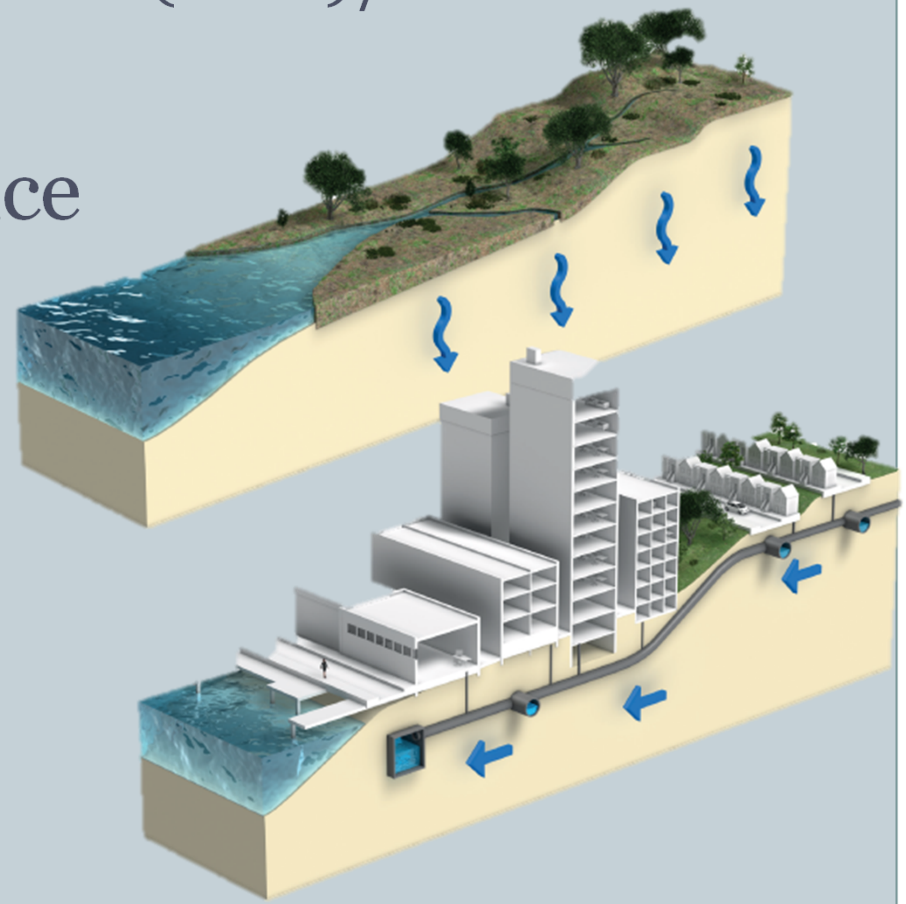
LOW IMPACT DEVELOPMENT

ERIC ZICKLER, AECOM

FEBRUARY 18, 2015

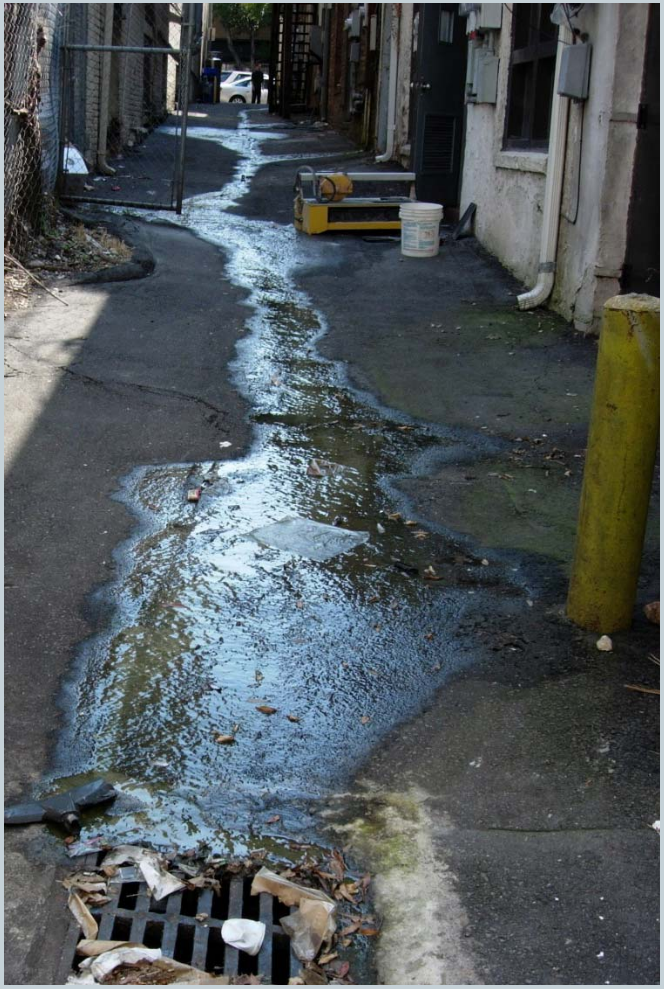
Tonight's Topics

- Low Impact Development (LID)/Green Infrastructure
- Evolution and Relevance
  - Regulatory Context
  - Co-Benefits / ROI
- Complete Streets



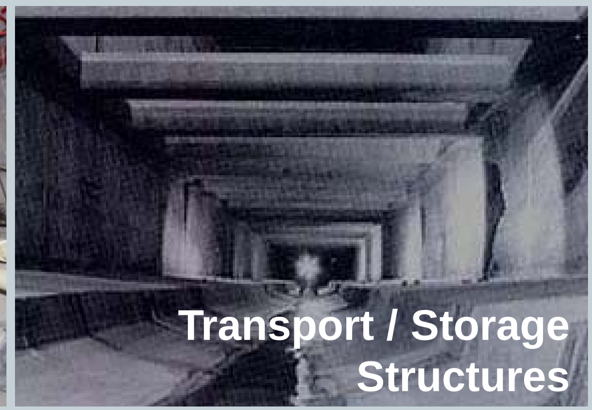
Common Urban Stormwater Pollutants

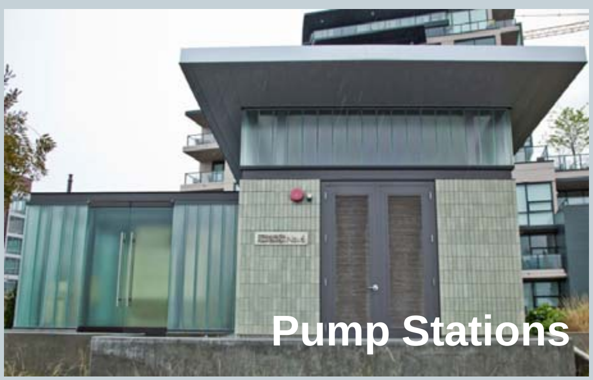
- Polynuclear Aromatic Hydrocarbons (PAH)
- Pesticides
- Metals
- Mercury
- Lead
- Copper
- Zinc
- Dioxins
- Bacteria
- VOCs



