Landscape Stratification, Watershed Processes, and Hydromodification Control—

A new approach from the Central Coast

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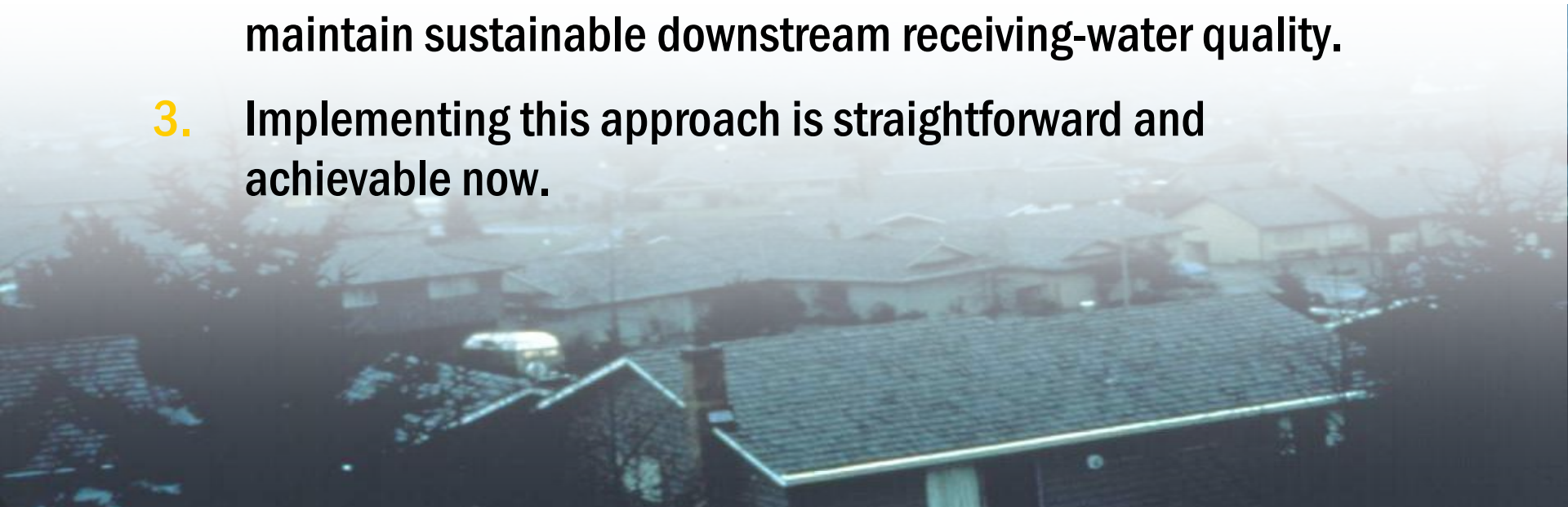
PRESENTATION OVERVIEW

1. STATEMENT OF THE PROBLEM:
   Stormwater mitigation typically (i) has only limited and narrowly defined objectives, and (2) is applied uniformly across a diverse landscape.

2. ALTERNATIVE APPROACH:
   Identify ***key watershed processes*** as they actually occur across the landscape; and recognize that the goal of mitigation must be to protect those processes in order to maintain sustainable downstream receiving-water quality.

3. Implementing this approach is straightforward and achievable now.



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For Sacramento County:

Provision 15.c of the "Planning and New Development Program" section in the permit establishes the following requirements for the HMP:

"The HMP shall require controls to manage the increases in the magnitude (e.g., flow control), frequency, volume and duration of runoff from development projects in order to protect receiving waters from increased potential for erosion and other adverse impacts with consideration towards maintaining (or reproducing) the pre-development hydrology. The HMP shall address, but not be limited to, the following:

"The HPM shall require controls to manage the increases in the magnitude (e.g., flow control), frequency, volume and duration of runoff from development projects in order to protect receiving waters from increased potential for erosion and other adverse impacts…."

For Sacramento County:

Background Information (Continued)

In addition, the permit specifies that the HMP requirements will not be applicable to projects discharging to creeks that have a low erosion potential. These include:

(a) Discharges into creeks that are concrete-lined or significantly armored;
(b)Underground storm drain systems discharging directly to the rivers;
(c) Construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal; and
(d) Projects that do not create an increase in impervious surfaces over pre-project conditions.

ISSUES:

- "Stream-centric"
- Focus is on avoiding channel erosion (by any/all means available, but particularly by controlling runoff)

But…where's the stream?

Where's the runoff?


Control for erosion?—here, YES. But...


