Low Impact Development Projects in the Monterey Bay Region

Robyn Cooper, M.S.
Fall Creek Engineering Inc.

LID in SCC

- A few words about LID - Hydrology
- Santa Cruz County Requirements
- Review of 4 Projects in Santa Cruz/Salinas
  - Single Family Residential
  - Multi Family Residential
  - Commercial Parking
  - Community Stormwater (Salinas)

LID in SCC – Hydrograph Concept

- Pre-development
  - Interception
  - Infiltration
- Post Development
  - Faster time to peak
  - Higher Volumetric Flow Rate
  - Greater Volume of Runoff

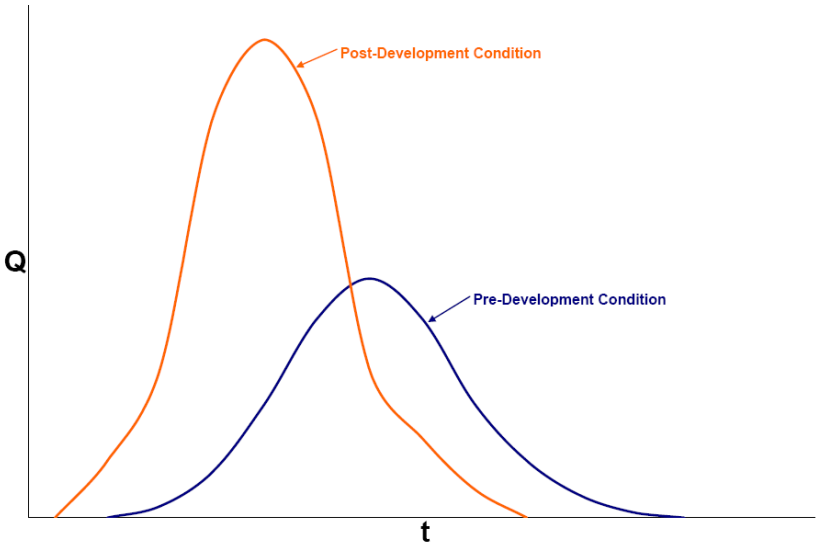


Figure 1. Hydrographs showing development's impact on runoff.
(Q = volumetric flow rate; t = time)

LID in SCC – Hydrograph Concept

- Conventional BMP
  - Reduces Peak
  - Increases time
  - Volume > Pre-development
- LID BMP
  - Reduces Peak
  - Time = Pre-development
  - Volume = Pre-development

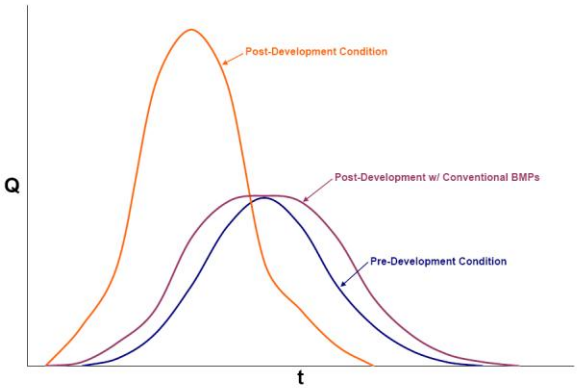


Figure 2. Post-development hydrograph response to conventional BMPs.
(Q = volumetric flow rate; t = time)

