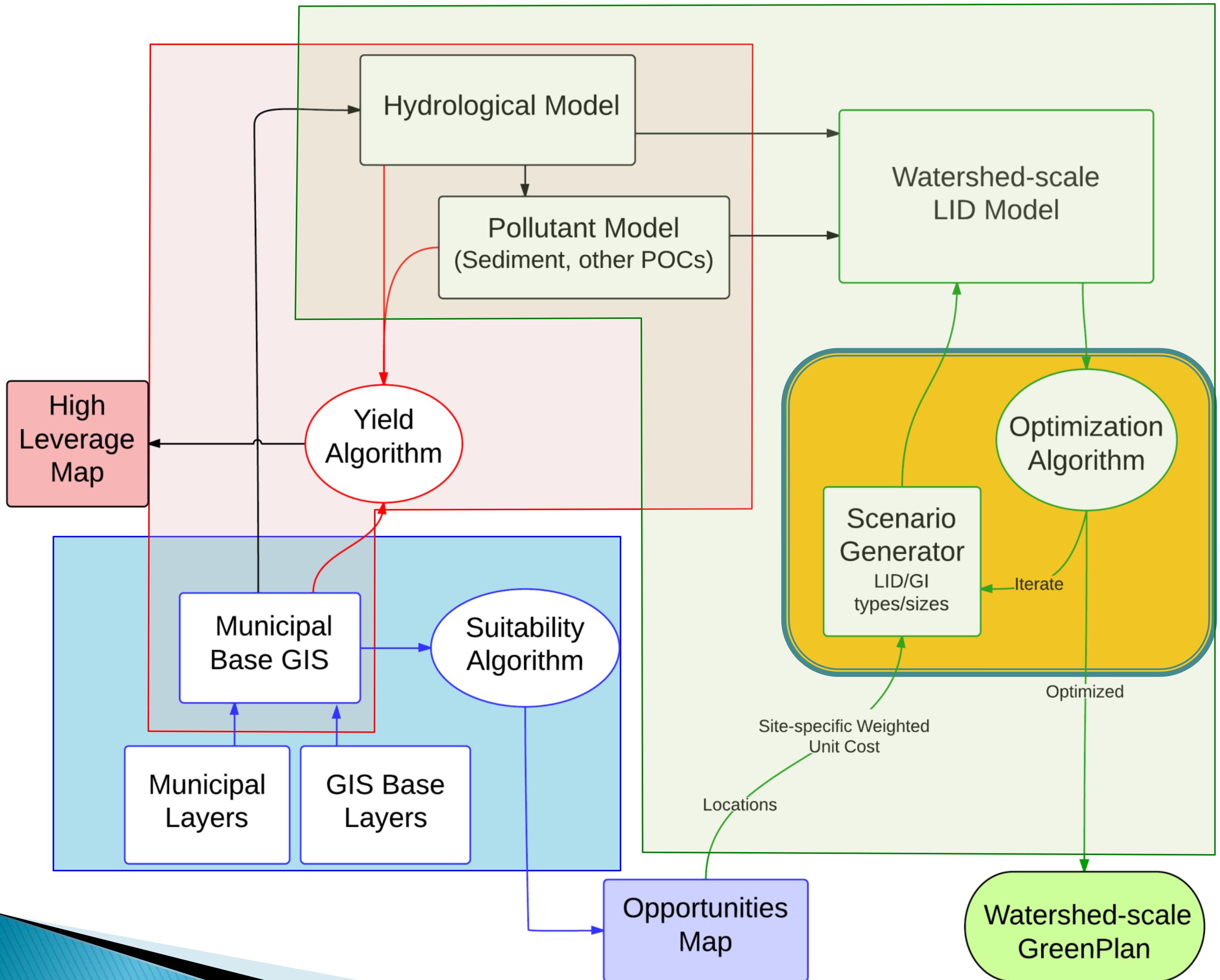
Optimization Tool Development

Green PlanIT TAC meeting

Jing Wu

June 17, 2014

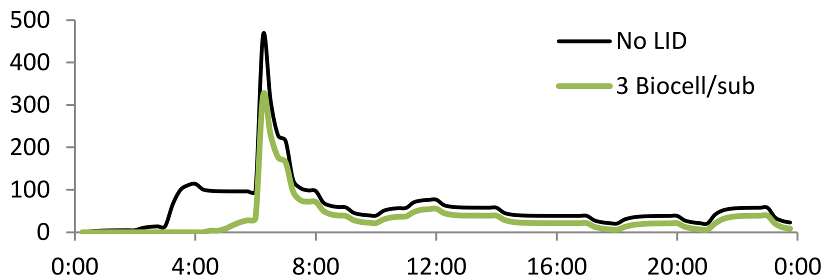
Item #5

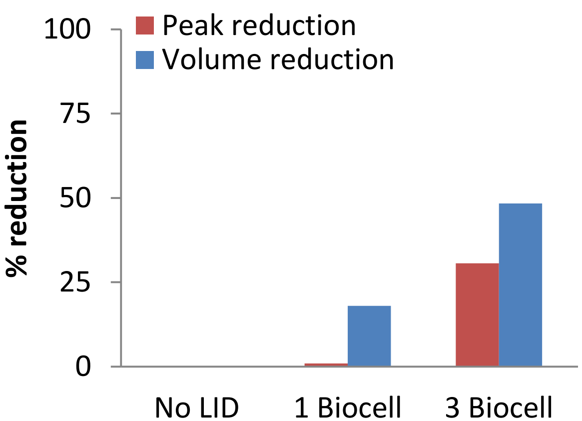

Hydrological Model
Watershed-scale
LID Model
Pollutant Model
(Sediment, other POCs)
High
Leverage
Map
Yield
Algorithm
Optimization
Algorithm
Scenario