...here?

Here?


Or, here???


What if the primary receiving water is
not even visible (GW aquifer)?


...or if erosion is not the only impact of development?

IN SUMMARY (Part 1):

1. Not every part of a landscape produces “runoff.”
2. Not every part of a landscape drains to an erosion-susceptible stream (or to a stream, at all).
3. Regulations that do not recognize these differences will not achieve meaningful mitigation across (real) watersheds.

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Central Coast
Regional Water Quality Control Board

Overview

The Central Coast Region includes all of Santa Cruz, San Benito, Monterey, San Luis Obispo and Santa Barbara counties and small portions of several other counties. Prime agricultural lands dominate the bottomlands of many watersheds, and upper watersheds are in rugged national forest lands. The area ranges climatically from the extremely wet Santa Cruz Mountains to the very arid Carrizo Plain. Important marine resources have been afforded protection through two National Marine Sanctuary programs and the Morro Bay National Estuary Program. The region's population has increased considerably in recent years to approximately 1.4 million.

Water Facts

Healthy Watersheds—a vision for the future

The guiding vision for the Central Coast Water Board is one of Healthy Watersheds. Healthy Watersheds are sustainable; they support healthy, diverse aquatic habitat, have healthy riparian areas and corridors to maintain healthy habitat, and have near-natural levels of sediment transport. Surface waters meet water quality objectives, sediments are low in pollutants, and groundwater is near natural levels in quantity and quality. All combine to support human and ecosystem health.

Central Coast Water Board

For more information, visit:

Central Coast Water Board: http://www.waterboards.ca.gov/centralcoast/

Central Coast LID Initiative: http://www.centralcoastlidi.org/Central_Coast_LIDI/Home.html

To achieve healthy watersheds—must first identify the "key watershed processes" that support them :

- Overland flow, rilling & gullying
- Infiltration and groundwater recharge
- Interflow (i.e., shallow groundwater flow)
- Evapotranspiration
- Delivery of sediment to waterbodies
- Delivery of organic matter to waterbodies
- Chemical/biological transformations

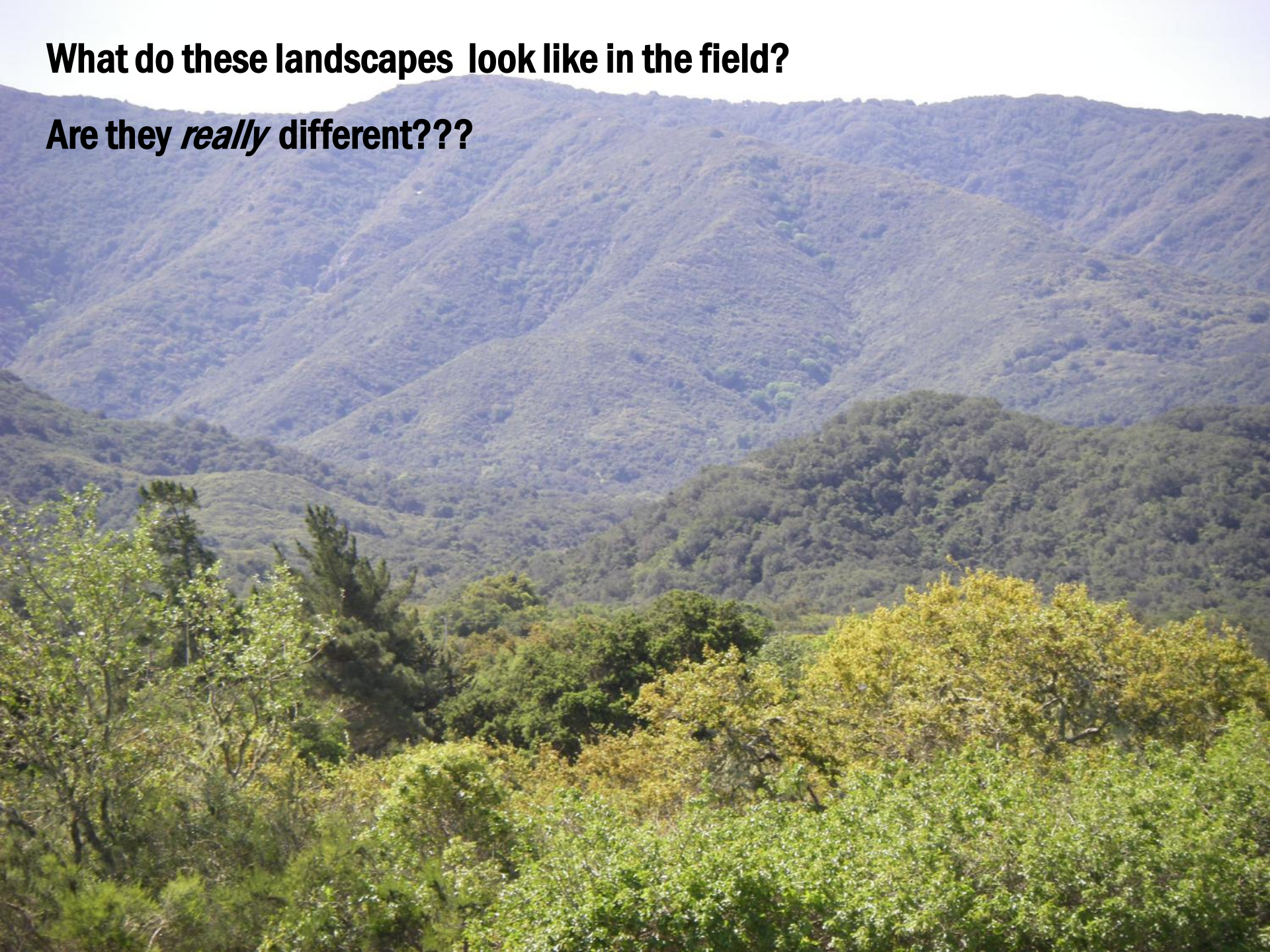
How are these processes recognized and mapped on the landscape?