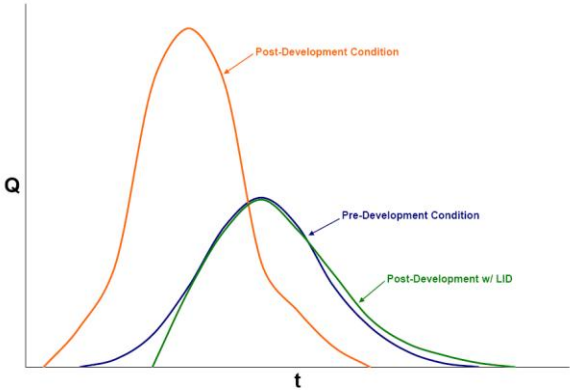
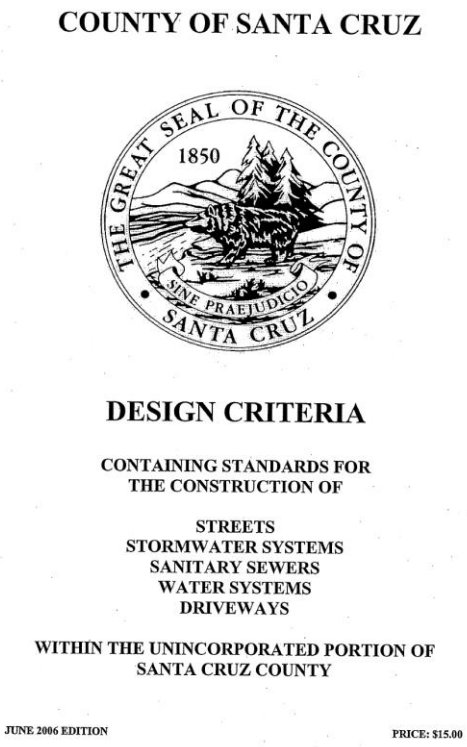


Figure 3. Post-development hydrograph response to LID controls.
(Q = volumetric flow rate; t = time)

LID in SCC – Santa Cruz County Requirements

- Conveyance
- $Q_{post} = Q_{pre}$
- Minimum Detention
- Minimum Retention



COUNTY OF SANTA CRUZ

THE GREAT SEAL OF THE COUNTY OF SANTA CRUZ
1850
SINE PRAEJUDICIO

DESIGN CRITERIA

CONTAINING STANDARDS FOR
THE CONSTRUCTION OF

STREETS
STORMWATER SYSTEMS
SANITARY SEWERS
WATER SYSTEMS
DRIVEWAYS

WITHIN THE UNINCORPORATED PORTION OF
SANTA CRUZ COUNTY

JUNE 2006 EDITION

PRICE: $15.00

http://www.dpw.co.santa-cruz.ca.us/DESIGNCRITERIA.pdf

LID in SCC – Santa Cruz County Methodologies

- Basins less than 200 acres
  - Rational Method
- Larger Basins
  - Unit Hydrograph
  - NRCS Methods
  - USGS Regional Regression + 25%
  - Other methods

$$Q = C * i * A * Ca$$

Q = peak discharge (cfs)

C = runoff coefficient (0-1.0)

i = rainfall intensity (in/hr)

A = Area (acres)

