



SACRAMENTO
STATE

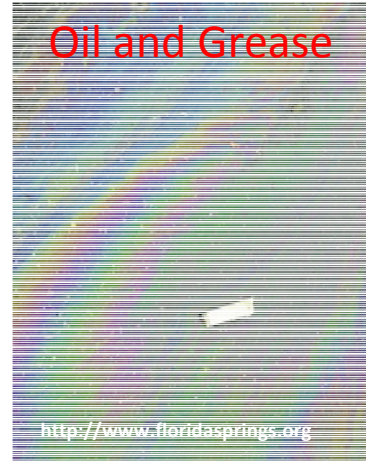
Designing and Constructing Low Impact Development Stormwater Devices at Sacramento State

City of Sacramento
Sacramento State Facilities Management

Overview

- Stormwater Issues
- Managing Stormwater: LID
- Project
 - Background, collaboration, funding, benefits
 - Design goals and challenges
 - Construction
 - Operation and maintenance
 - Monitoring, education, outreach
- Site Visits

Stormwater – Water Quality Pollutants



Stormwater: Pollutant Sources

- Fertilizers
- Tree/leaf litter
- Pesticides
- Vehicles & Roads
- Industrial activities
- Stream erosion
- Construction
- Pets & wildlife
- Humans



Stormwater: Pollutant Impacts

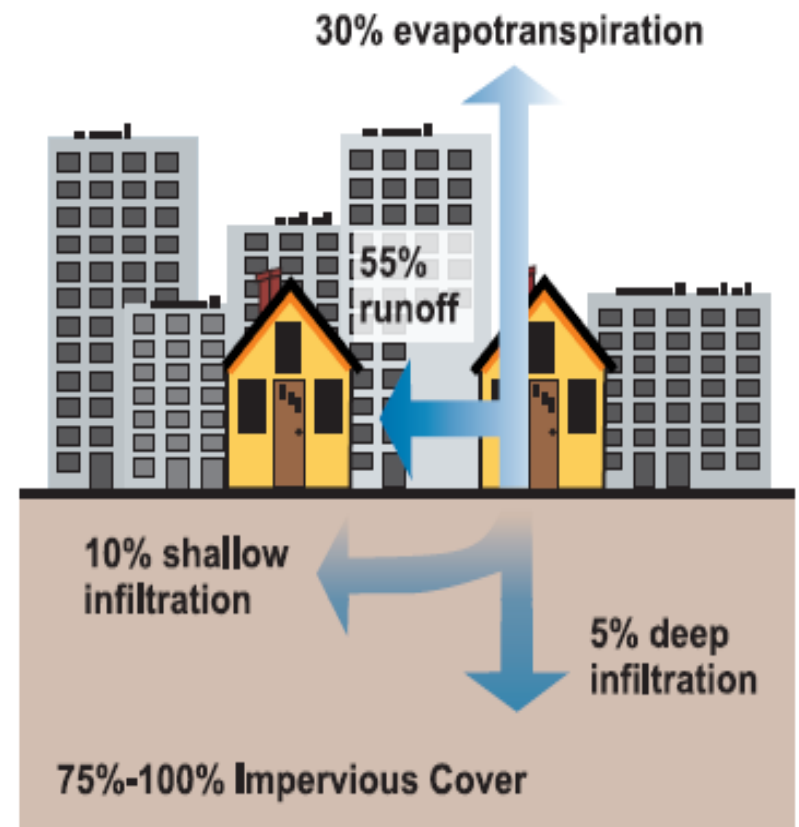
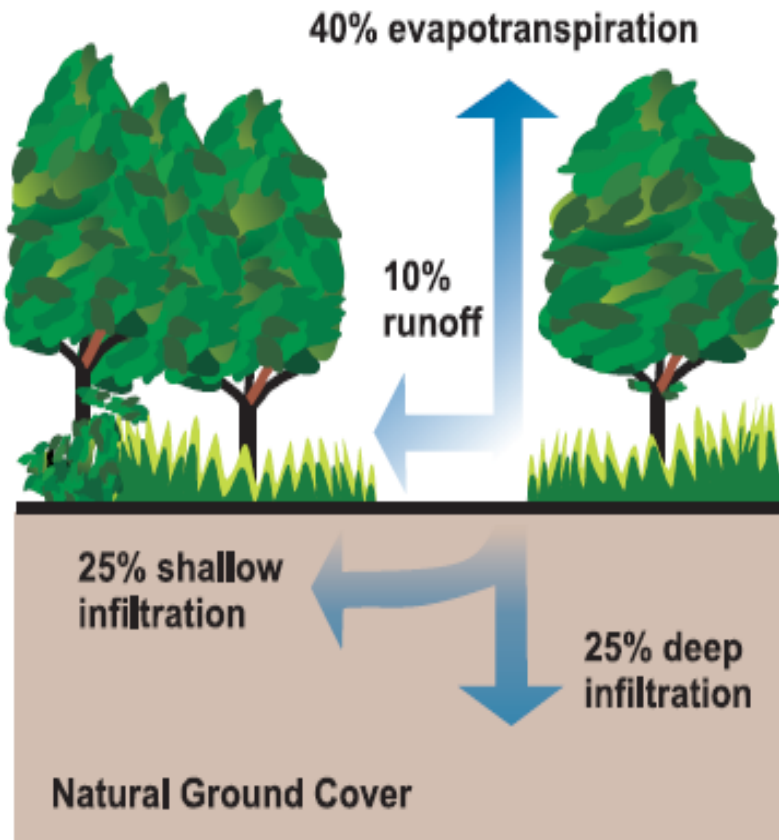
- Algae blooms
- Fish kills
- Habitat destruction
- Reservoir storage loss
- Visually Unappealing
- Odors
- Toxicity
- Beach closures



Stormwater is one of the leading, remaining causes of water quality problems (EPA)

Stormwater

A Common Theme: Urbanization



<http://www.peachcounty.net/stormwaterdepartment.cfm>

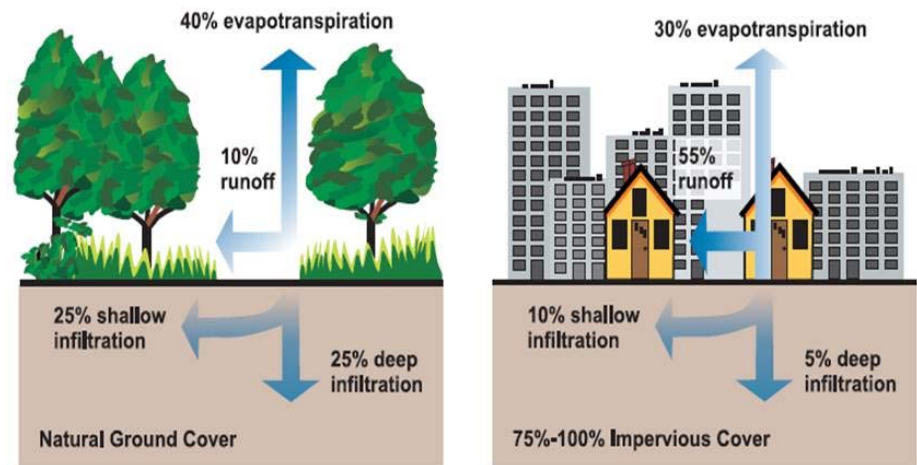
Stormwater: Urbanization Impacts

- Increased Flow and Volume Results in
 - Increased Flooding
 - Increased Stream Bed and Bank erosion
 - Enlarged channels
 - Habitat Loss and Damage
 - Increased Pollutant Transport (Increase Water Quality Impacts)
 - ✓ Increased Aquatic Toxicity
 - ✓ Increased Consumer Toxicity
 - ✓ Increased Health Outbreaks
 - ✓ Increased Beach Closures
 - ✓ Degradation of Aesthetics



