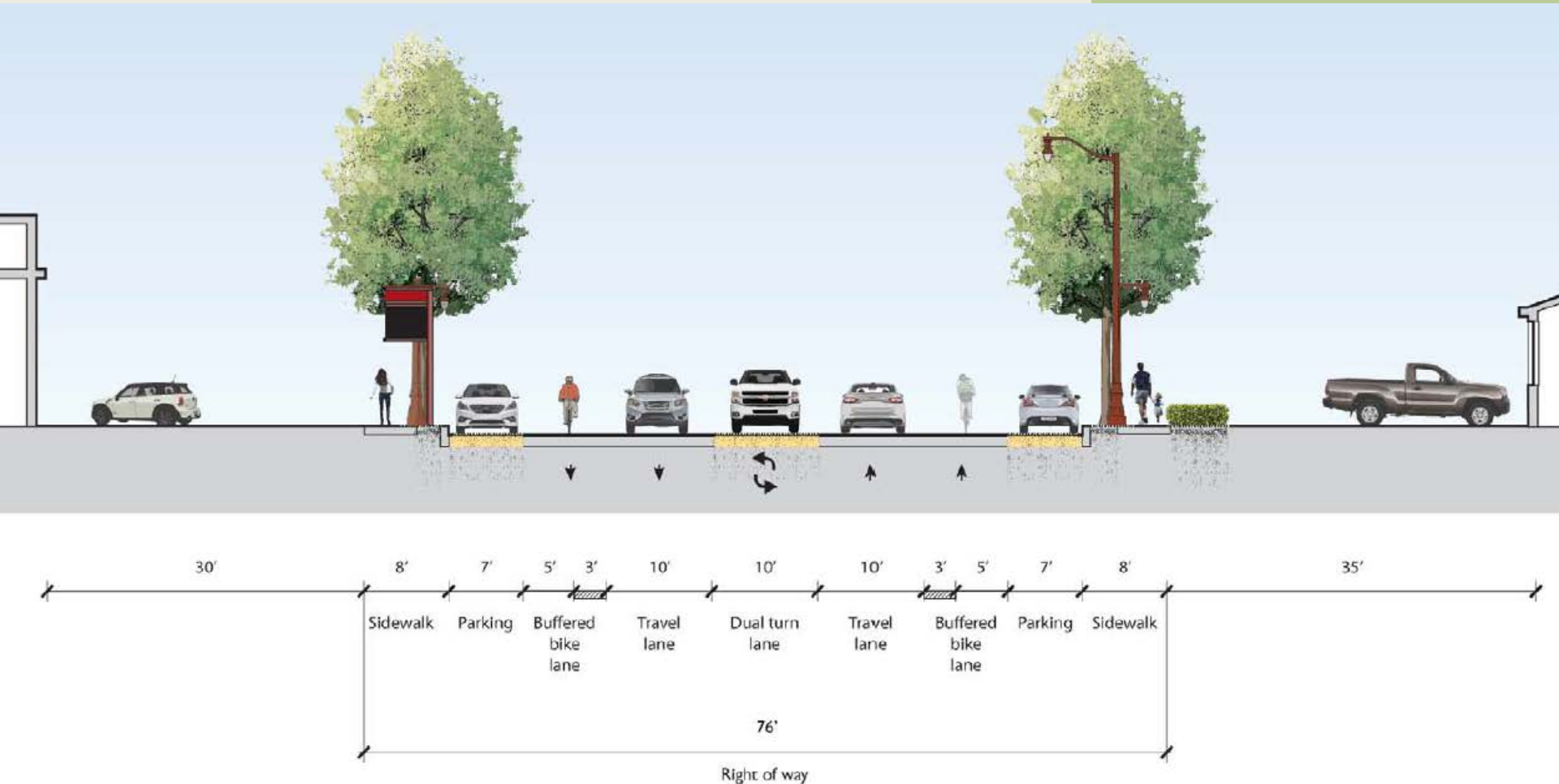
- 1 Bike lanes with striped buffer median.
- 2 On-street parking with permeable paving.
- 3 Narrowed driveway.
- 4 Information kiosk.
- 5 Bike parking.
- 6 Sidewalk level maintained at driveways.
- 7 Permeable paver planting strip and stormwater planters.
- 8 Benches.
- 9 Small intersection corner radii.
- 10 Public Art.