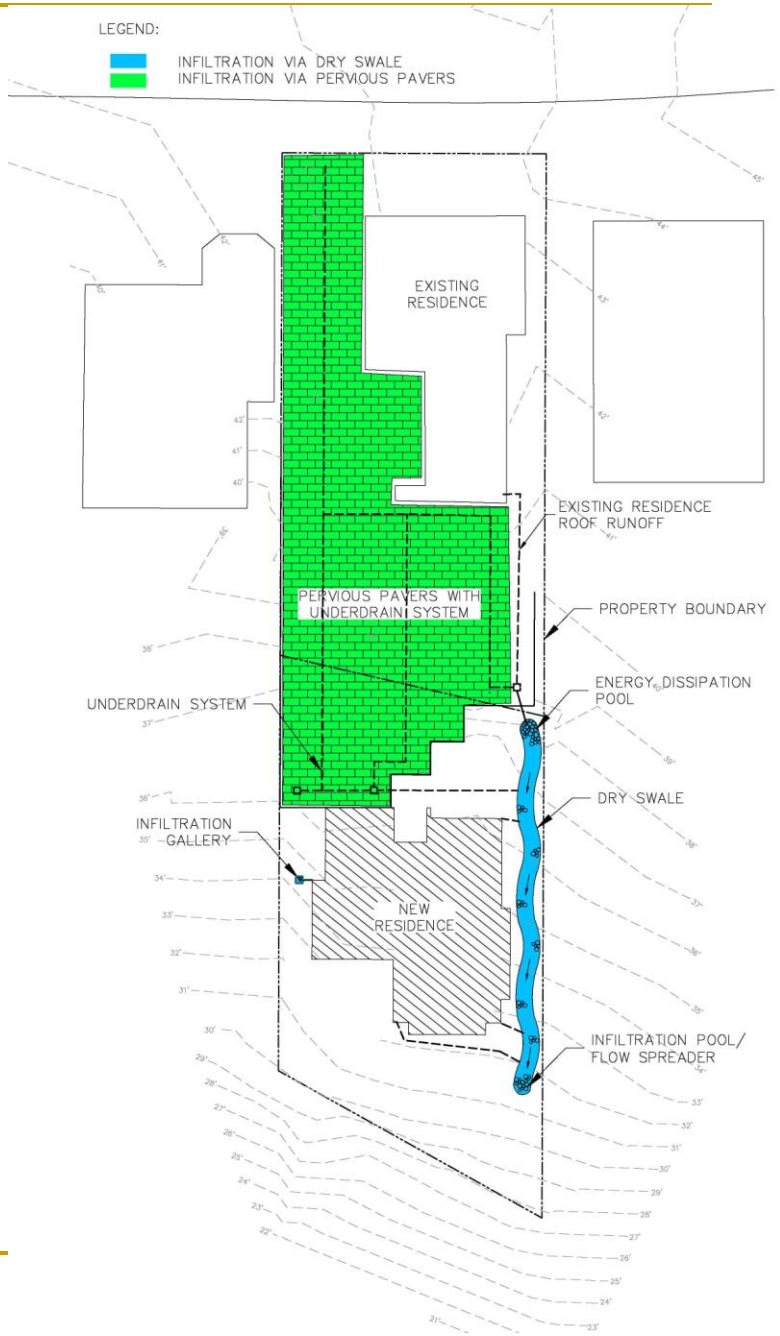
Ca = Antecedent Moisture Condition

REQUIRED ANTECEDENT MOISTURE FACTORS (Ca) FOR THE RATIONAL METHOD*

Recurrence Interval (Years)	Ca
2 to 10	1.0
25	1.1
50	1.2
100	1.25

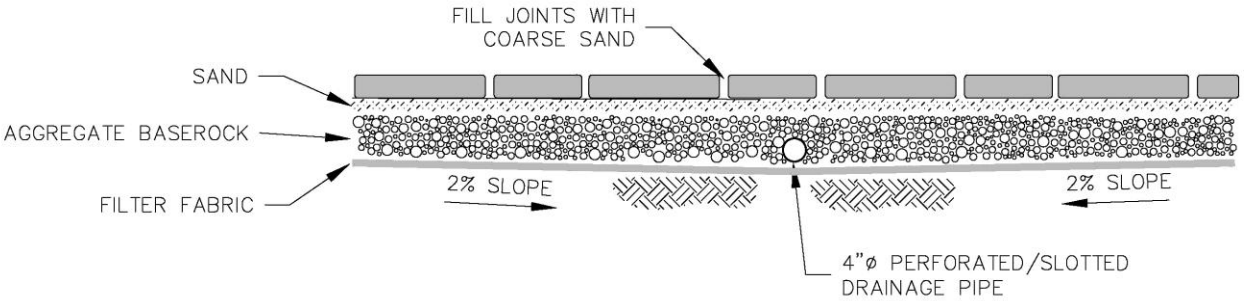
LID in SC
Single Family Residential

- Soils Type:
  - Silty Sand, Clayey Sand
  - Silty Sand, Sand
- County Criteria:
  - $Q_{post} = Q_{pre}$
  - Detention/retention requirements
- Project Design:
  - Pervious Pavers – new driveway
  - Dry Swale – roof runoff, driveway overflow
- Design Methodology:
  - Rational Method
  - Detention – Pervious Paving
  - Retention – Dry Swale



