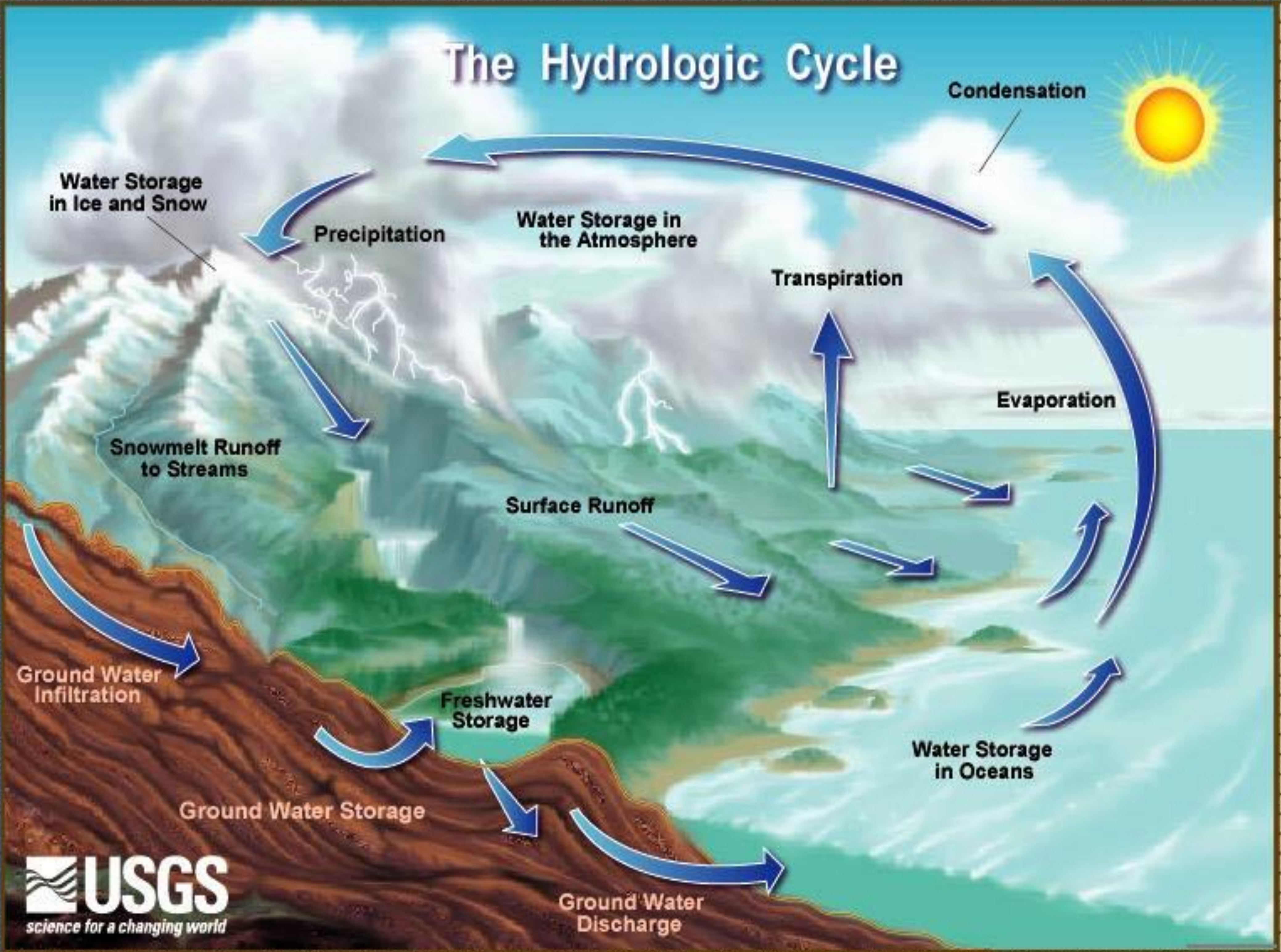
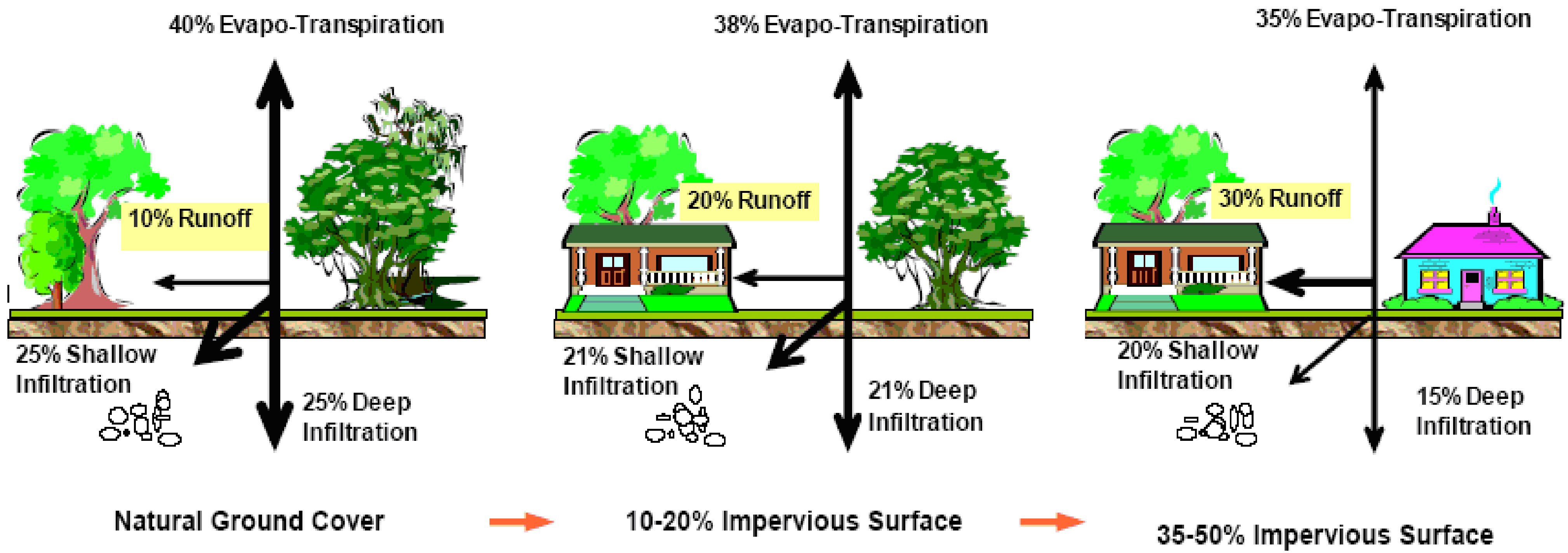
Sediment and Stormwater Management

CSMW Workshop #2

eric berntsen

stormwater program / SWRCB


The Hydrologic Cycle
Condensation
Water Storage
in Ice and Snow
Precipitation
Water Storage in
the Atmosphere
Transpiration
Evaporation
Snowmelt Runoff
to Streams
Surface Runoff
Ground Water
Infiltration
Freshwater
Storage
Water Storage
in Oceans
Ground Water Storage
Ground Water
Discharge
USGS
science for a changing world



