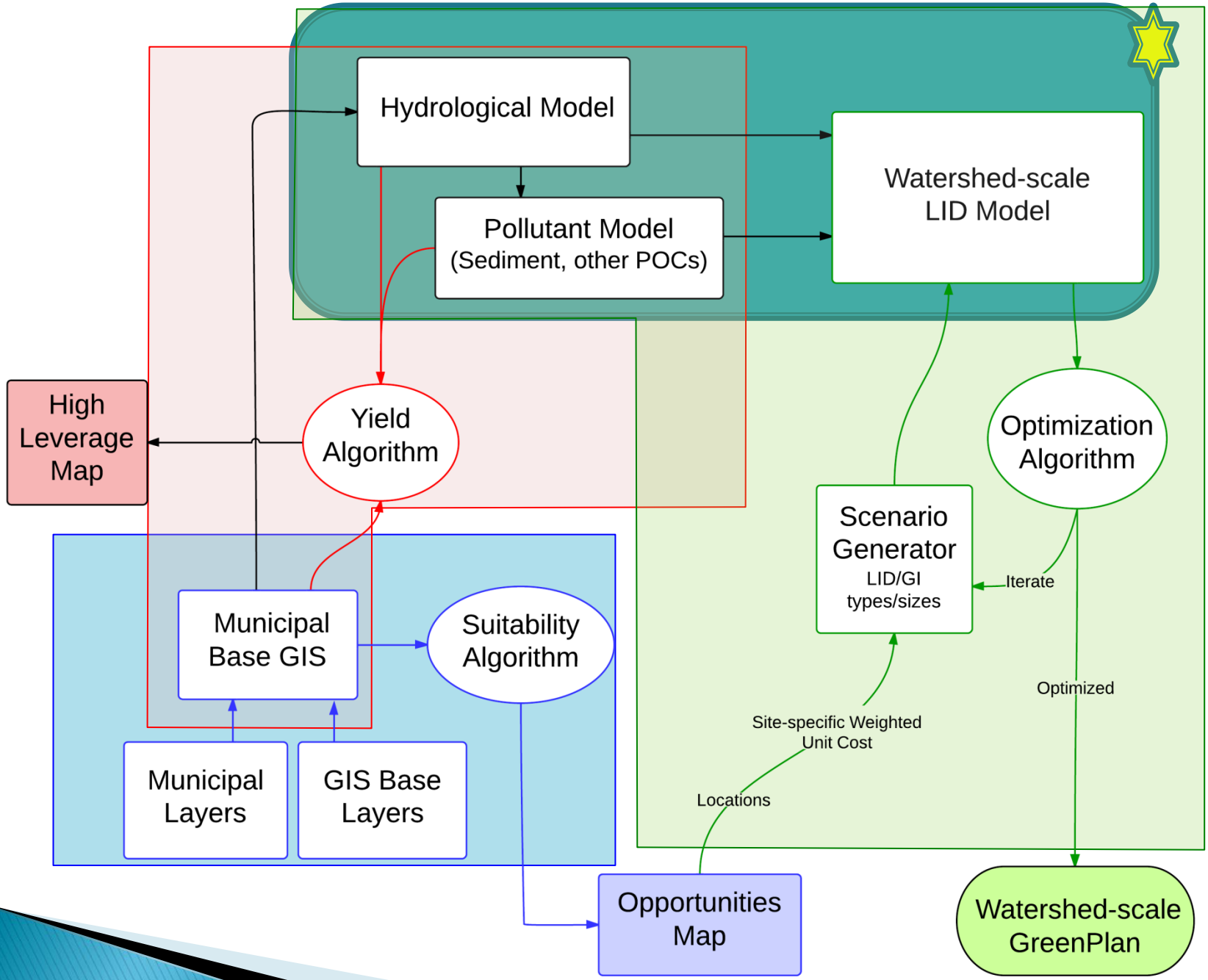
Modeling Tool Development

GreenPlanIT TAC meeting

Jing Wu

June 17, 2014

Item #4

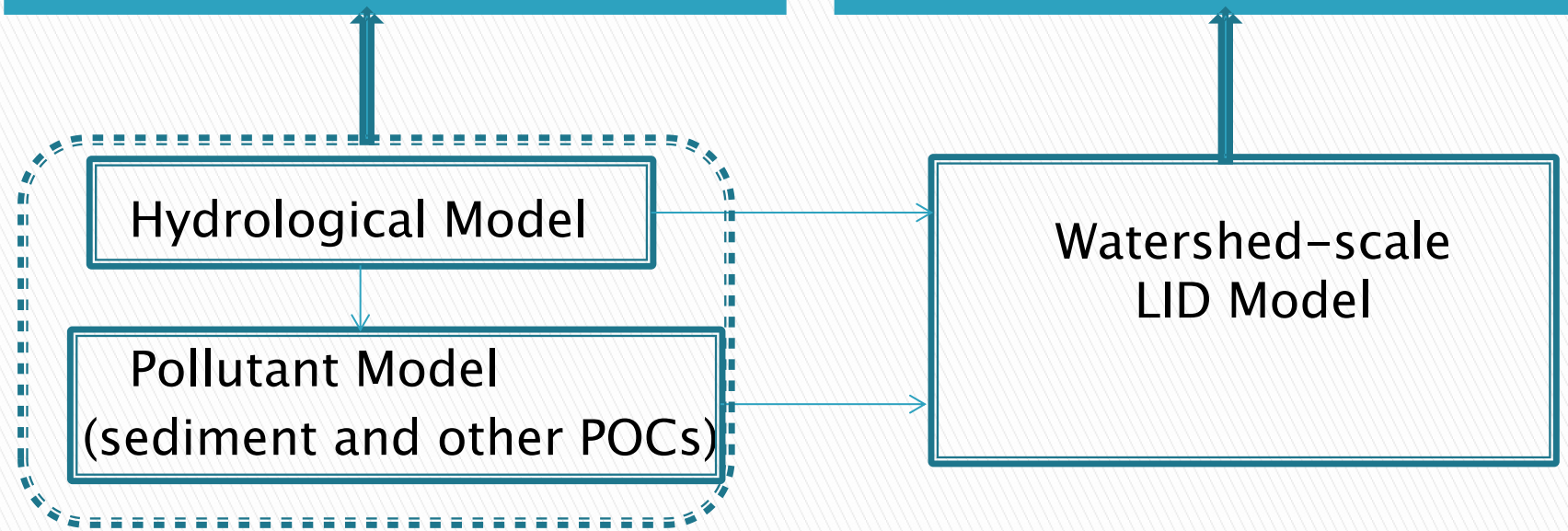

Hydrological Model
Pollutant Model
(Sediment, other POCs)
Watershed-scale
LID Model
High
Leverage
Map
Yield
Algorithm
Optimization
Algorithm
Scenario
Generator
LID/GI
types/sizes
Iterate
Municipal
Base GIS
Suitability
Algorithm
Optimized
Site-specific Weighted
Unit Cost
Municipal
Layers
GIS Base
Layers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