Greening America's Capitals –

Carson City, Nevada

Site 5: N. Stewart Street Intersection – Sustainable Streets Design Option



Greening America's Capitals –

Carson City Nevada

Site 5: N. Stewart Street Intersection – Existing Conditions



Greening America's Capitals –

Carson City Nevada

Site 5: N. Stewart Street Intersection – Sustainable Streets Design Option

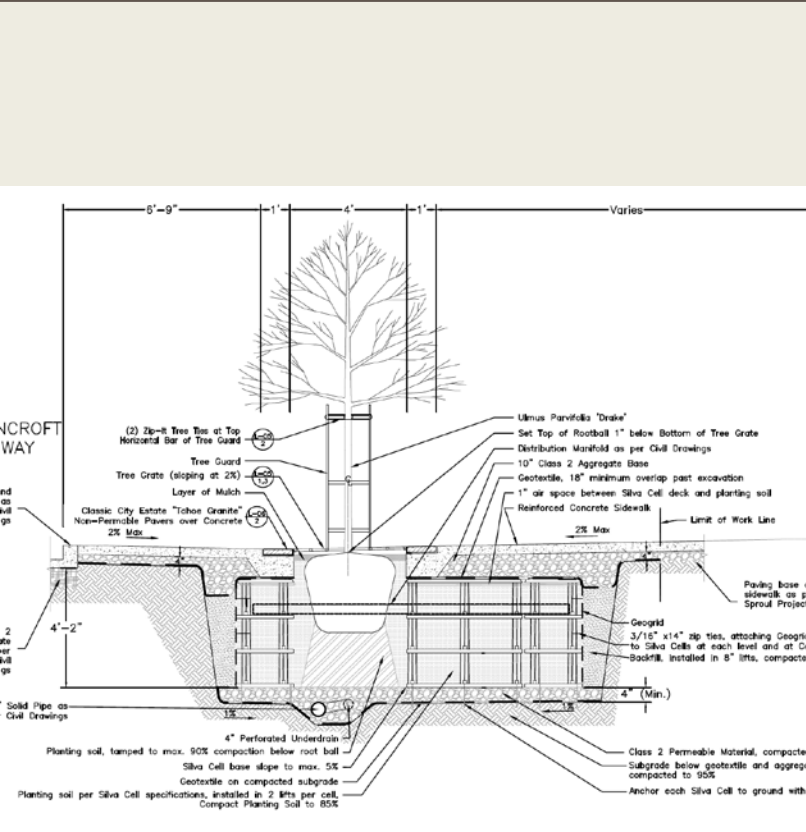




Source: CD+A, 2012

Source: CD+A, 2012

Group Working Session



COMPASS Technical Workshop