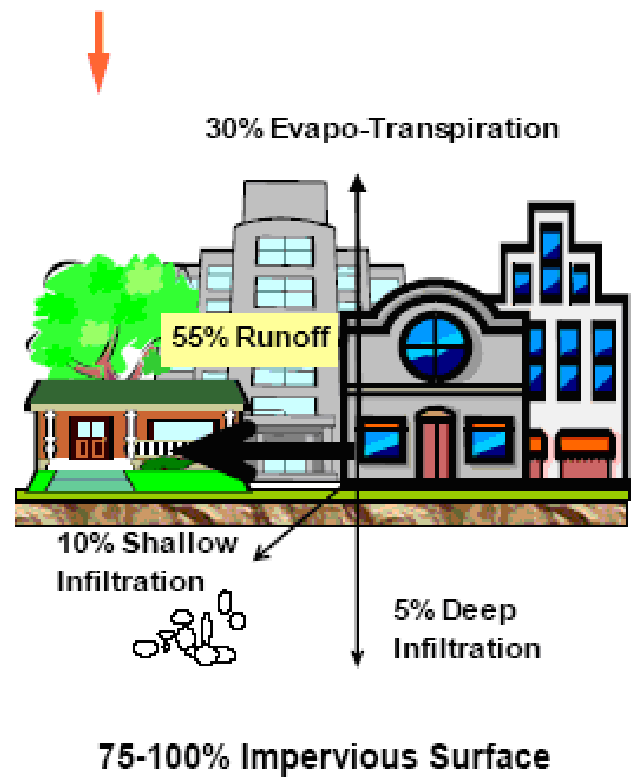


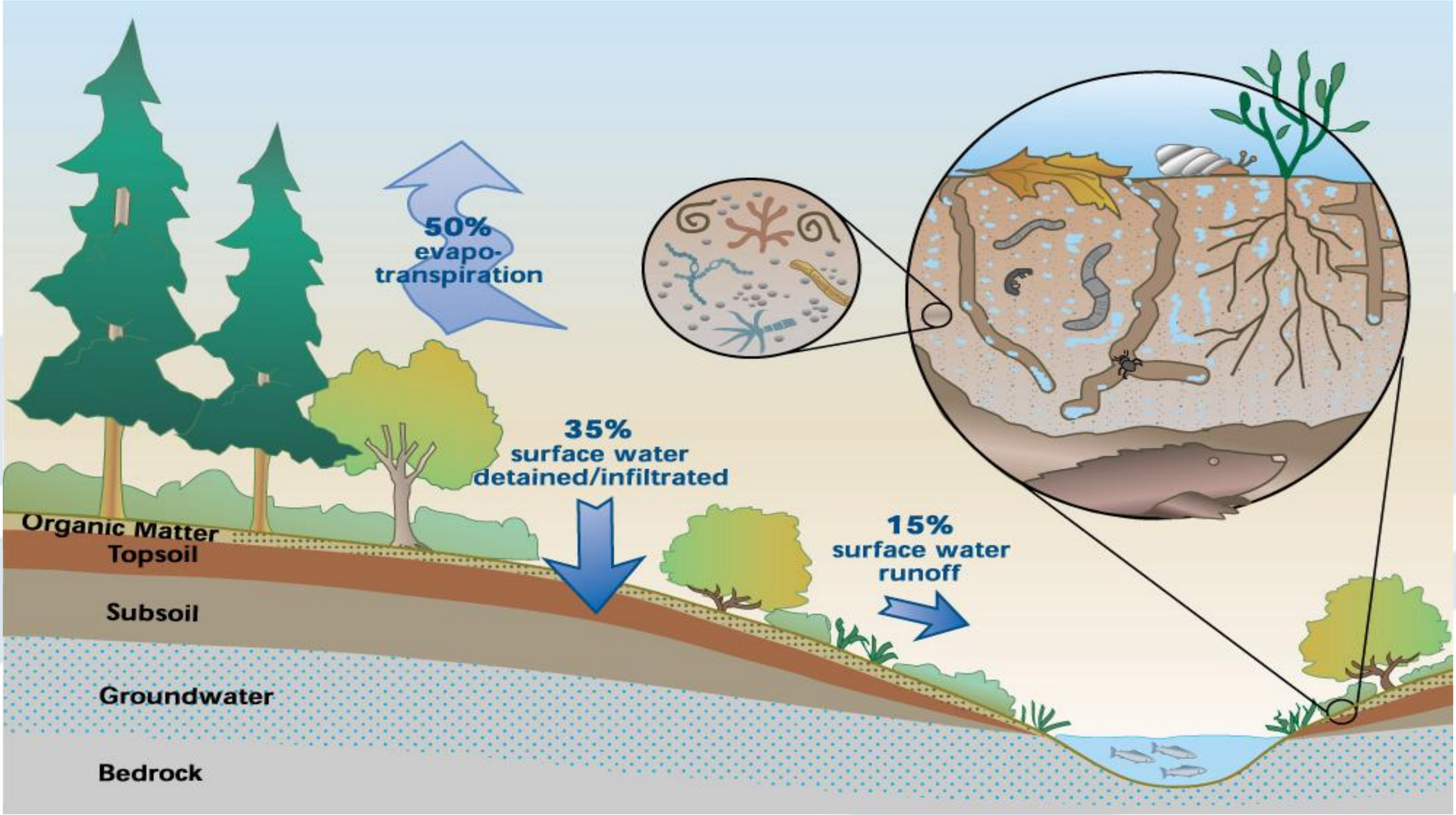
Figure 2. How impervious cover affects the water cycle.

With natural groundcover, 25% of rain infiltrates into the aquifer and only 10% ends up as runoff. As imperviousness increases, less water infiltrates and more and more runs off. In highly urbanized areas, over one-half of all rain becomes surface runoff, and deep infiltration is only a fraction of what it was naturally [6].

The increased surface runoff requires more infrastructure to minimize flooding. Natural waterways end up being used as drainage channels, and are frequently lined with rocks or concrete to move water more quickly and prevent erosion.

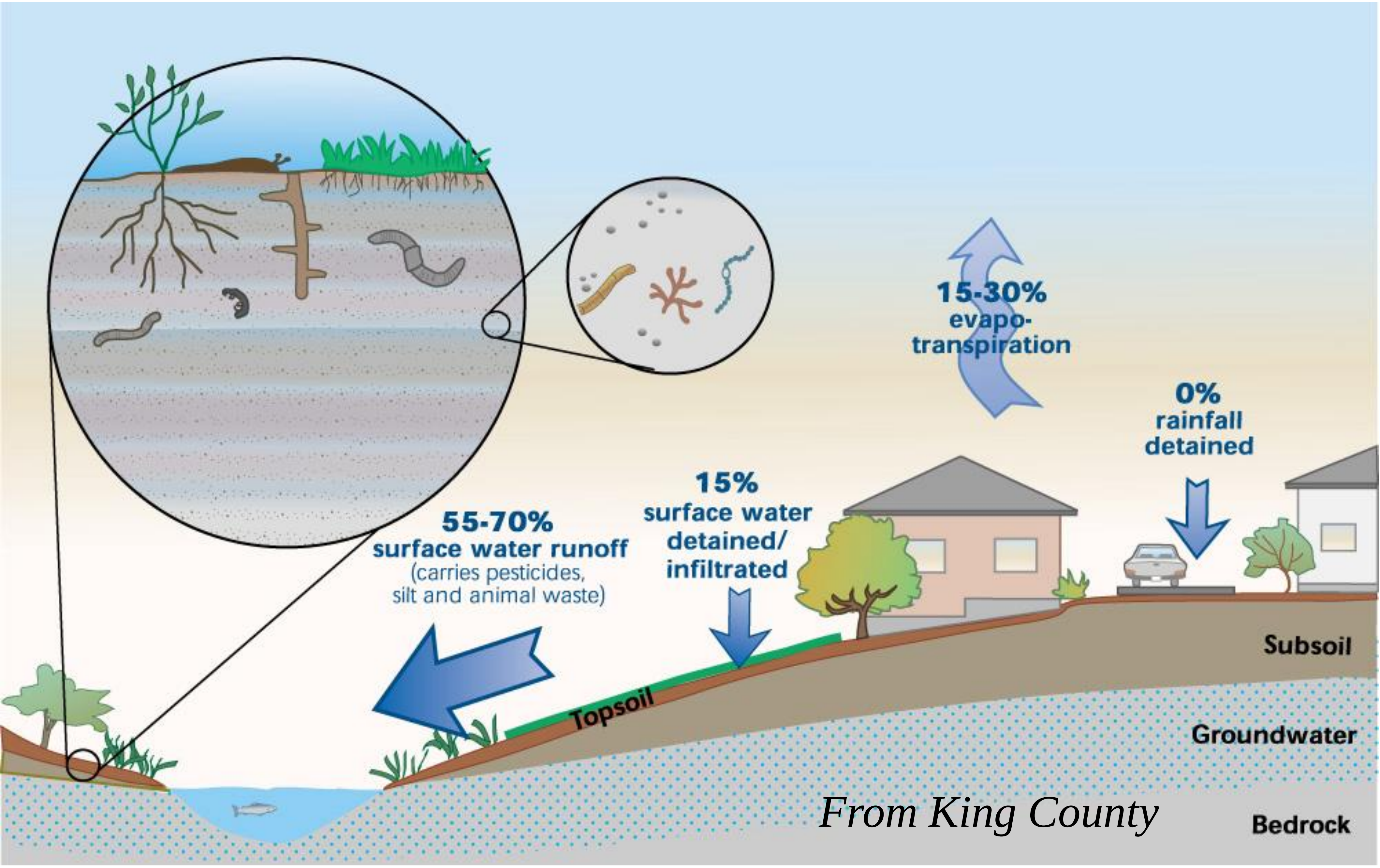
In addition, as deep infiltration decreases, the water table drops, reducing groundwater for wetlands, riparian vegetation, wells, and other uses.