Generator
LID/GI
types/sizes
Iterate
Municipal
Base GIS
Suitability
Algorithm
Optimized
Site-specific Weighted
Unit Cost
Locations
Municipal
Layers
GIS Base
Layers
Opportunities
Map
Watershed-scale
GreenPlan

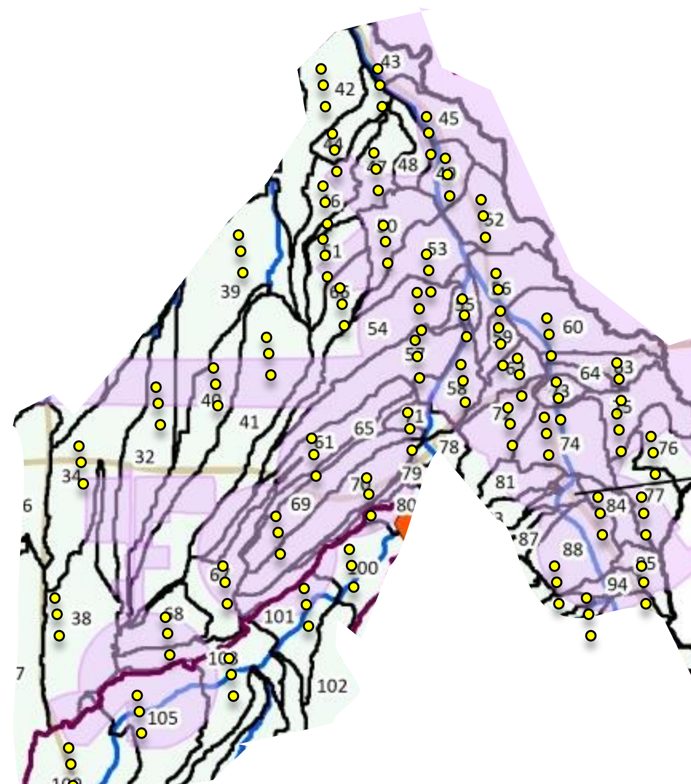
Item #5

Optimization tool

- What are the most cost-effective LID combinations for achieving certain reduction goal?