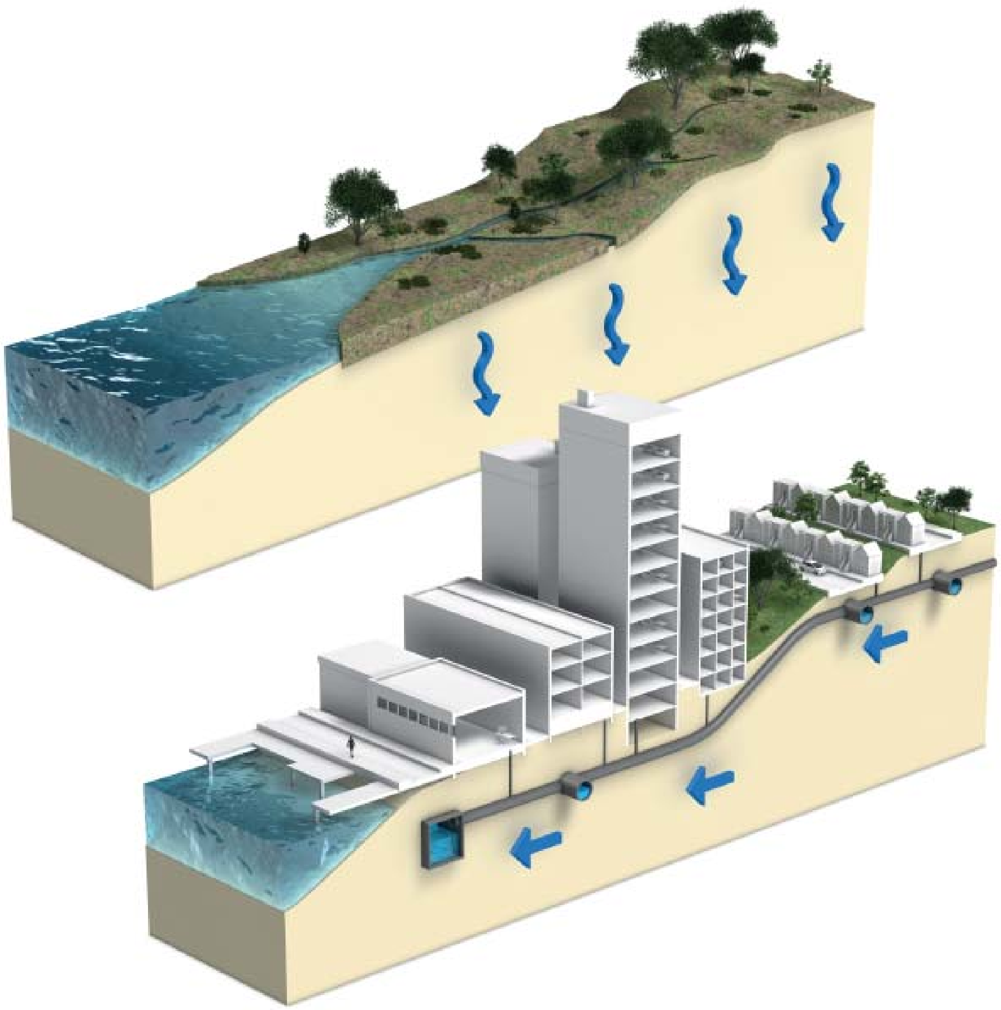
Stormwater Management – Conventional

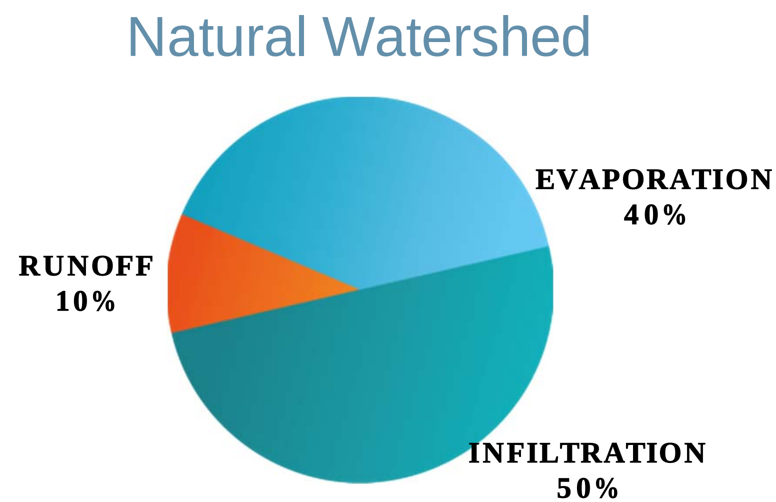
- **Convey** stormwater quickly from site to detention pond or waterbody to manage peak flows for flood control

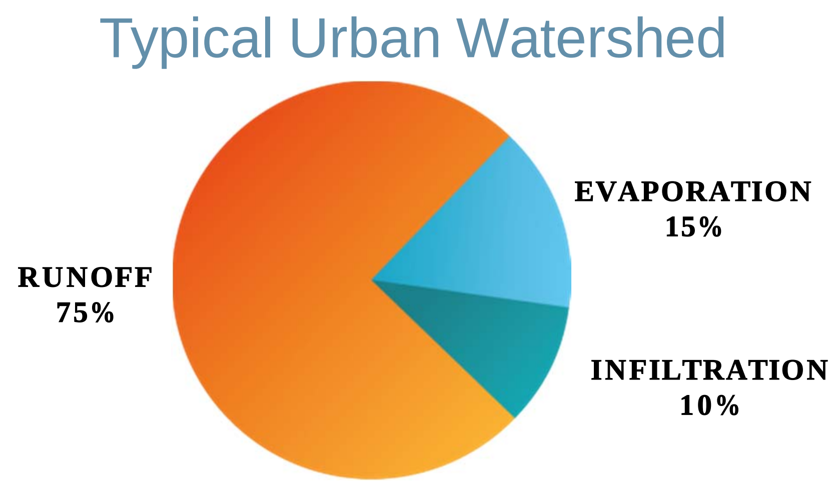




Why Green Infrastructure?







Note: These percentages vary by watershed depending on local conditions: climate, soils, vegetation, topography, etc.

LID (Green Infrastructure)

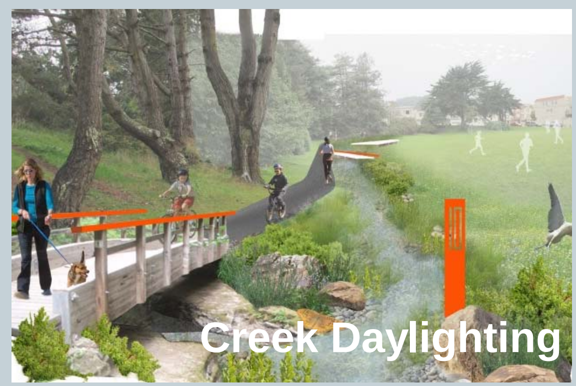
Development approach that seeks to **mimic the natural processes** occurring on a site to manage stormwater **close to its source.**

Employs principles such as **preserving and recreating natural landscape features** while **minimizing impervious area** to create functional and appealing site drainage systems that treat **stormwater as a resource** rather than a waste product.

Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions.

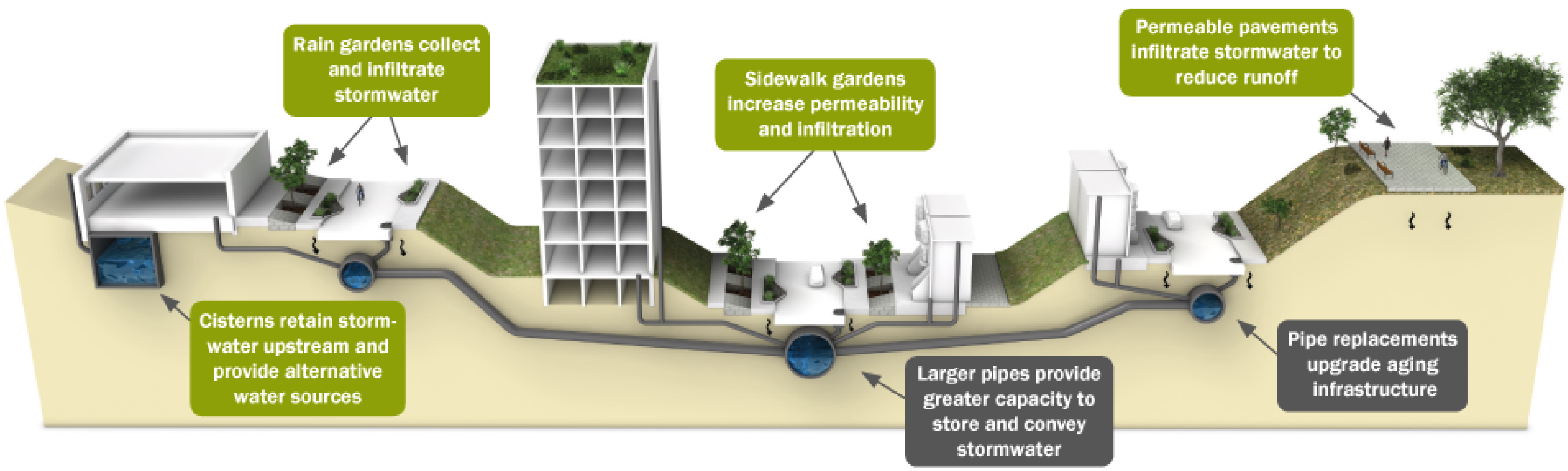
Stormwater Management – LID

- **Slow, sink, spread** to reduce pollutant loads, utilize stormwater as a resource, and provide multiple community benefits



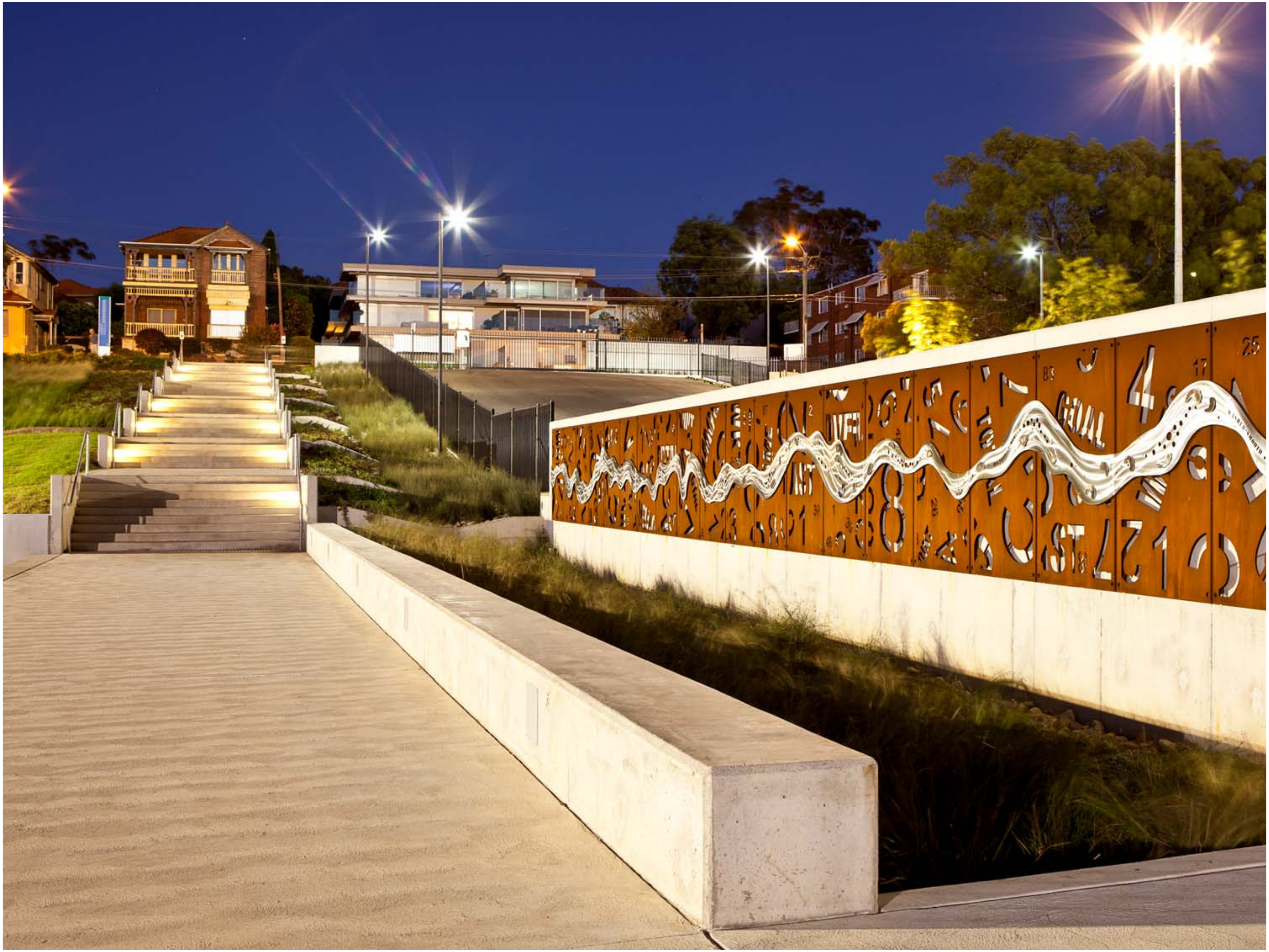
LID - Basic Concept

Creek Daylighting | Constructed Wetlands | Vegetated Roof | Bioretention Planter | Rainwater Harvesting | Permeable Paving



URBAN WATERSHED GREY AND GREEN SOLUTIONS

Pump Stations | Outfall Retrofit/ Replacement | Tunnels | Transport/Storage Structures | Pipe Upsizing/ Replacement




WING STOP
JUICE IT UP!

