SCCWRP & SFEI Stormwater Research Programs and Priorities

SFEI and SCCWRP Have A Similar Stormwater Niche

- Both have stormwater regulated and regulatory agencies on our Boards
- Both have a great collection of top notch scientists
- Both are driven by applied research needs
  - Management utilization and improved decisionmaking
- Our goal is to help define where we have similar foci
  - Where and/or why they differ

Statewide Priority Issues

- Bio-objectives
- Hydromodification
- Low impact development assessment
- Stormwater toxicity
- Contaminant loading & modeling
- Design storm / Numeric sizing criteria
- Emerging contaminants in stormwater
- Cross-media contamination
  - Air – surface water
  - Groundwater - surface water
- Alternate floodplain management
- Fire effects

Comparison of Research Priorities

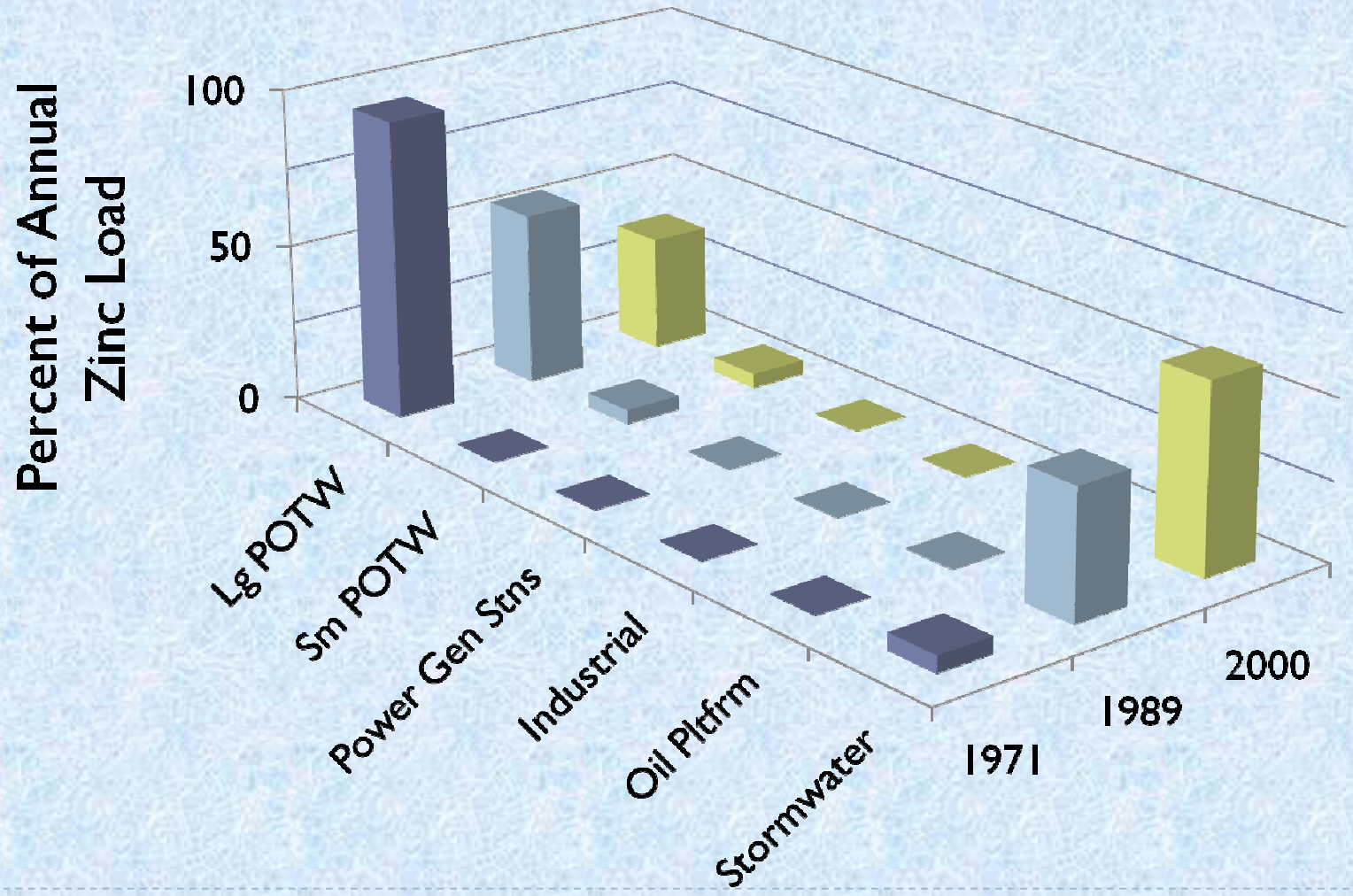
	SCCWRP	SFEI
Bio-objectives	XX	
Hydromodification	XX	
LID Assessment/design		XX
Stormwater toxicity	X	X
Contaminant loading/modeling/BMP support	XX	XX
Design storm / Numeric sizing	X	
Emerging contaminants	X	X
Cross-media contamination	X	
Alternative floodplain management/geomorphic assessments		XX
Fire effects	X	