Item #4

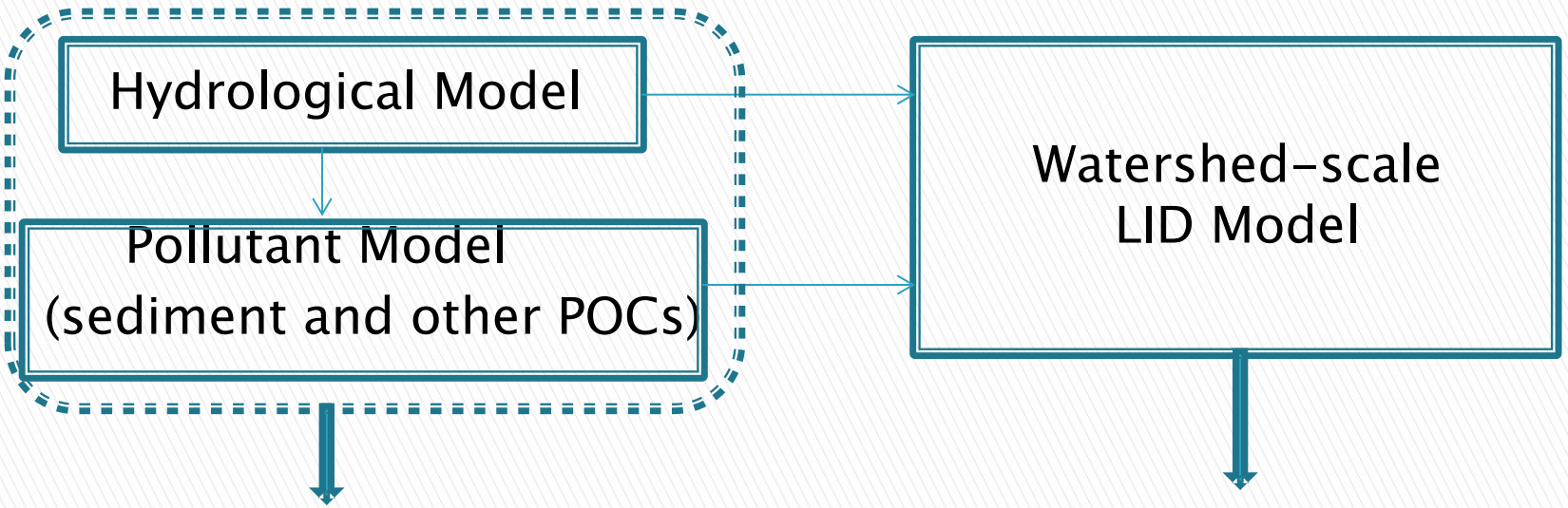
Modeling tool

What are the most effective locations for LID/GI implementation?

What quantitative water quality and hydrological improvement can be made with LID?



Modeling tool



- Establish baseline condition
  - Characterizes the current physical system
  - Represents the reference point for any improvement made through LIDs
  - The starting point for LID selection and placement optimization
- Identify critical sources areas

- Quantify flow and water quality reduction from various LID scenarios

Modeling tool development

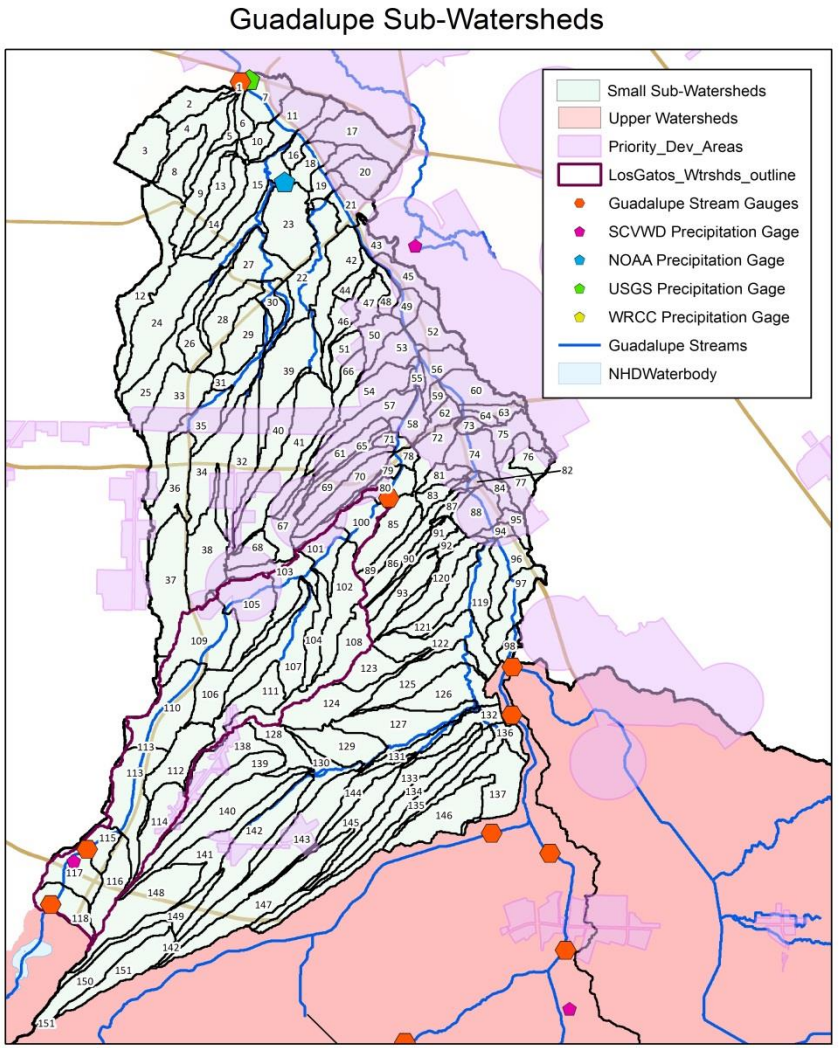
- Model development steps
  - Select model platform
  - Identify target watershed
  - Collect model input data
  - Calibrate model with observed data
  - Generate pre- and post-LID hydrographs and pollutographs

Model platform

- Storm Water Management Model (SWMM)
  - Support by EPA
  - Widely used for stormwater management
  - Capable of simulating hydrology, water quality and LID performance
  - Simplified hydrology and water quality mechanisms
  - Essentially overland flow and no in-stream processes so flow could be flashy