BIORETENTION AREA

Bioretention areas are shallow, landscaped areas that receive and treat stormwater. Runoff is allowed to pond on the surface of the bioretention area, typically less than a foot deep, where it can then filter through a vegetative layer and engineered soil media to remove sediment and pollutants. In locations of well drained subsoils, the water may then infiltrate into the subgrade. At sites or locations that will not allow for infiltration, flow-through systems are required; underdrains are installed beneath the planting soil to drain the facility and release the treated water to a conveyance feature or storm drain system. Bioretention areas are very versatile facilities that can fit a wide range of settings.

Bioretention areas are among the most common LID techniques implemented, often in highly visible locations, and can be a valuable educational opportunity especially if signage is installed illustrating function, intent, or native plants.

Retrofit Opportunities

Benefits

- Applicable to a wide range of sites and layout, easily integrated into urban retrofit projects
- Provides reliable water quality function and facilitates evapotranspiration
- Attenuates peak flows; reduces runoff volume and recharges groundwater when infiltration possible
- Provides greening and reduces heat island effect in urban areas
- Provides aesthetic amenity and creates habitat

Potential Constraints

- Infiltration design requires sufficiently permeable soils, depth to groundwater/hardpan; underdrain system increases cost and infrastructure
- Vegetation requires maintenance
- Maintaining desired aesthetics may require dry season irrigation
- Should not receive more than about 1 acre of runoff; divide larger watersheds among dispersed cells

Siting Applications

- Residential yards
- Office and commercial storefronts
- Roadway medians, bulb-outs, and traffic circles
- Parking lot islands, cul-de-sacs
- Parks and other landscaped areas

Other Names: Raingarden, Bioretention Cell, Bioretention Swale, Dry Swale, Flow-Through Planter

Technical Information

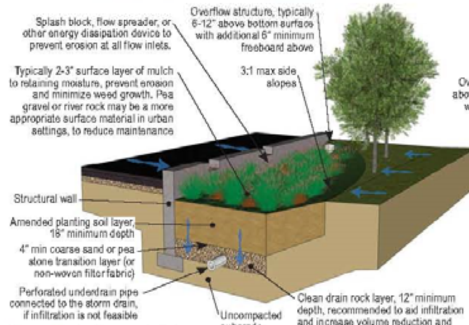


Figure: Bioretention area detail, showing hard edge and soft edge

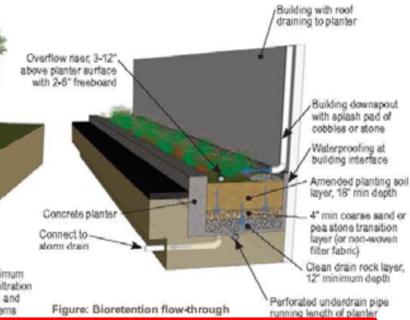


Figure: Bioretention flow-through planter typical detail

Design & Sizing Criteria

- Bioretention areas can be sized as either volume-based or flow-based systems (or a combination).
- Volume-based systems are sized to capture the WQV within the surface ponding area and void space of the drain rock storage layer and should release all captured runoff within a maximum 48 hour drawdown time (either by subgrade infiltration or through an underdrain).
- Flow-based systems are sized to percolate the WQF through the bottom of the facility. The surface area of the system multiplied by the infiltration rate of the planting media (which should be considered as 5 in/hr for design) must equal or exceed the WQF. The subgrade infiltration rate must be high enough to process this flow as well, or an underdrain is necessary.
- Reliance on subgrade infiltration requires a minimum soil infiltration rate of 0.5 in/hr, in addition to the above requirements. Within impermeable soils (Type C and D), an underdrain should be installed.
- If the separation from the bottom of the facility to the seasonally high groundwater elevation is less than 10 feet then an underdrain should be installed, with an impermeable liner placed beneath all system media.
- Infiltrating bioretention systems should be placed a minimum of 10 feet from building foundations and 100 feet from drinking water wells.
- Pretreatment (vegetated buffer strip, swale, sediment forebay) can improve function and ease maintenance.
- Runoff from storms larger than the water quality event are ideally diverted to the storm drain system.

Plant Selection *(See Appendix A)*

Plants should be suitable for periods of inundation during the rainy season. Vegetation should be drought-tolerant, especially at the edges, but may require irrigation during initial establishment or dry periods. Trees require more intensive maintenance, and may show limited growth.