Managing Stormwater Today: Low Impact Development (LID)

1. Mimic Natural Hydrology (Infiltrate)
2. Protect Receiving Waters
3. Reduce Flooding
4. Groundwater Recharge
5. Opportunities for Reuse

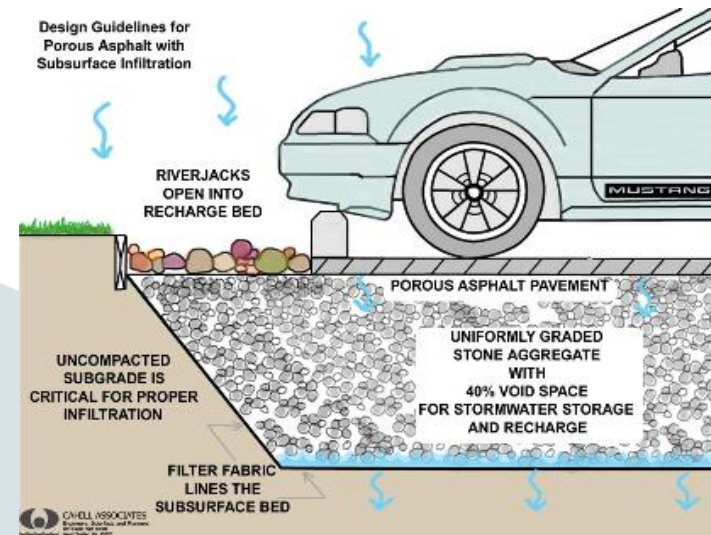


US
EPA

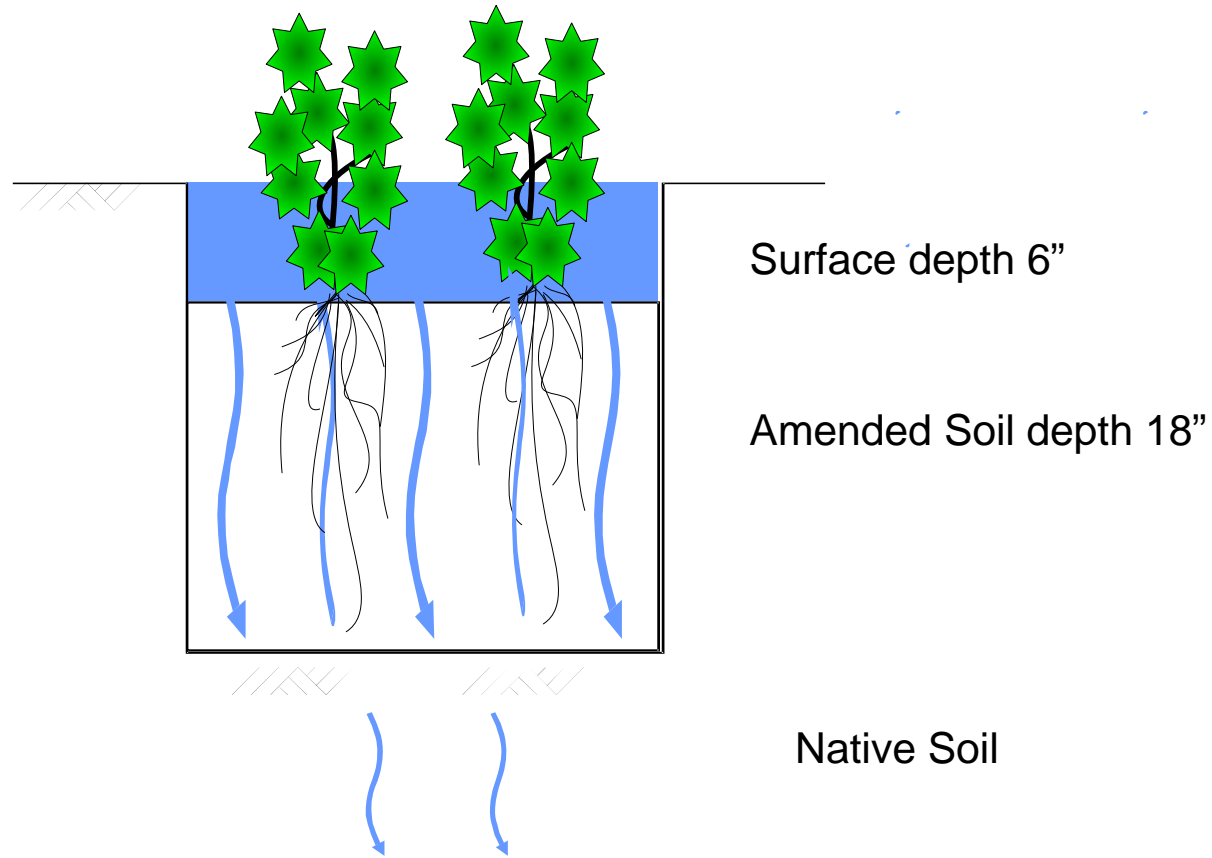
LOW IMPACT DEVELOPMENT (LID)

Types of Devices

- Bioretention Planters
- Rain Gardens
- Bioswales
- Porous Pavement
- Biostrips
- Road Narrowing (reduce impervious area)
- Cisterns or Rain Barrels
- Tree Box Filters
- Constructed Wetlands
- Green Roofs
- Infiltration Trenches