Native Soil



From King County

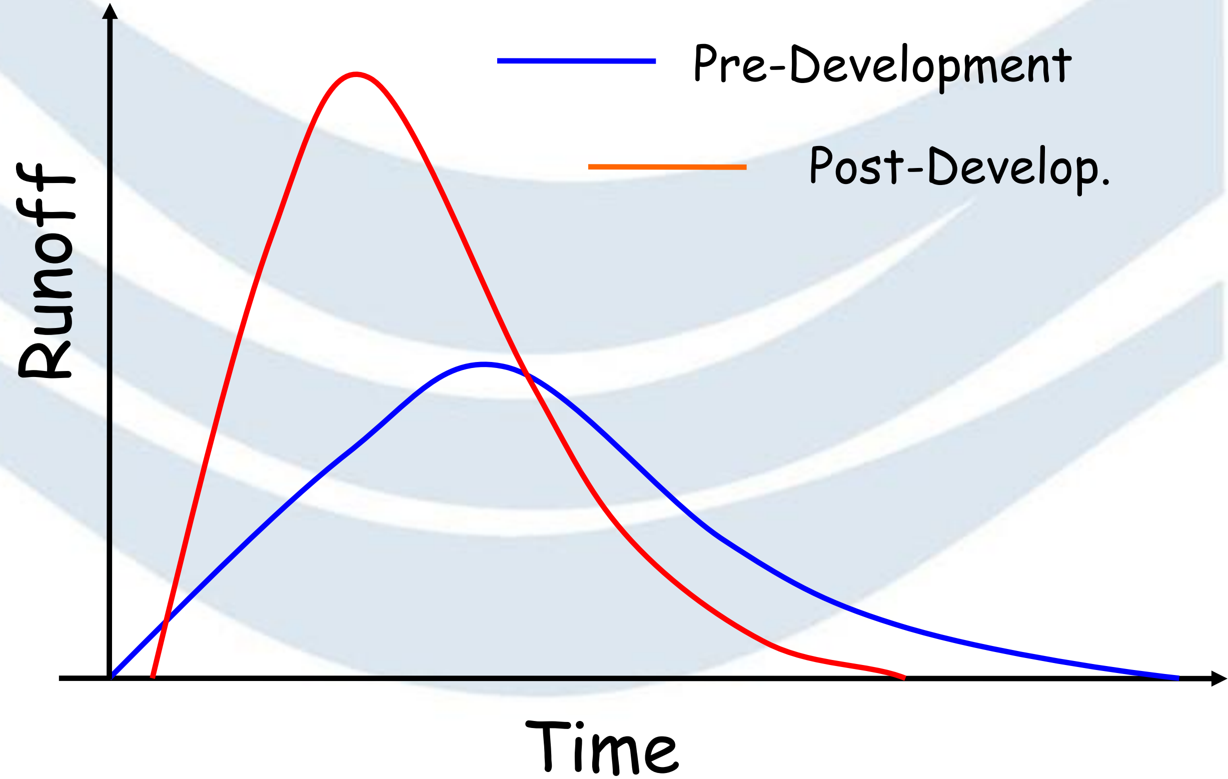
Disturbed Soil



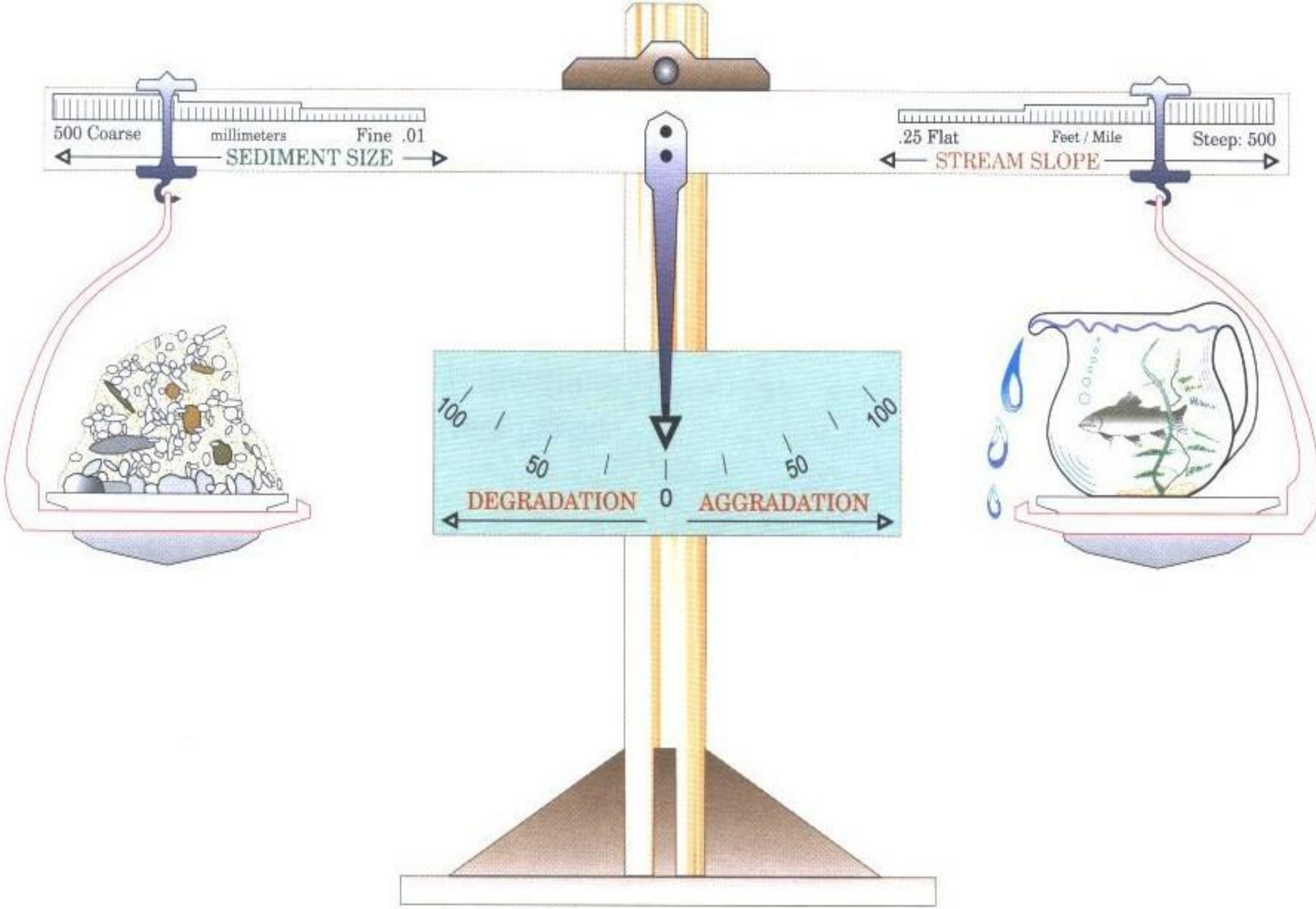
Hydrologic Changes

Urbanization tends to increase storm water runoff:

- peak flows
- volume
- frequency



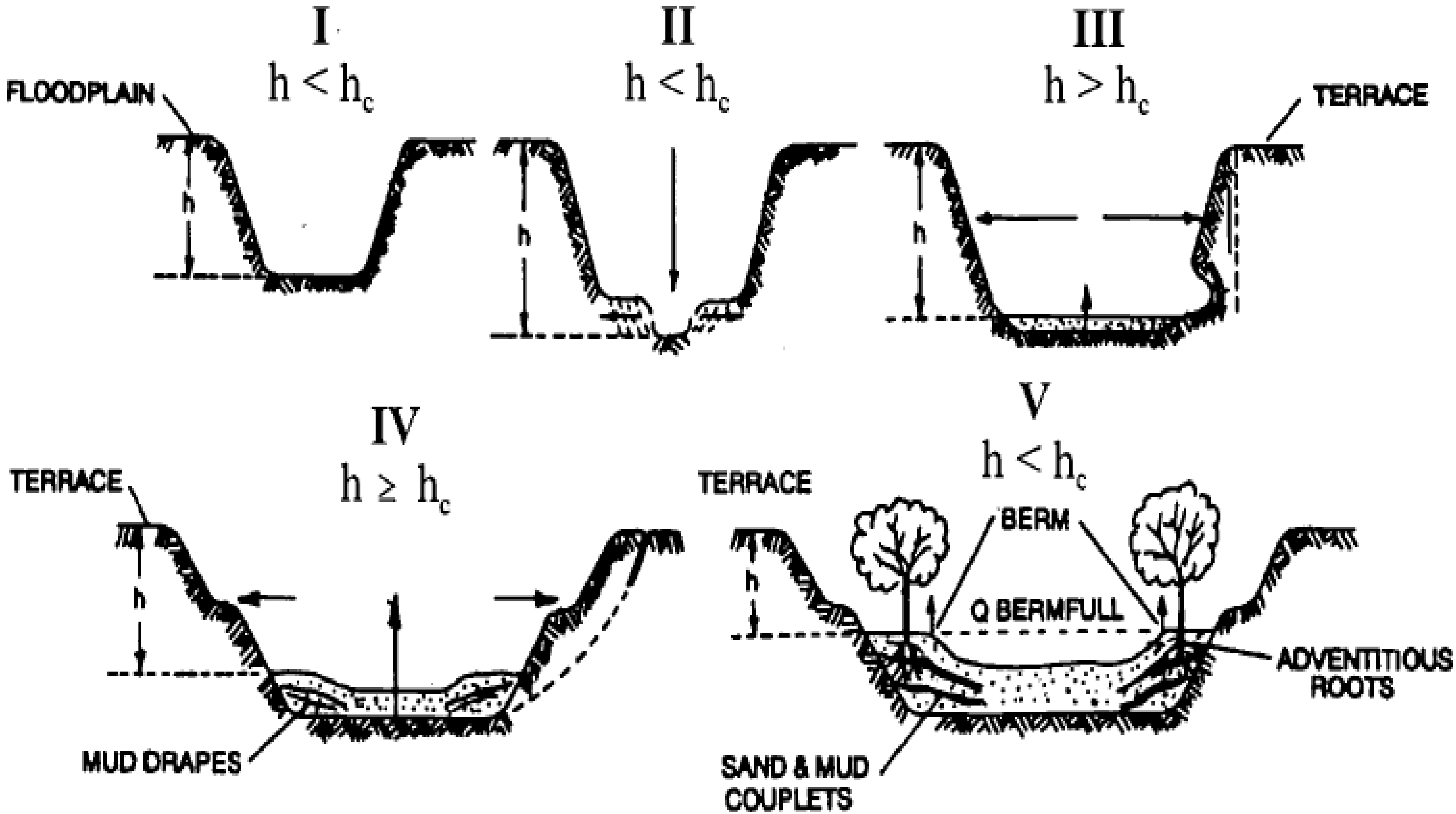
From Haltiner (2006)



(Sediment LOAD) x (Sediment SIZE) $\propto$ (Stream SLOPE) x (Stream DISCHARGE)

After Lane (1955) as cited in Rosgen (1996)

Channel Changes Associated with Urbanization



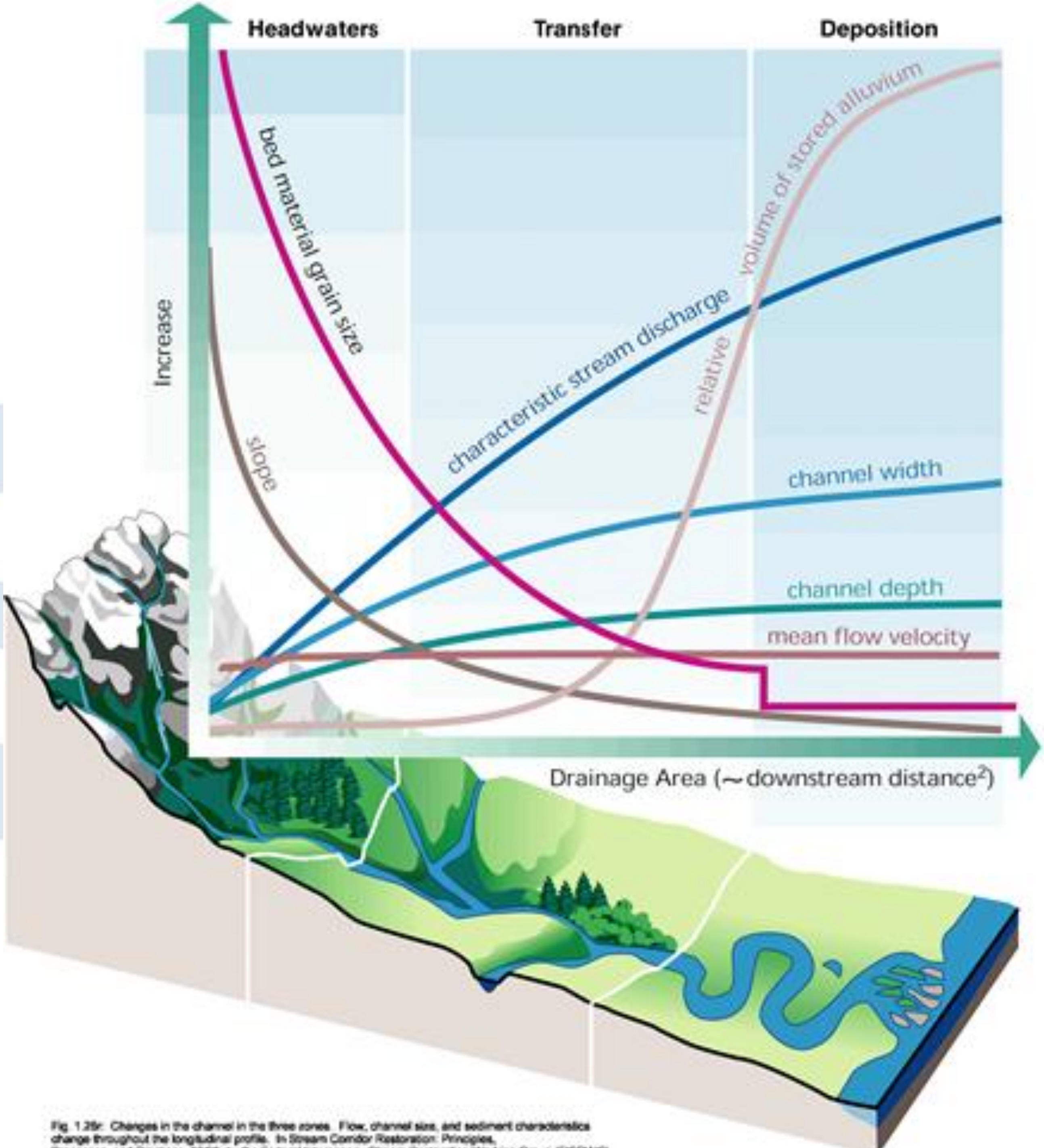


Fig. 1.28r: Changes in the channel in the three zones. Flow, channel size, and sediment characteristics change throughout the longitudinal profile. In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98, by the Federal Interagency Stream Restoration Working Group (FISRWG) (15 federal agencies of the US government).

From FISRWG

Hydromodification-historic approach
(still done in many places)