X = active research area
XX = priority research area

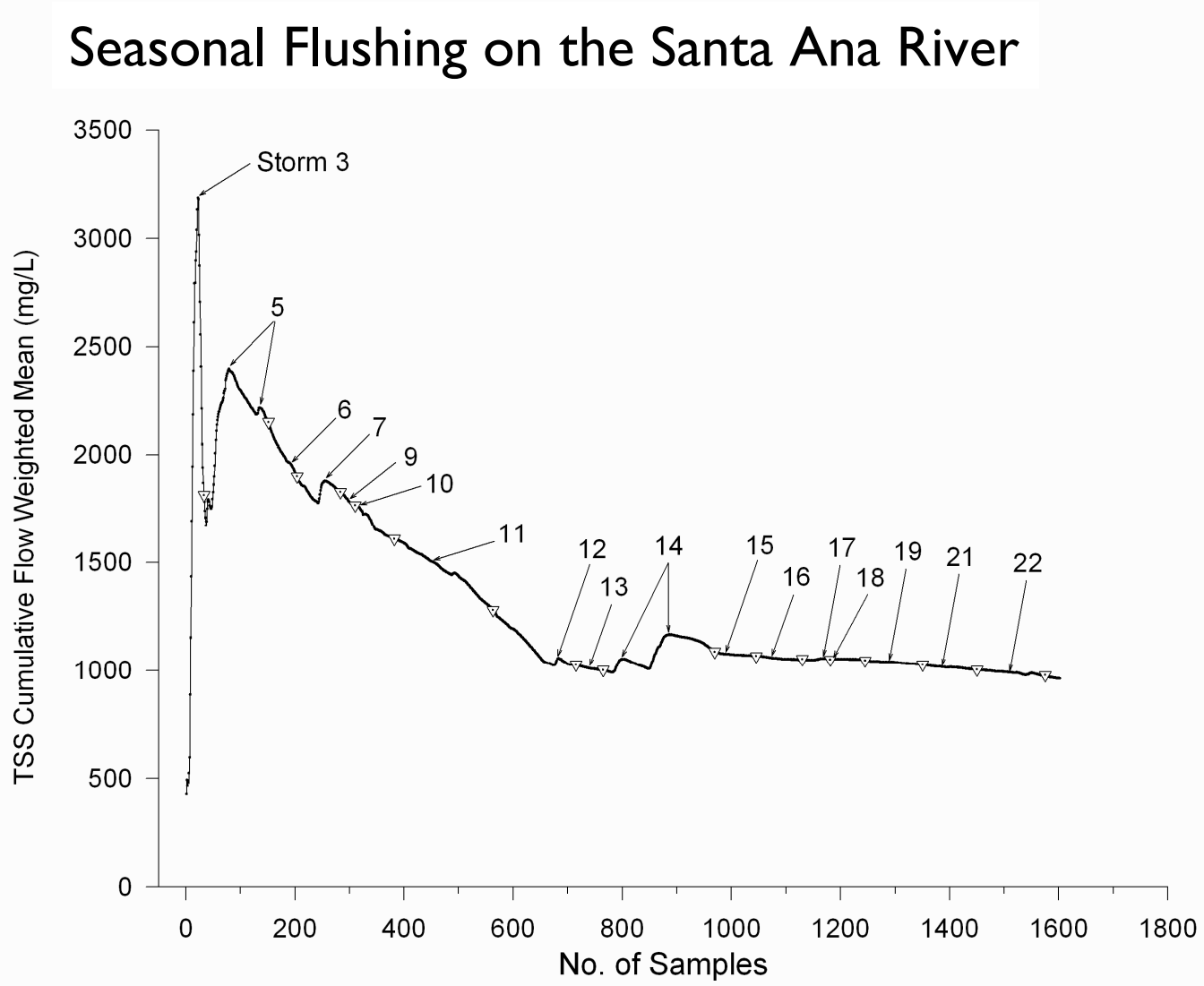
SCCWRP Stormwater Questions For Today

- **Watershed loading/modeling**
  - What are the sources and loads of contaminants to our estuaries/ocean?
  - What is the most efficient and effective way to reduce contaminant loads (or concentrations)?
- **Hydromodification**
  - What is the physical condition of streams?
- **Regional monitoring**
  - What is the regional condition and how is it changing over time?