To recognize? Just go and look!

To map? In an *undisturbed* landscape, they are best determined by a site's GEOLOGY and SLOPE.

But—what about…

- Land use?—not for undisturbed conditions.
- Soils?—useful for site design, but duplicative with geology (and not useful for processes).
- Precipitation?—also relevant, but for primarly for design.


What do these landscapes look like in the field?
Are they *really* different???

IN SUMMARY (Part 2):

1. Key watershed processes can be inferred from observation.

2. The spatial distribution of those processes correlates well (but not perfectly!) with the interplay of underlying geology and slope.

3. Other factors may be useful in design and at finer scales of discrimination, but they do not alter the fundamental patterns and relationships of watershed processes.

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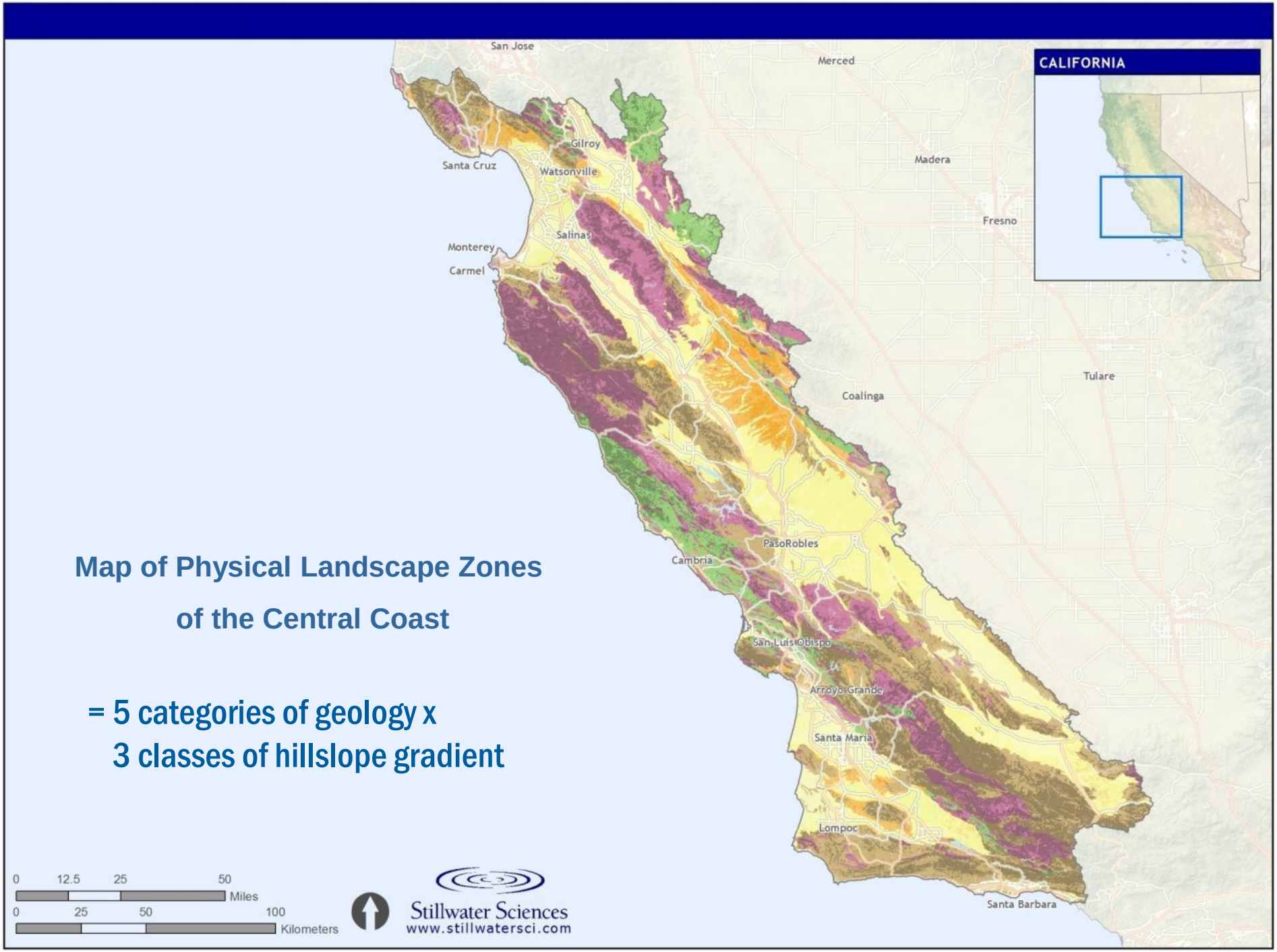
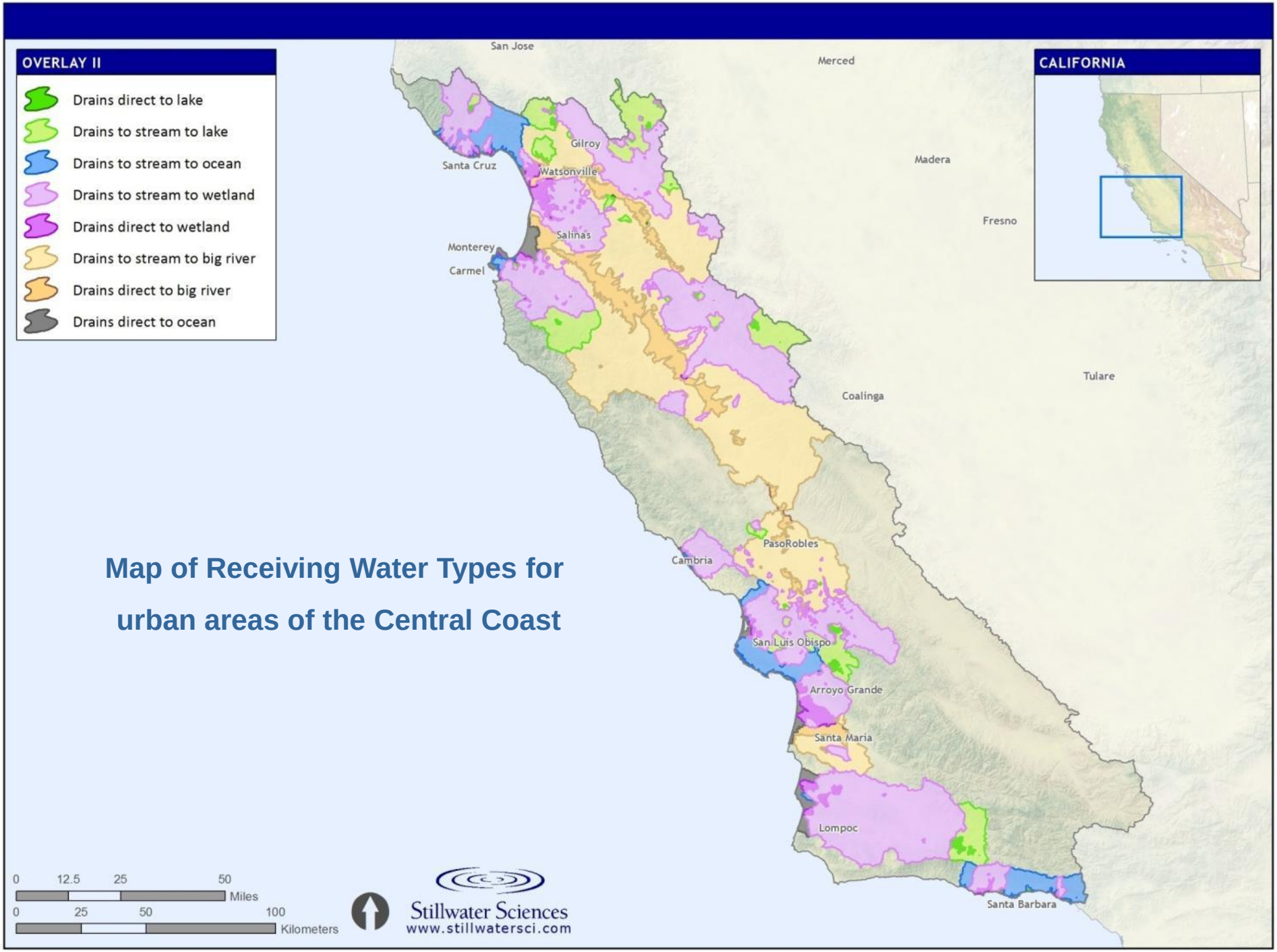