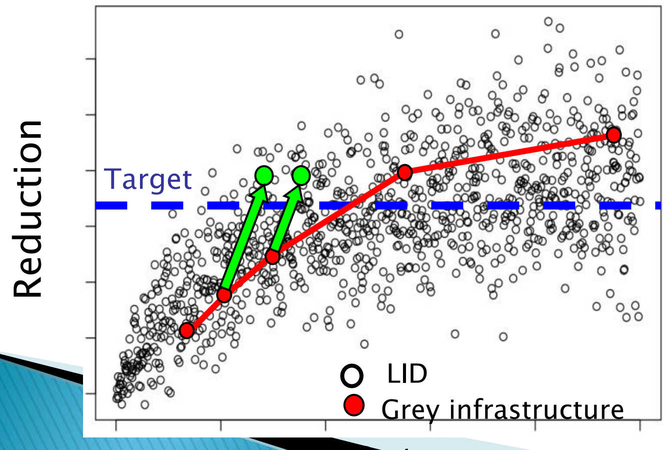


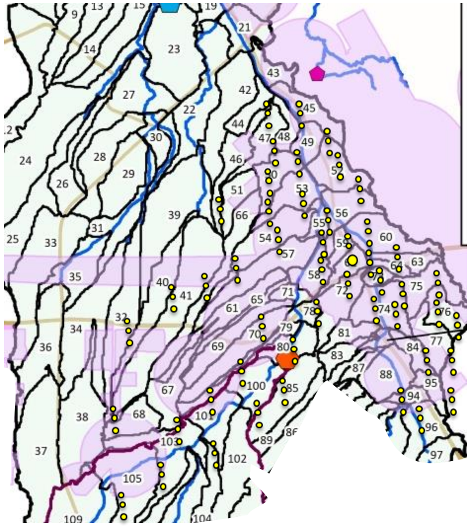


Item #5

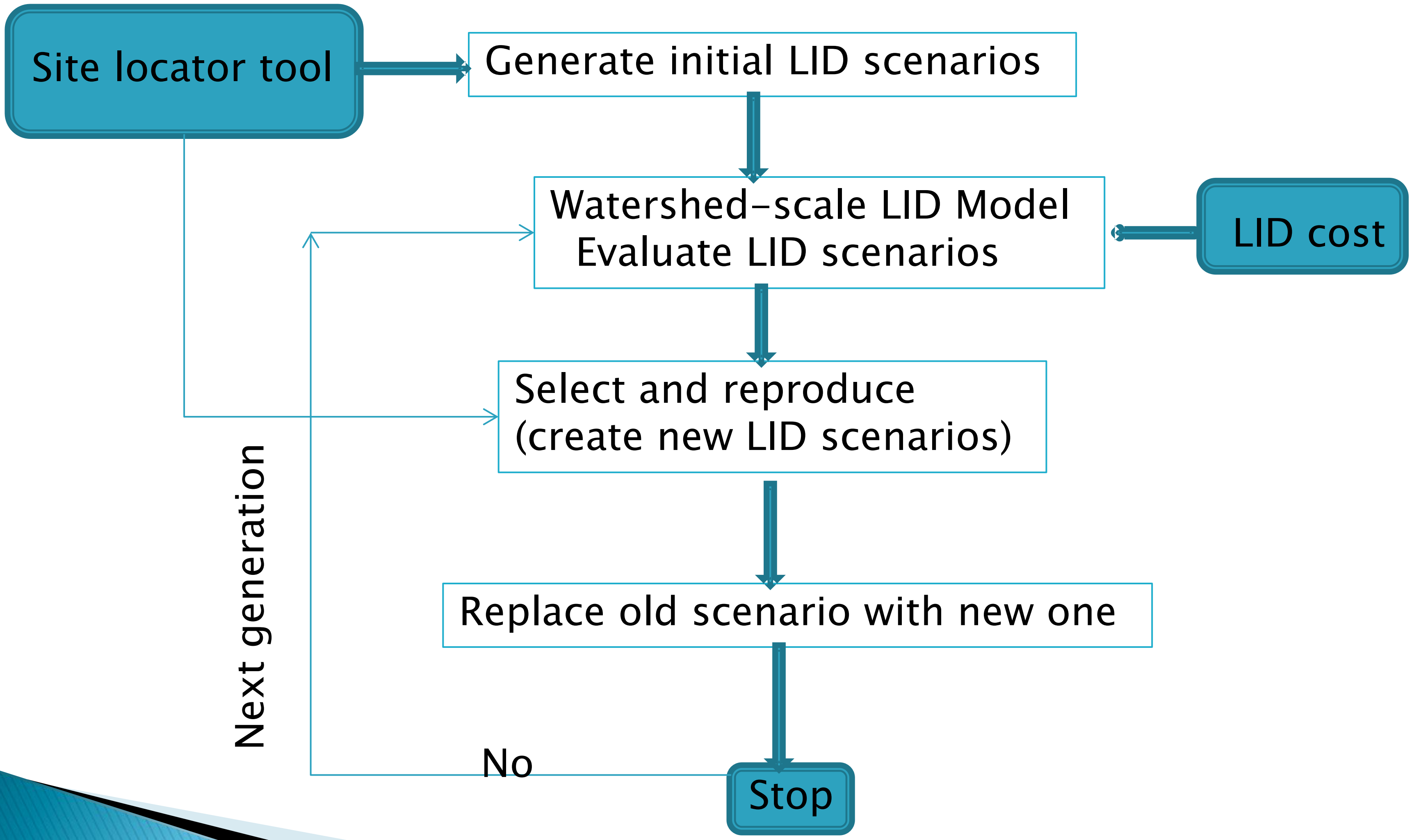
Optimization tool

- Used to evaluate and identify cost-effective LID placement and selection strategies for a preselected list of potential sites, applicable LID types, and ranges of LID size
- Utilizes information from other components of toolkit
  - Serve as an engine that calls modeling tool within each iteration
  - Use outputs from siting tool and LID cost information
- Outputs used for developing watershed-scale master plan