Storm Water Can Be An Important Pathway



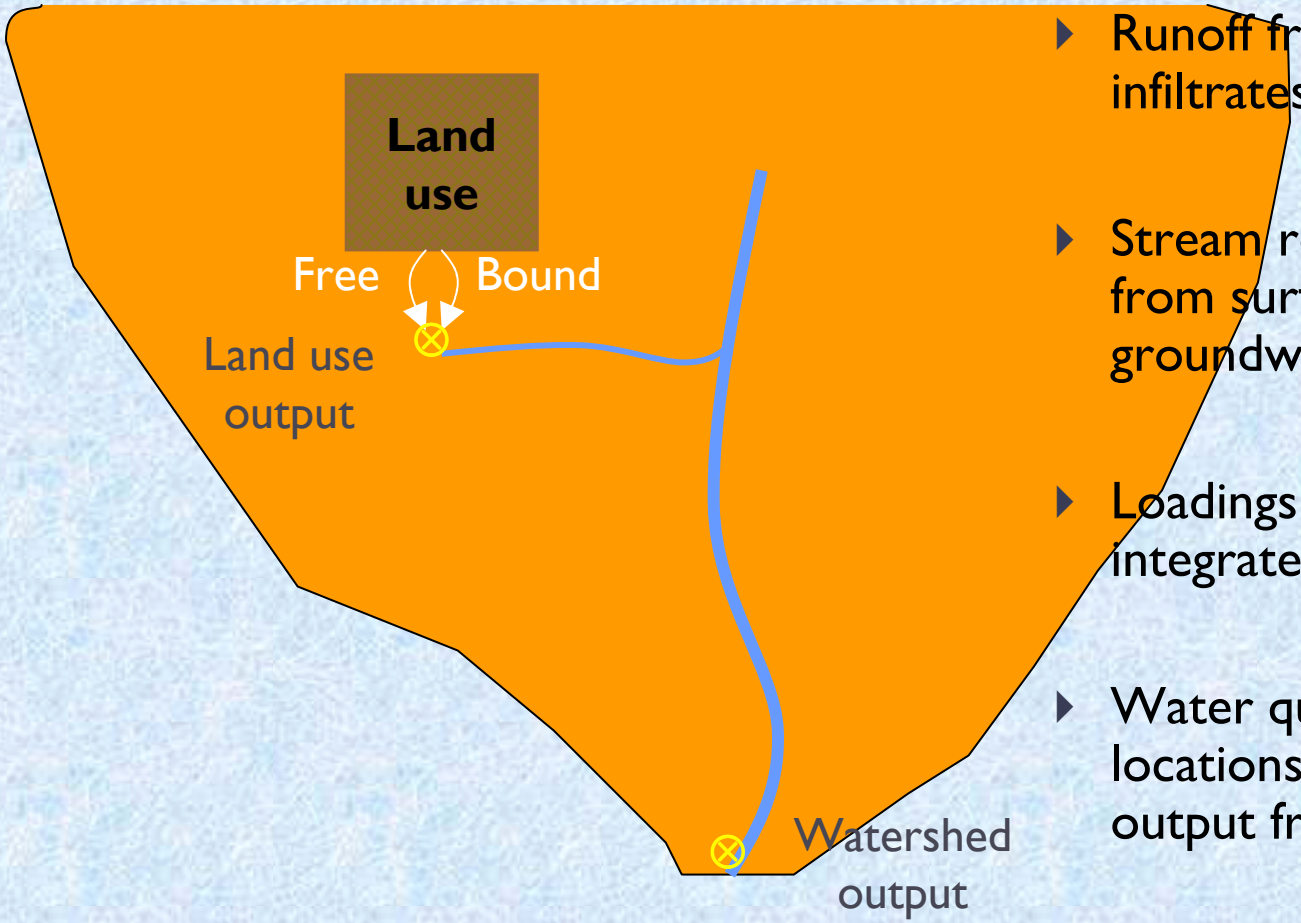
Stormwater Estimates Aren't Easy



Models Are a Valuable Tool

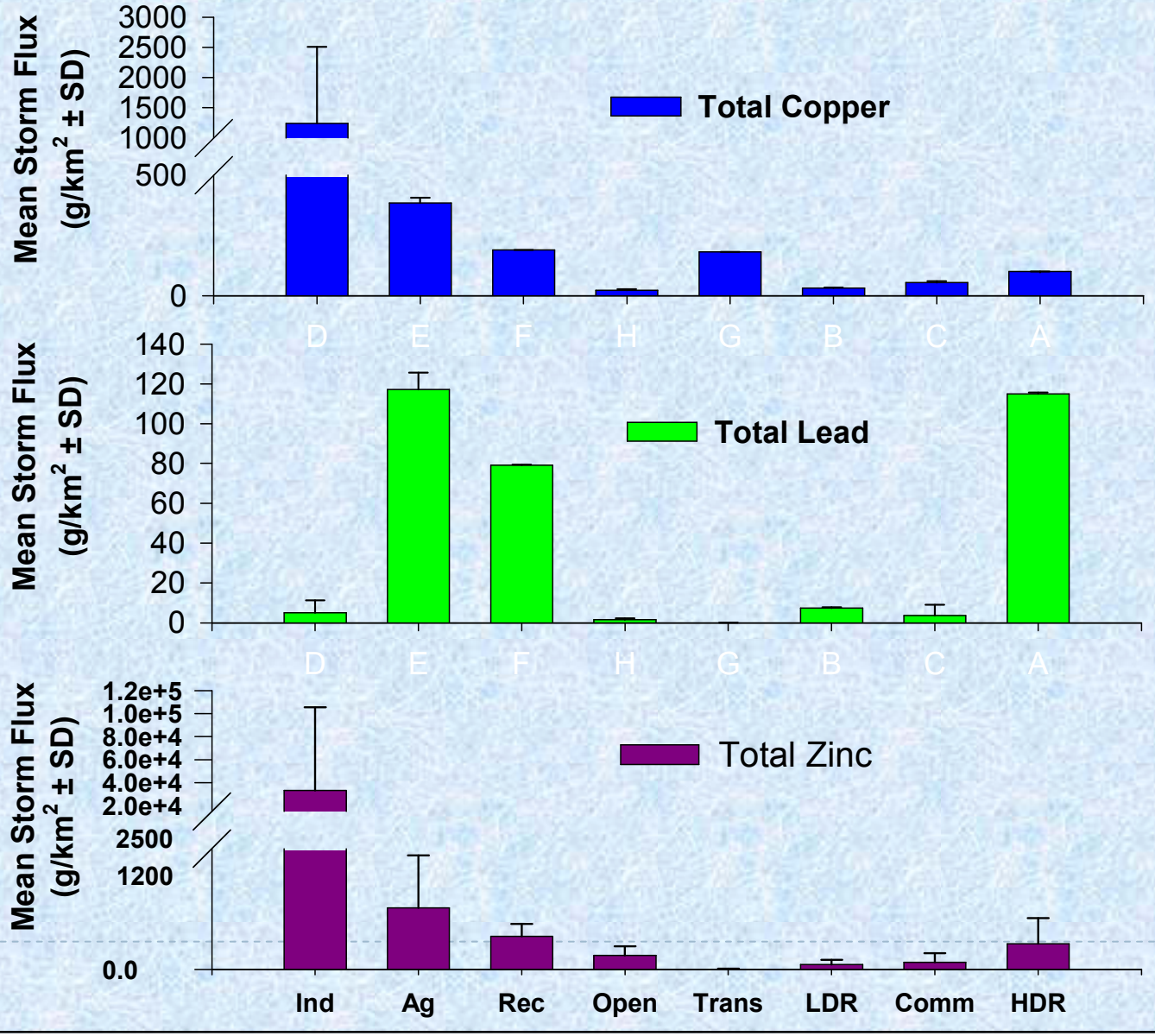
- Help fill gaps in space and time
  - Missing storms, watersheds
- Helps identify potential sources
  - Source areas
- Identify knowledge gaps
  - Focus for future research
- Determine the most cost efficient management scenarios
  - "What if …….?"

General Modeling Approach

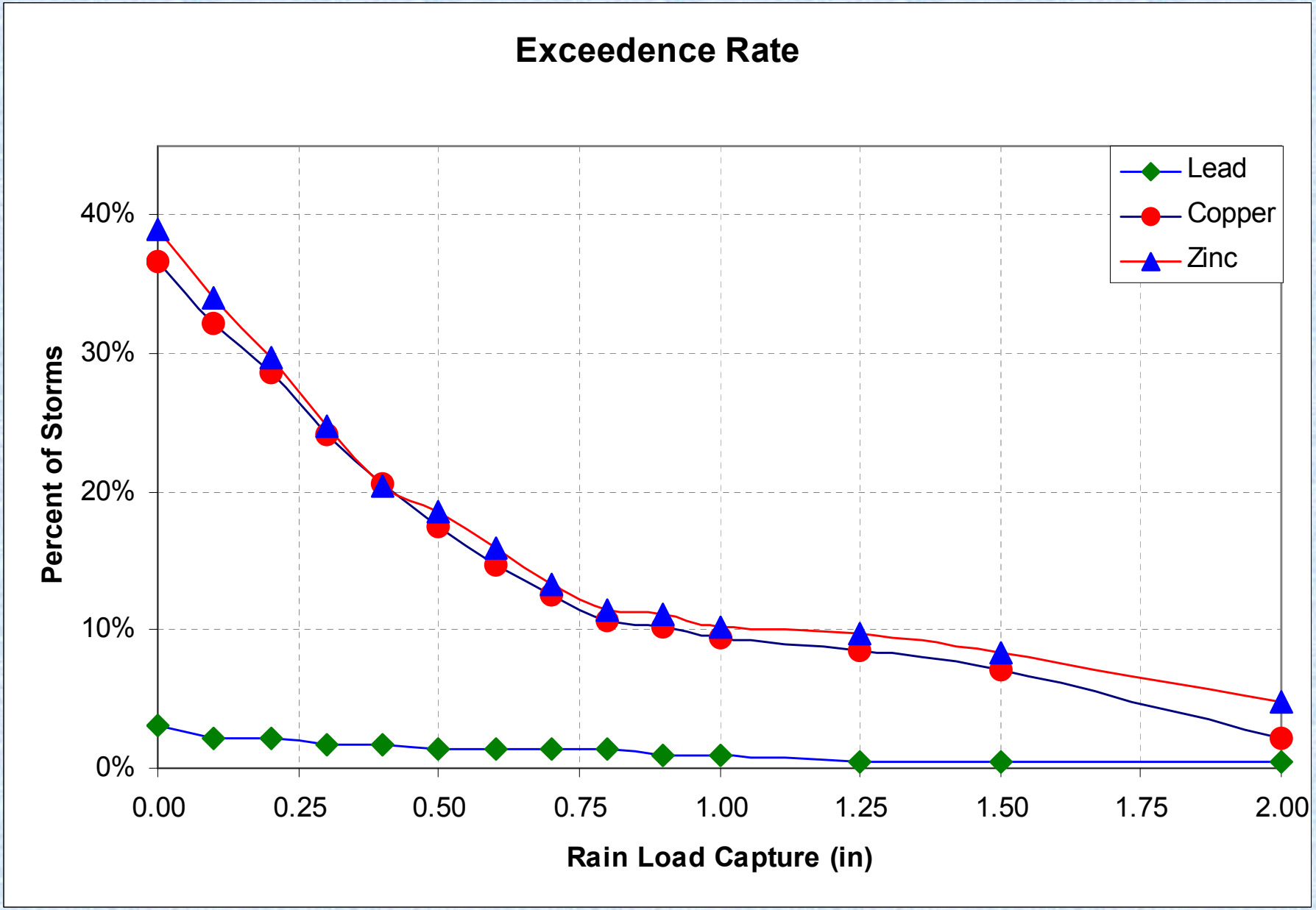


- Runoff from land surfaces either infiltrates or runs off
- Stream receives contributions from surface runoff and active groundwater
- Loadings from specific land uses integrated across sub-basins
- Water quality at downstream locations determined based on output from each sub-basin