CALIFORNIA
San Jose
Merced
Gilroy
Santa Cruz
Watsonville
Madera
Fresno
Salinas
Monterey
Carmel
Tulare
Coalinga
PasoRobles
Cambria
San Luis Obispo
Arroyo Grande
Santa Maria
Lompoc
Santa Barbara
Map of Physical Landscape Zones
of the Central Coast
= 5 categories of geology x
3 classes of hillslope gradient
0 12.5 25 50 Miles
0 25 50 100 Kilometers
Stillwater Sciences
www.stillwatersci.com


OVERLAY II
Drains direct to lake
Drains to stream to lake
Drains to stream to ocean
Drains to stream to wetland
Drains direct to wetland
Drains to stream to big river
Drains direct to big river
Drains direct to ocean
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Map of Receiving Water Types for
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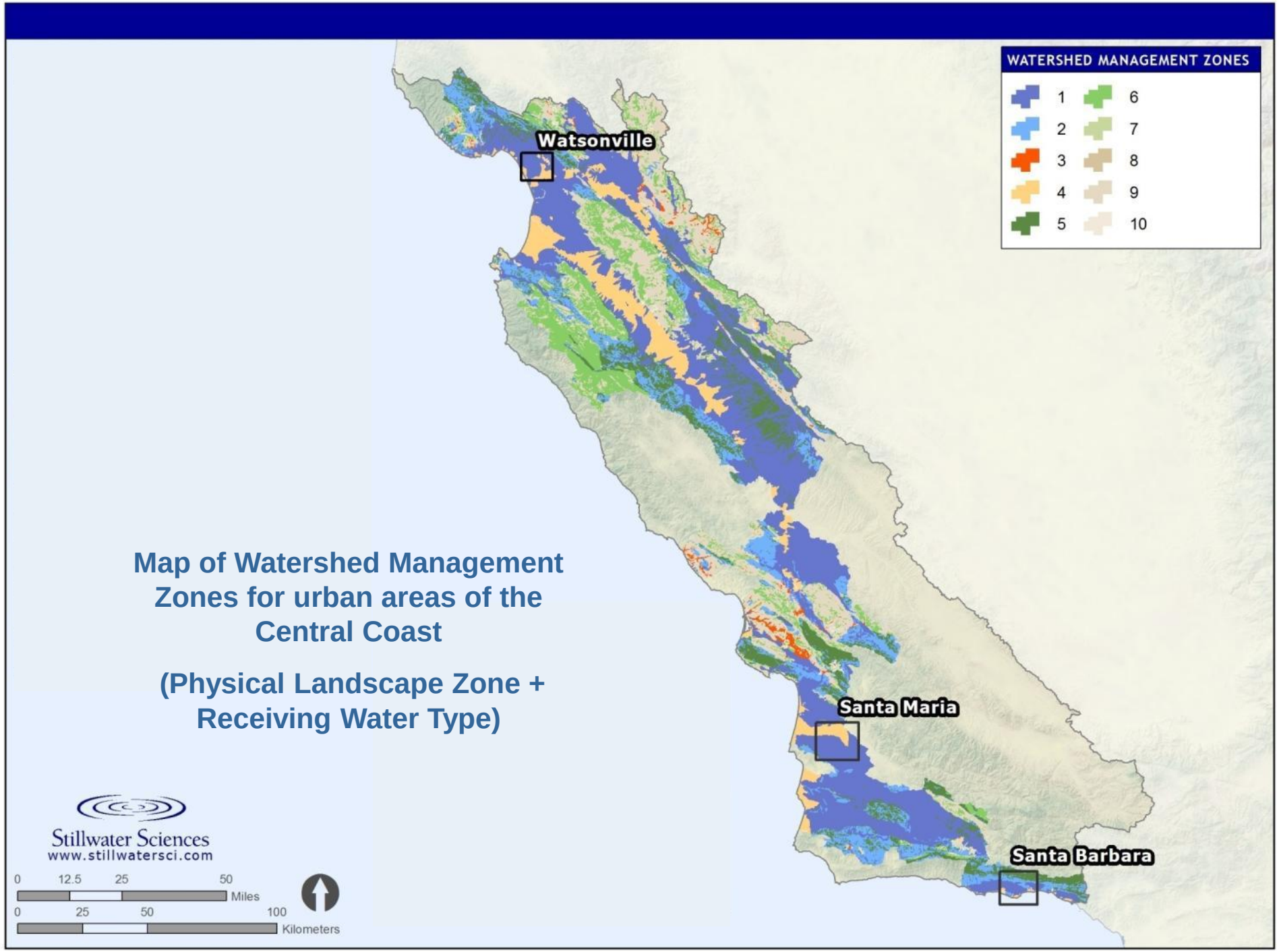