Flowchart of the tool



Item #5

Optimization tool development

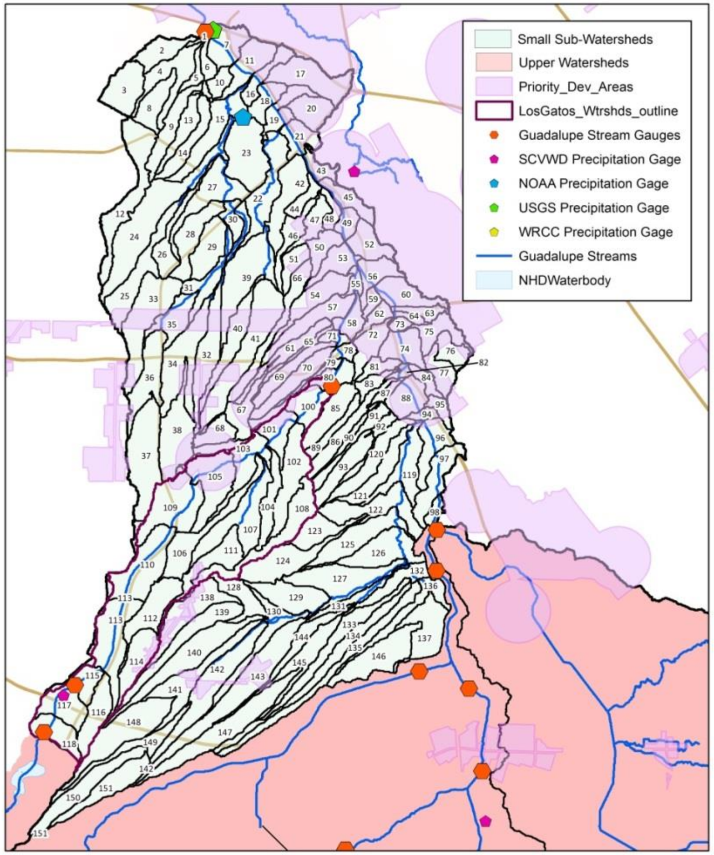
- Decide on optimization approach
- Formulate the problem
  - Decision variables
  - Assessment points
  - Evaluation factor, control targets
- Implement the approach (programming)
- Post-processing the simulation results for decision making

Item #5

Optimization tool development

- Case study – San Jose development area

Guadalupe Sub-Watersheds



Item #5

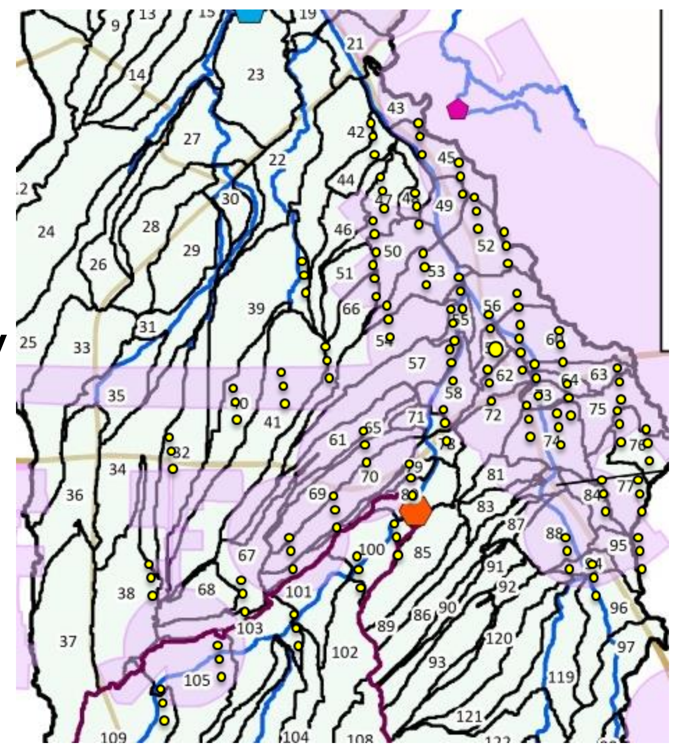
Key decision –Optimization technique

- Non-dominated Sorting Genetic Algorithm (NSGA-II)
  - One of the most widely used multi-objective optimization algorithms
  - Capable of producing optimal or near-optimal tradeoff solutions among competing objectives
  - Provides trade-off curves (optimal fronts) between pollutant reduction and total net cost increase, thereby offering a range of optimal LID solutions
  - One of two approaches used in EPA's SUSTAIN

Item #5

Key decision –Scale

- San Jose development area = 4300 acre
- 53 sub-basins range from 20 ~ 150 acre
  too big to pinpoint exact LID locations
- Aggregated approach for LID simulation(EPA)
- Use site suitability tool to identify particular sites



Item #5

Key decision –Environmental goals

- What do we target?
  - Flow –volume or peak reduction?
  - WQ – POC?

