

# Lake Tahoe Watershed Modeling

Tahoe TMDL Symposium

December 10, 2004

*Presented by:*

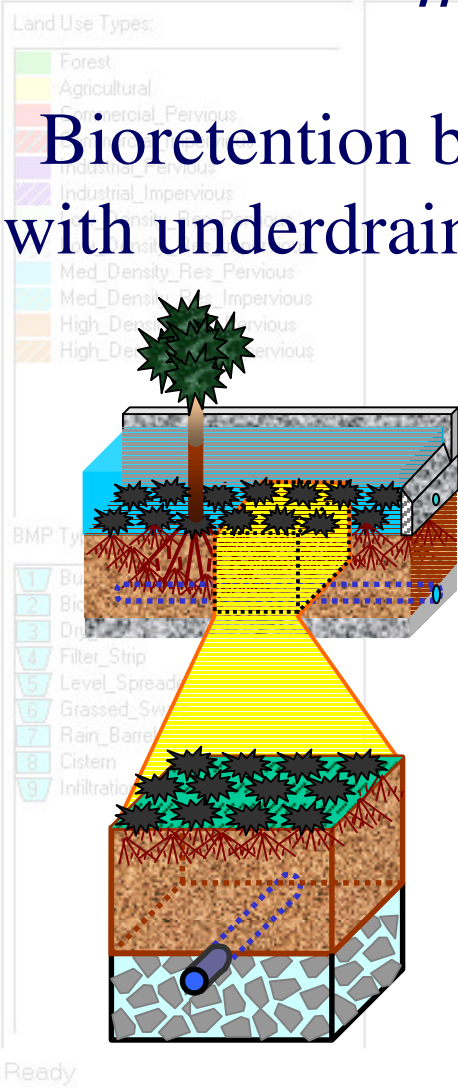
Leslie Shoemaker



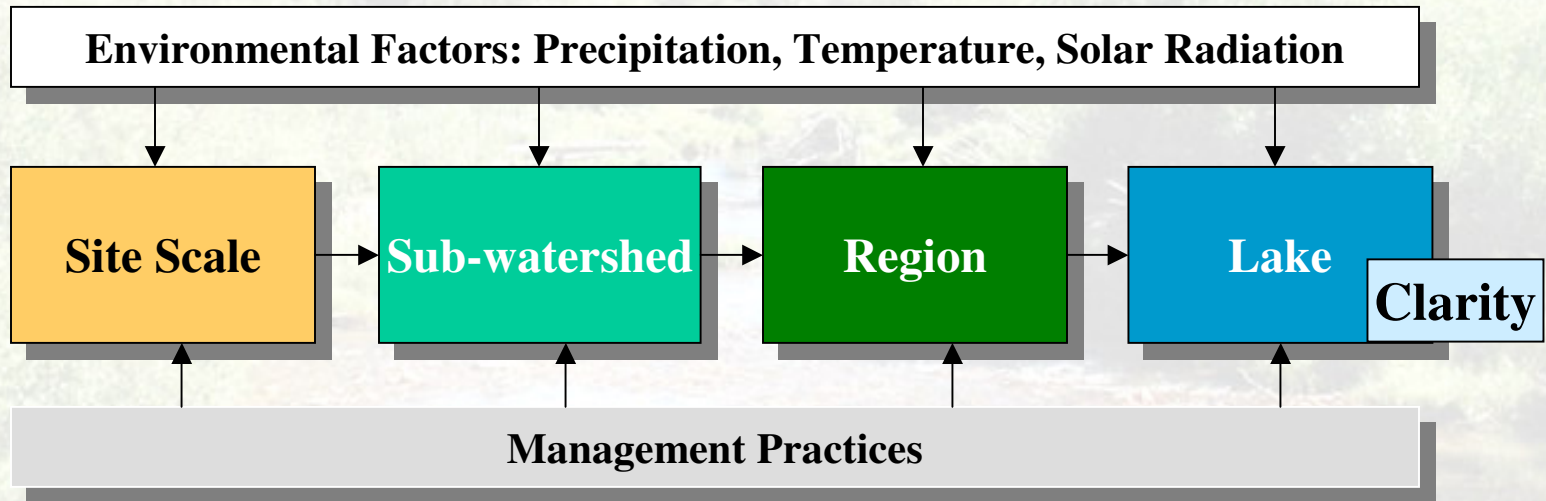
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# How do we evaluate the cumulative benefit of management practices?