Map of Watershed Management Zones for urban areas of the Central Coast

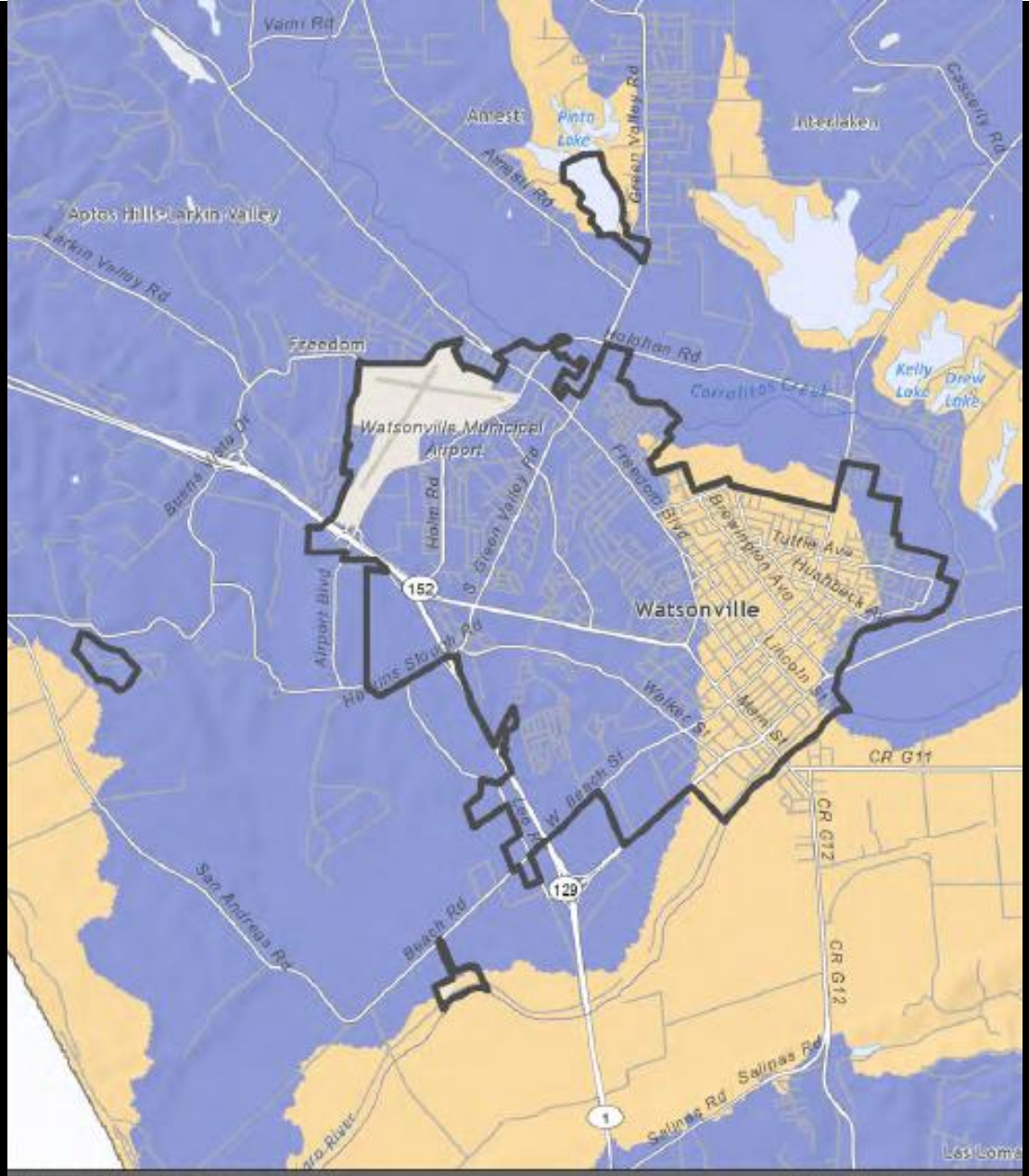
(Physical Landscape Zone + Receiving Water Type)