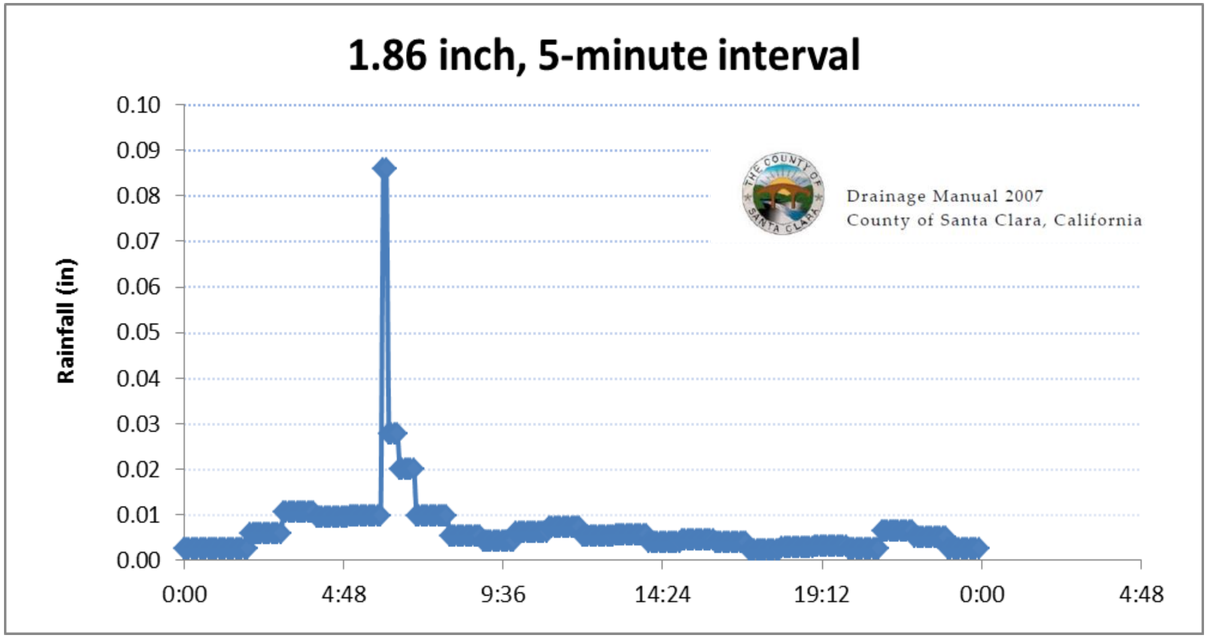
    SWMM has no built-in mechanism to simulate pollutant reduction, how do we deal with it?

- What are the desired reduction goal?

Item #5

Key decision – Design storm

- What storm should be used for sizing LIDs?
  - San Jose proposes a 2-year storm with 24-hour duration



  - LA requires to treat 0.75inch rainfall

Item #5

Key Decision –LID types

- Five LID types in SWMM, which ones should be included for optimization?
  - Bioretention
  - Porous Pavement
  - Infiltration Trench
  - Rain Barrel
  - Vegetative Swale
- Grey Infrastructure(regional facility)
  - Should we consider?
  - What type?   Enlarged bioretention with storage?

Key Decision –LID size

- Use a typical design/size for each LID
  - What are the typical design for each LID?
- Number of LIDs implemented as decision variable
  - Should we set upper limit for # of LID implemented or %impervious area treated?

Item #5

Key Decision – LID cost

- LID cost largely determine the optimal scenario
- LID cost = capital + operation + maintenance, vary by LID type/size/location
- Limited cost info from San Jose. Some cost info from SUSTAIN applications.
- How to derive a realistic cost function?
  - Capital cost: $/sq feet surface area or $/volume treated (SUSTAIN applications)
  - O & M cost: how to quantify for various LID types?
  - Tiered cost: use certain matrix to break cost into tiers

Item #5

Key Decision –Scenarios

- LID scenarios – need to test full range of possible options for decision making
  - Green Infrastructure only – may be too costly or infeasible
  - Grey Infrastructure only – not desired
  - Green + Grey Infrastructure – may be more realistic and one serves as supplementary to another
  - Other?

Item #5