May 26, 2016

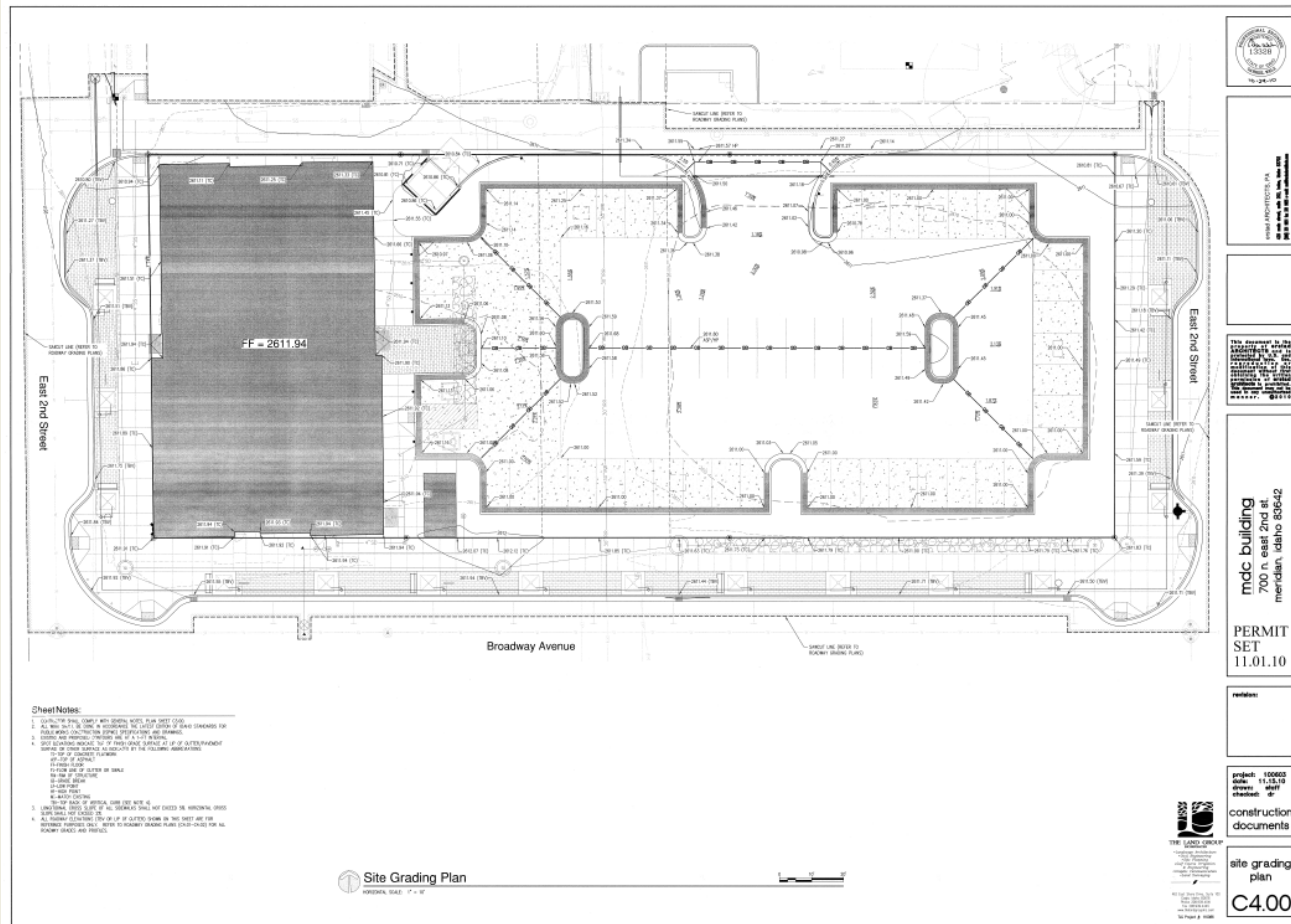
Phil Erickson

COMMUNITY
 DESIGN +
 ARCHITECTURE

Group Working Session

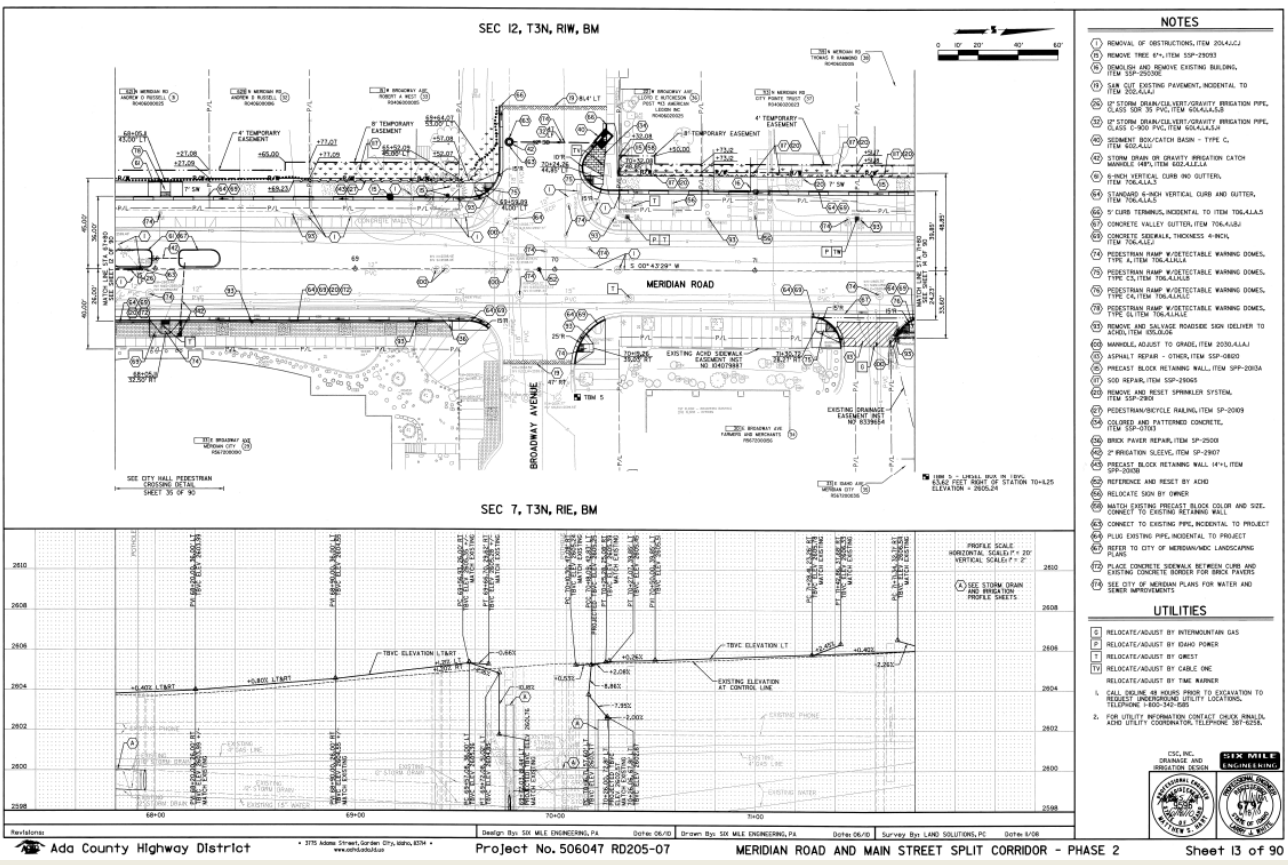
Explore concepts for green infrastructure on existing streets and sites