Stillwater Sciences
www.stillwatersci.com

0 12.5 25 50 Miles

0 25 50 100 Kilometers

Table of Watershed Management Zones (1-10)	DIRECT RECEIVING WATER					
PHYSICAL LANDSCAPE ZONE	Stream	Wetland	Lake	Lake, w/GW basin	Large rivers & marine nearshore	Rivers & marine, w/GW basin
Franciscan mélange 0-10%	3	3	4	4	4	4
Franciscan mélange 10-40%	9	9	10	10	10	10
Franciscan mélange >40%	6	9	10	10	7	7
Pre-Quaternary crystalline 0-10%	3	3	4	4	4	4
Pre-Quaternary crystalline 10-40%	9	9	10	10	10	10
Pre-Quaternary crystalline >40%	6	9	10	10	7	7
Quaternary deposits 0-10%	1	1	4	4*	4	4*
Quaternary deposits 10-40%	1	1	4	4*	4	4*
Quaternary deposits >40%	5	8	10	10*	7	7*
Late Tertiary sediments 0-10%	1	1	4	4*	4	4*
Late Tertiary sediments 10-40%	1	1	4	4*	4	4*
Late Tertiary sediments >40%	5	8	10	10*	7	7*
Early to Mid-Tertiary sed. 0-10%	1	1	4	4*	4	4*
Early to Mid-Tertiary sed. 10-40%	2	2	10	10*	10	10*
Early to Mid-Tertiary sed. >40%	5	8	10	10*	7	7*



CENTRAL COAST JOINT EFFORT — **Watsonville, California**

Watershed management zones

1 2 3 4 5 6 7 8 9 10

Urban area boundary

Data sources
Watershed management zones: Stillwater Sciences, 2012
Base data: ESRI 2010

Miles

Stillwater Sciences
www.stillwatersci.com

Associating WMZ's with Stormwater Control Practices

Preserve/maintain ● ◕ ◑ ◔ ○ No benefit

WMZ #1 (OF, GW; also IF, ET) Management Strategy	Example Criteria	Watershed Processes: Overland flow	Infiltration and groundwater recharge	Interflow	Evapotranspiration	Delivery of sediment to waterbodies	Delivery of organic matter to waterbodies	Chemical/biological transformations
Flow Control	San Diego County – Hydromodification Plan	○	◕	◕	◑	○	○	◕
	Section 438 of EISA – Retain 95th Percentile Event	◕	◕	◕	◕	○	○	◕
	State of New Jersey – Groundwater Recharge	◑	●	●	◑	○	○	◑
Water Quality Treatment	City of Santa Monica – Urban Runoff Mitigation Plan	◑	◕	◕	◕	○	○	◕
Land Preservation	King County, Washington – Requirements for Sensitive Watersheds	◕	◕	◕	◕	◕	◕	◑
	State of Delaware – Final Draft Stormwater Regulations to Minimize Effective Impervious Area	◕	◕	◕	◕	○	○	◕

WMZ 1 = low to mid-gradient, infiltrative sedimentary deposits; drains to stream or wetland

Associating WMZ's with Stormwater Control Practices

Preserve/maintain ● ◕ ◑ ◔ ○ No benefit

WMZ #5 (DS / GW, IF, ET) Management Strategy	Example Criteria	Watershed Processes: Overland flow	Infiltration and groundwater recharge	Interflow	Evapotranspiration	Delivery of sediment to waterbodies	Delivery of organic matter to waterbodies	Chemical/biological transformations
Flow Control	San Diego County – Hydromodification Plan	○	◕	◕	◑	○	○	◕
	Section 438 of EISA – Retain 95th Percentile Event	◕	◕	◕	◕	○	○	◕
	State of New Jersey – Groundwater Recharge	◑	●	●	◑	○	○	◑
Water Quality Treatment	City of Santa Monica – Urban Runoff Mitigation Plan	◑	◕	◕	◕	○	○	◕
Preserve Delivery of Sediment and Organics	Santa Cruz – City-wide Creeks and Wetlands Management Plan (Variable Width)	◔	◑	◔	◔	◕	◕	◔
Land Preservation	King County, Washington – Requirements for Sensitive Watersheds	◕	◕	◕	◕	◕	◕	◑
	State of Delaware – Final Draft Stormwater Regulations to Minimize Effective Impervious Area	◕	◕	◕	◕	○	○	◕