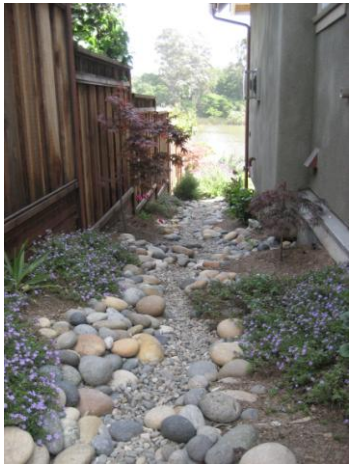
LID in SC
Single Family Residential

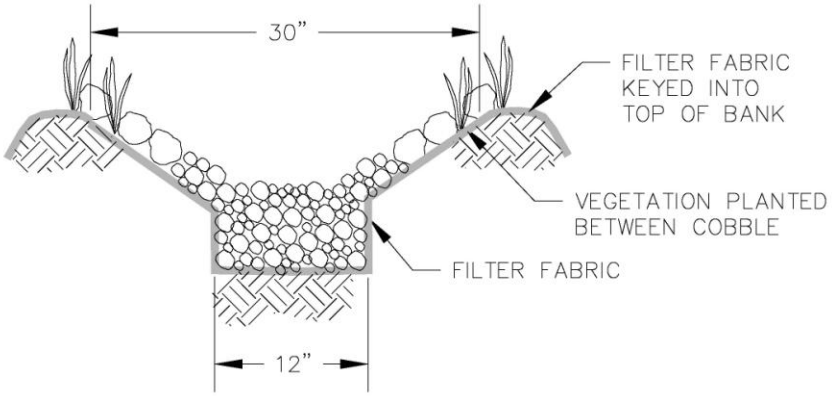
- Pervious Pavers
  - Lower Runoff Coefficient
  - Provides Storage
  - Maintenance
    - Periodic cleaning of surface



LID in SC
Single Family Residential

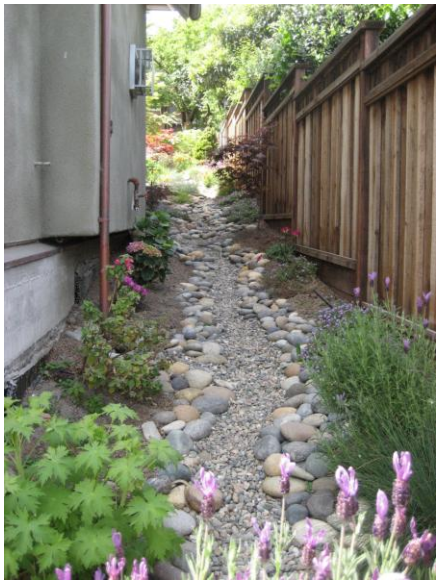
- Dry Swale
  - Owner Installed
  - Materials Cost – Craigslist!
  - Maintenance
    - Periodic Cleaning of debris from gravel
    - Pruning surrounding vegetation





LID in SC
Single Family Residential

- Results
  - Reduced Peak Discharge
  - Reduced Volume
  - Improved Water Quality
  - Happy Home Owner!

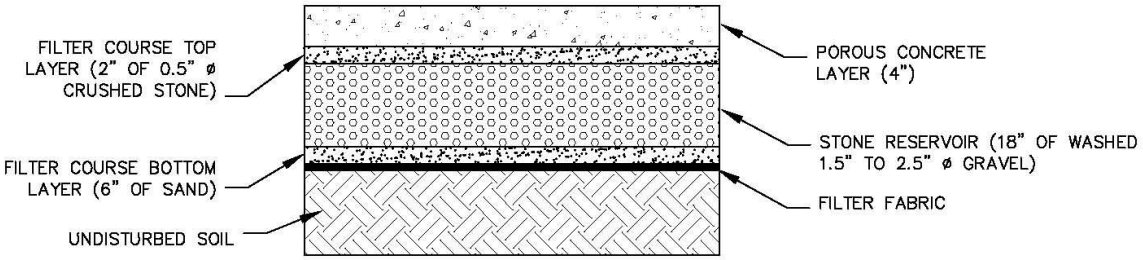


LID in SCC
Multi Family Residential

- Project:
  - Redevelopment Project
    - 19 Buildings
    - 67 Low Income Units
    - Community Center
    - Recreation Areas
- Soils Type:
  - Silty Sand
- County Criteria :
  - $Q_{post}=Q_{pre}$
  - 25-year conveyance
- Project Design:
  - Porous Concrete – Parking Stalls/Lots
  - Infiltration Chambers – Roof Runoff
  - Vortex Separator – Main System