Rain Garden Profile and Function



Rain Gardens

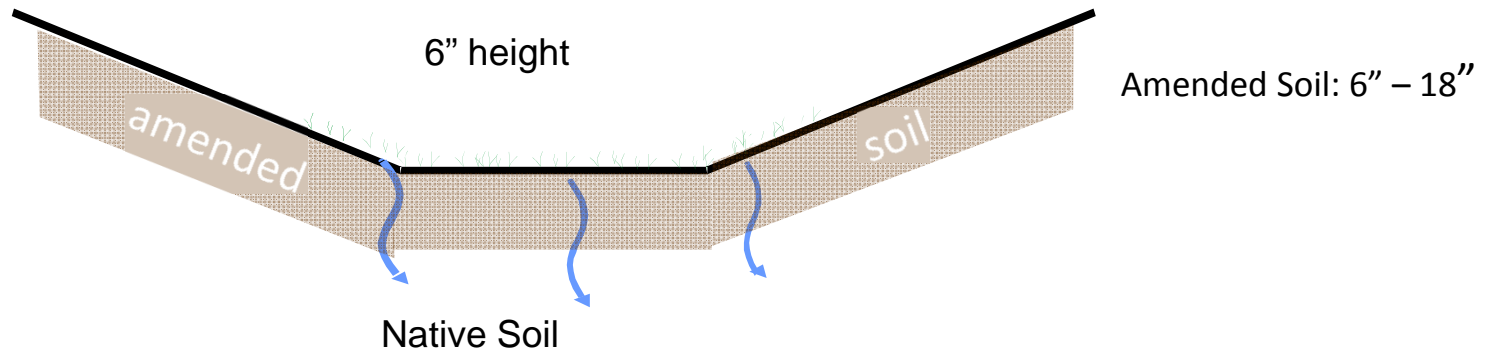


US EPA



Harford County, MD

Bioswale - Profile



Bioswales

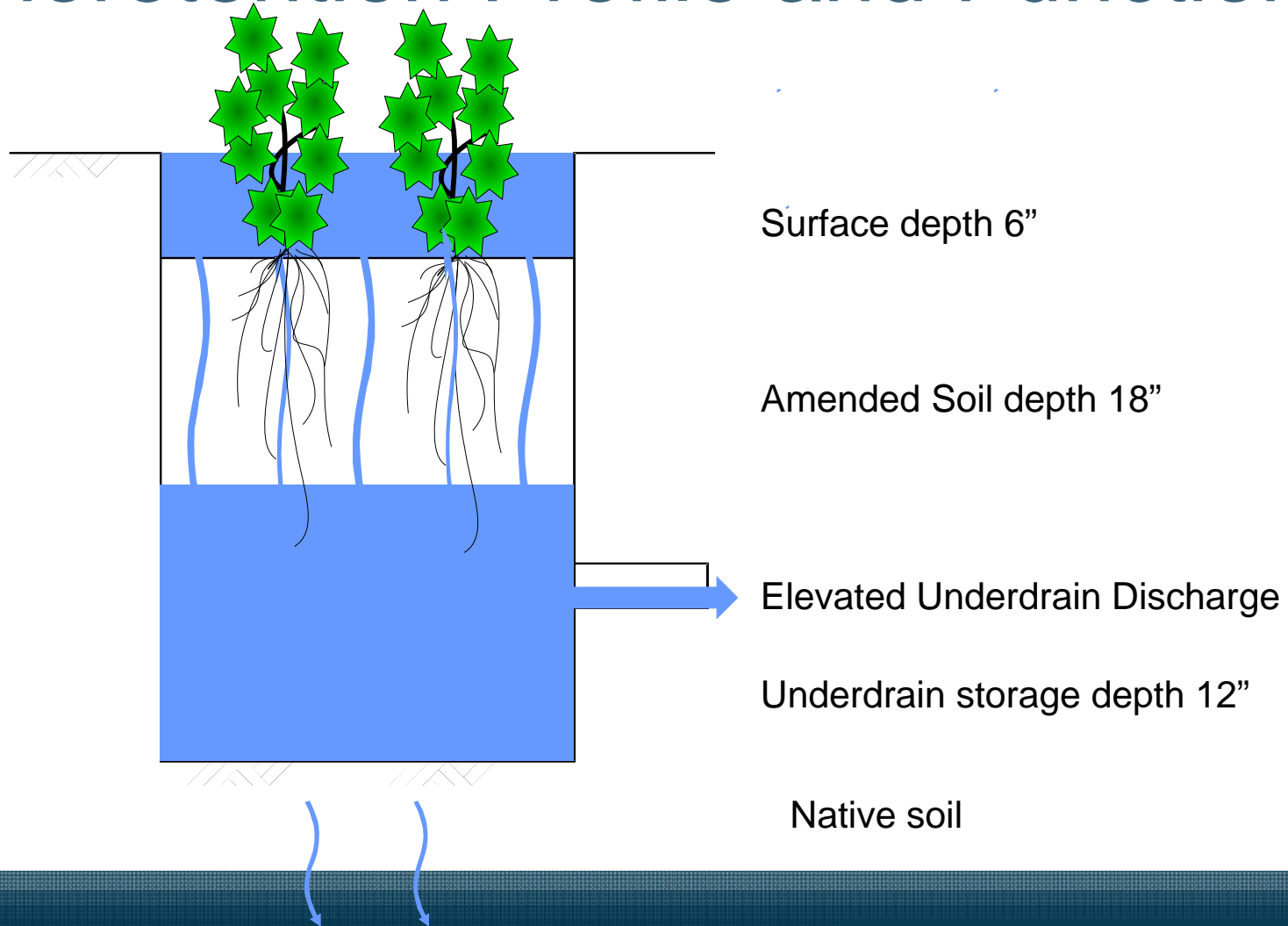


Caltrans



Lake County, IL

Bioretention Profile and Function



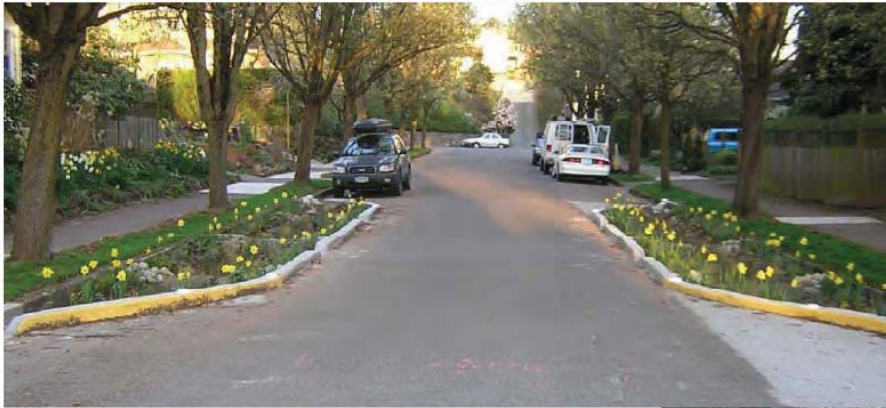
Bioretention – Parking Lots



Scott Taylor, PE
RBF Consulting

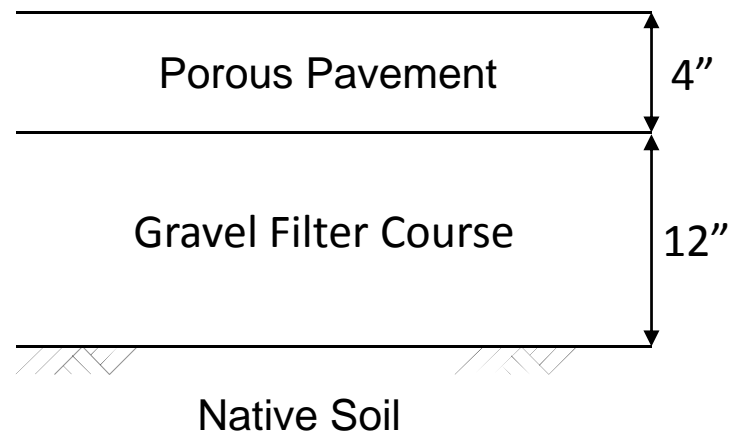


Bioretention – Streets



Scott Taylor, PE
RBF Consulting

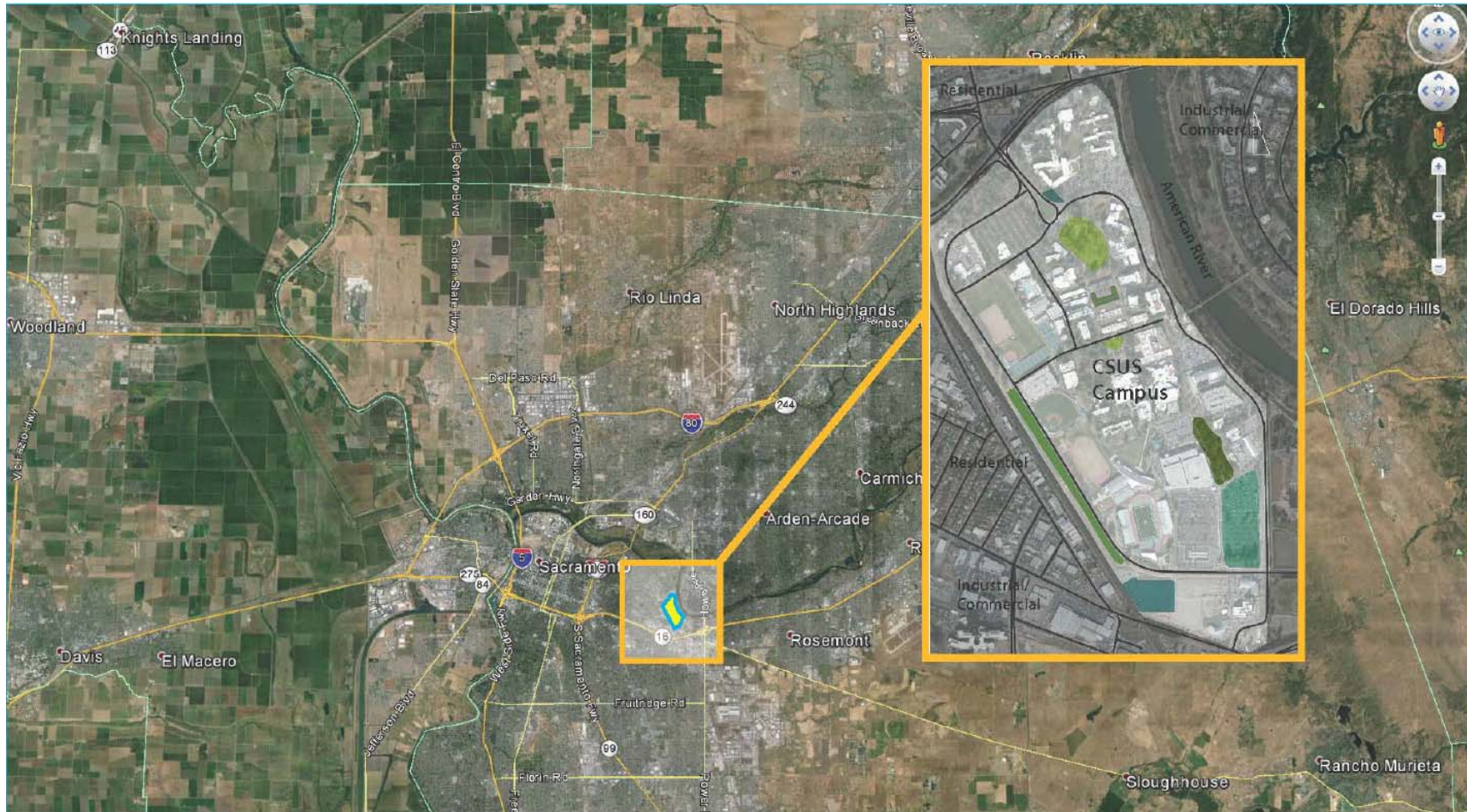
Porous Pavement - Profile



Porous Pavement



LID Implementation at Sacramento



Project Background: Campus Stormwater



Drain Inlet - Campus