Blue eyed grass

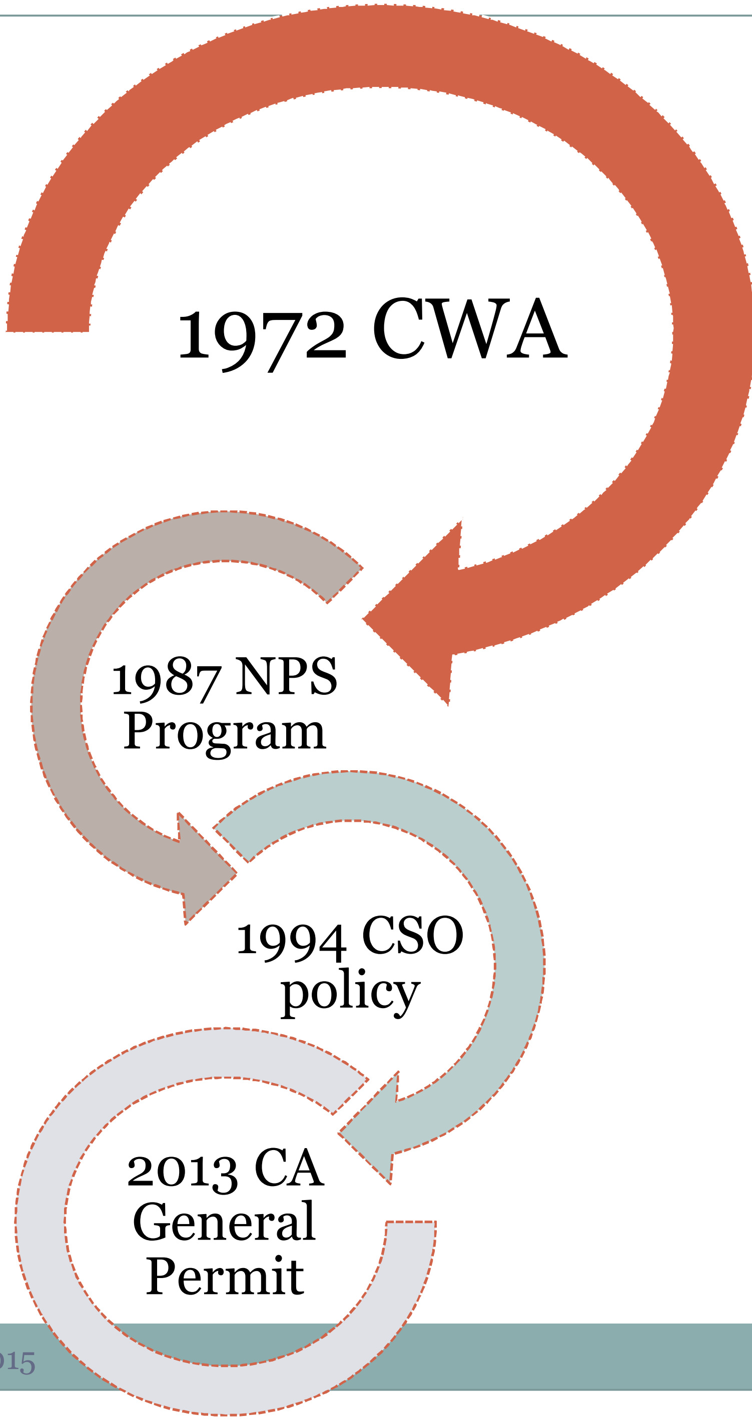
Desert baccharis

California rose

San Diego sedge

Green Infrastructure – Evolution & Relavance

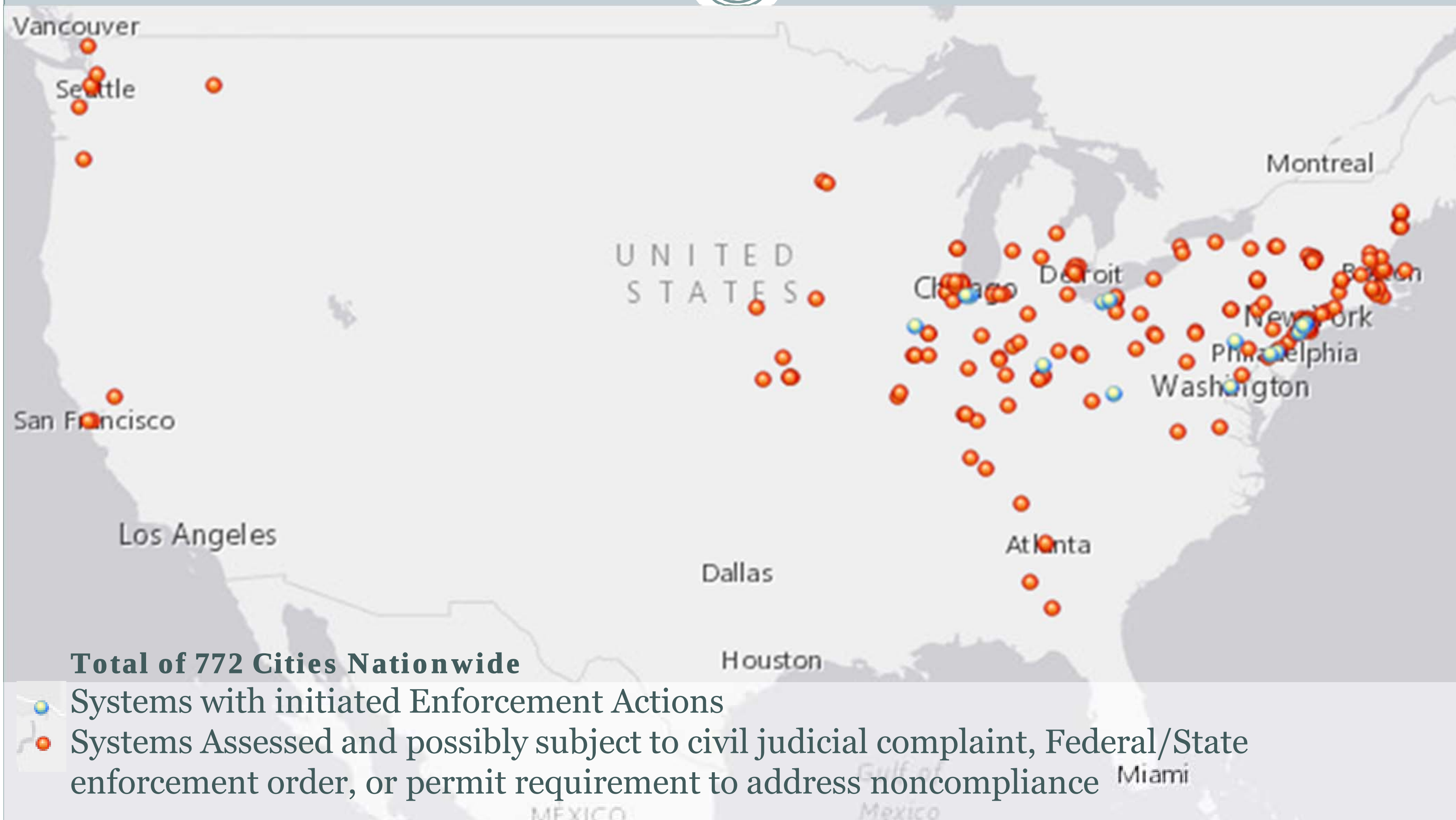
February 18th, 2015


1972 CWA
1987 NPS Program
1994 CSO policy
2013 CA General Permit

1972 Federal Clean Water Act **(CWA)**

- **Technology-based**
  - National Pollutant Discharge Elimination System **(NPDES)** permit – Point Source
- **Water quality-based**
  - 'Impaired' or 'threatened' waters (TMDL)
    - 1987 Section 319 - Nonpoint source **(NPS)** Management Program Grant funding