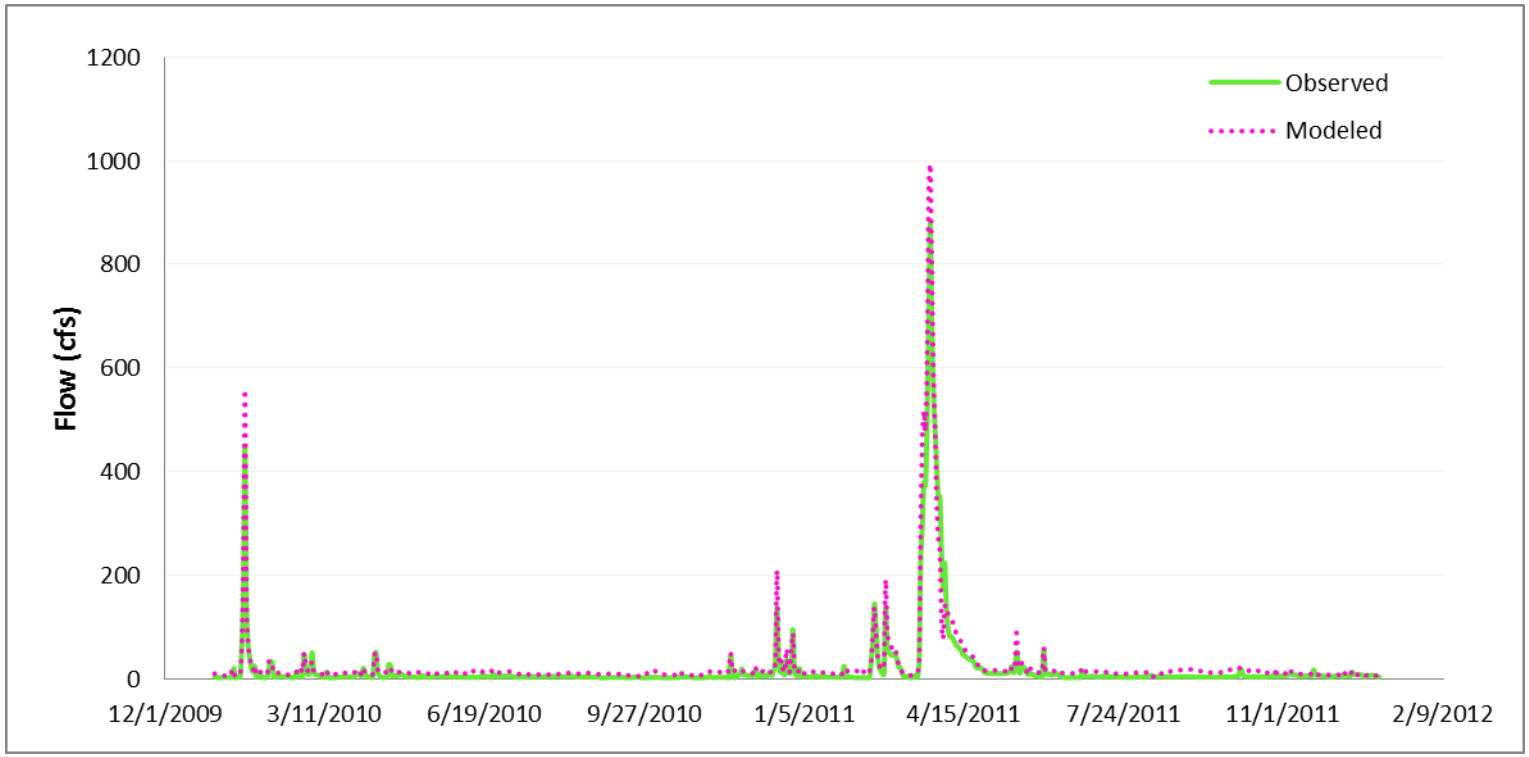
Hydrological and WQ model

- Develop calibrated hydrological and WQ model
- San Jose case study
  - Development area largely within Guadalupe
  - Model area (18613 acre) delineated into 150 sub-basins
  - Model simulation period 2010-2011at 15 minutes step
  - Model calibration@ 2 stations for hydrology and @1 for sediment