Storm Drain Discharges into American River

Project Background: American River



Outfall – Guy West Bridge



Upstream
Sample

Discharge
Sample

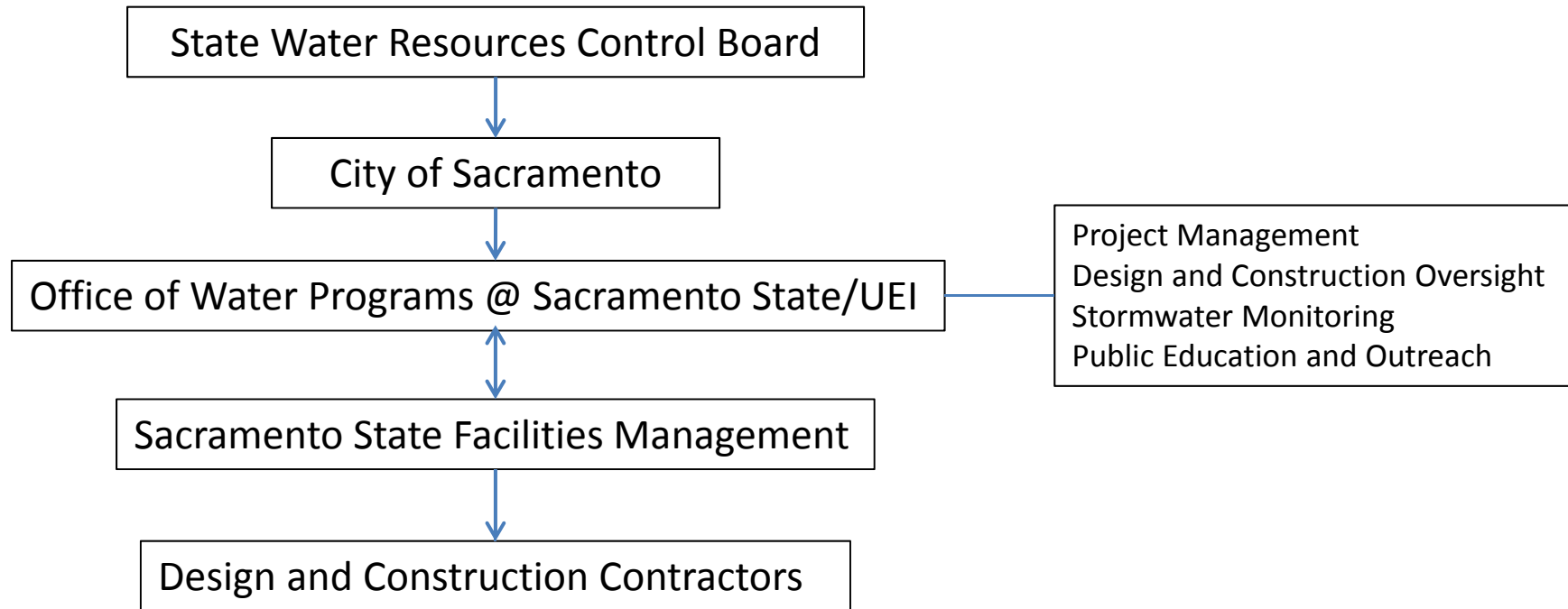
Project Background

1. Proposition 84 – Stormwater Grant Program
2. State Water Resources Control Board
3. Objectives:
 - a) Prevent stormwater contamination of rivers, lakes, and streams.
 - b) Implement requirements of stormwater permits
 - c) Implement Low Impact Development (LID)
 - d) Monitoring and Education Outreach



City of Kirkland, WA

Project Collaboration



Project Funding

Project Total - \$3.3M

A. Prop 84 - \$2.6M

B. Local Match - \$0.7M

- i. Sacramento State FM - \$500K