- Sample Sites
 - COMPASS Block



Group Working Session

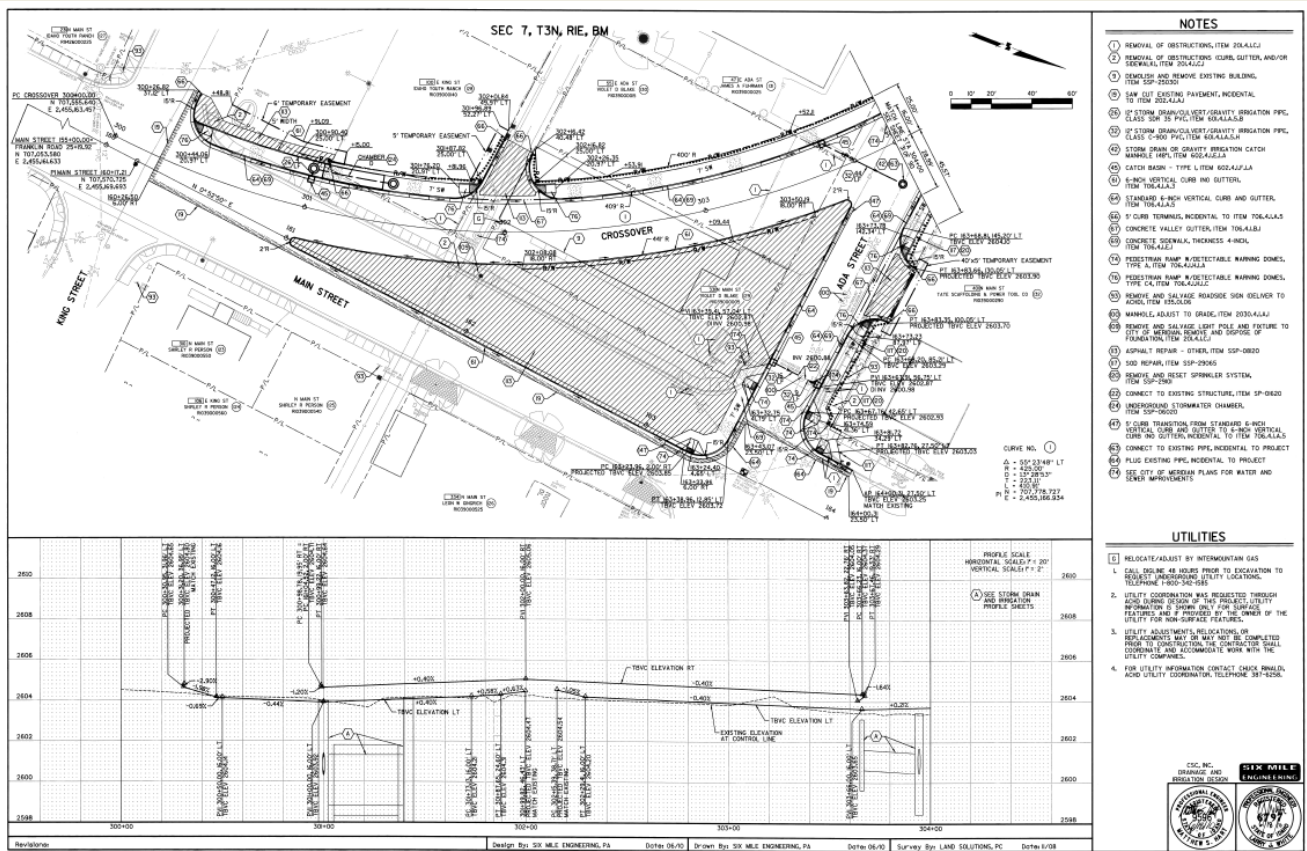
Explore concepts for green infrastructure on existing streets and sites



- Sample Sites
- COMPASS Block
 - Meridian Road

Group Working Session

Explore concepts for green infrastructure on existing streets and sites



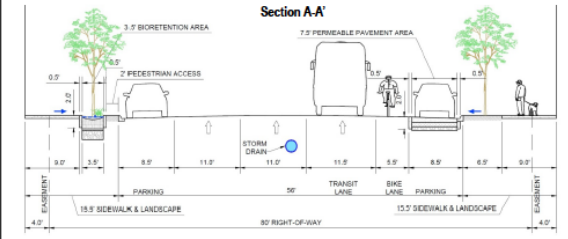
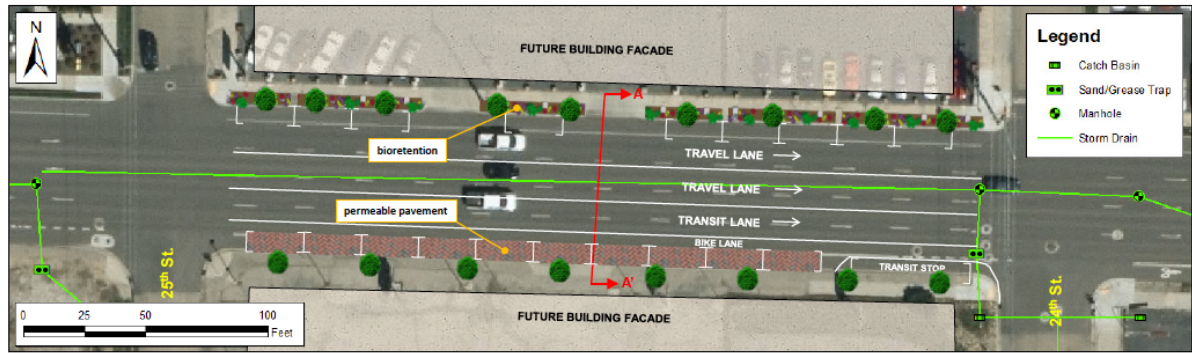
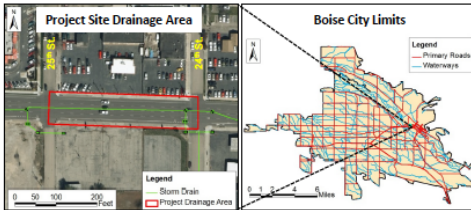
- Sample Sites
- COMPASS Block
 - Meridian Road
 - Main Street and Crossover, Meridian