Empirical Metals Flux by Land Use



Modeled Water Quality Targets for BMPs



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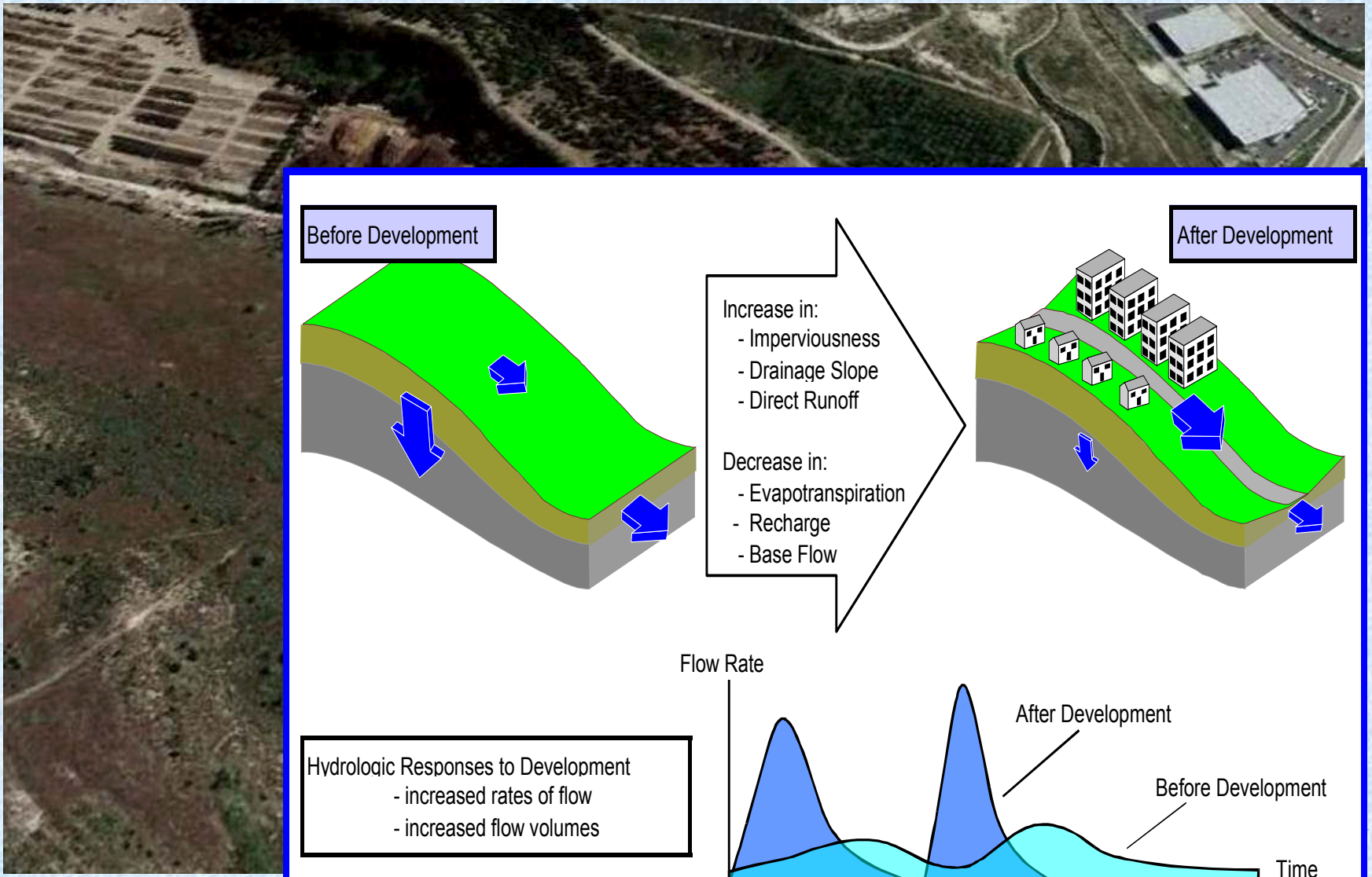
Hydromodification: Channel Erosion



Hydromodification Tool Development

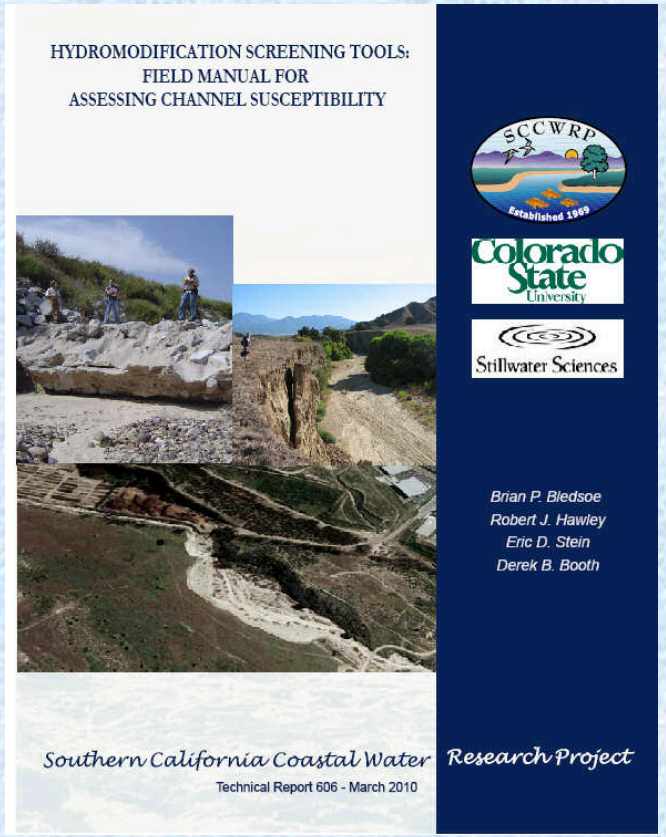
1. Which streams are at the greatest risk of effects of hydromodification? → ***Screening Tool***

2. What are the anticipated effects in terms of increased erosion, sedimentation, or habitat loss, associated with increases in impervious cover? → ***Modeling Tools***

3. What are some potential management measures that could be implemented to offset hydromodification effects?
   → ***Management Tools***