- ii. City of Sacramento - \$112K
- iii. Office of Water Programs – \$31K
- iv. Dry Creek Conservancy - \$30K
- v. Local LID Expertise - \$25K
- vi. County of Sacramento - \$1K

Project Benefits

1. Meet Stormwater Permit Requirements
2. Faculty/Student Involvement
3. High Visibility
4. Protects the American River
5. Replenish Irrigation Wells
6. Demonstration and Training Facility for Northern CA



Campus Layout



Design Goals

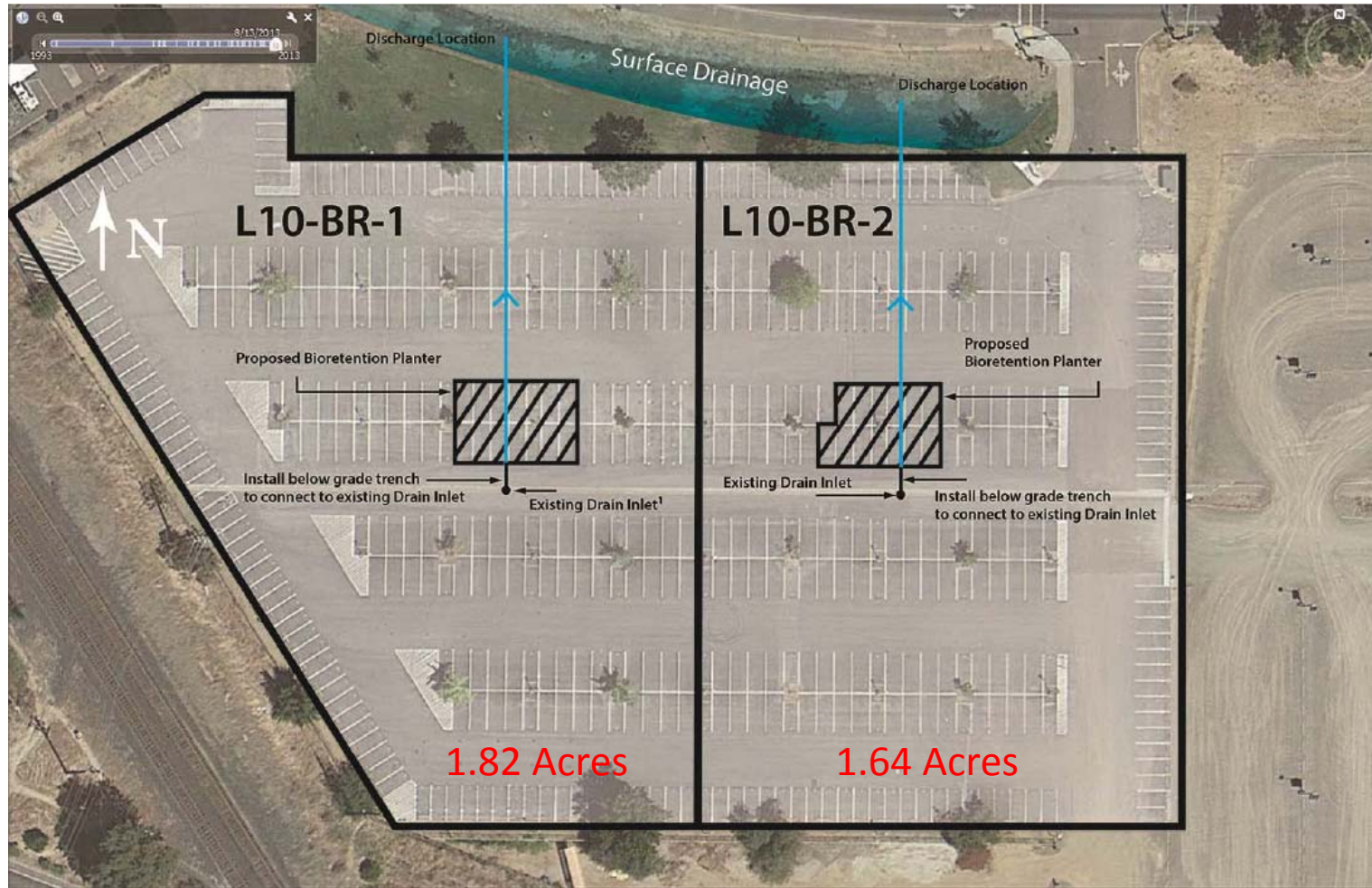
Enhance Infiltration

- A. Silty sands over gravels
- B. No devices lined
- C. 14 acre-feet per year infiltrated or treated
- D. 13.2 acre-feet per year - infiltration alone
- E. Total Tributary Area ~ 13 acres