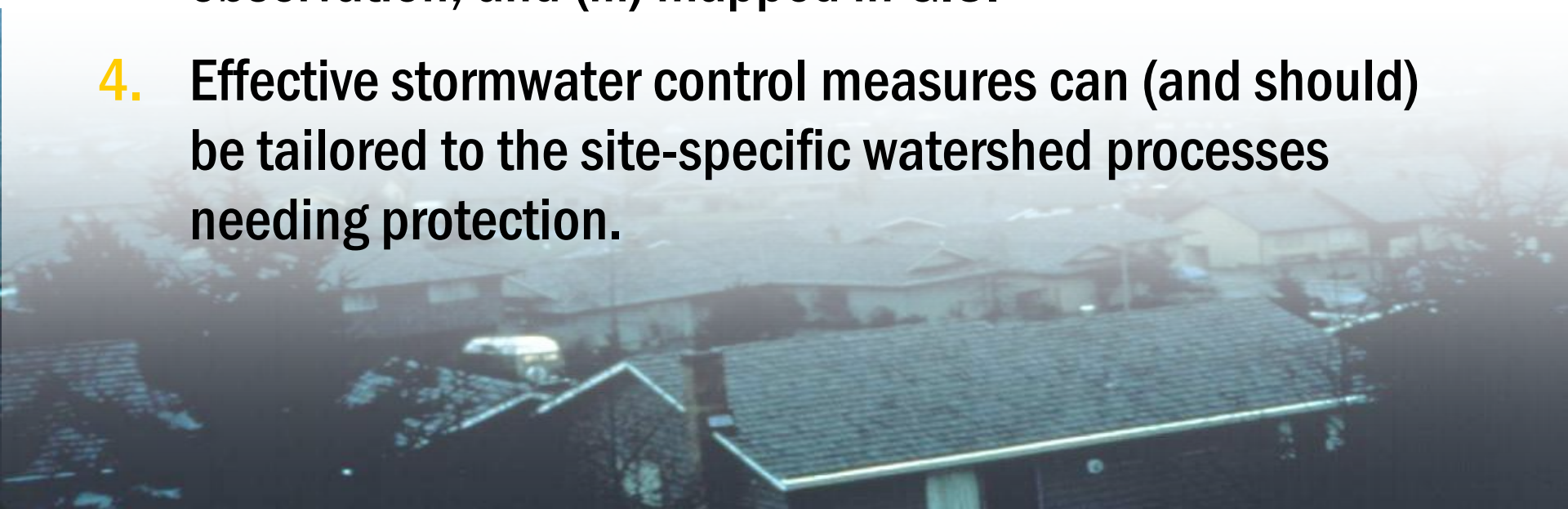
WMZ 5 = steep infiltrative sedimentary deposits; drains to stream

IN SUMMARY (Part 3):

1. "Watershed Management Zones" = the combination of [geology + slope] and [receiving-water type].
2. WMZ's are easily mapped in GIS, at a level of detail determined by the scale of the underlying data.
3. Effective stormwater control strategies can be associated with each WMZ. But....
4. It's not entirely "simple"—implementation also needs to provide easy off-ramps for small projects.

SUMMARY

1. "Stable stream channels" is a overly narrow, unworthy goal for hydromodification control in the 21st century.
2. Watersheds and receiving waters are not everywhere the same; for hydromodification, one size does NOT fit all.
3. Coarse-scale but robust discrimination of key watershed processes can be (i) identified in theory, (ii) confirmed by observation, and (iii) mapped in GIS.
4. Effective stormwater control measures can (and should) be tailored to the site-specific watershed processes needing protection.



This is not a desired outcome…


...but neither is this.


Central Coast
Water Board
BREN SCHOOL OF
ENVIRONMENTAL SCIENCE
& MANAGEMENT
University of California, Santa Barbara
CENTER FOR WATER
& LAND USE
Stillwater Sciences