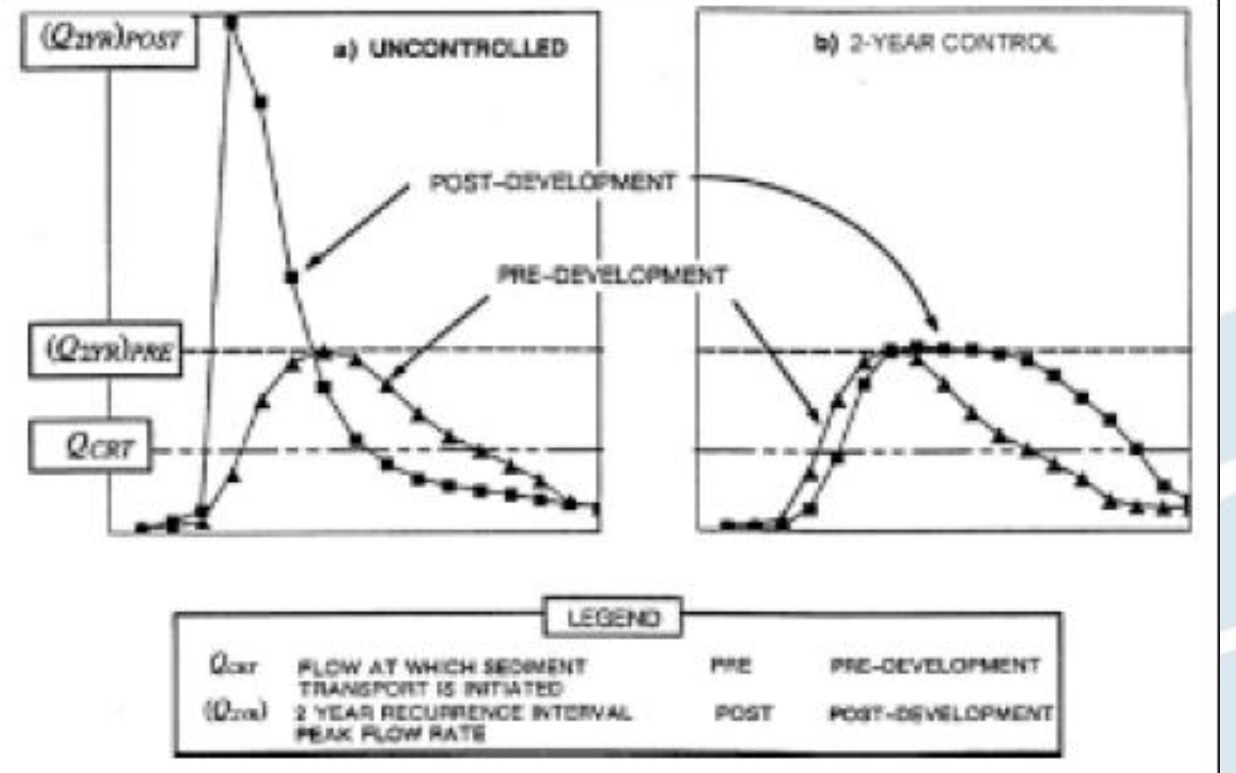
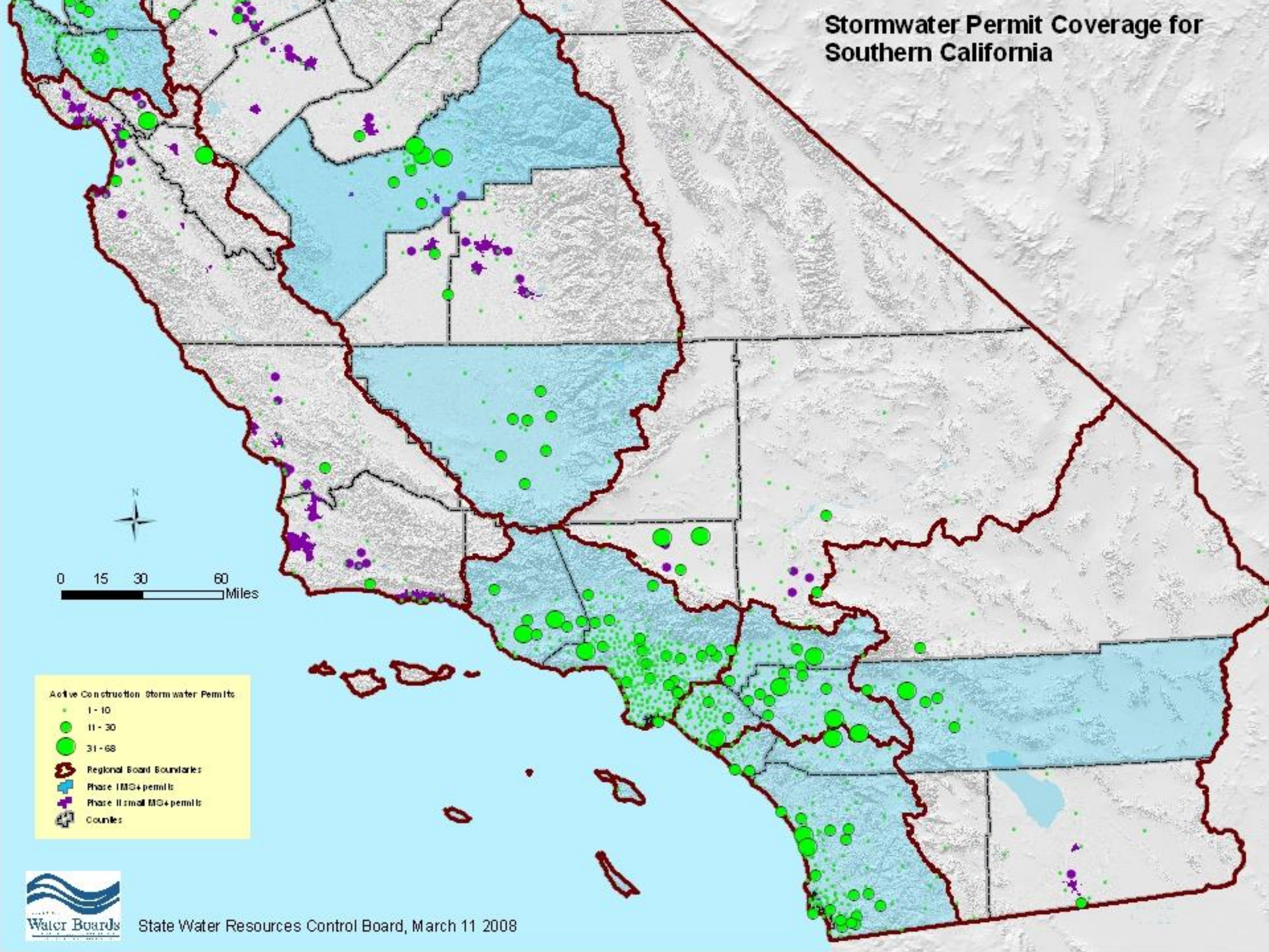
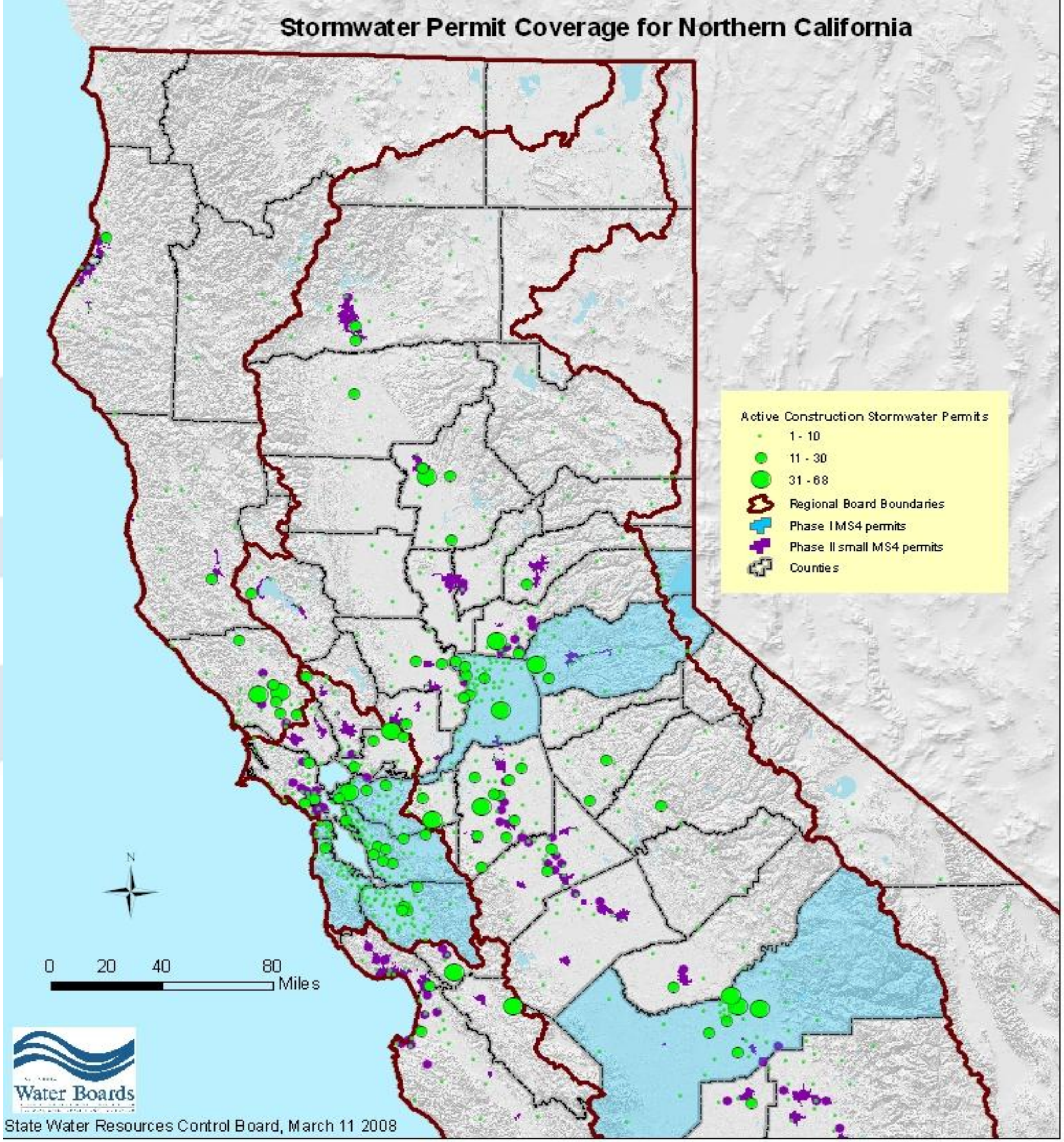


Figure 3. No. Control vs. Two-Year Control
(MacRae and Rowney, 1992).