Hearty Vegetation

- A. Drought- and Inundation-Tolerant
- B. Variety of Types and Combinations

Design Goals – Large Tributary Areas

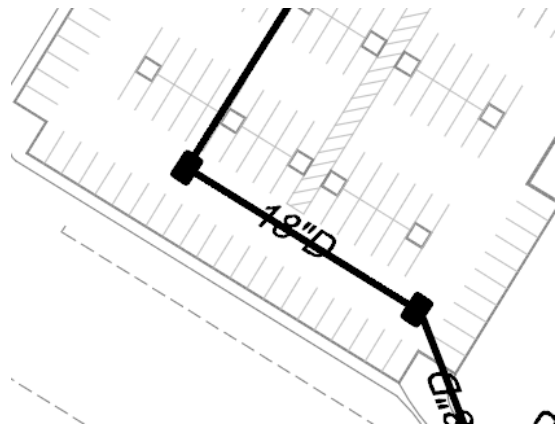


Design Challenges

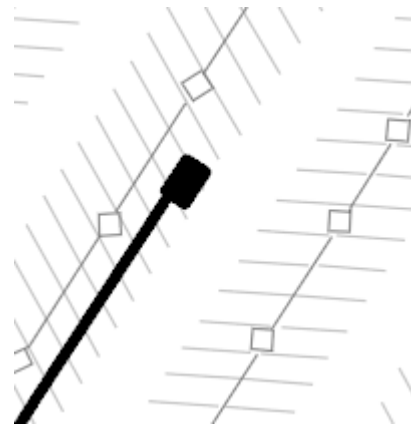
1. Fitting into the existing drainage system
 - a. Horizontal
 - b. Vertical
2. Negotiating the removal of parking stalls
3. Fitting into existing topography
4. Existing infrastructure
5. Interactions with buildings
6. Subsurface soil?
7. Timing
8. Compatibility with Campus Master Plan

Design Challenges

- Fitting into the existing drainage system
 - Horizontal



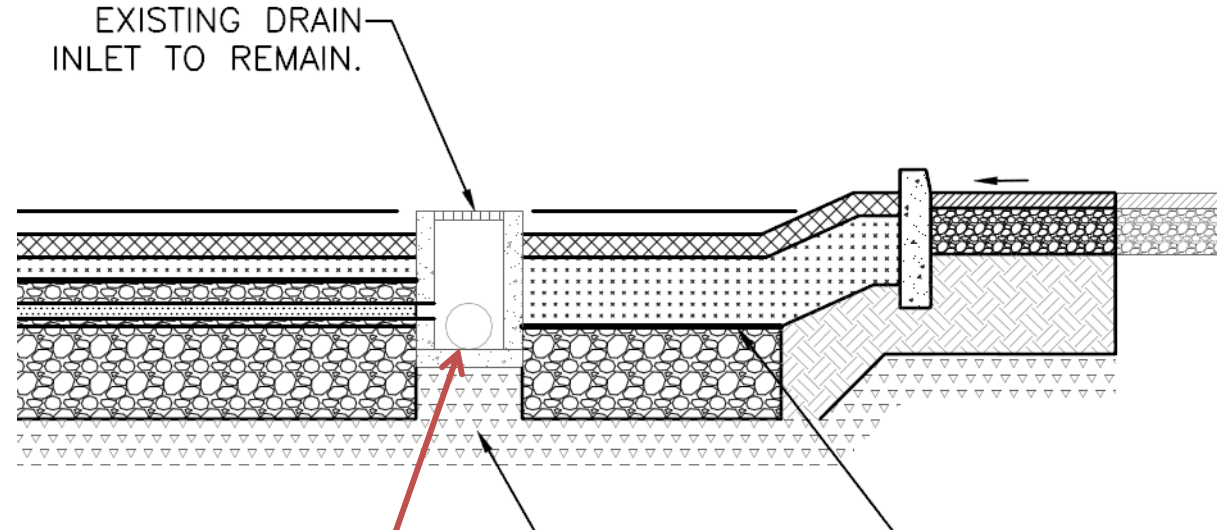
Drain in traveled way



Drain conveniently located

Design Challenges

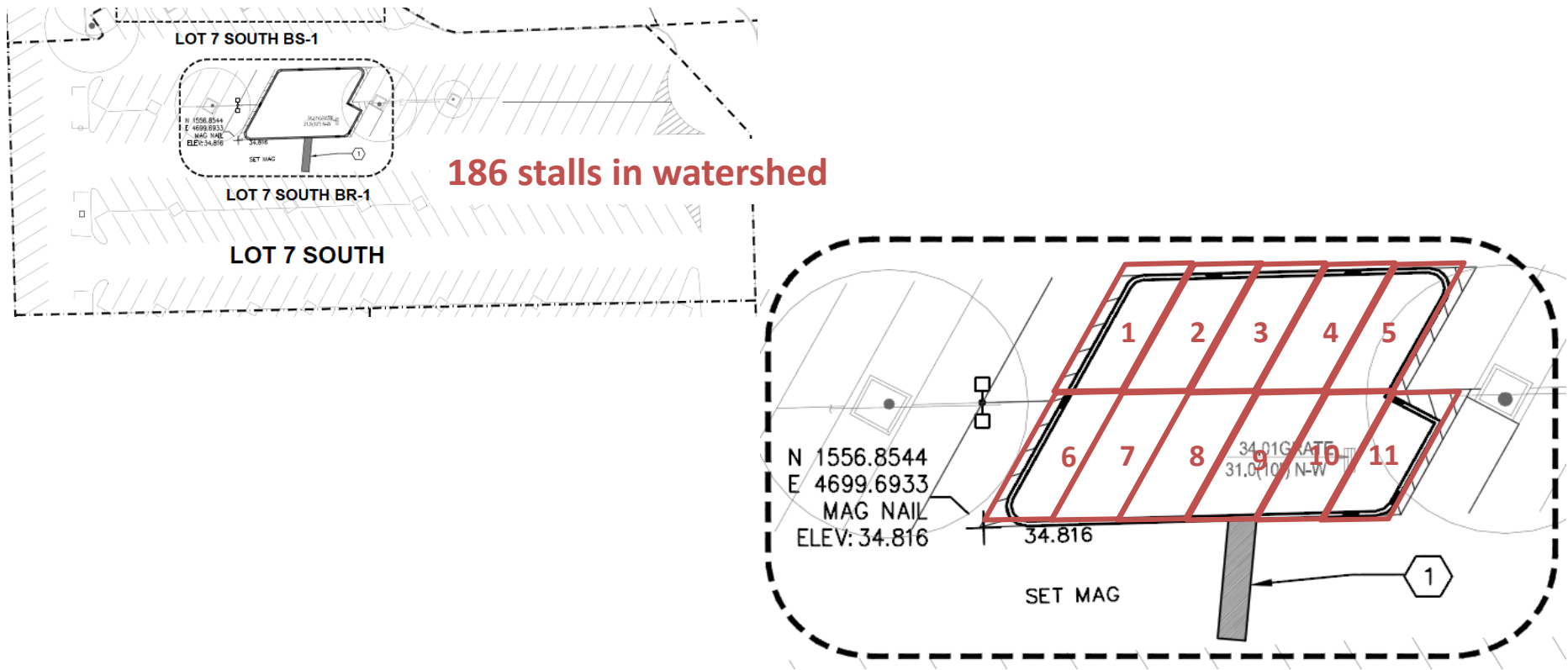
- Fitting into the existing drainage system
 - Vertical



Existing pipe invert to be maintained
(can limit depth of bioretention media)