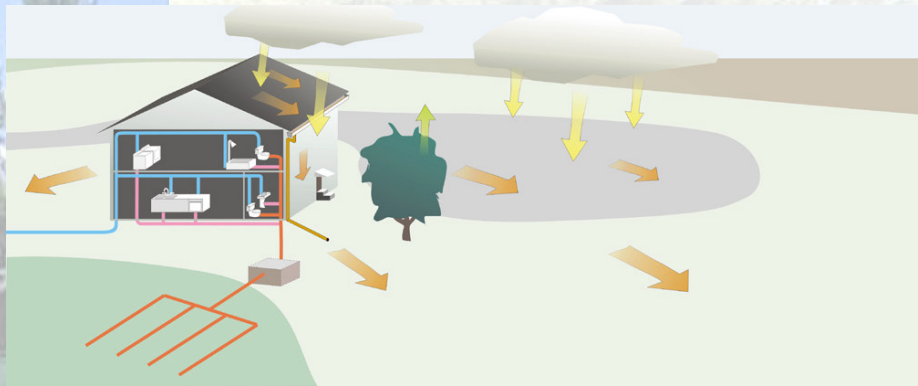
Bioretention basin with underdrain pipe



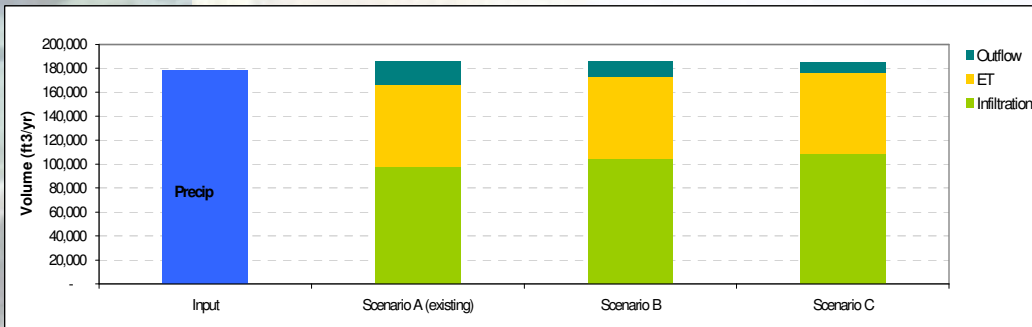
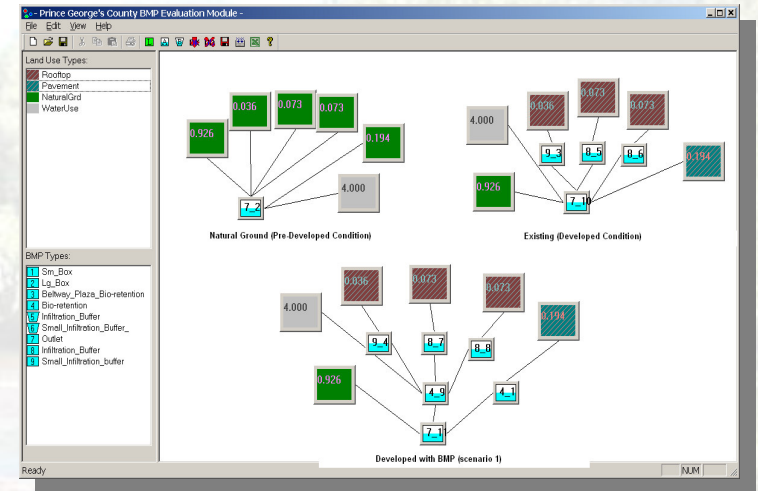
# Multiple Scale Modeling and Analysis



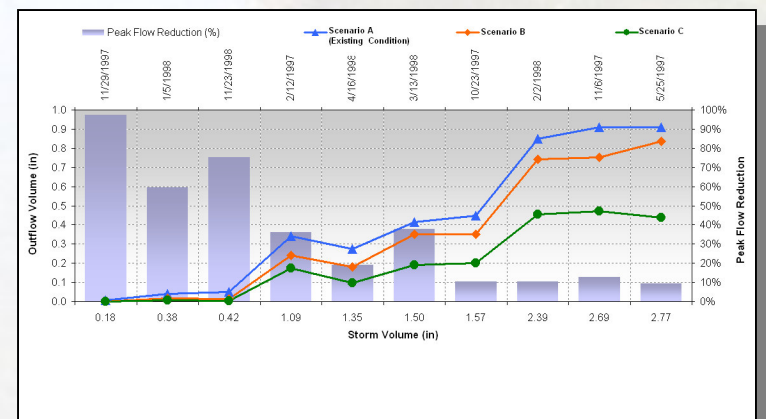
# BMP Module: Integrated Water Management at a Local Scale



**BMP Module**



**Annual Water Balance**



**Storm Event Analysis** TRA TECH, INC

# BMP Class A: Storage/Detention

Inflow:

From Land Surface

Storage

Evapotranspiration

Outflow:

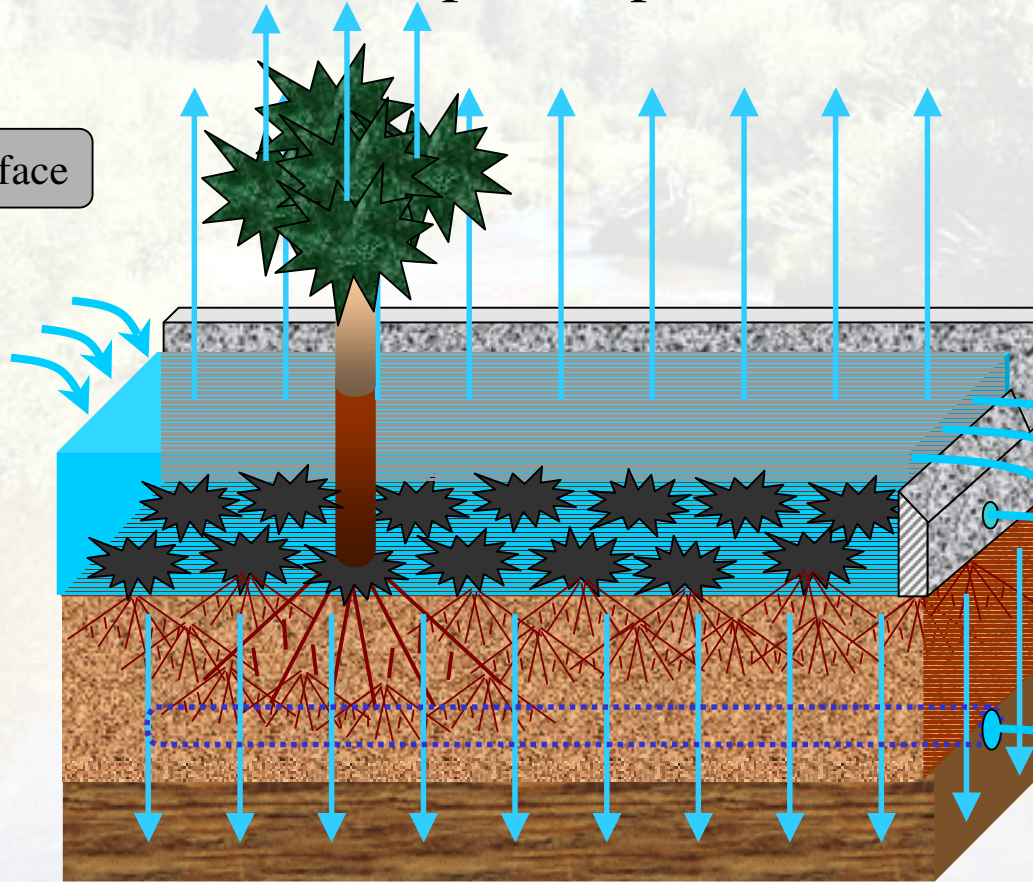
Modified Flow &  
Water Quality

Overflow  
Spillway

Bottom  
Orifice

Underdrain  
Outflow

Infiltration



# BMP Class B: Open Channel

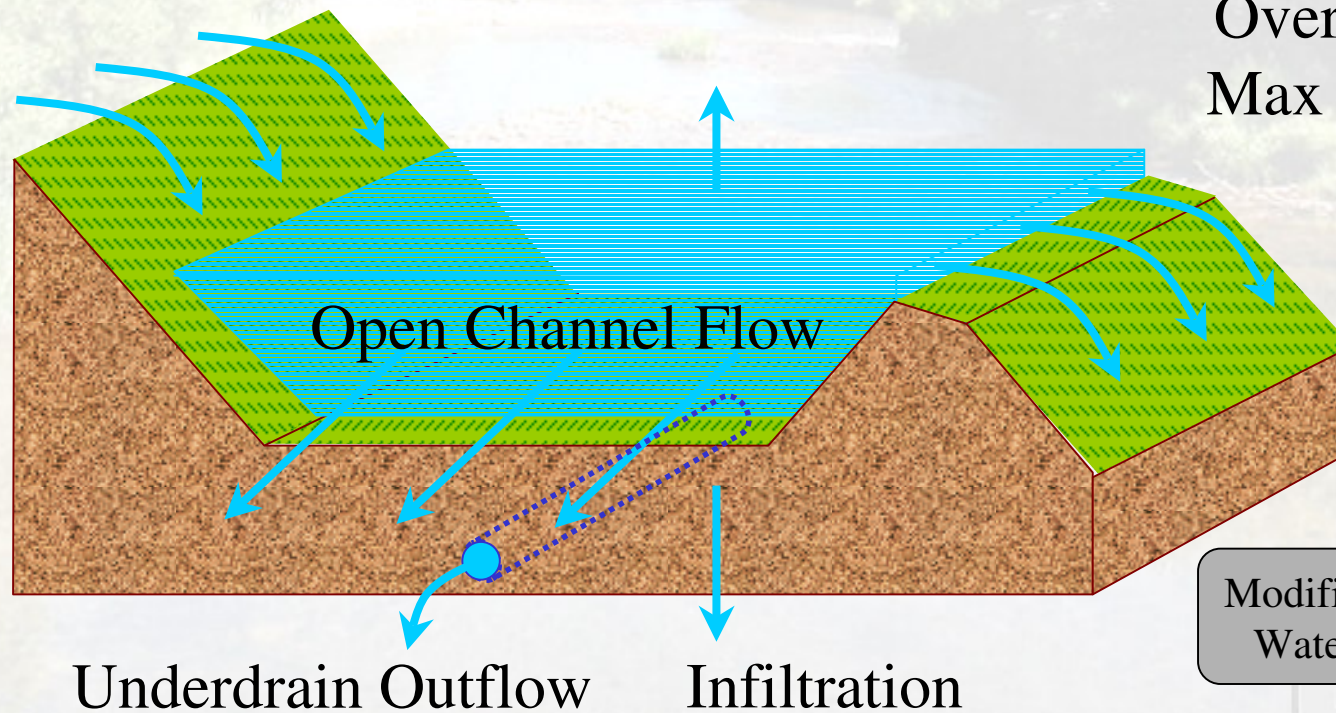
Inflow:

From Land Surface

Outflow:

Overflow at  
Max Design  
Depth

Evapotranspiration



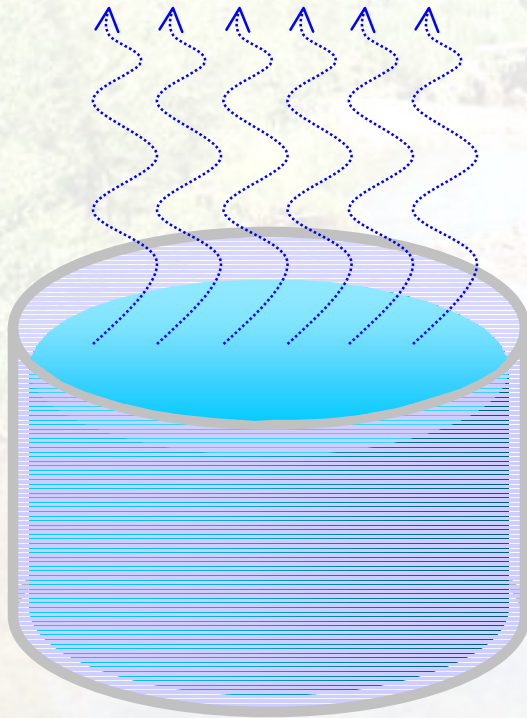
Modified Flow &  
Water Quality

Underdrain Outflow

Infiltration

# Incorporating Benefits of Land Cover

Evaporation



+

Transpiration

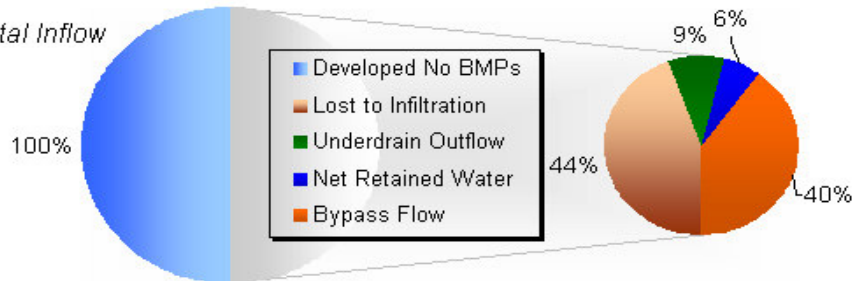


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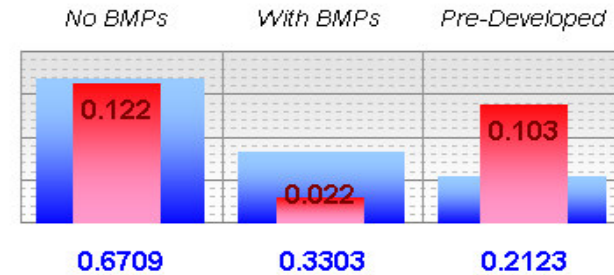
Summary	Rainfall (in)	Water Budget (in)					Runoff
		Developed No BMPs	Lost to Infiltration	Underdrain Outflow	Net Retained Water	Bypass Flow	Pre-Developed
Total Weekly	3.0500	0.6709	0.2985	0.0618	0.0421	0.2684	0.2123
Max Hourly	0.3200	0.1216	0.0175	0.0005	Not Applicable	0.0211	0.1029

### Water Budget for the Week

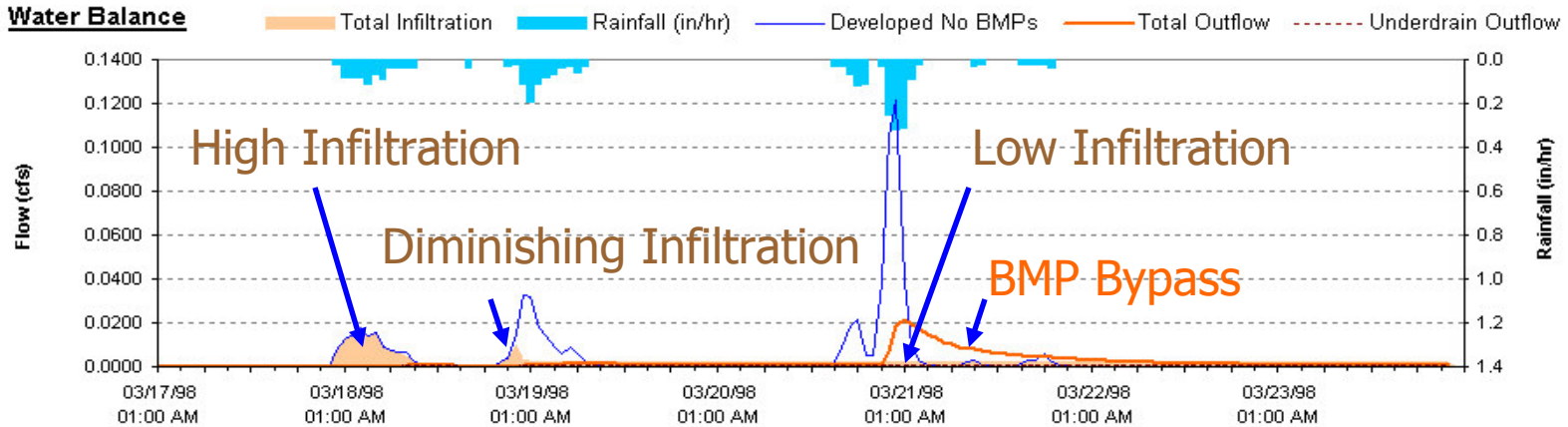
Total Inflow



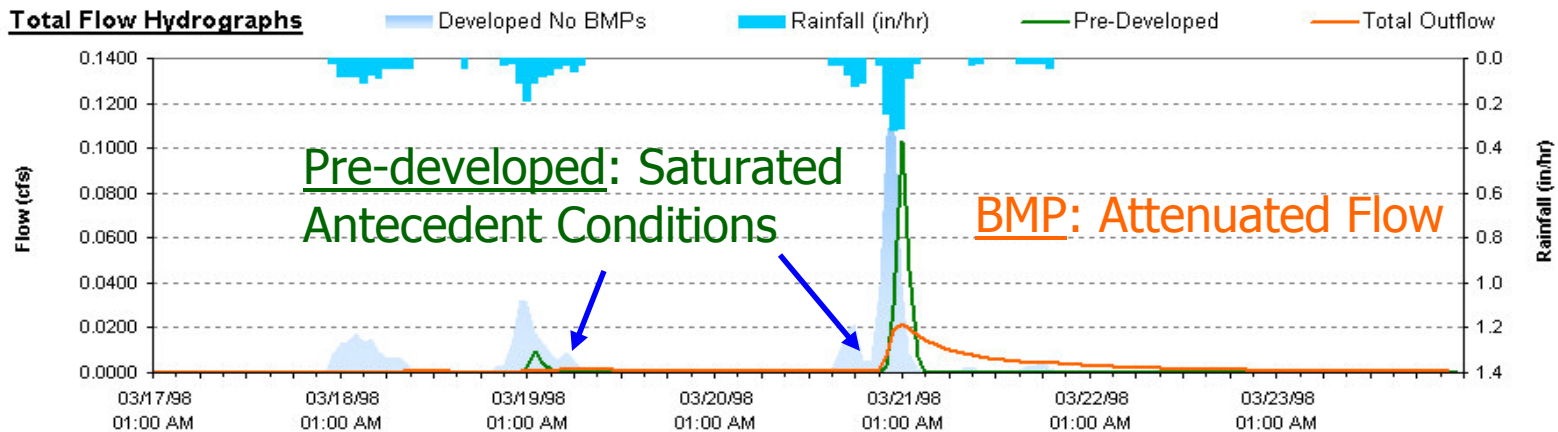
Peak Flow (cfs) Stormwater Volume (in)