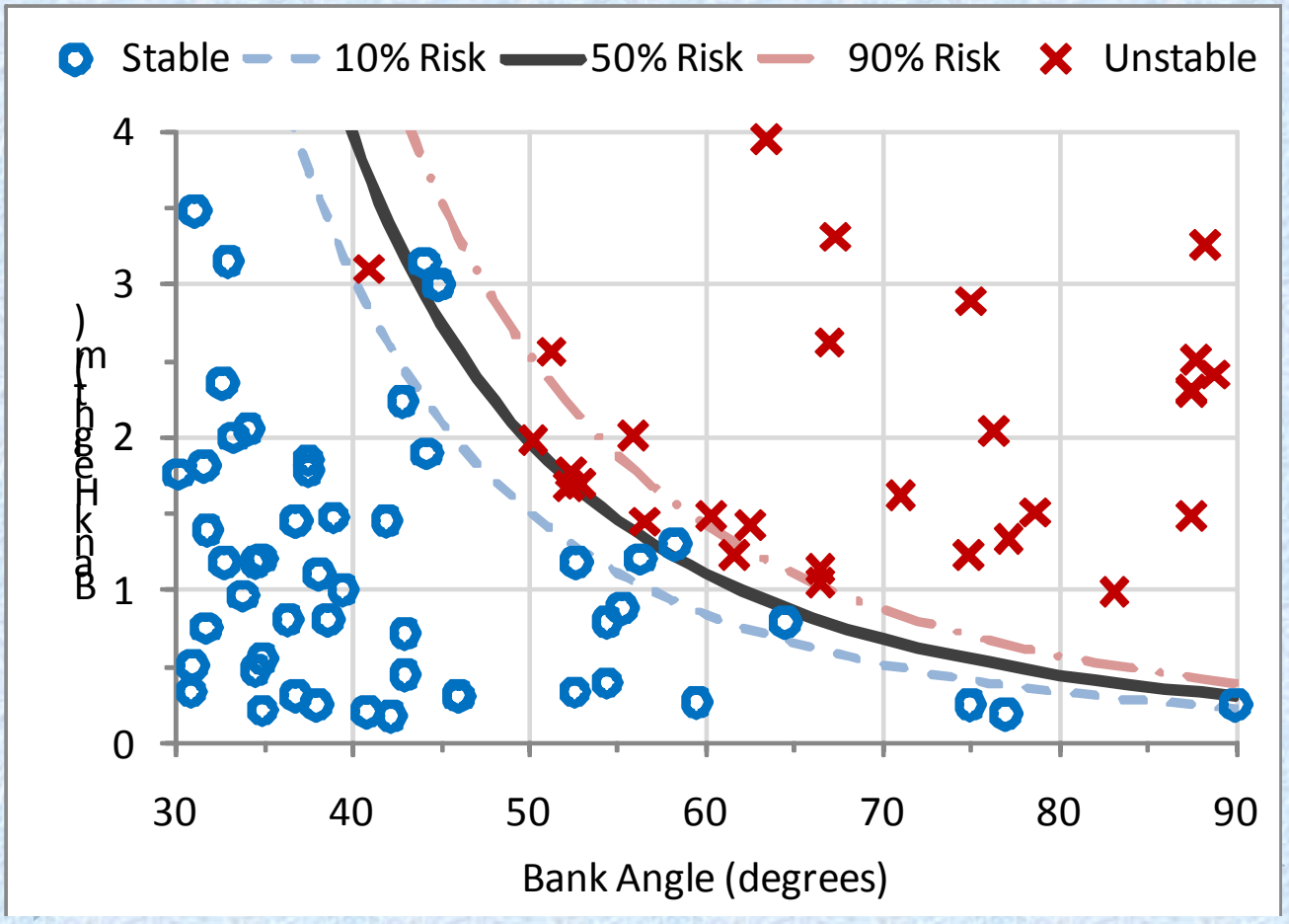
Screening Tool General Approach

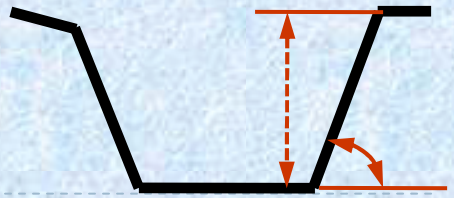
- Decision trees
  - Clear endpoints – *very high, high, medium, low*
  - repeatable
- Separate analysis for vertical vs. lateral response
- Simple to apply field metrics
  - Does not rely on complex field measures
  - Empirically derived relationships
- Rapid - < 1 day in office + 1 day in field
- Classification informs management decisions
  - Adaptive trigger



Example – Bank Height vs. Angle

probability of mass wasting
in moderately/well consolidated banks





SCCWRP Stormwater Questions For Today

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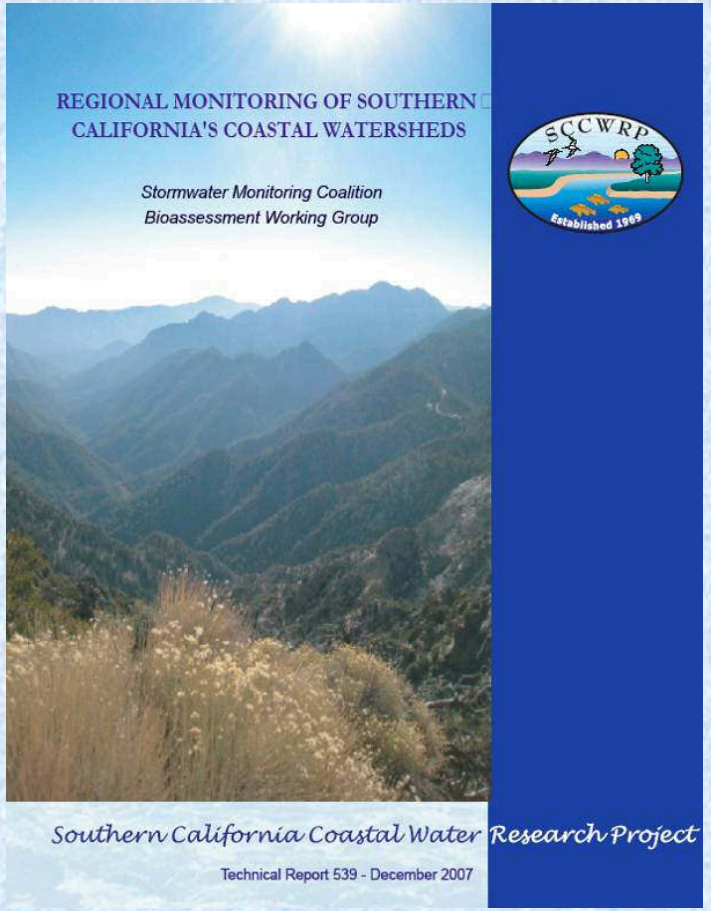
Regional Watershed Monitoring Program

1. What is the condition of streams in our region?
2. What are the stressors that affect stream condition?
3. Are conditions getting better or worse?