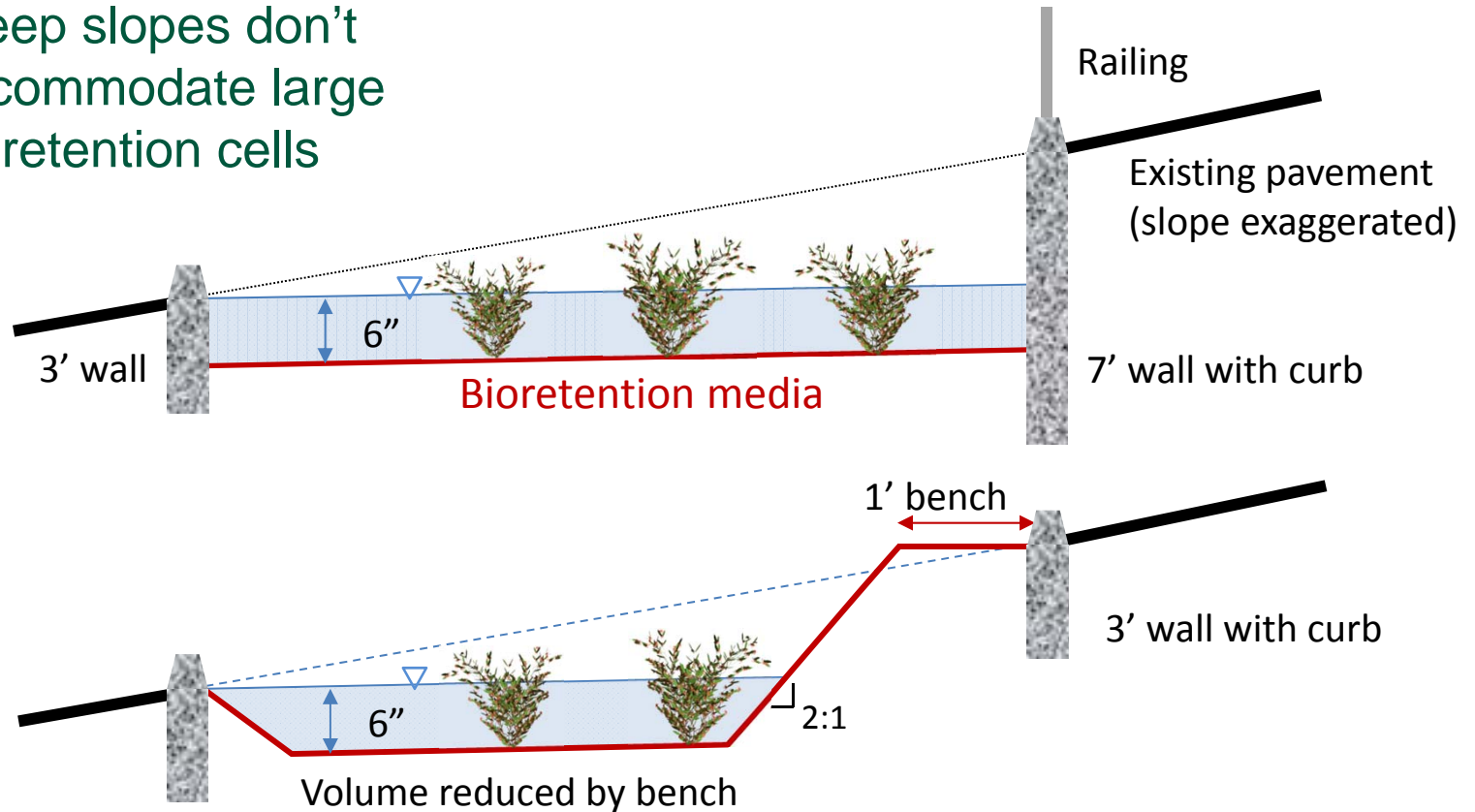
Design Challenges

- Negotiating the removal of parking stalls



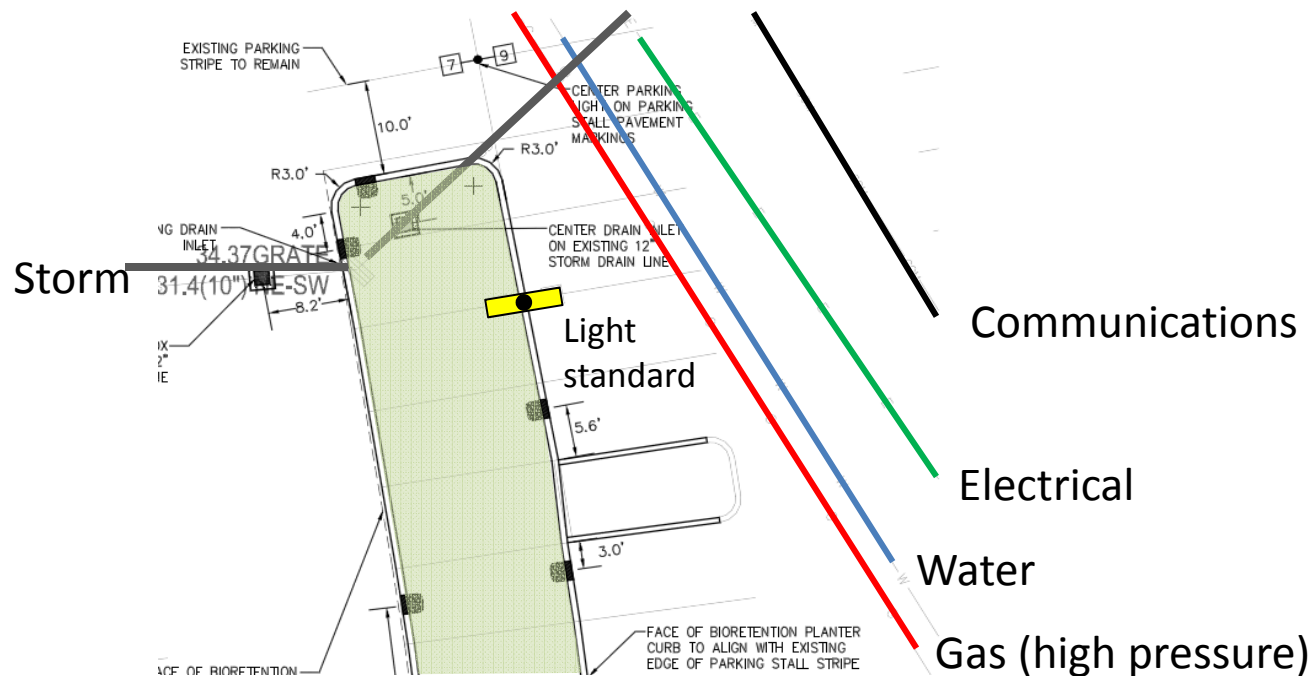
Design Challenge

- Fitting into existing topography
 - Steep slopes don't accommodate large bioretention cells