### Water Balance

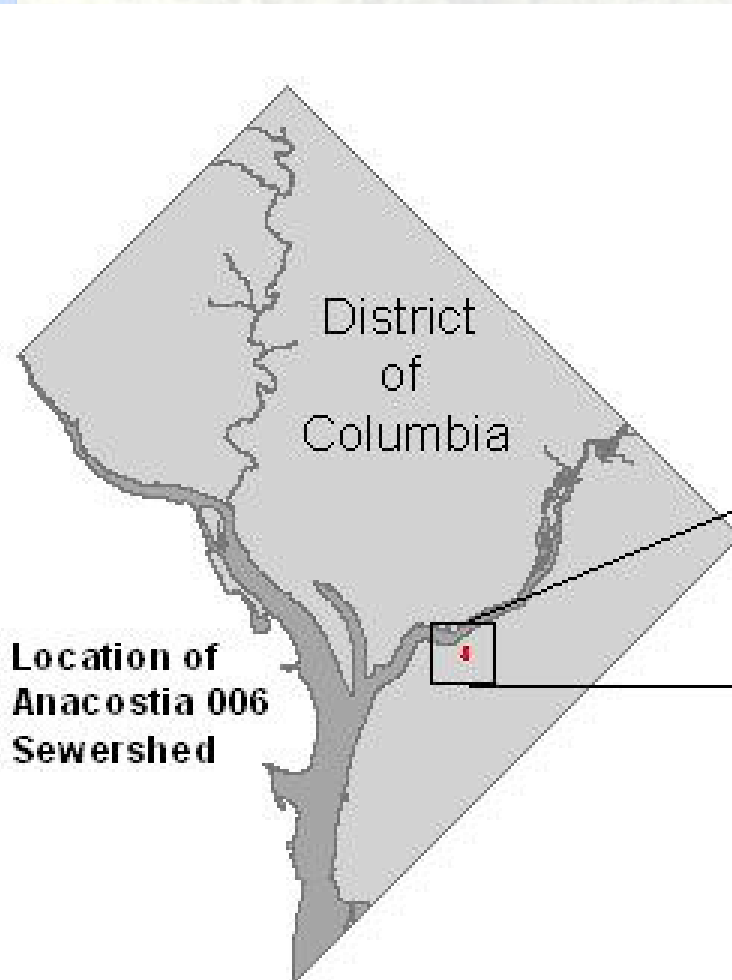


### Total Flow Hydrographs



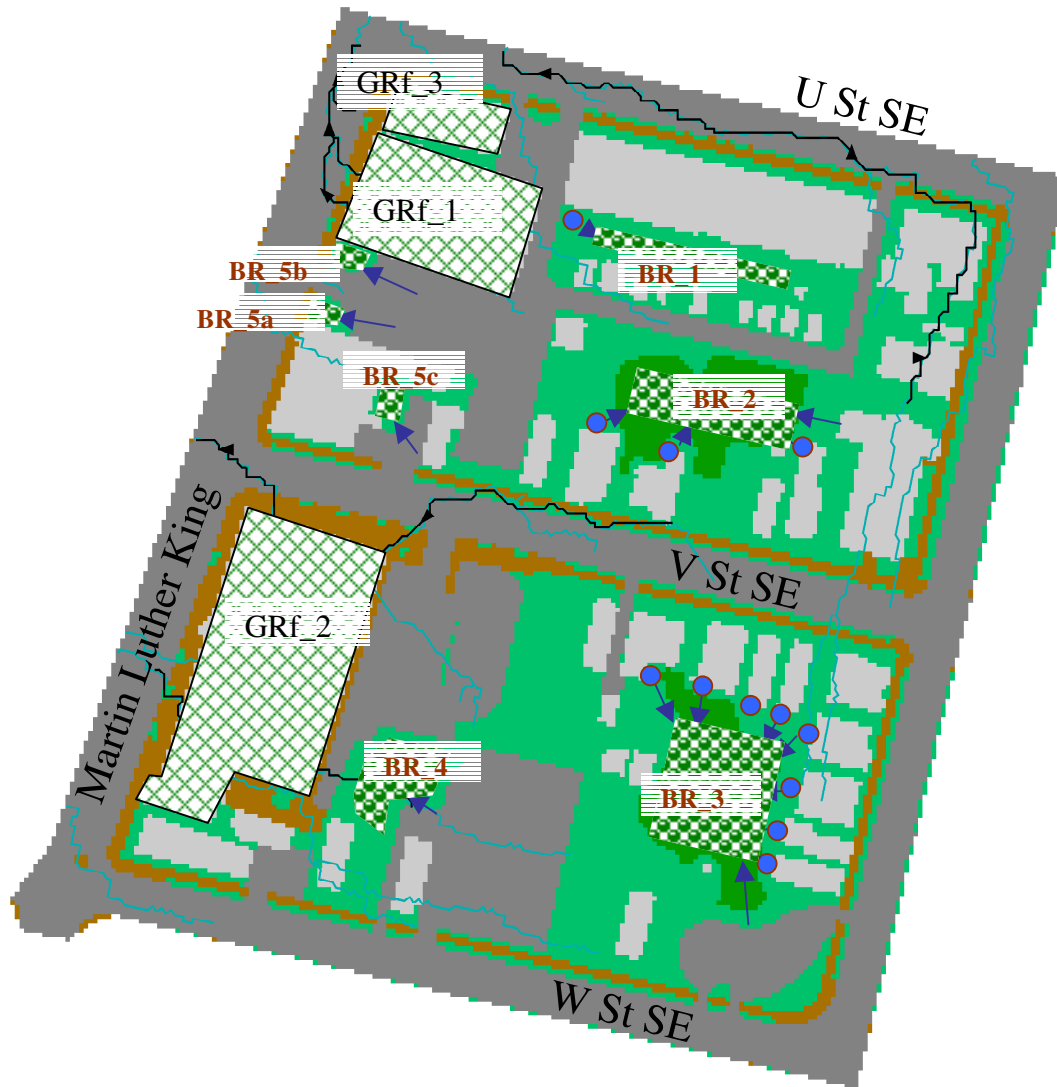


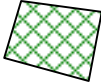


# Case Study Location



Anacostia 006 Sewershed

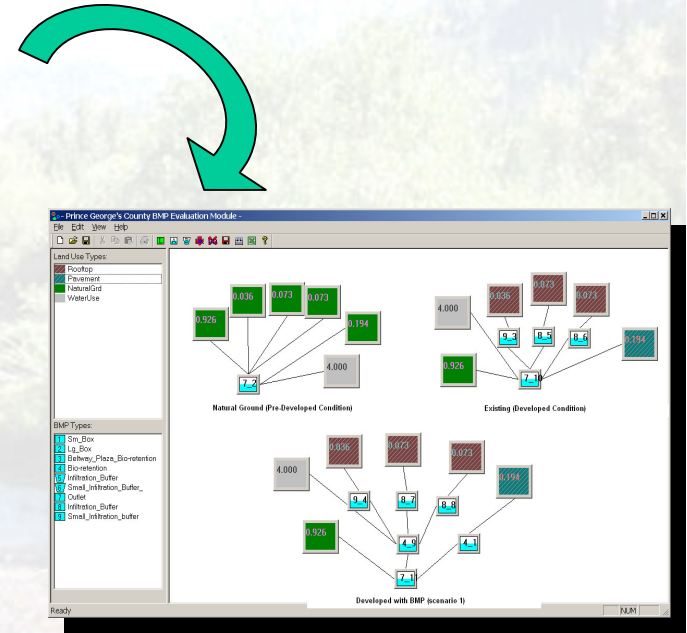
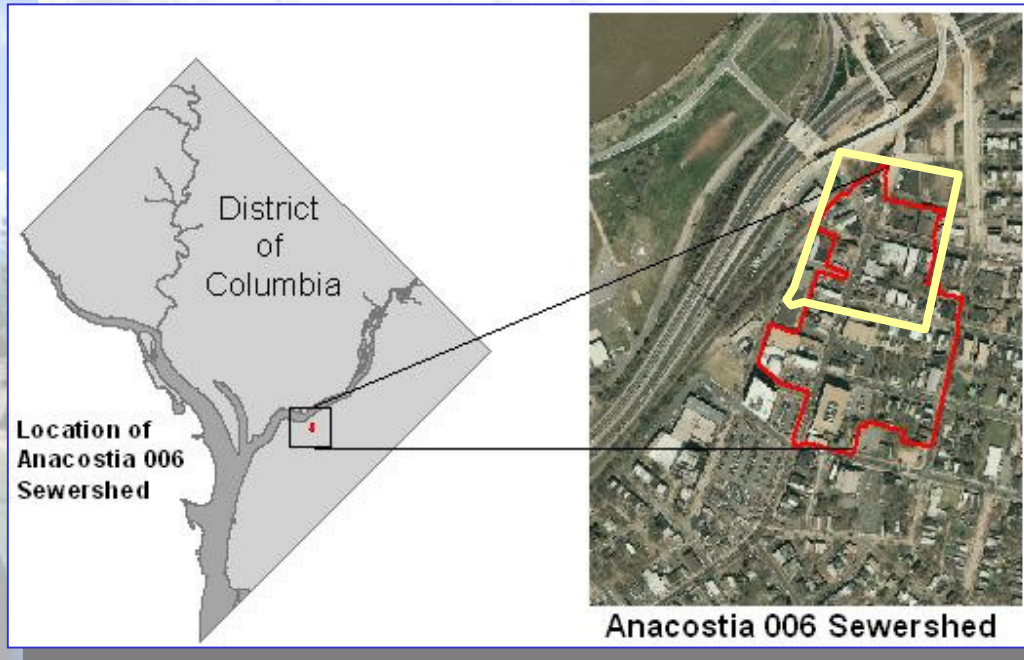
# Example LID Retrofit



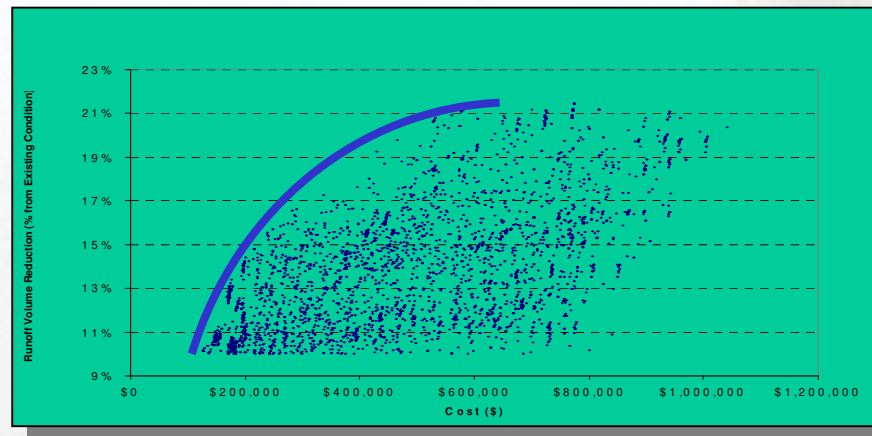
-  Green Roof
-  Rain Barrel
-  Bio-retention



# Example Project – Anacostia Watershed, DC



*Primary Objective*  
Runoff volume  
reduction



*Trade-off Curve*

# Cost Function

$$\text{Cost} = (Aa \times \text{Area}^{Ab}) \times (Da \times \text{Depth}^{Db}) + \text{Land Cost} \times \text{Area} + \text{Fixed Cost}$$