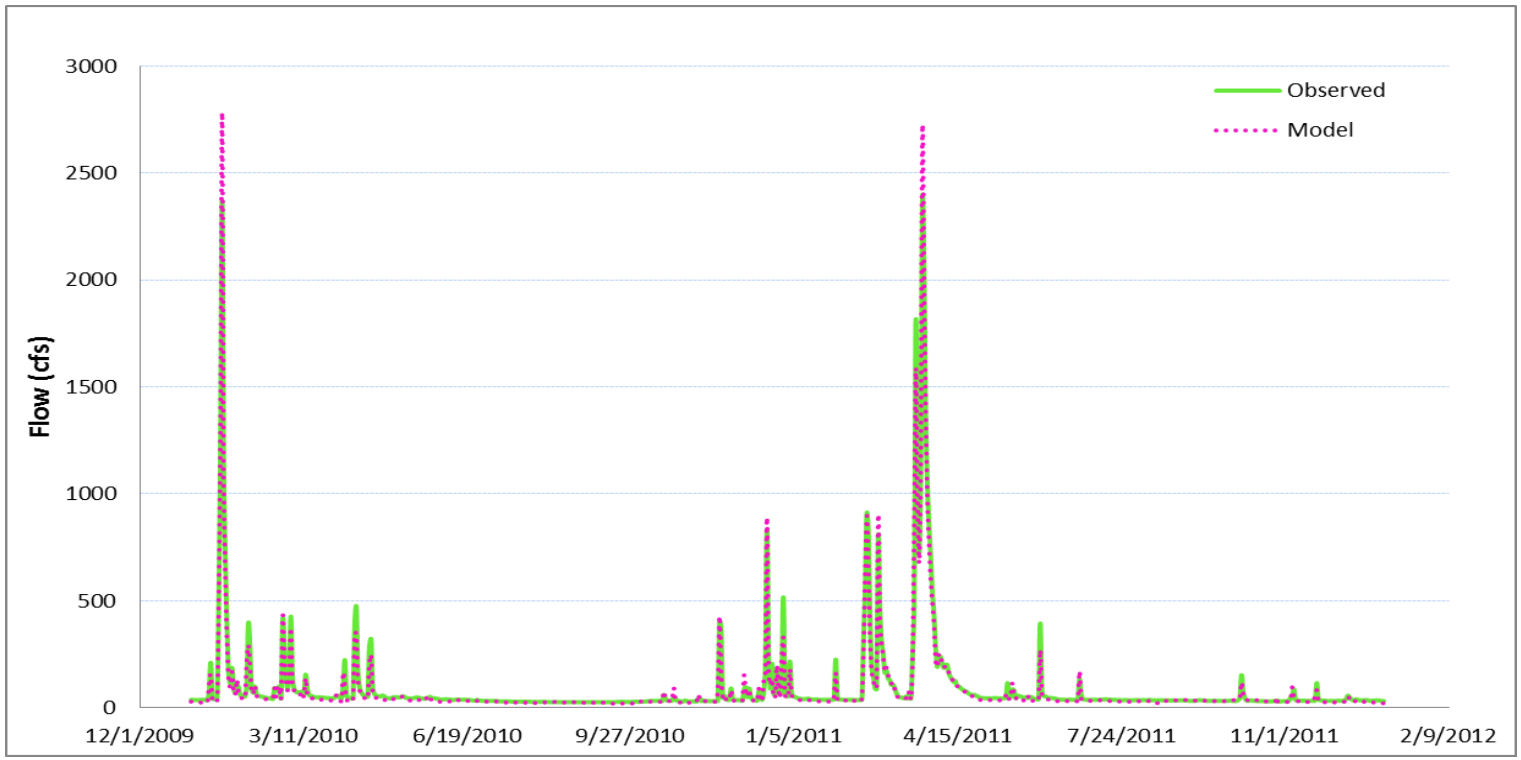
Hydrology calibration

Los Gatos at Lincoln Ave



Hydrology calibration

USGS 11169025 at highway 101

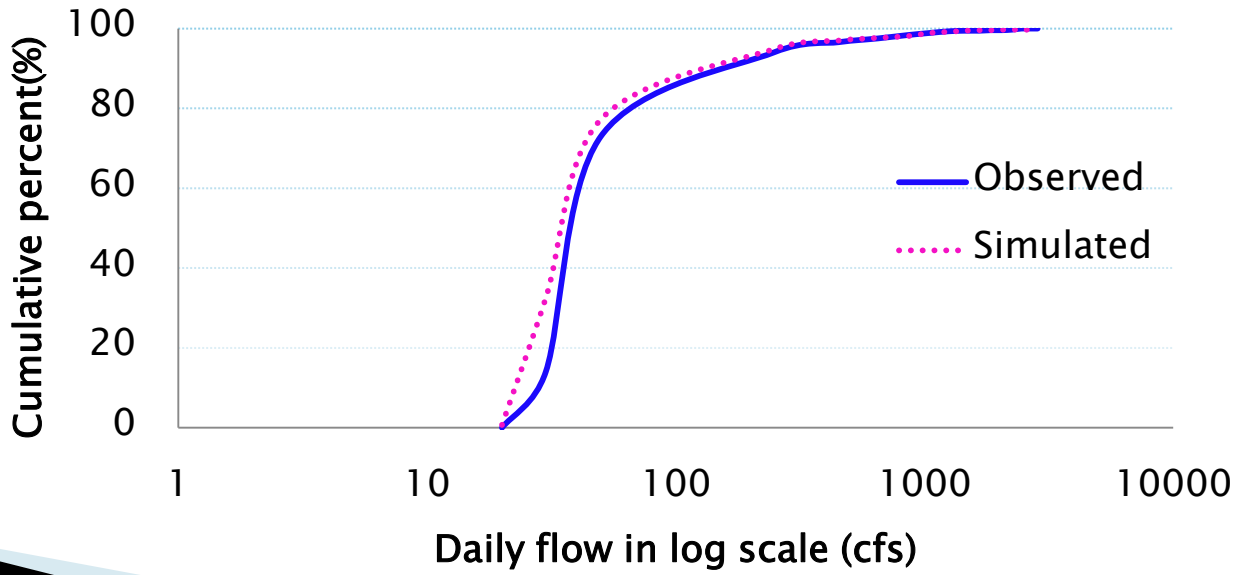


Hydrology calibration

- Calibration statistics

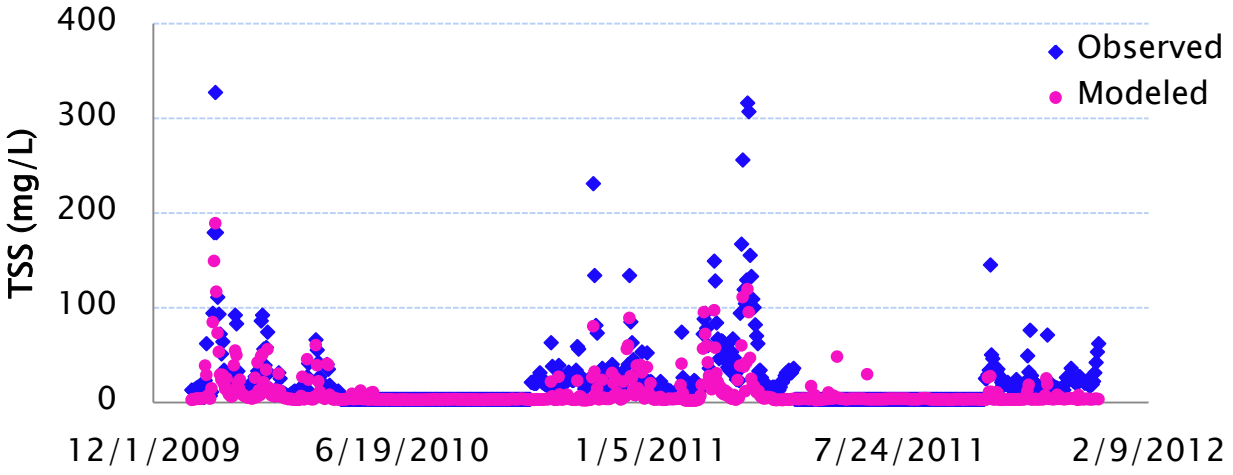
Statistics	Model results	Criteria
Difference in storm volume	-4%	< 10%
Model efficiency	0.97	>=0.7

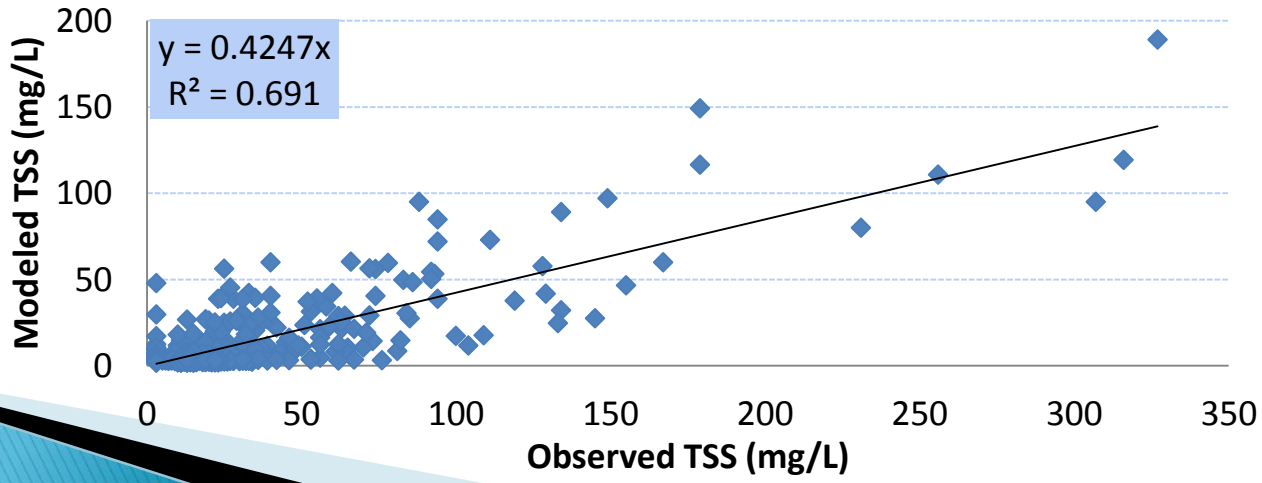
$$NSE = 1 - \left[\frac{\sum_{i=1}^{n} (Y_i^{obs} - Y_i^{sim})^2}{\sum_{i=1}^{n} (Y_i^{obs} - Y^{mean})^2} \right]$$