1950's – Sacramento Area


2000's – Sacramento Area


Stormwater Permit Coverage for Southern California
N
0 15 30 60
Miles
Active Construction Stormwater Permits
1 - 10
11 - 30
31 - 68
Regional Board Boundaries
Phase I MS4 permits
Phase II small MS4 permits
Counties
Water Boards
State Water Resources Control Board, March 11 2008


Stormwater Permit Coverage for Northern California
Active Construction Stormwater Permits
1 - 10
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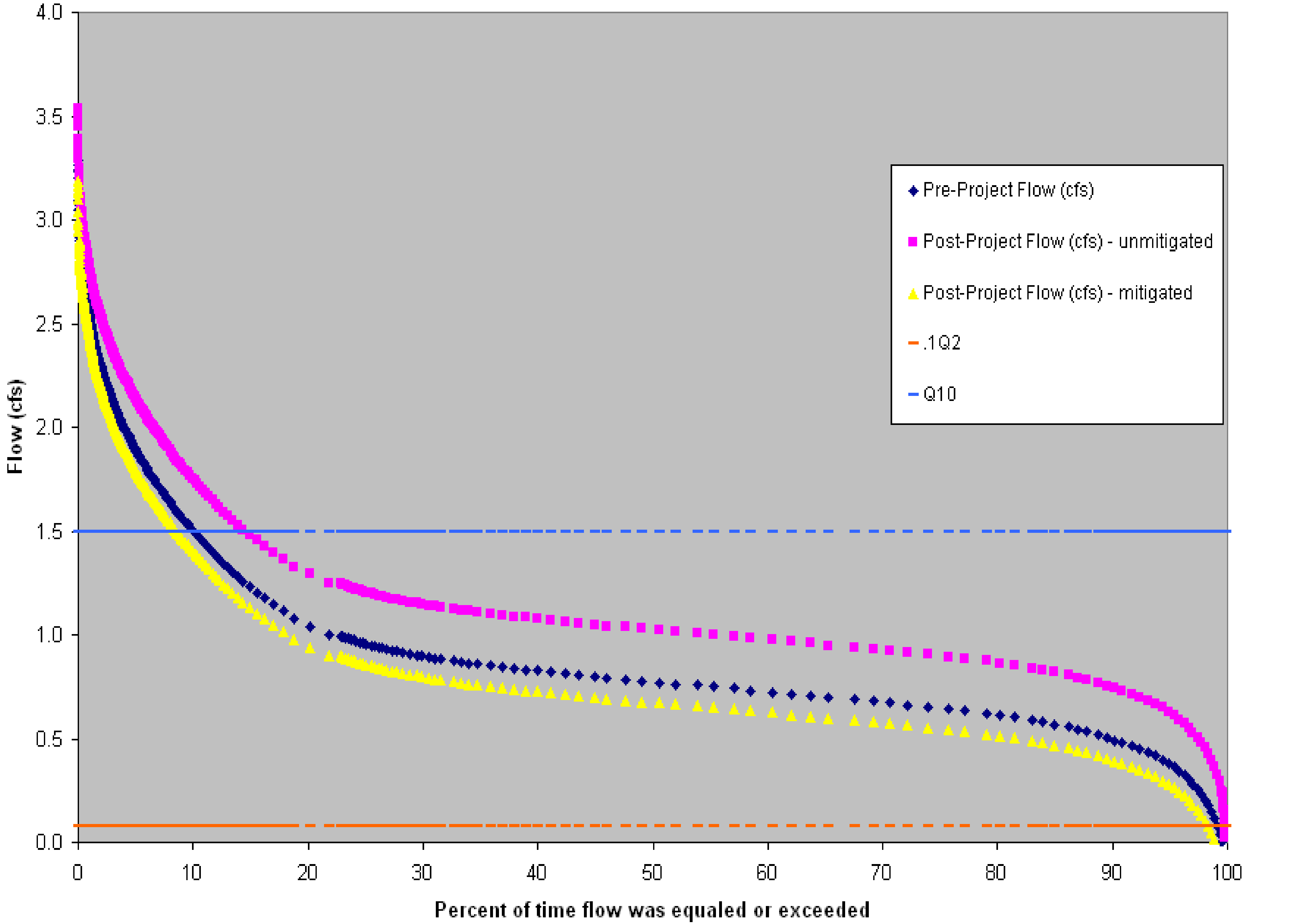
Regional Board Boundaries
Phase I MS4 permits
Phase II small MS4 permits
Counties
N
0
20
40
80
Miles
Water Boards
State Water Resources Control Board, March 11 2008

Continuous Simulation Models

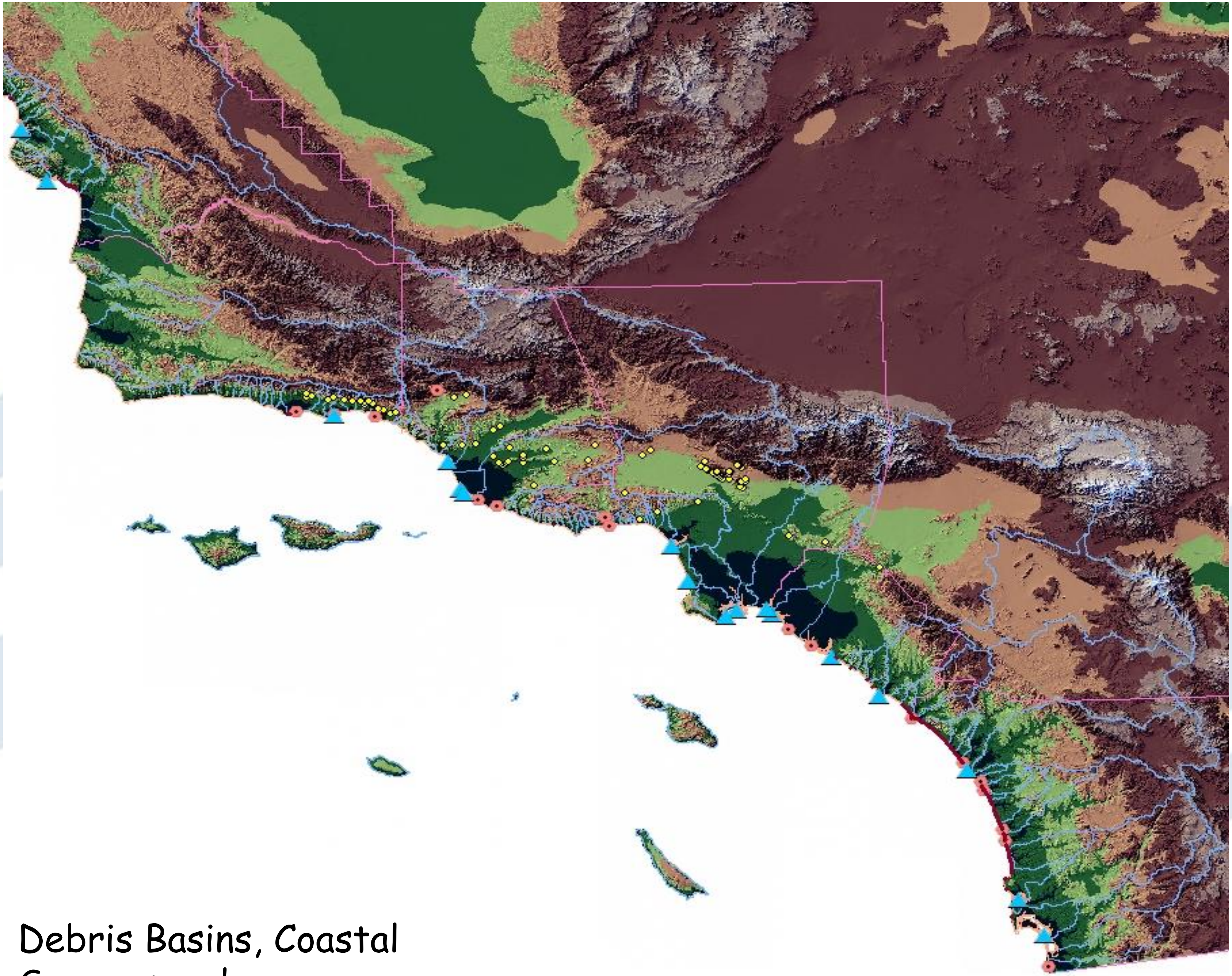
- Use long term rainfall record (20-30 years) and can simulate flows for entire period of record
- Incorporate evapotranspiration and infiltration estimates – simulate the water balance
- Major models being used these days - HSPF, SWMM, HEC-HMS