CSS serving population of 50,000 or more people



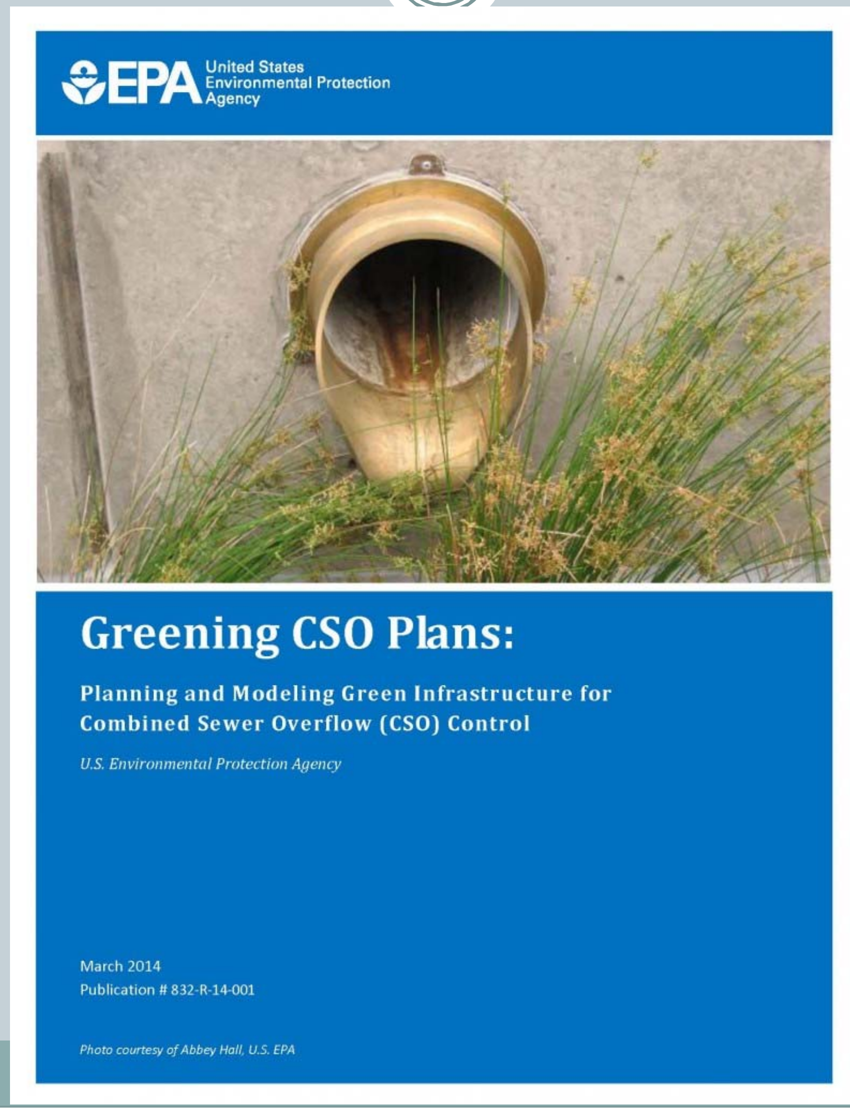
Total of 772 Cities Nationwide

- Systems with initiated Enforcement Actions
- Systems Assessed and possibly subject to civil judicial complaint, Federal/State enforcement order, or permit requirement to address noncompliance

Combined Sewer Overflow (CSO) Consent Decrees

- Goal: reduce raw sewage overflows and stormwater discharges that pose significant threat to water quality and public health
- 1994 Legal framework for CSS to meet CSA
  - Set 1997 deadline for cities to have 'nine minimum controls'
  - Thereafter, long-term control plans (LTCPs)
- 2010 switch to collaborative, 'integrated planning' effort with emphasis on Green Infrastructure and public input

2014 EPA Green Infrastructure Promotion



United States Environmental Protection Agency

Greening CSO Plans:

Planning and Modeling Green Infrastructure for Combined Sewer Overflow (CSO) Control

U.S. Environmental Protection Agency

March 2014
Publication # 832-R-14-001

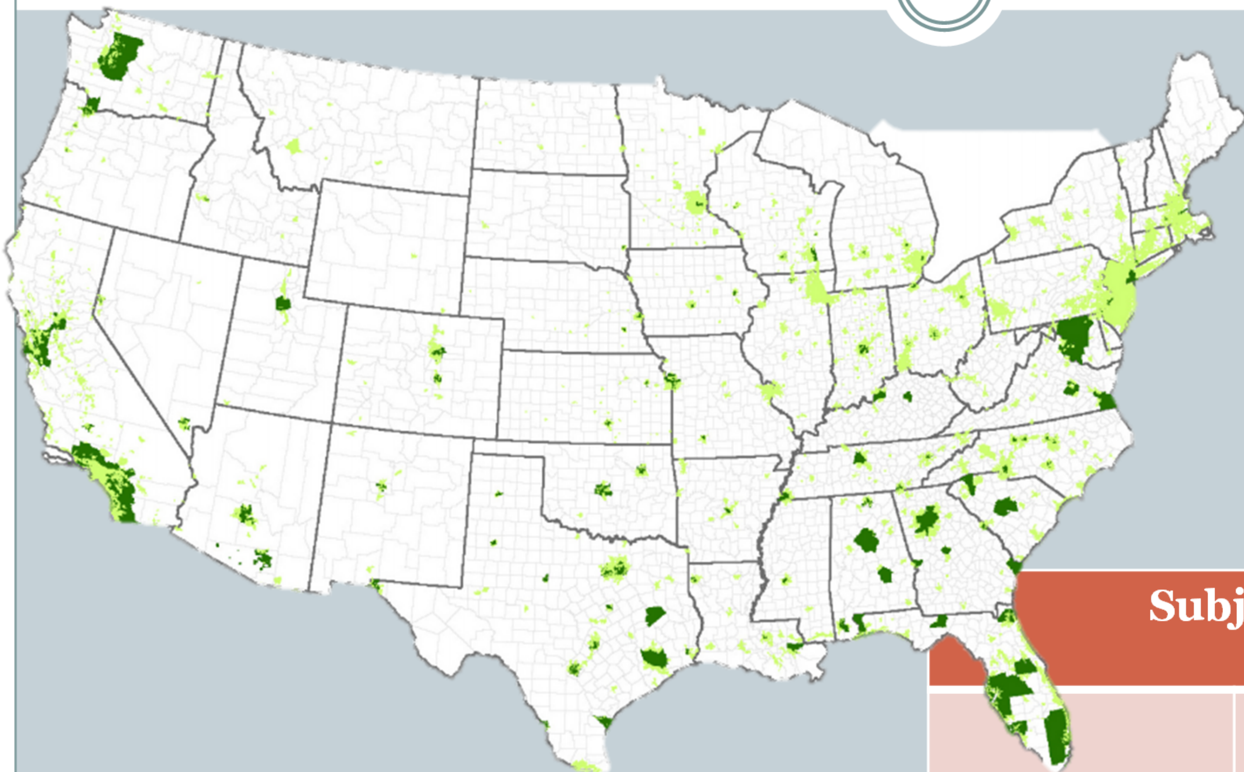
Photo courtesy of Abbey Hall, U.S. EPA

LID in MS4 California Context

*'in CA, **urban storm water** is listed as the **primary source of impairment** for ten percent of all rivers, **ten percent** of all lakes and reservoirs, and 17 percent of all estuaries'*

-2010 INTEGRATED REPORT

Regulated MS4s



Subject to Water Quality Based Regulations	Discharge to Impaired Waters	≥1 TMDL
Phase I MS4s	50%	53%
Phase II MS4s	64%	73%