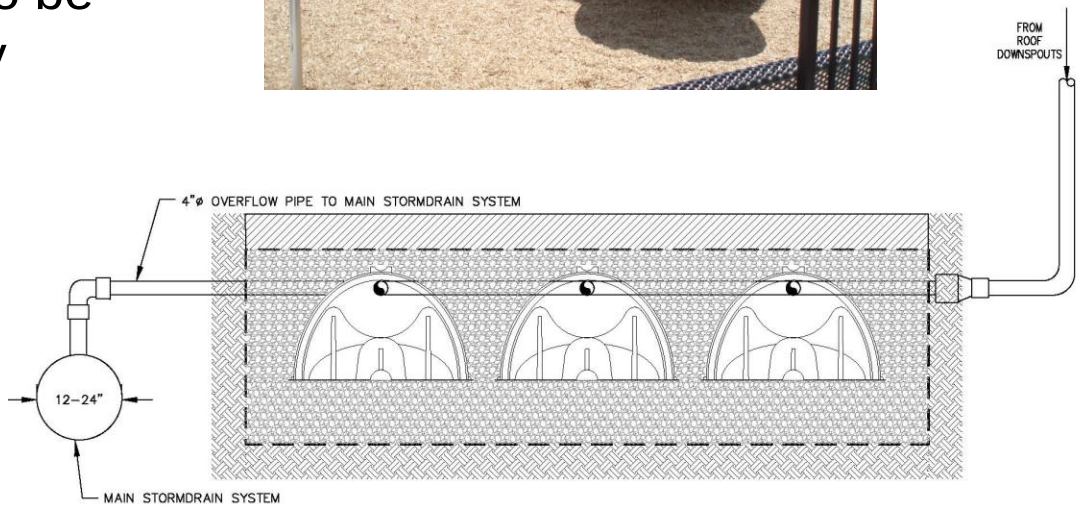
LID in SCC
Multi Family Residential

- Porous Concrete:
  - Parking Stalls/Lots
  - Lower Runoff Coefficient
  - Provides Storage
  - Cost:
    - Porous Concrete: $6.29/ sq.ft. Installed & Finished
    - Base Prep and Excavation: $4.28/sq.ft
    - Total Cost $10.57/sq.ft.
  - Maintenance:
    - Periodic cleaning of surface



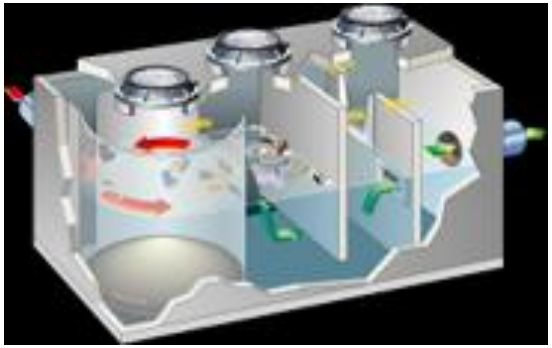
LID in SCC
Multi Family Residential

- Infiltration Chambers
  - Provide Storage
  - Allow Infiltration
  - Maintenance
    - Roof gutters need to be cleaned periodically
    - Collection system maintained