4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Flow (cfs)
0
10
20
30
40
50
60
70
80
90
100
Percent of time flow was equaled or exceeded
Pre-Project Flow (cfs)
Post-Project Flow (cfs) - unmitigated
Post-Project Flow (cfs) - mitigated
.1Q2
Q10

Continuous Simulation Models

- Continuous simulation models are better at predicting variability in flow and pollutant loads because they are based on long term observed hydrologic data
- Output from these models can help assess expected variability and inform water resource decisions



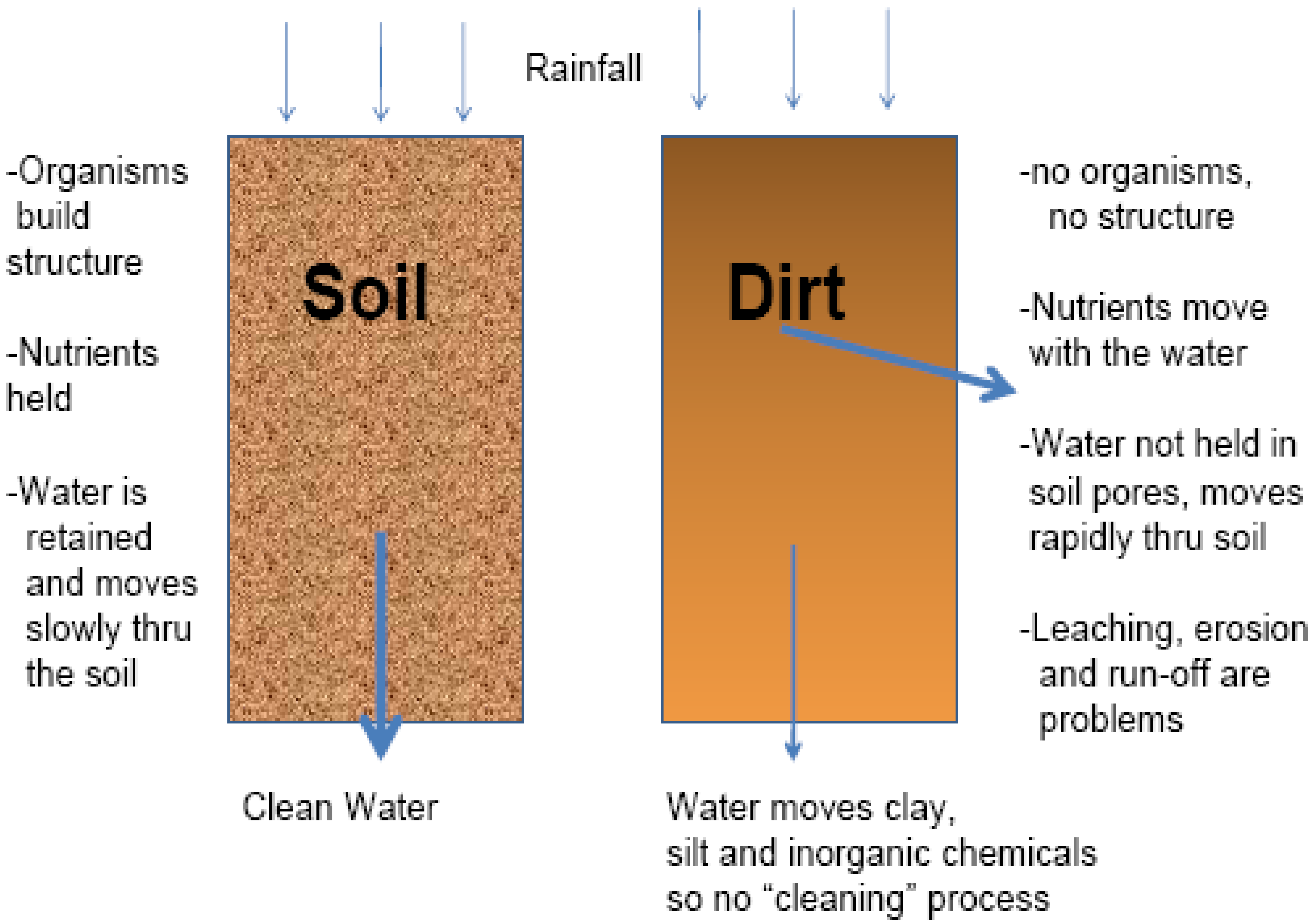
Debris Basins, Coastal Sources and Watersheds