*where*

*Area* = area excavated for BMP site ( $\text{ft}^2$ ),

*Depth* = average depth of soil excavated (ft),

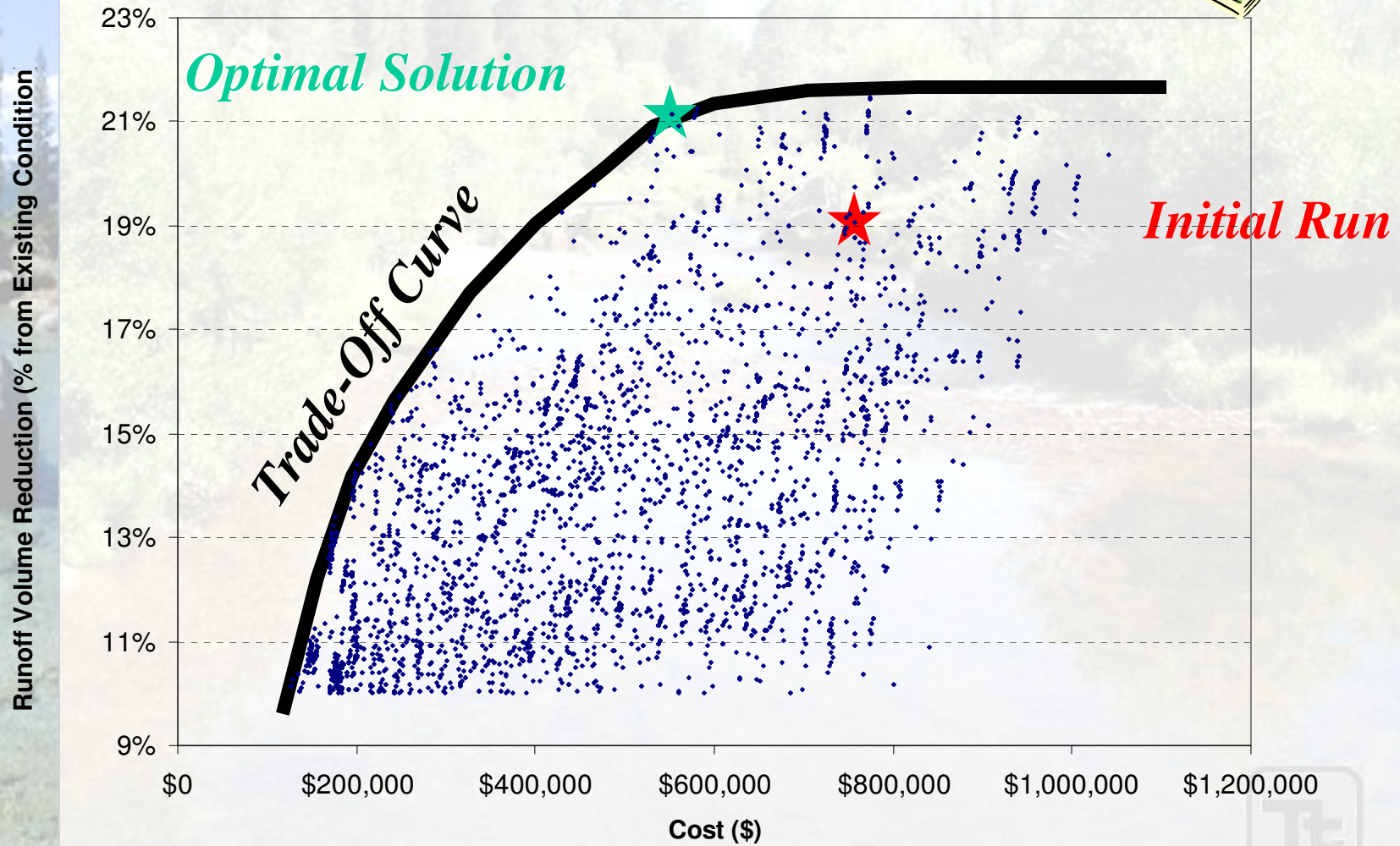
*Land Cost* = unit cost of land (\$/ft),

*Fixed Cost* = fixed cost (\$), and

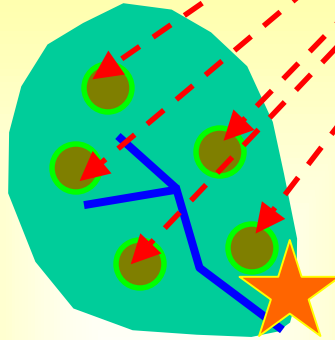
*Aa, Ab, Da, Db* are coefficients of the cost function