Phase I: 858 MS4s
Phase II: 6,735 MS4s

MS4– **California**

- 2003 – WQ Order No. 2003-0005-DWQ
  - Coverage to all small MS4s state-wide
  - Framed around six Minimum Control Measures
- 2013 – WQ Order No. 2013-0001-DWQ
  - Framed around water quality
  - Areas of Special Biological Significance (ASBS)
  - TMDL Implementation Requirements
  - New and Re-development (post-construction) **LID standards**
  - Increased monitoring/tracking to high priority water bodies
  - Specifies actions needed to reduce stormwater pollutants to MEP
  - Replaces SWMP with electronic NOI and Annual Report (SMARTS)

writing GI into NPDES permits

- Establish performance standards for post-construction stormwater volume control for sites
- Require Green Infrastructure measures be considered and/or implemented as part of local building and site development approval process
- Establish ceilings on effective impervious area
- Incorporate water-quality based requirements in form of numeric effluent limits and/or specific control measures

writing GI into NPDES permits – examples

- Santa Ana RWQCB, Orange County Permit
  - Requires priority development projects *infiltrate, harvest and reuse, evapotranspire or biotreat* the 85th percentile storm event
  - Design capture volume not managed by LID must be treated and discharged off-site (mitigation), or via in-lieu fees
- Los Angeles RWQCB, Ventura County Permit
  - Requires all new development and redevelopment projects to control pollutants and runoff volume through *infiltration, storage for reuse, evapotranspiration, or bioretention* by reducing effective impervious area to 5% of less of total project area

NPDES - **Central Valley**

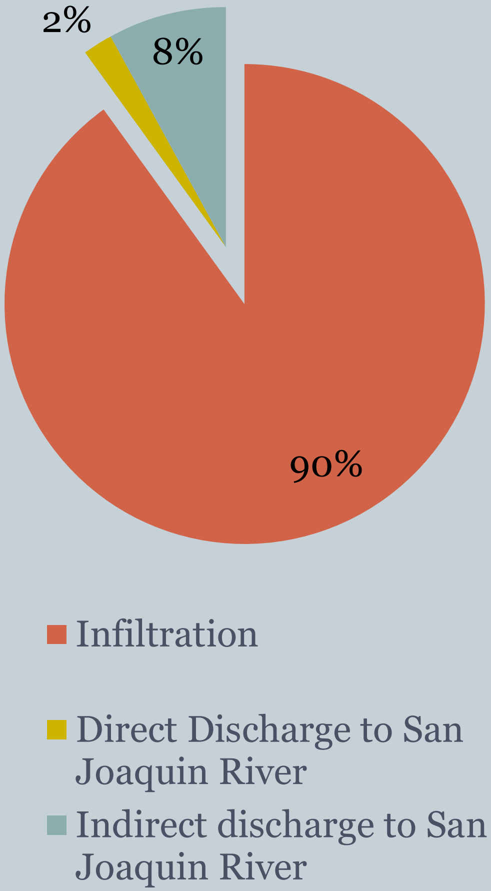
- Phase I
  - East Contra Costa County
    - Antioch, Brentwood, Oakley
  - Sacramento County
    - Citrus Heights, Elk Grove, Folsom, Galt
  - City of Stockton / San Joaquin County
  - Port of Stockton
  - City of Modesto
  - Bakersfield Kern County
  - Fresno County
    - Fresno, Clovis, UCA Fresno
- Phase II
  - One General Permit covers all 86 cities in Central Valley

NPDES - Central Valley **Future**

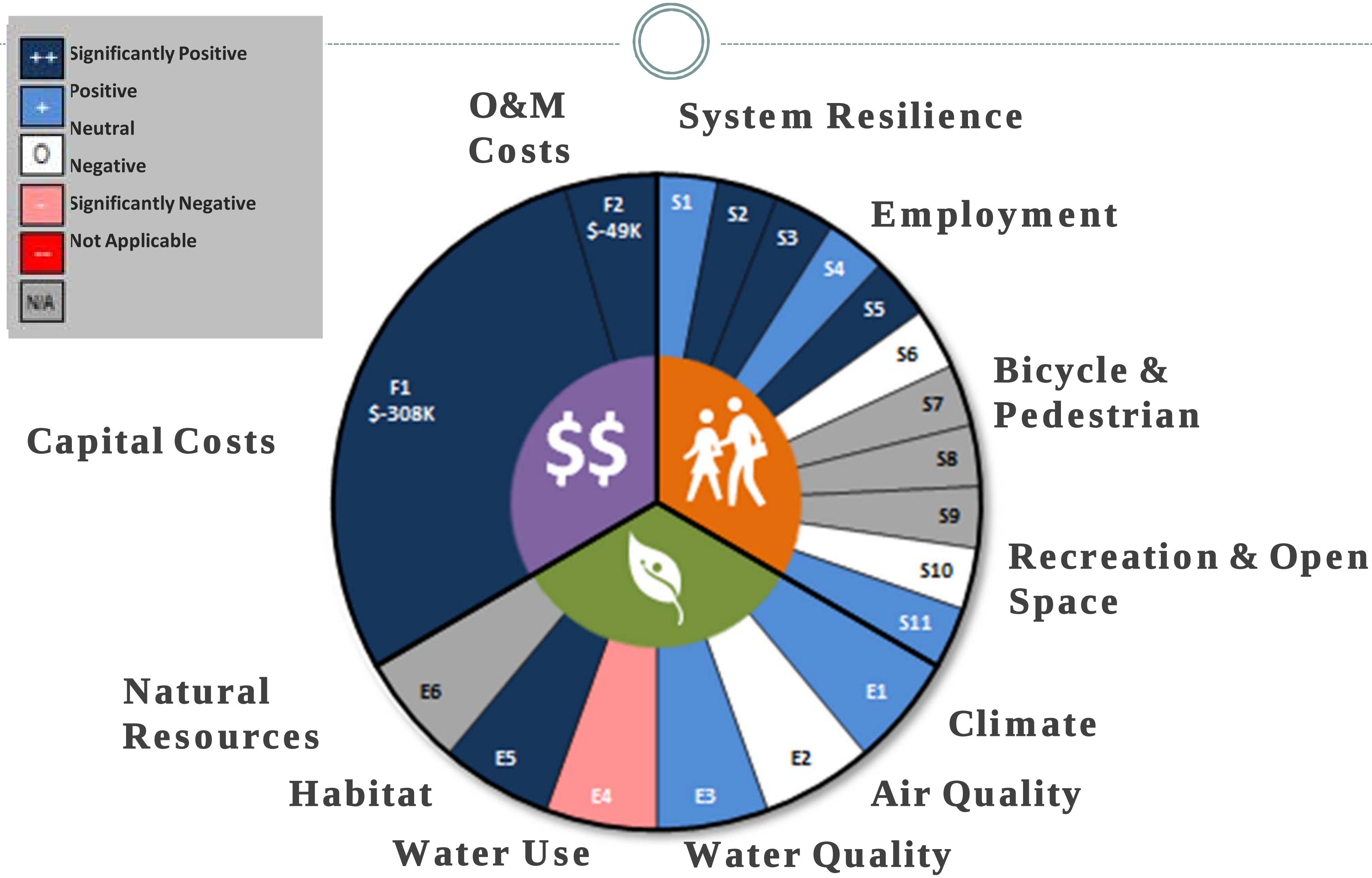
- Stormwater Strategic Initiative
  - Regionalize approach through integration of Phase I and II
  - 2014 – SWRCB Stakeholder Meetings focused on:
    - Stormwater as a resource
    - Removal of pollutants by true source control
    - Increase programmatic efficiency and effectiveness