Group Working Session

Explore concepts for green infrastructure on existing streets and sites

Site Location		Drainage Area Characteristics		Proposed Characteristics*	
Date of Field Visit	7/14/2014	Latitude	43° 37' 14" N	Proposed BMPs	BR, PP
Field Visit Personnel	J. Smith, M. Frey	Longitude	116° 13' 14" W	Hydrologic Soil Group	D, Urban
Major Watershed	Boise River	Landowner	City of Boise	Total Detention Vol., ft ³	1,334
Street Address	2400 block of Fairview Avenue	Total Impervious, %	100	Bioretention Area, ft ²	896
Existing Site Description: The proposed project site includes the Fairview Avenue roadway corridor between 24th Street and 25th Street. Fairview Avenue is a 4-lane roadway that forms a one-way couplet with Main Street. The existing lanes are 12.5-ft wide with 5 to 6-ft sidewalks. Fairview Avenue has more capacity than is needed for current traffic volumes. The project site is served by a separate storm sewer system managed by Ada County Highway District. Fairview Avenue is currently slated to undergo improvements within the next few years. Potential improvements include reducing the number of travel lanes from four to three, adding a bicycle lane, on-street parallel parking and streetscaping, and widening sidewalks.		Proposed Green Infrastructure Description: Proposed BMPs within the right-of-way (ROW) include bioretention areas along the north side and permeable pavers along the south side of Fairview Avenue. These BMPs are designed to capture and treat runoff from the entire ROW while still allowing pedestrian, vehicle, and transit access.		Total Perm. Pavement Area, ft ²	
		BR = Bioretention, PP = Permeable Pavement		1,763	

*Green infrastructure characteristics are based on field observations and GIS data resources available at the time of conceptual design analysis. Note that final design characteristics will be dependent on a detailed site survey and could vary slightly from conceptual design characteristics.



ADA COUNTY HIGHWAY DISTRICT, BOISE, IDAHO
GREEN INFRASTRUCTURE CONCEPTUAL PLAN
SITE: FAIRVIEW AVENUE



- ### Sample Sites
- COMPASS Block
 - Meridian Road
 - Main Street and Crossover, Meridian
 - Fairview Avenue, Boise

Group Working Session

Explore concepts for green infrastructure on existing streets and sites



- ### Sample Sites
- COMPASS Block
 - Meridian Road
 - Main Street and Crossover, Meridian
 - Fairview Avenue, Boise
 - Telegraph Avenue, Oakland, CA



CITY OF OAKLAND
DEPARTMENT OF ENGINEERING
AND CONSTRUCTION
200 FRANK OGBURN AVENUE, SUITE 500 • OAKLAND, CALIFORNIA
510.238.3400 • FAX 510.238.7400

TELEGRAPH AVENUE
COMPLETE STREETS PROJECT
CITY OF OAKLAND



FEHR & PEERS
201 Franklin Avenue, Suite 400, Oakland, CA 94612
(510) 533-7000

CHECKED BY: IR
DESIGNED BY: RMCH
DRAWN BY: LGDD

NO.	BY	DATE	REFERENCE

CONSTRUCTION PLANS
SIGNING & STRIPING
PLAN

PROJECT NO.