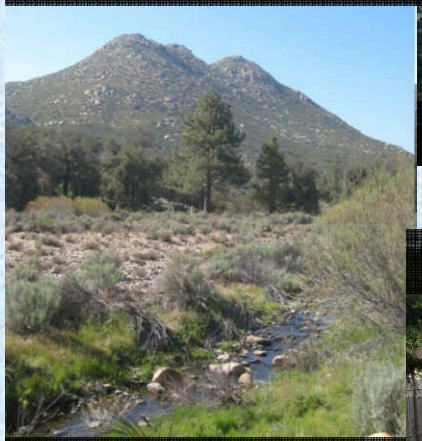
Monitoring Design

- Integrated, collaborative monitoring
  - All So Cal MS4 permittees
  - All So Cal RWQCBs and SWRCB
- Probabilistic design
  - Stratified by watershed (N=15)
  - Land use (Urban, Ag, Open)
- Multiple indicators of condition
  - Benthic invertebrates
  - Algae
  - Riparian
  - Toxicity
  - Chemistry

Agricultural

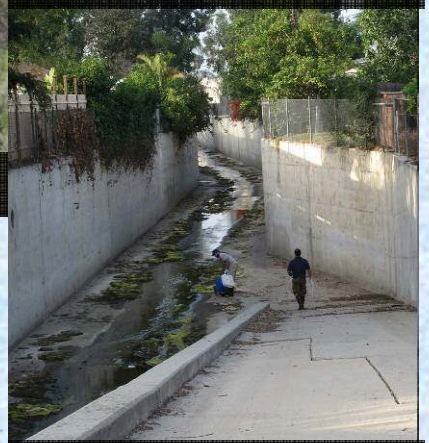
San Pasqual Valley

Open

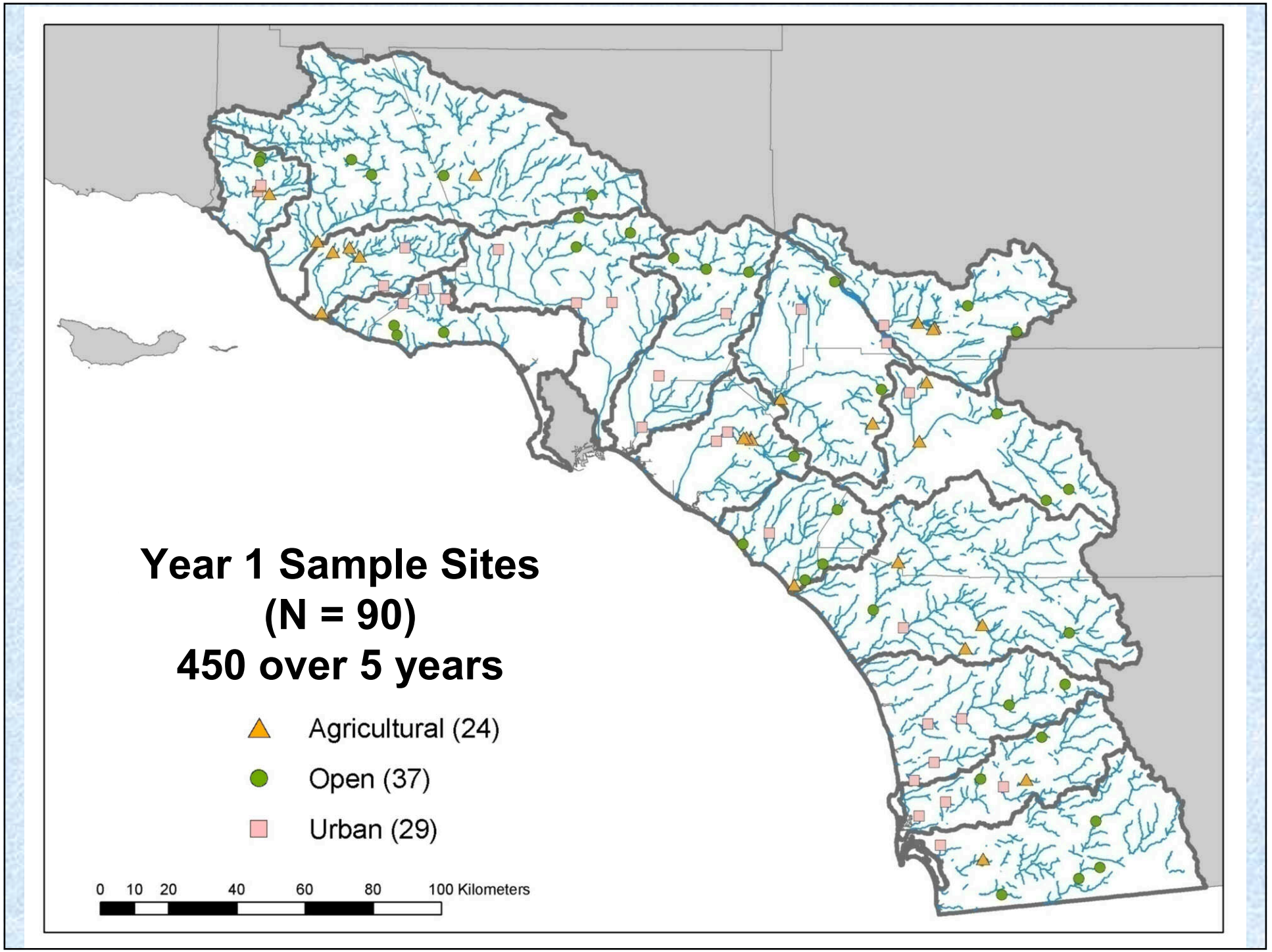


Pine Valley Creek

Urban



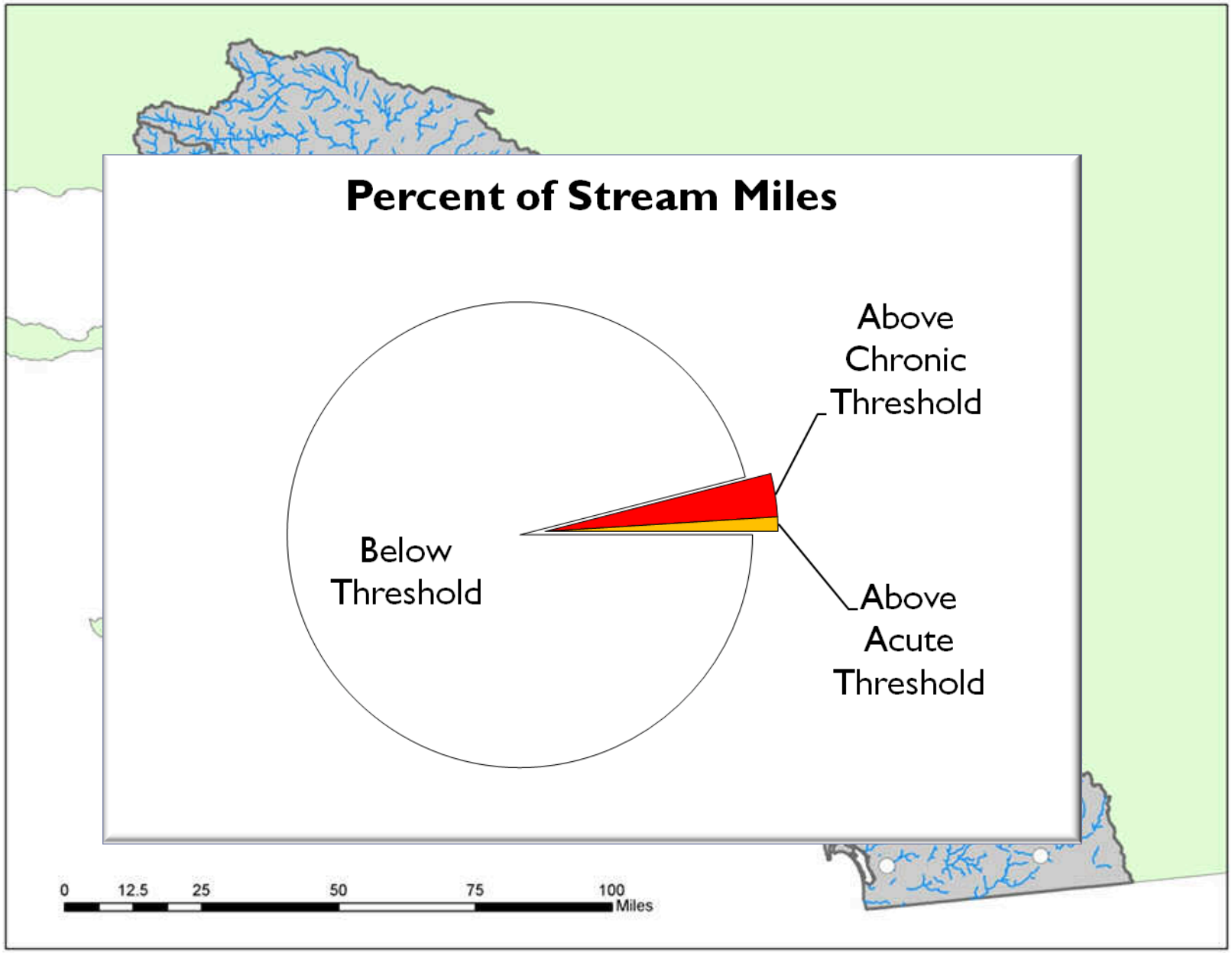
Fullerton Creek


Year 1 Sample Sites
(N = 90)
450 over 5 years
Agricultural (24)
Open (37)
Urban (29)
0 10 20 40 60 80 100 Kilometers

Watershed Monitoring Partners

- Ventura County WPD
- Los Angeles County DPW
- Orange County RDMD
- Riverside County FCD
- San Bernardino County FCD
- San Diego County DEH
- City of Los Angeles WPD
- San Diego RWQCB
- Santa Ana RWQCB
- Los Angeles RWQCB
- State Water Resources Control Board
- US EPA
- CA Dept. of Fish & Game

Stream Condition: Total Copper



Regional Monitoring Intangibles

- Leveraged resources
  - Additional expertise not available in-house
  - Indicator add-ons
- Intercalibrations, training and audits of participating agencies
  - Raises everyone's level of quality
- Monitoring infrastructure
  - SOPs, QAPPs, Data protocols
- Scientific consensus on results and interpretation