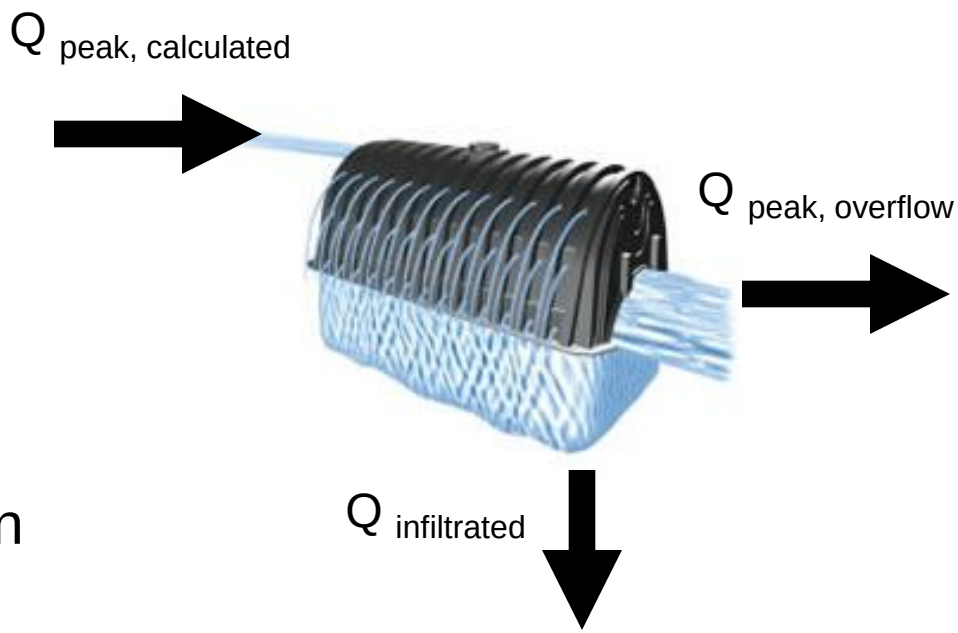
LID in SCC
Multi Family Residential

- Vortex Separator
  - Improves Water Quality
    - Removes:
      - Sediment
      - Oil/Grease
      - Heavy Metals
    - Removal Efficiency
  - Maintenance
    - Inspect Spring and Fall
    - Cleaning Site Dependent



LID in SCC
Multi Family Residential

- Design
  - Rational Method
  - Hydraflow StormSewer



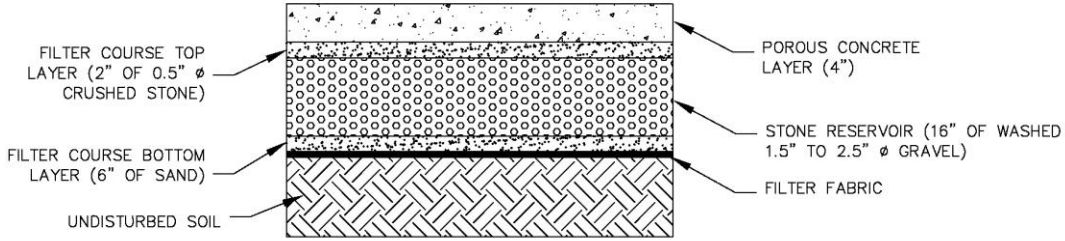
- Results
  - Reduce Impervious Area
  - Convey 25-year + Run-on
  - Reduce Peak Discharge
  - Reduce Volume 15%

LID in SCC
Commercial Parking Lot

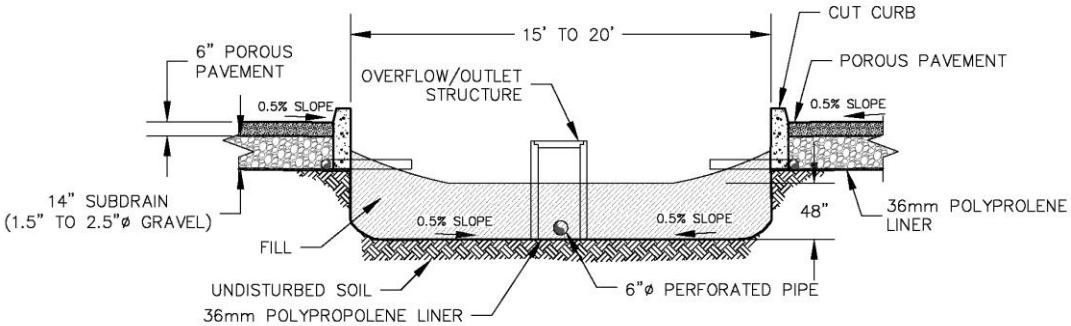
- Project:
  - Overflow parking lot
  - 200+ parking spaces
- Soils Type:
  - Silty Sand
  - FILL
- County Criteria:
  - $Q_{post,25} = Q_{pre,10}$
  - Conveyance – 25 year
- Project Design:
  - Porous Concrete- Parking Stalls (Lined)
  - Bio-filtration (Lined)

LID in SCC
Commercial Parking

- Porous Concrete



- Bio-filtration



LID in SCC
Commercial Parking

- Results:
  - Reduced Q_{post} 25-year to Q_{pre}10-year
  - Exceeded minimum detention requirements
  - Provided treatment of stormwater through vegetated system