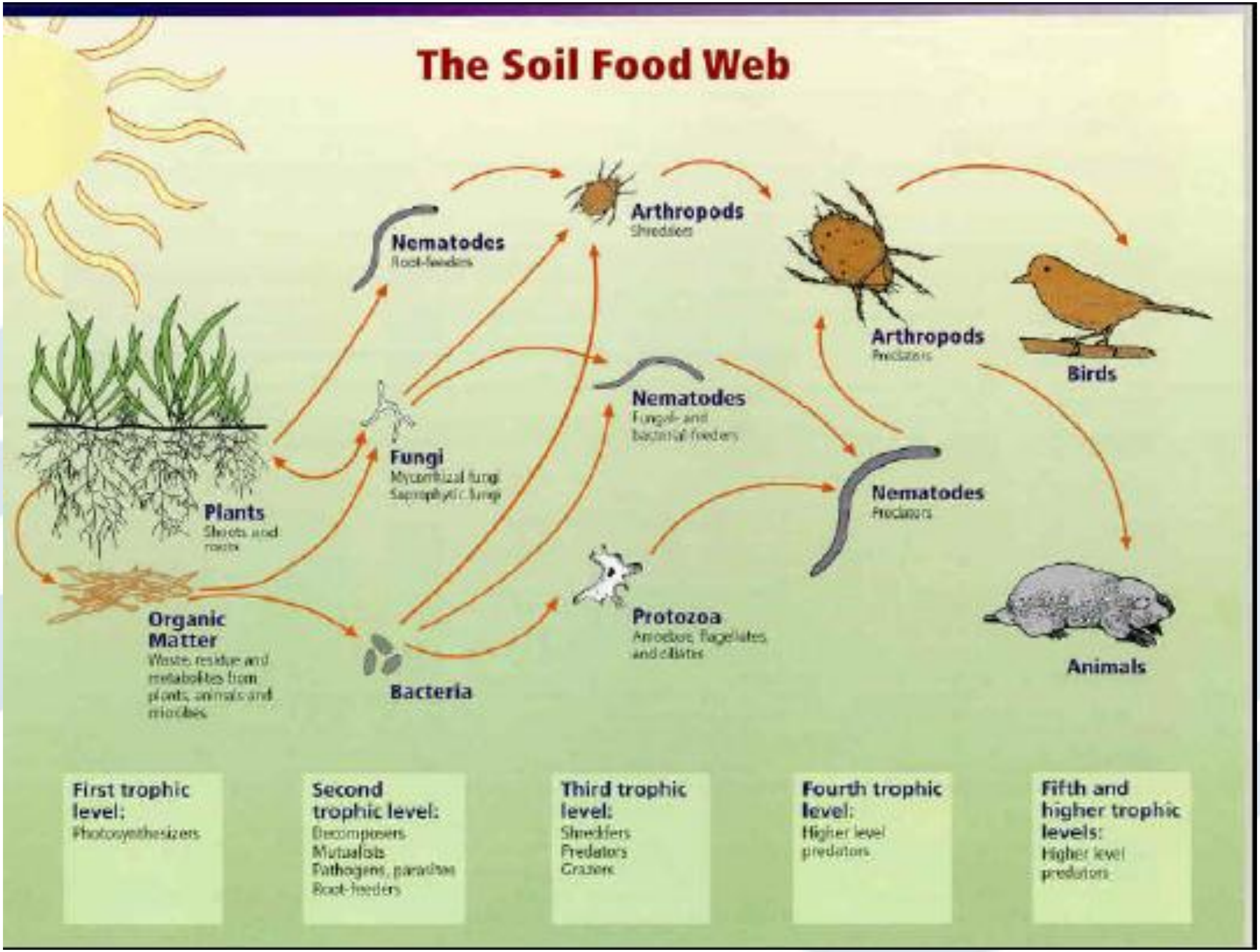
Low Impact Development (LID) Principles

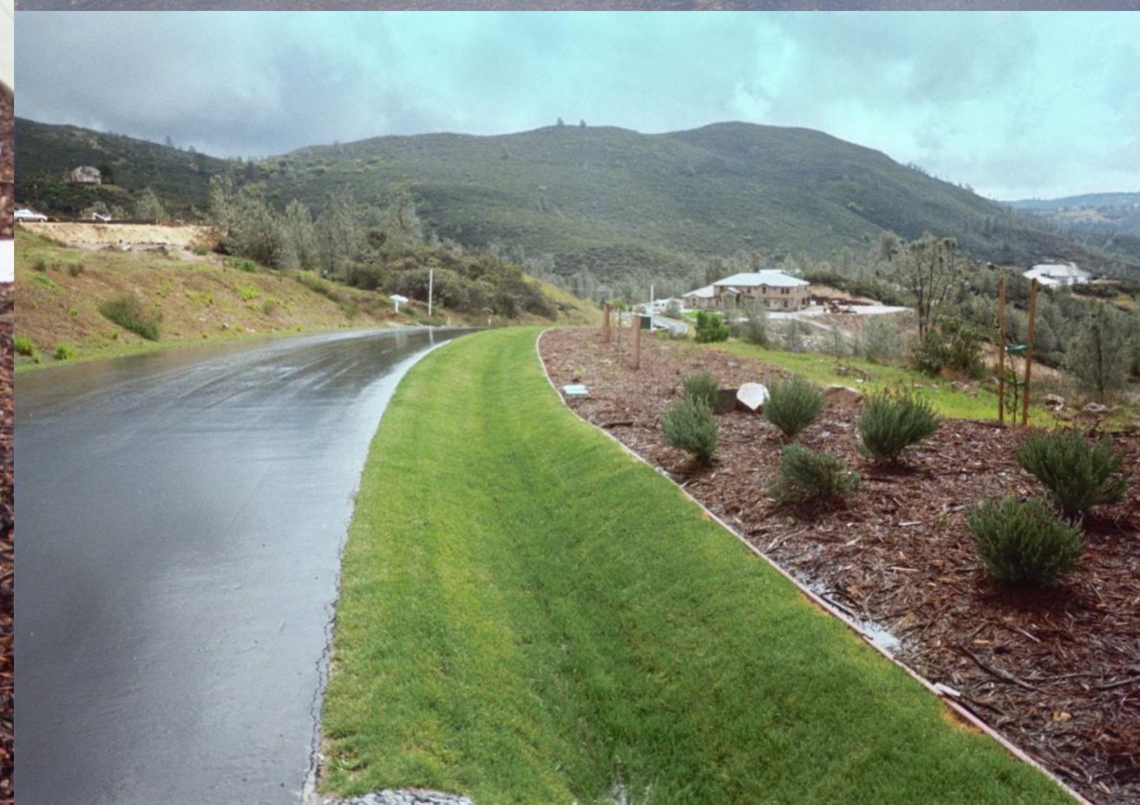
LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source.

Ways to mimic pre-development hydrology

- Soil quality improvement (porosity)
- Native and drought tolerant vegetation
- Trees
- Permeable pavement
- Riparian buffers
- A general reduction of connected, impervious surfaces in runoff pathways
- Bioretention
- Disconnected downspouts/rain chains/rain barrels


Rainfall
-Organisms build structure
-Nutrients held
-Water is retained and moves slowly thru the soil
Soil
Clean Water
Dirt
-no organisms, no structure
-Nutrients move with the water
-Water not held in soil pores, moves rapidly thru soil
-Leaching, erosion and run-off are problems
Water moves clay, silt and inorganic chemicals so no "cleaning" process


The Soil Food Web
Nematodes
Root-feeders
Arthropods
Shredders
Arthropods
Predators
Birds
Nematodes
Fungal- and bacterial-feeders
Fungi
Mycorrhizal fungi
Saprophytic fungi
Plants
Shoots and roots
Nematodes
Predators
Organic Matter
Waste, residue and metabolites from plants, animals and microbes
Protozoa
Amoebae, flagellates, and ciliates
Bacteria
Animals
First trophic level:
Photosynthesizers
Second trophic level:
Decomposers
Mutualists
Pathogens, parasites
Root-feeders
Third trophic level:
Shredders
Predators
Grazers
Fourth trophic level:
Higher level predators
Fifth and higher trophic levels:
Higher level predators

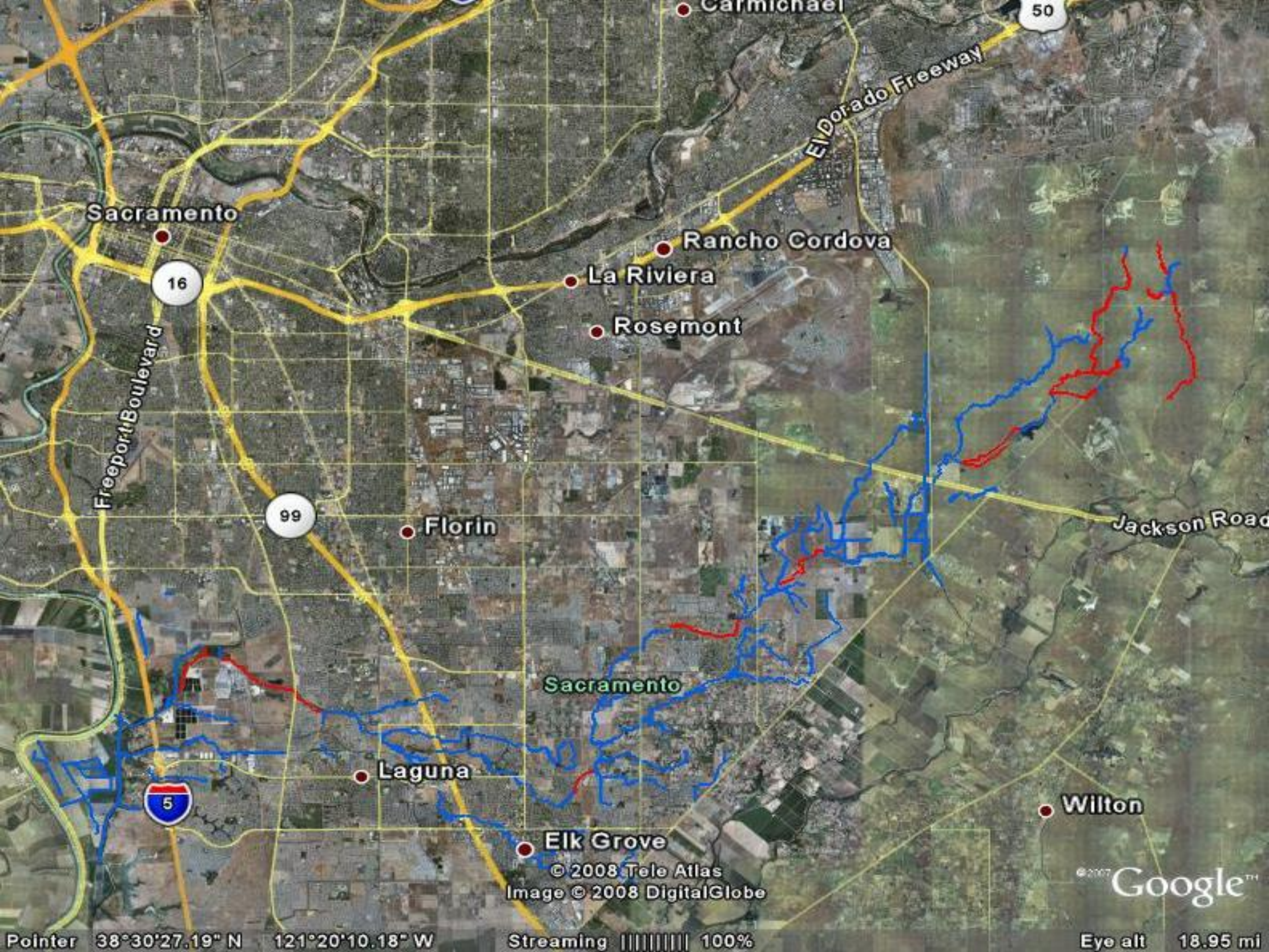


School Parking Lot, Portland OR

Sediment and Stormwater- Points to Consider

- Can LID include identifying and preserving/enhancing coarse sediment supply and transport areas?
- How do we mitigate for trapping of coarse sediment in detention/retention and flow duration control basins?
- We do sediment budgets for FERC relicensing, timber harvest, why not stormwater? "SEDSHED" management

Stakeholder Process



Carmichael
50
El Dorado Freeway
Sacramento
Rancho Cordova
La Riviera
16
Rosemont
Freeport Boulevard
99
Florin
Jackson Road
Sacramento
Laguna
5
Wilton
Elk Grove
© 2008 Tele Atlas
Image © 2008 DigitalGlobe
©2007 Google™
Pointer 38°30'27.19" N 121°20'10.18" W
Streaming |||||||||| 100%
Eye alt 18.95 mi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