  - Communication is perhaps the greatest value

Comparison of Research Priorities

	SCCWRP	SFEI
Bio-objectives	XX	
Hydromodification	XX	
LID Assessment/design		XX
Stormwater toxicity	X	X
Contaminant loading/modeling/BMP support	XX	XX
Design storm / Numeric sizing	X	
Emerging contaminants	X	X
Cross-media contamination	X	
Alternative floodplain management/geomorphic assessments		XX
Fire effects	X	

X = active research area
XX = priority research area

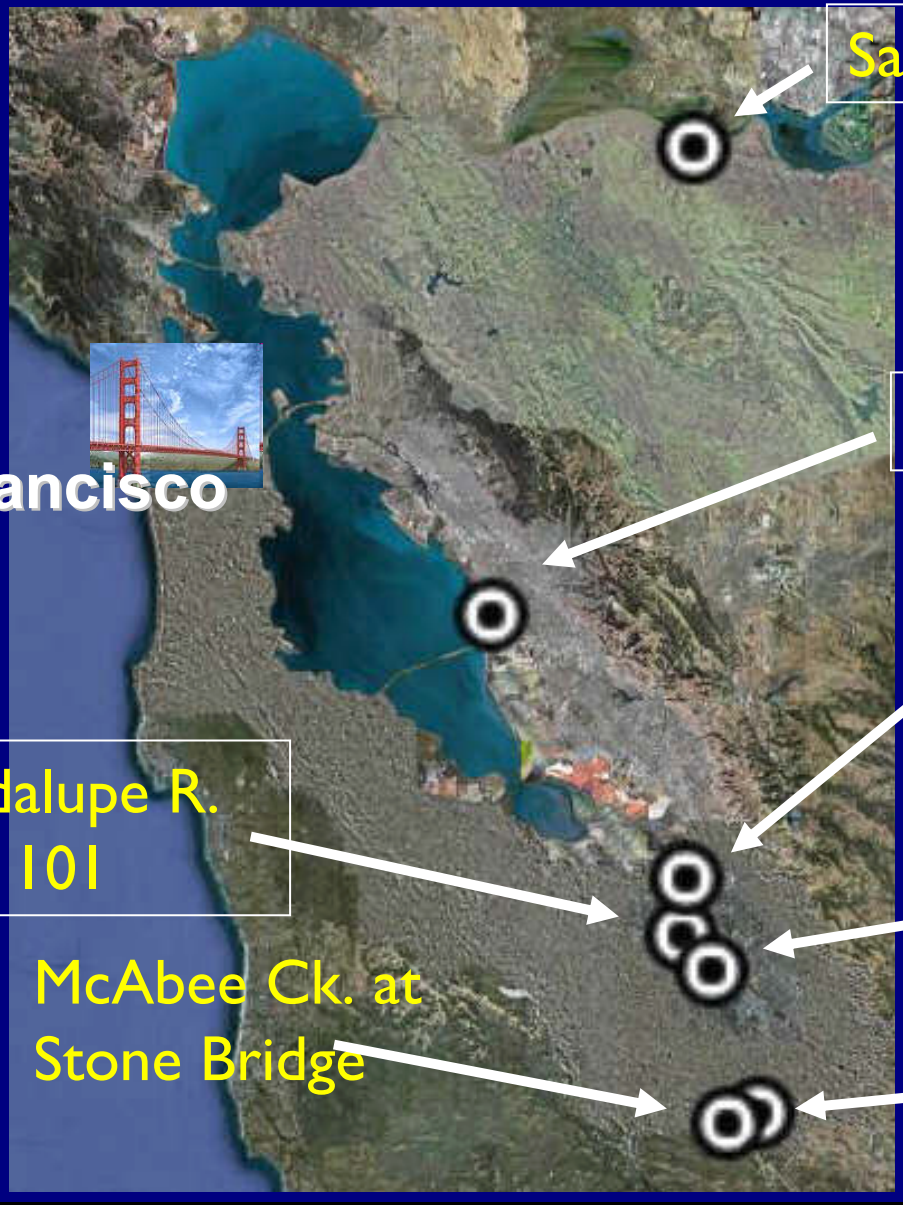
SFEI Stormwater Questions

- **Impairment:** Which are the "high-leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
- **Loads:** What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
- **Trends:** How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?
- **Management actions:** What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries and where should management actions be implemented in the region to have the greatest impact?

SFEI Stormwater Questions

- What is the condition of creek channels in the Bay Area?
  - **Goals:** What do we want the channels to be able to do?
  - **Form:** Why do they look the way they do and how are they changing?
  - **Management:** Are there alternative designs or management regimes that can help channels to meet more of the goals?
  - **Linkage:** How can watershed and channel management help to meet goals for the Bay?