LID in SCC
Community Stormwater

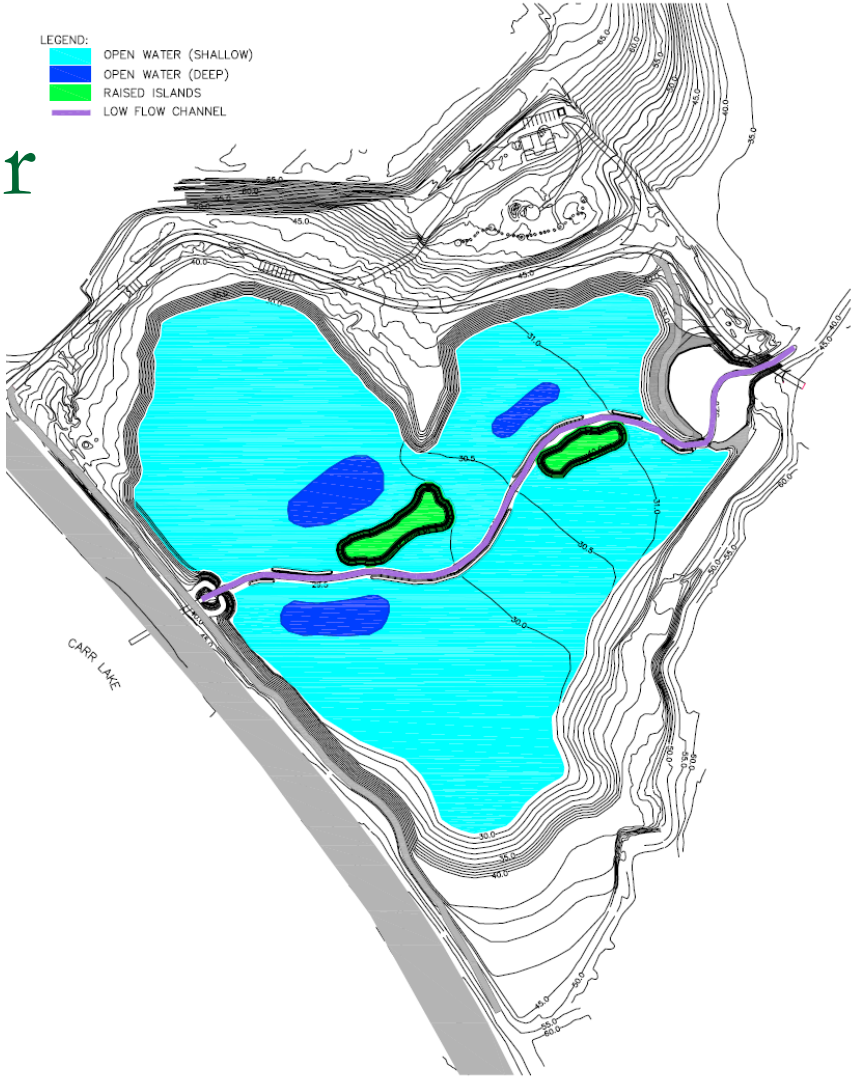
- Project:
  - Restore existing stormwater facility
- Design Criteria:
  - Provide Stormwater Retention
  - Enhance Riparian/Wetland
  - Improve Stormwater Quality
  - Provide Recreational Uses
- Project Design:
  - Stormwater Wetland
- Design Methods:
  - HEC-HMS/HEC-RAS

LID in SCC
Community Stormwater

- Existing Condition
  - 11.8 acre
  - Poor Circulation
    - Isolated Pond
    - Anoxic condition

LID in SCC Community Stormwater

- Proposed Plan
  - Increase wetland to 17.5 acres
  - Sediment basin
  - Low flow channel
  - Deep pools
  - Islands provide habitat
  - Control structure – slide gates



LID in SCC
Community Stormwater

- Construction – gets worse before it gets better !

LID in SCC
Community Stormwater

- Finished Project !

1.5 years later

2.5 years later

LID in SCC
Community Stormwater

- Maintenance
  - Sediment removal
    - 3 to 5 years or
    - 50% capacity
  - Slide Gate maintenance
    - Debris removal
  - General
    - Remove trash/debris
    - Remove invasive non-native vegetation

LID in SCC

Other Resources

- California Stormwater BMP Handbooks
  - http://www.cabmphandbooks.com/
- Center for Watershed Protection
  - http://www.cwp.org/
- International BMP Database
  - http://www.bmpdatabase.org/
- Maryland Stormwater Design Manual
  - http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp
- King County Surface Water Design Manual
  - http://dnr.metrokc.gov/wlr/dss/manual.htm