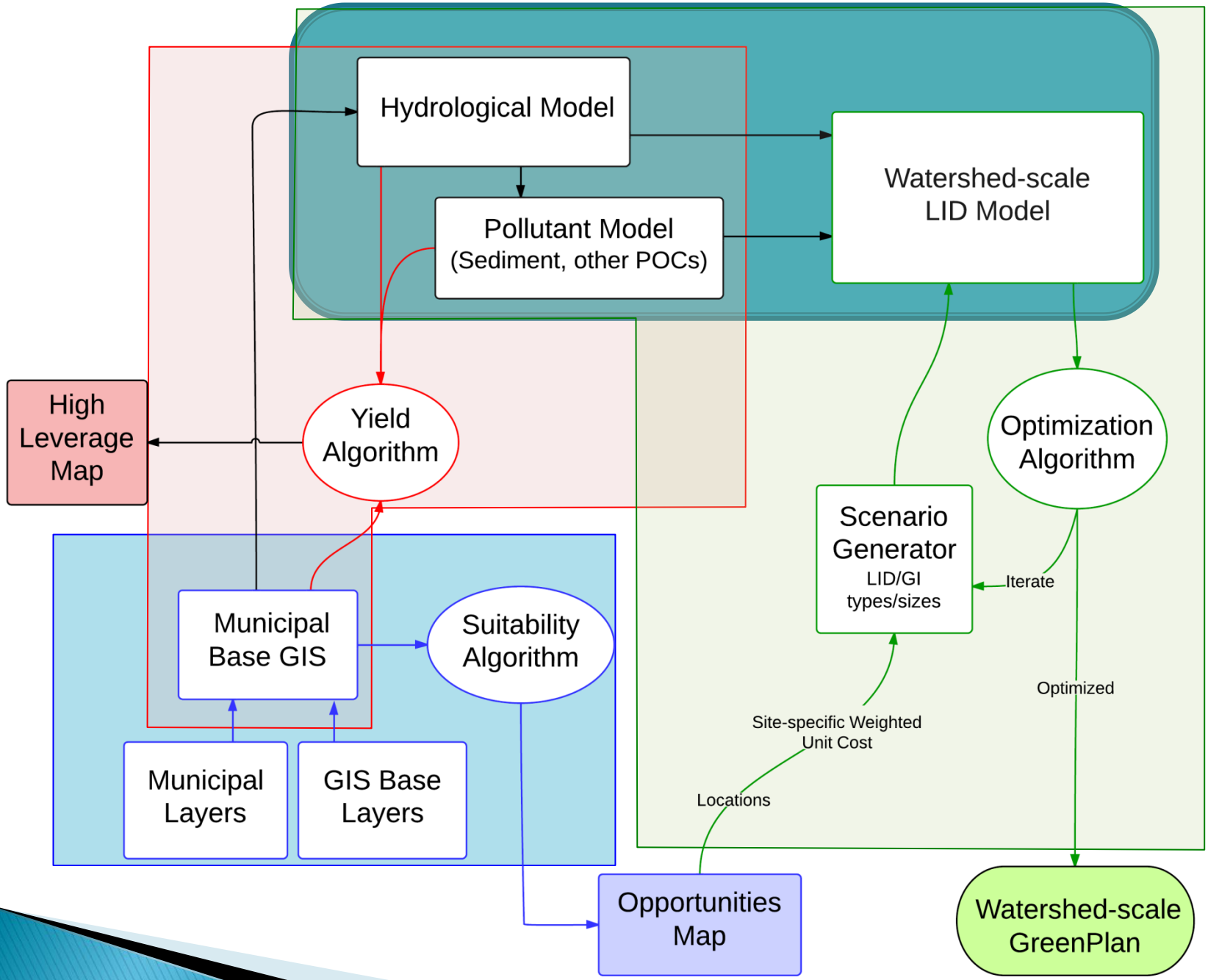


Sediment calibration

- Daily sediment concentration at USGS@101



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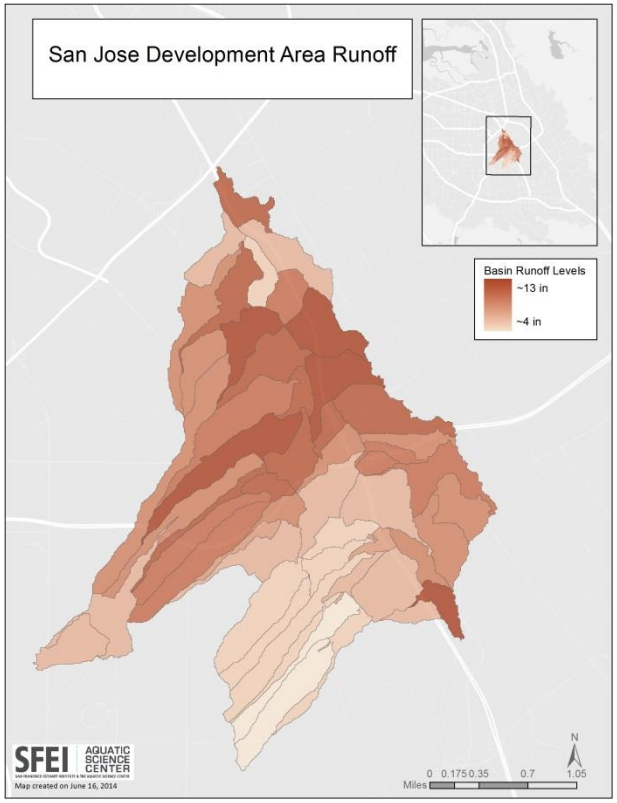
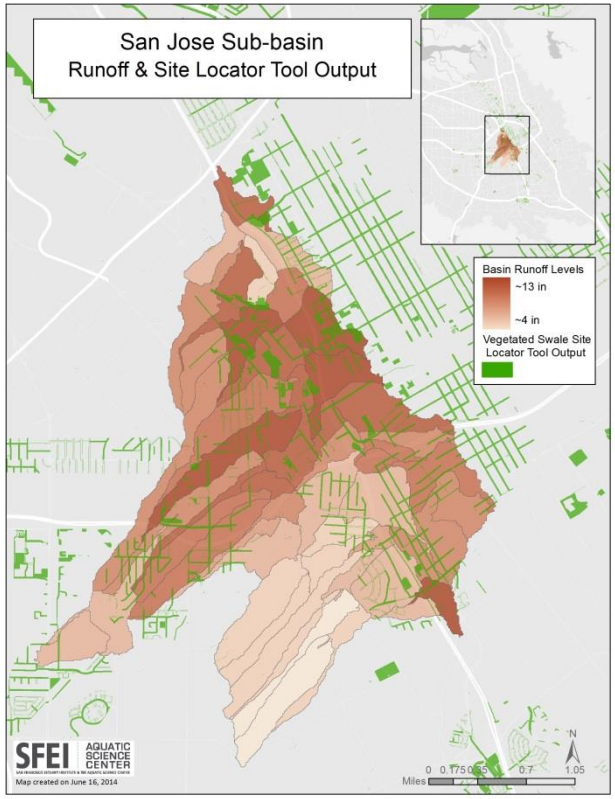
High-leverage sites

- Use calibrated hydrological and pollutant models to identify high-leverage sites





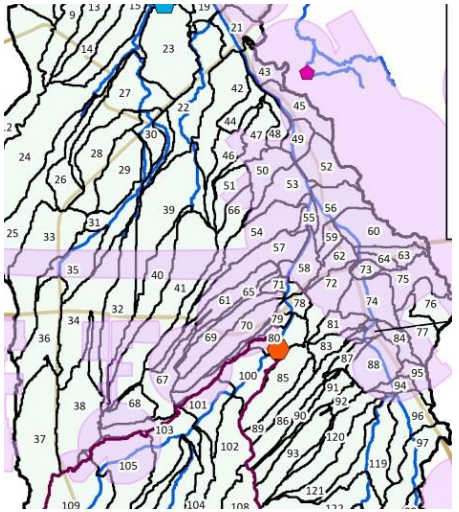
- Similar maps can be produced through GIS analysis (%impervious, source area layers, etc..)