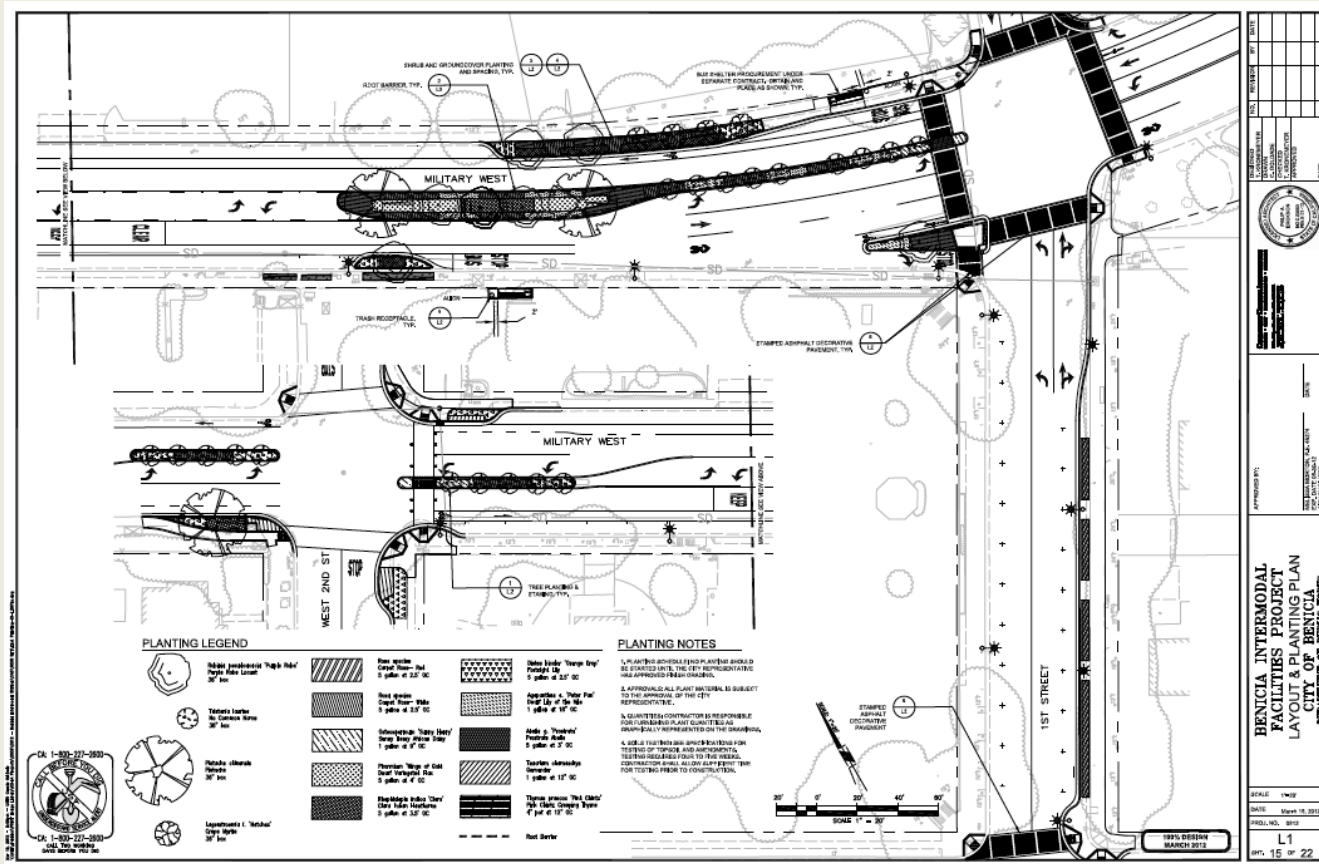
SCALE:
AS SHOWN
DATE:
JANUARY 13, 2014

SHEET NO.
SS-4
4 OF 5

DATE: 1/13/14

Group Working Session

Explore concepts for green infrastructure on existing streets and sites



- Sample Sites
- COMPASS Block
 - Meridian Road
 - Main Street and Crossover, Meridian
 - Fairview Avenue, Boise
 - Telegraph Avenue, Oakland, CA
 - Military West, Benicia, CA