    …Through providing regulatory relief, standardizing permitting approaches, and facilitating funding
  - March 2015 – Draft Release and Public Review
  - April 2015 – Final Document

Fresno-Clovis – Destination of Urban Runoff

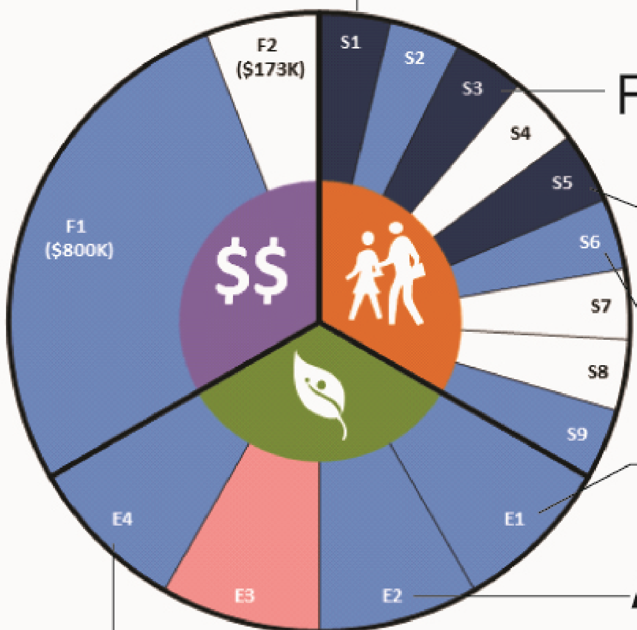


Quantifying the Other Benefits of LID



Quantifying the Other Benefits of LID

Sample Metrics / Outputs



Acres Mitigated Flood Risk .... ______

Feet Bike/Ped Enhancement .... ______

Acres Green Space Added .... ______

Labor Hours Generated .... ______

Tons GHG Reduced .... ______

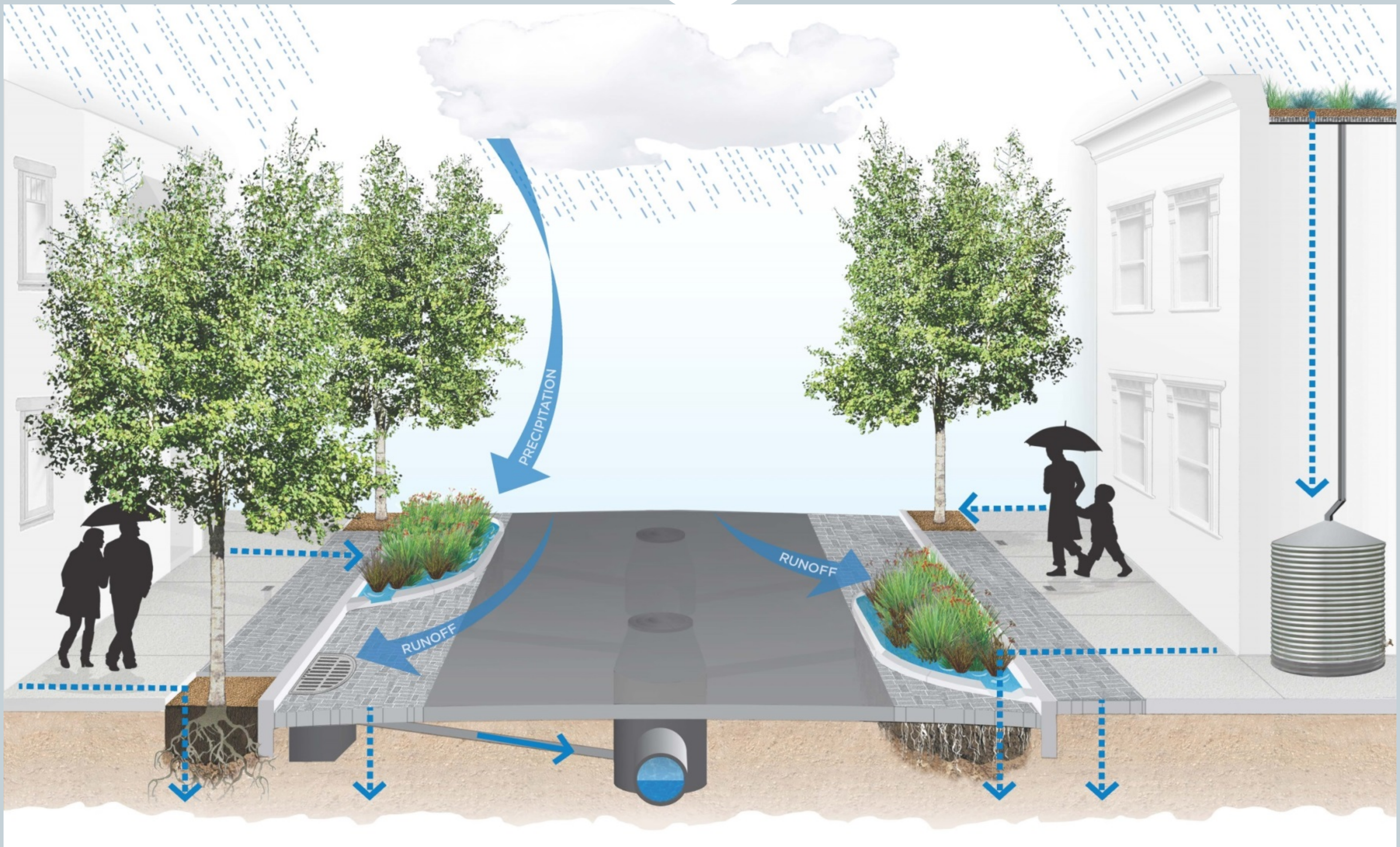
Acres Urban Habitat .... ______

Tons Criteria Pollutants Reduced .... ______

LID and complete streets

LID is **integral** part to a complete street framework that effectively **manages** and **treats** stormwater at its source, provides **aesthetic, health** and **safety,** benefits to pedestrians and bikers, and can ultimately restore the hydrologic and ecological functions of the urban watershed.

LID - rain garden bulb out



LID - rain garden bulb outs

LID – rain garden / bioretention

LID – green street

LID – permeable pavement and linear planters

LID – rain garden bulb out

SFPUC


DISCUSSION
CONTACT:
ERIC.ZICKLER@AECOM.COM