Watershed-scale LID model

- Use calibrated hydrological and pollutant models as baseline condition
- Generate pre- and post-LID hydrographs and pollutographs
- Quantify flow and water quality reduction for various LID scenarios
- Serve as the foundation for Optimization algorithm

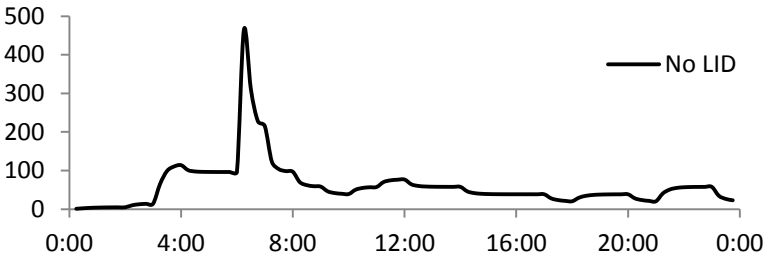
LID model demo

- San Jose development area
  - 4300 acre
  - 53 sub-basins
  - Range from 20 to 150 acres



- 1inch rain with 24-hour duration

- Example Bioretention
  - 5000 square feet surface area
  - Surface storage depth 12in
  - Soil thickness 18 in
  - Storage height 12 in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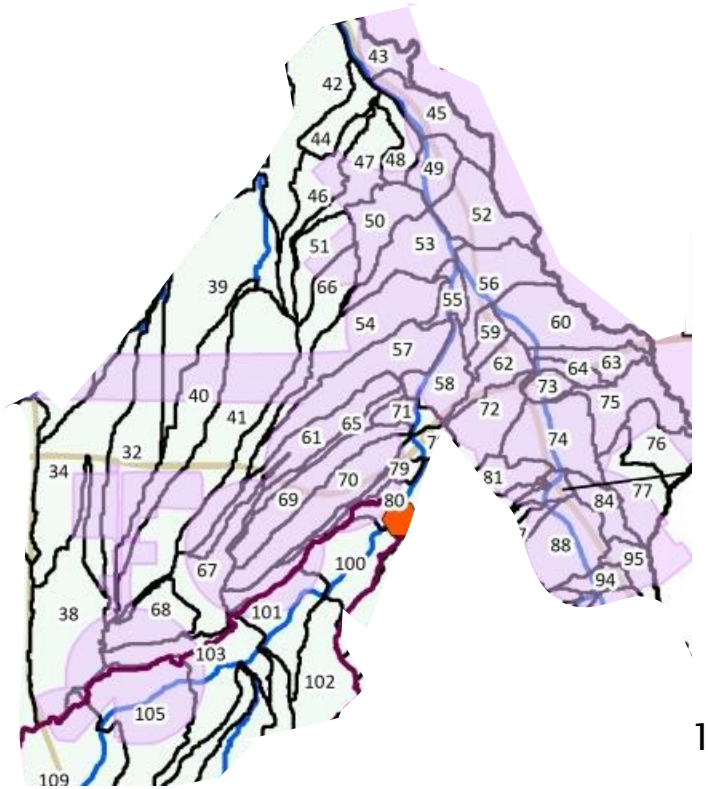
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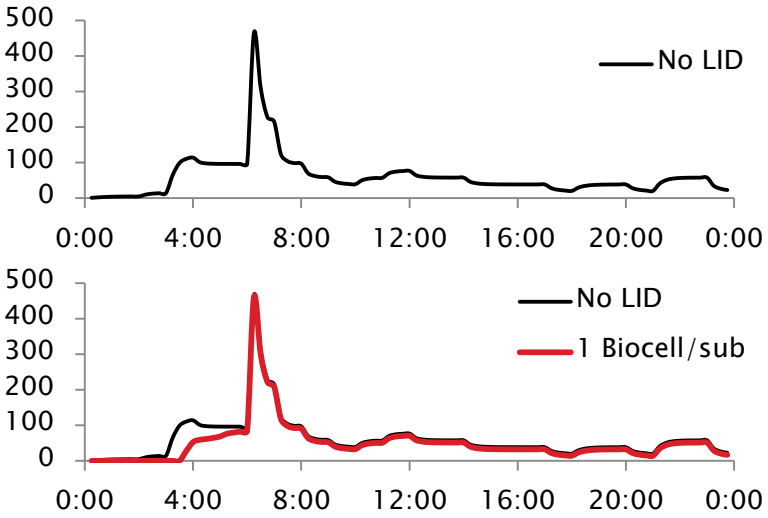
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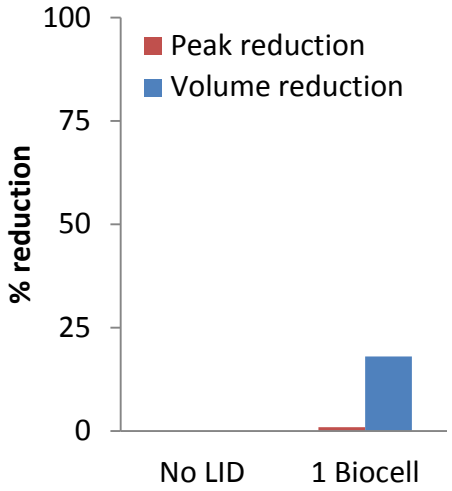
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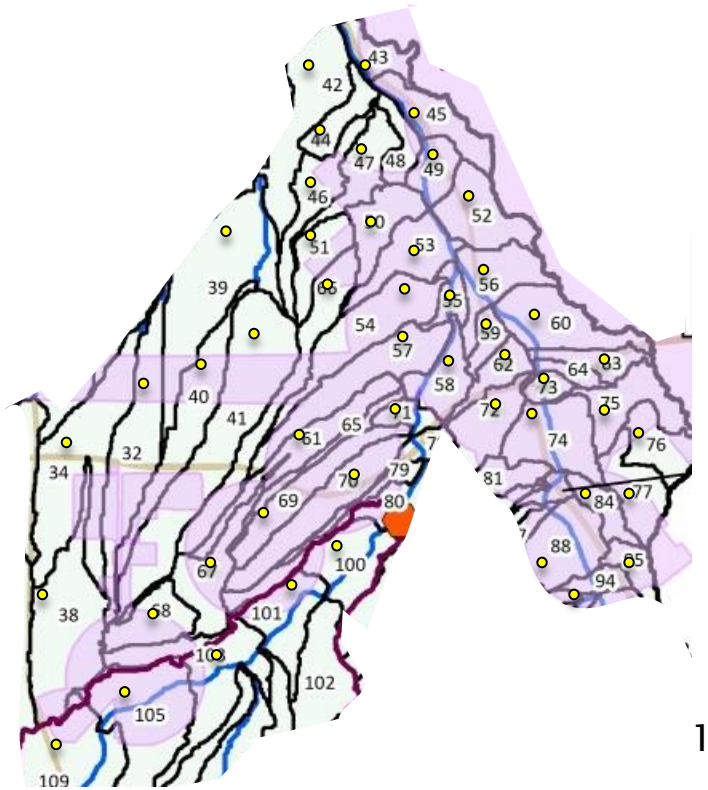
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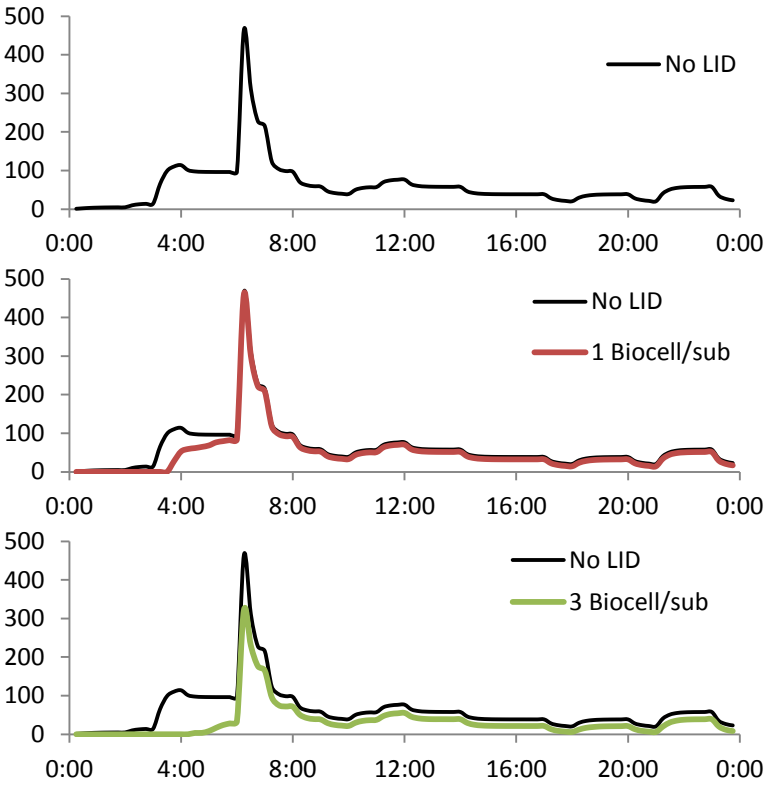
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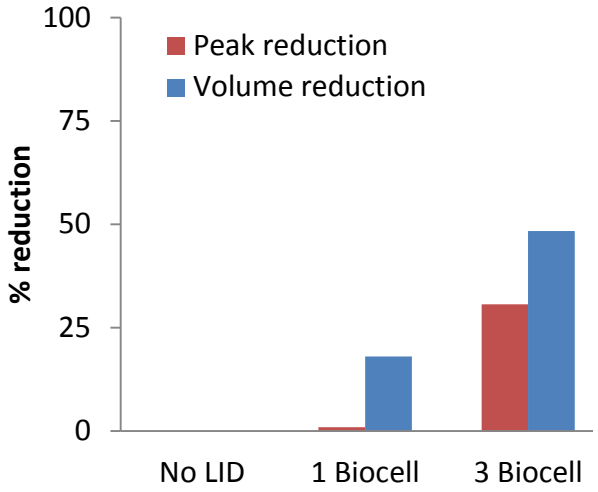
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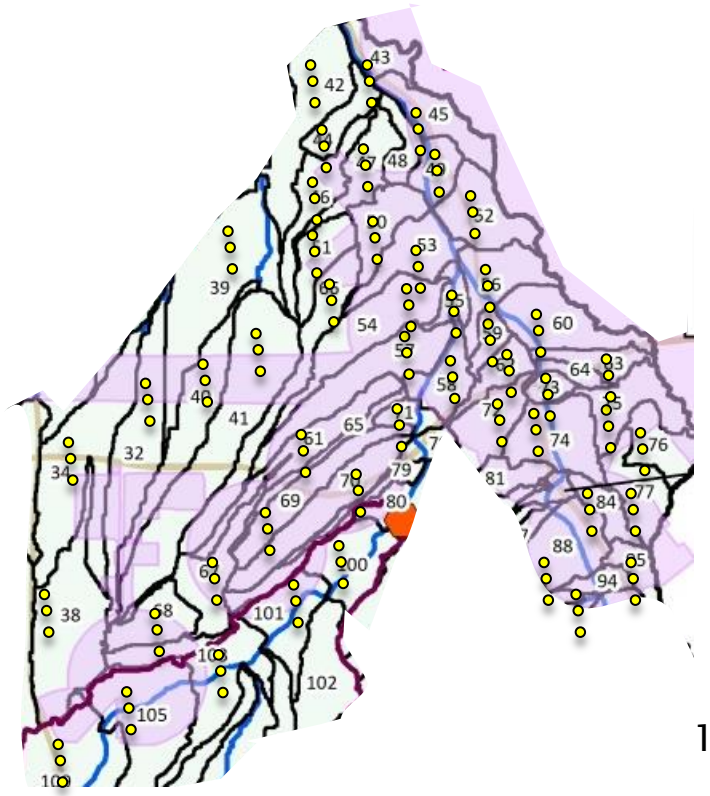