# Optimization Solutions



## BMP Modeling

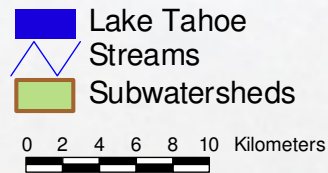
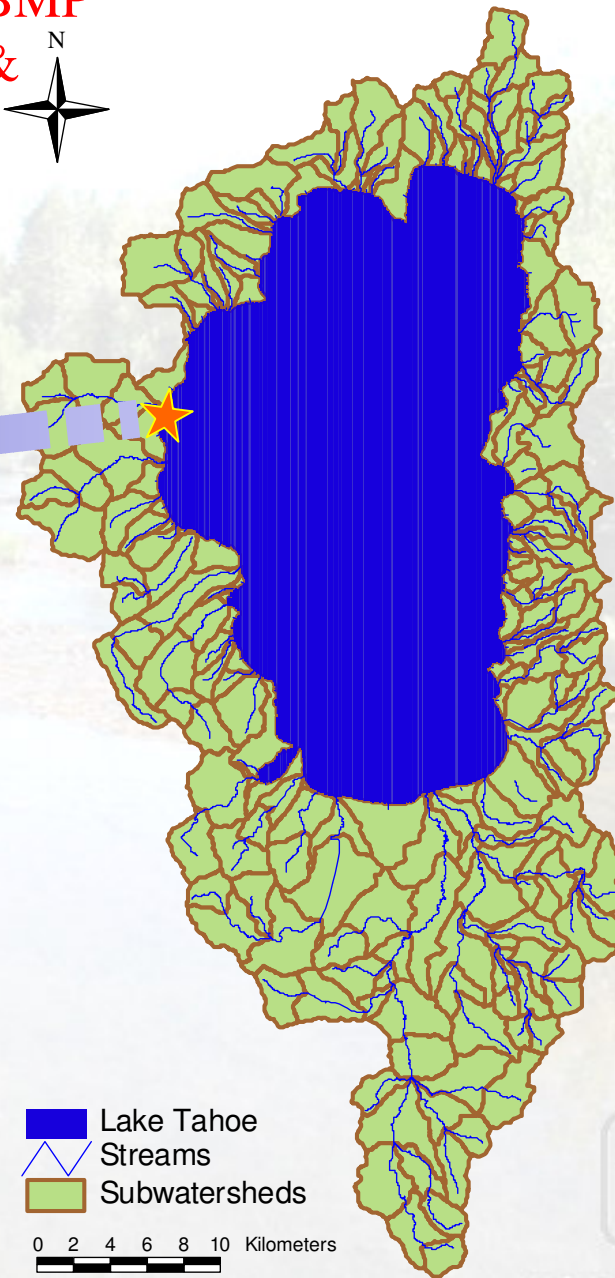


## BMP Options/Design

Potential Location	BMP types	BMP configuration		
1 (0-1)	A, B, C...	Depth	Surface area	...
2 (0-1)	A, B, C...	Depth	Surface area	...
...	...	...	...	...

- ★ Sub-watershed Load
- BMP Locations

## Site-Level BMP Placement & Design

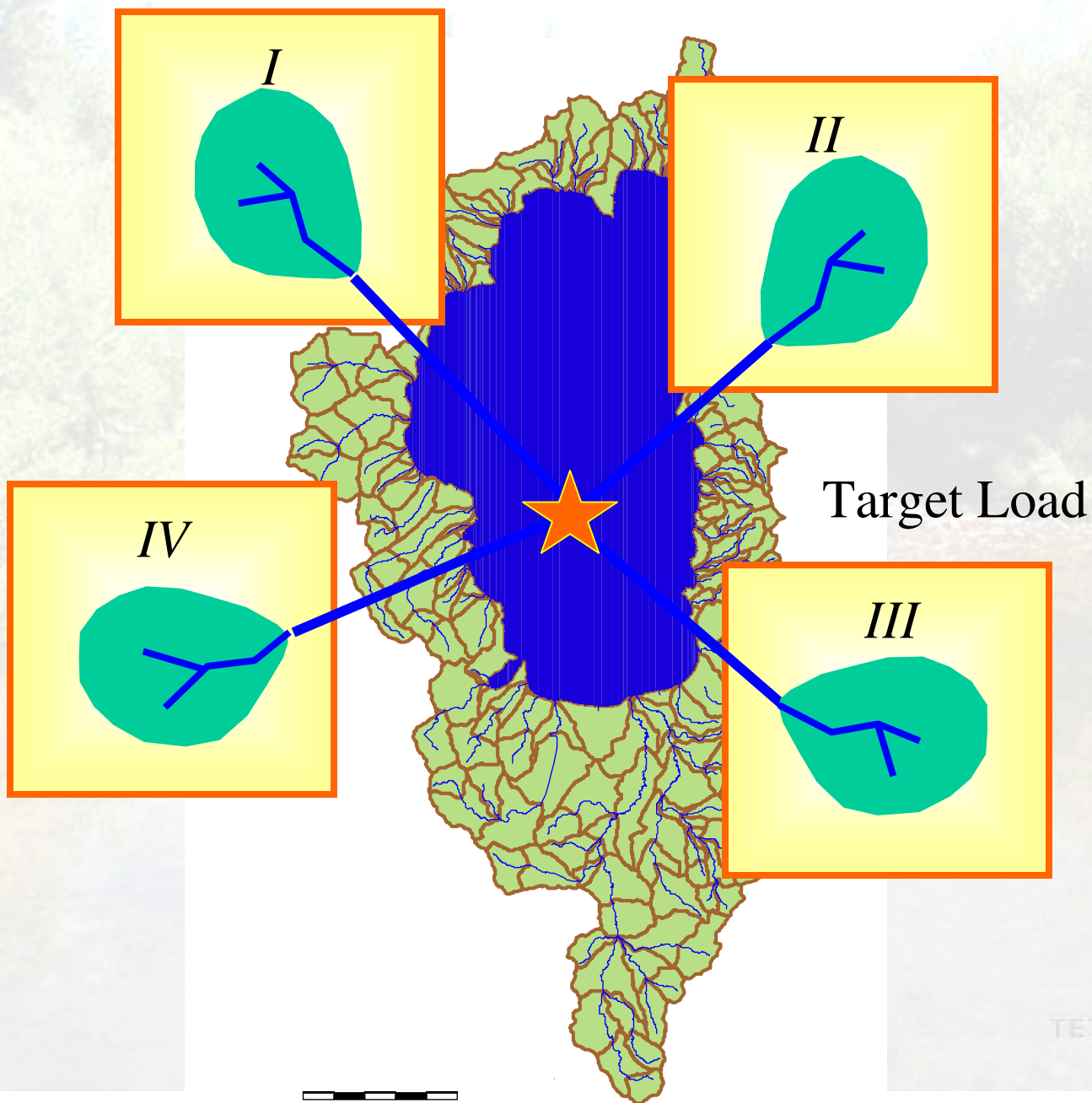


★ Water Quality Evaluation Point



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# Nested Watersheds



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*Thank You*  
Questions?



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