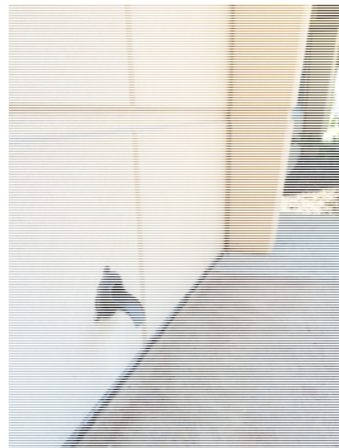
Design Challenges

- Conflicts with other infrastructure
 - Sanitary sewer, gas, electric, light standards, trees

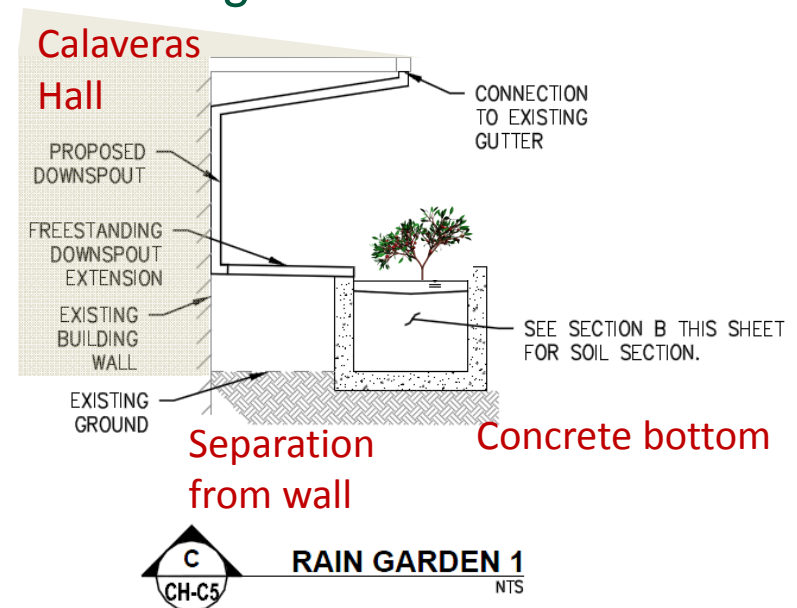


Design Challenges

- Interactions with buildings
 - Avoid saturating soils around foundations
 - Tapping into building drainage systems
 - May require architect or mechanical engineer
 - Some inaccessible



This one is OK but what if the pipe is inside the building?



Design Challenges

- Subsurface soil
 - Will it infiltrate?
 - How has it been affected by previous construction?
- Timing
 - Summer Construction Window

Design Challenges

- Compatibility with campus master plan



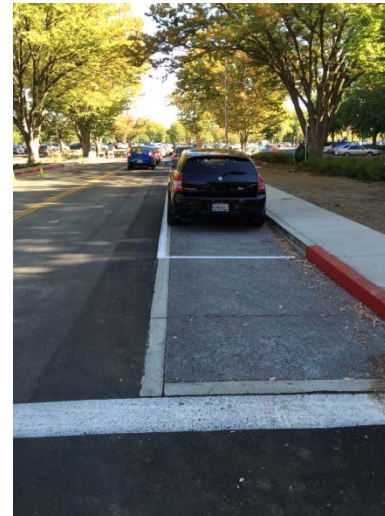
Construction Status

- Lot 7, Lot 10, College Town Drive
 - Construction complete
 - Contractor returning mid-October to replace plants



Construction Status

- Jed Smith Drive
 - Construction complete
 - Planting and landscaping currently underway



Construction Status

- Library Green, Campus Grove, & Calaveras Hall
 - Rain garden infrastructure complete
 - Planting and landscaping currently underway
 - Public access installations resuming soon



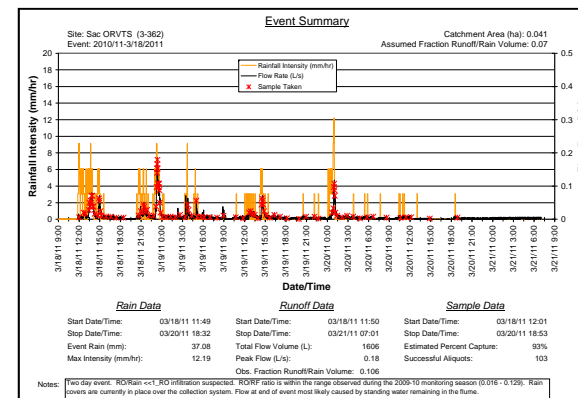
Construction Challenges

- Unanticipated utilities and tree roots
 - Reduced footprints
 - Changed geometry
 - Broken irrigation lines flooded excavations
 - Parking pass dispenser shut down
- Specified plants not available
- Keep heavy equipment off excavations
- Unknown vehicular access points
- Extremely hot weather
- Improper planting techniques



Monitoring

- Performance Monitoring
 - Flows (pressure heads)
 - Water Quality
 - TSS, TDS, turbidity
 - Chlorpyrifos & Diazinon
 - Copper, Lead, & Zinc
- Evaluation & Reporting
 - Up to 90% reductions



Education and Outreach

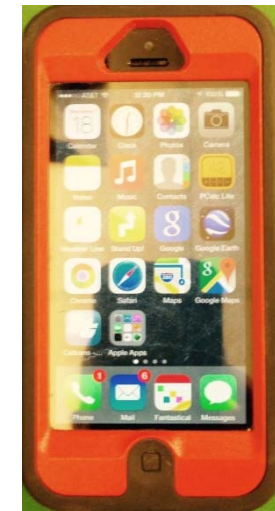
1. Signage, Website, Tours (Mobile App)
2. Brochures
3. Conferences and Papers
4. LID Conference
5. Campus Presentations
6. Public Affairs



Kitsap Conservation District



Green Side Up

A 'Save the Date' poster for the fifth Low Impact Development (LID) Regional Conference. The poster includes the date 'November 4th 2015' and the location 'California State University, Sacramento | Alumni Center'. It also provides details about the conference, registration information, and the website www.drycreekconservancy.org. The poster features images of various LID projects and a map of the Sacramento region.

Operation and Maintenance

1. Weed, Litter, and Debris Removal (As needed)
2. Infiltration Inspections (Runoff Infiltrating?) (Twice a year during storms)
3. Low or no Infiltration? Remove and Replace Topsoil (~ 5 to 10 years)
4. Use integrated pest management (IPM) techniques to minimize use of fertilizers, pesticides and herbicides. (As needed)
5. Inspect (~ 2 times per year – including once at end of wet season) for erosion and sediment buildup. Correct problems as needed.



Kevin Perry
Urban Rain Design

Project Timeline

Spring 2015: Complete Design

Summer and Fall 2015: Construction

2015/2016: Post-Construction Monitoring

January 2017: Final Report

2016 – 2036: O&M

Project Funded by SWRCB

Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for us.



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