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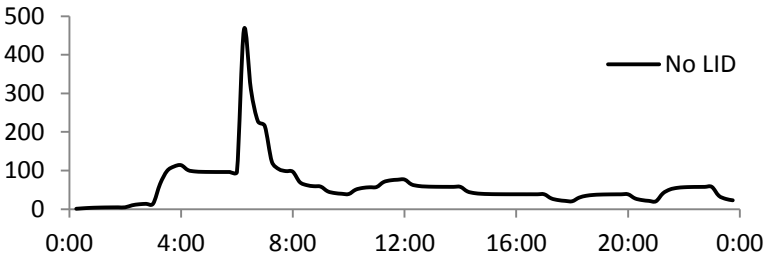
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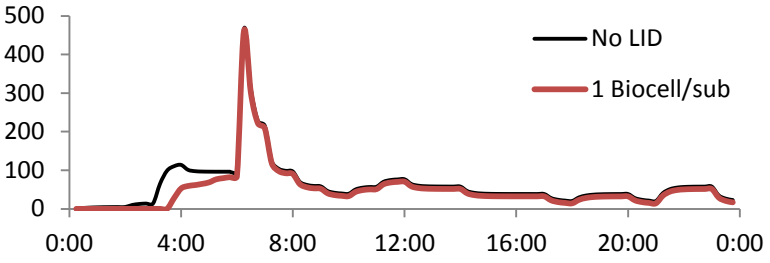
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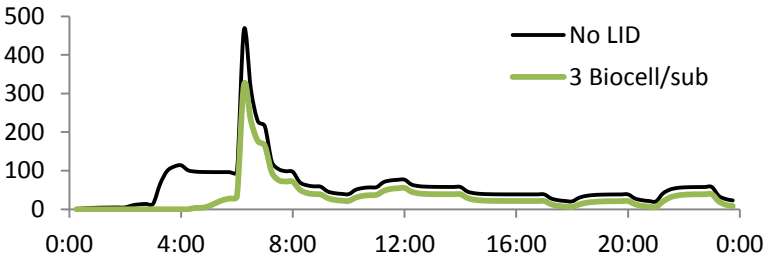
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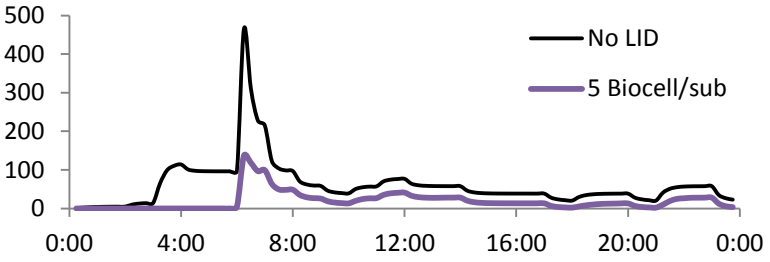
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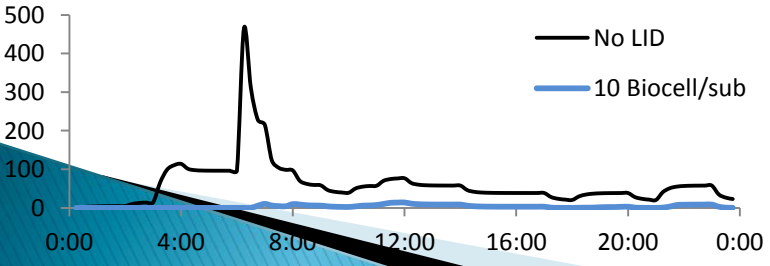
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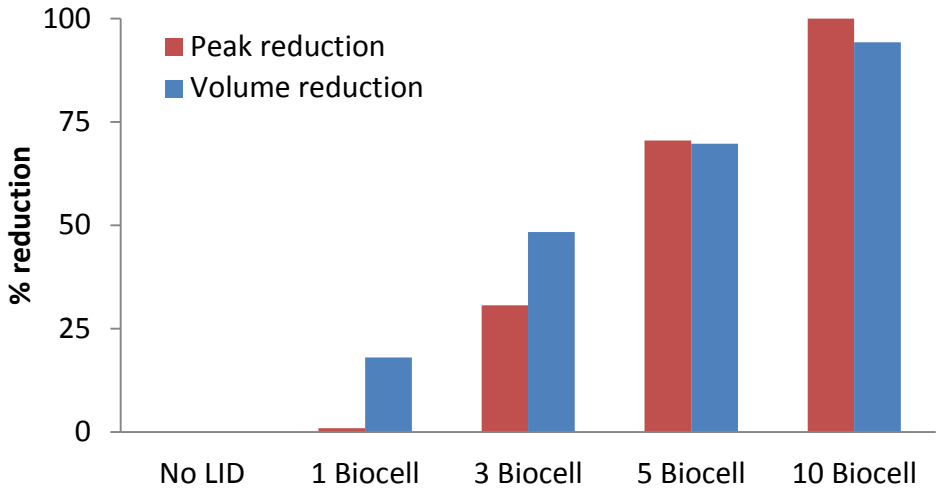
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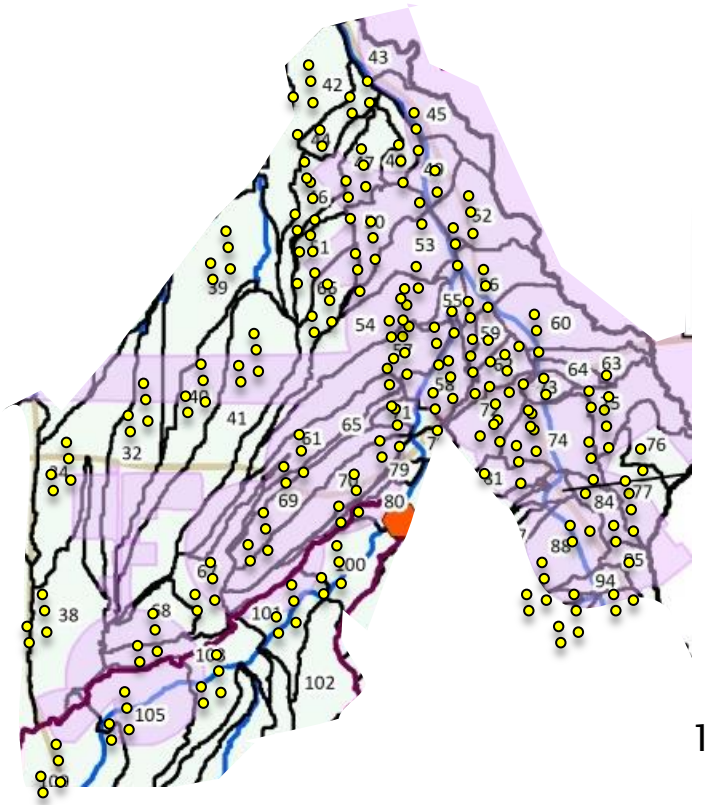
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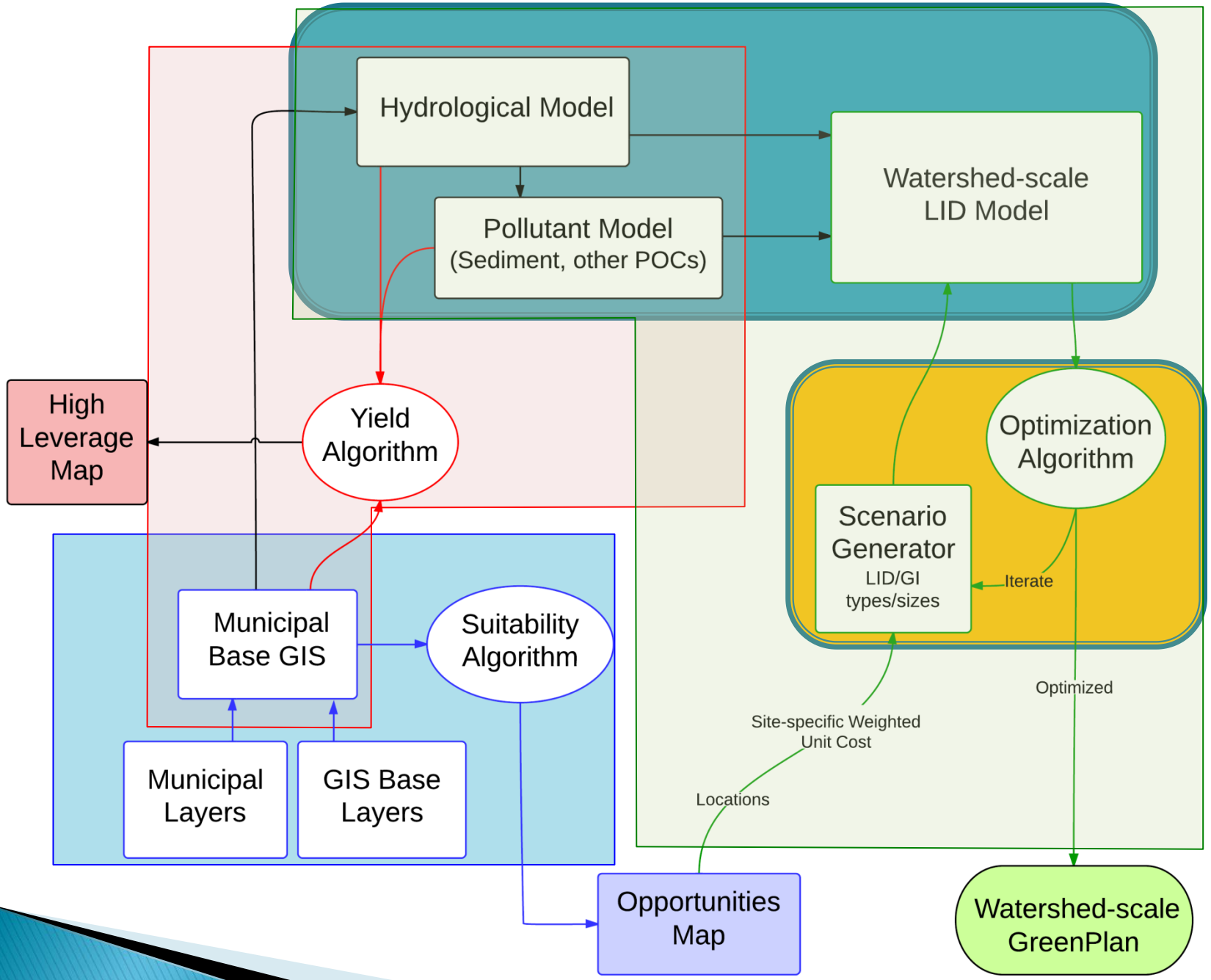
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Questions for TAC

- Is the current base model suitable for serving as a basis for optimization tool and master plan development?
  - Are current calibration results acceptable?
  - What further improvement is needed?
  - Other pollutants
    PCB/Hg
    Can simulate as a fraction of sediment