SFEI Empirical Stormwater Observations



SFEI Watershed Loading

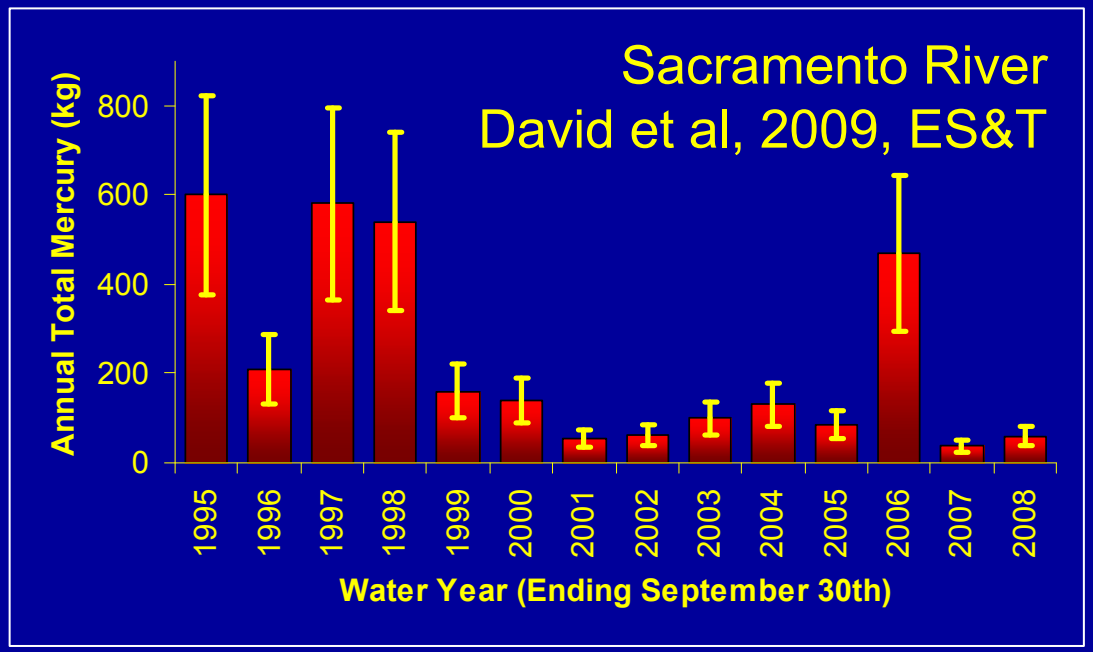
Sacramento River

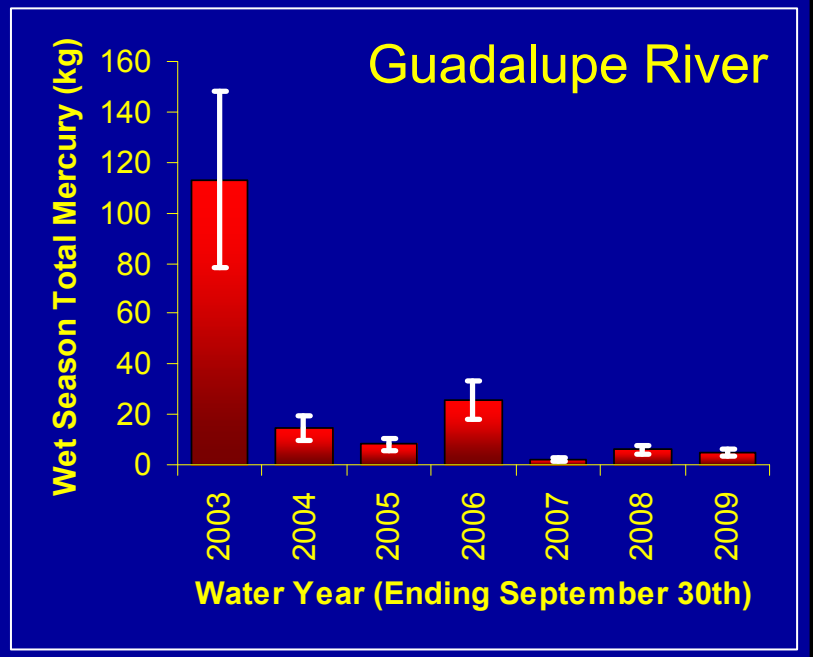
Guadalupe River

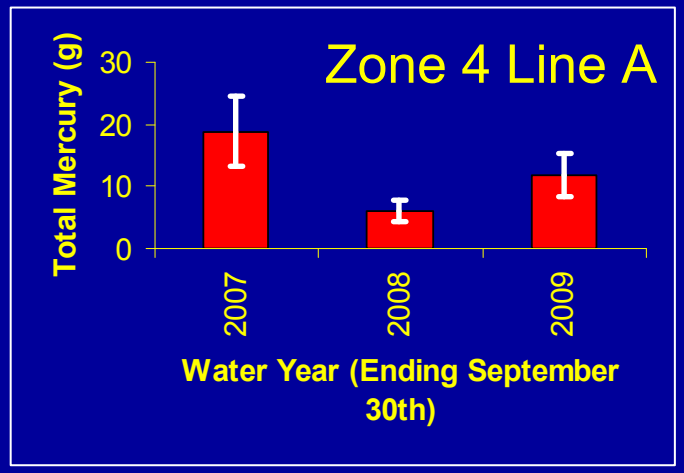
Zone 4 Line A

- Continuous turbidity
- Discrete sampling (13-50 samples/wet season)
- Turbidity surrogate regression estimator
- Continuous flow
- Daily, 15, and 5 min loads calculations

SFEI Watershed Loading







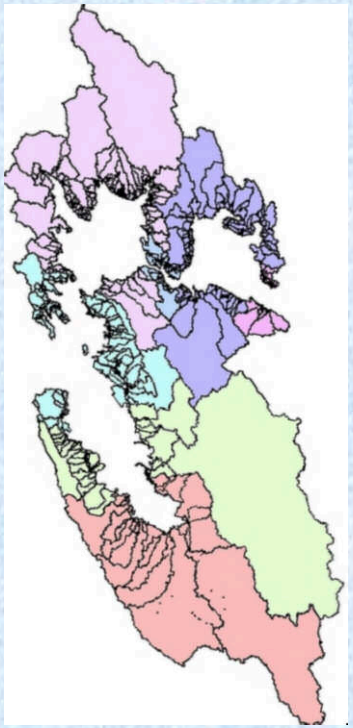
SFEI General Modeling Approach

- Two levels depending on questions:
  - Regional water, sediment, and contaminant loads?
    - SIMPLE model (or a hybrid) at an annual time step
      - Davis et al., 2000
      - Lewicki and McKee, 2009
      - Lent et al., 2010 (in prep)
  - Watershed specific questions (HSPF–runoff simulation model)
    - Future predicted channel geometry?
      - Lewicki, 2008
      - Oram, 2009
    - Future predicted loads based on BMP/attenuation scenarios?
      - Oram et al., 2008 (Environment International, 28)
      - Lent et al., 2009
      - Lent et al. (in prep)

SFEI Modeling Approach - SIMPLE

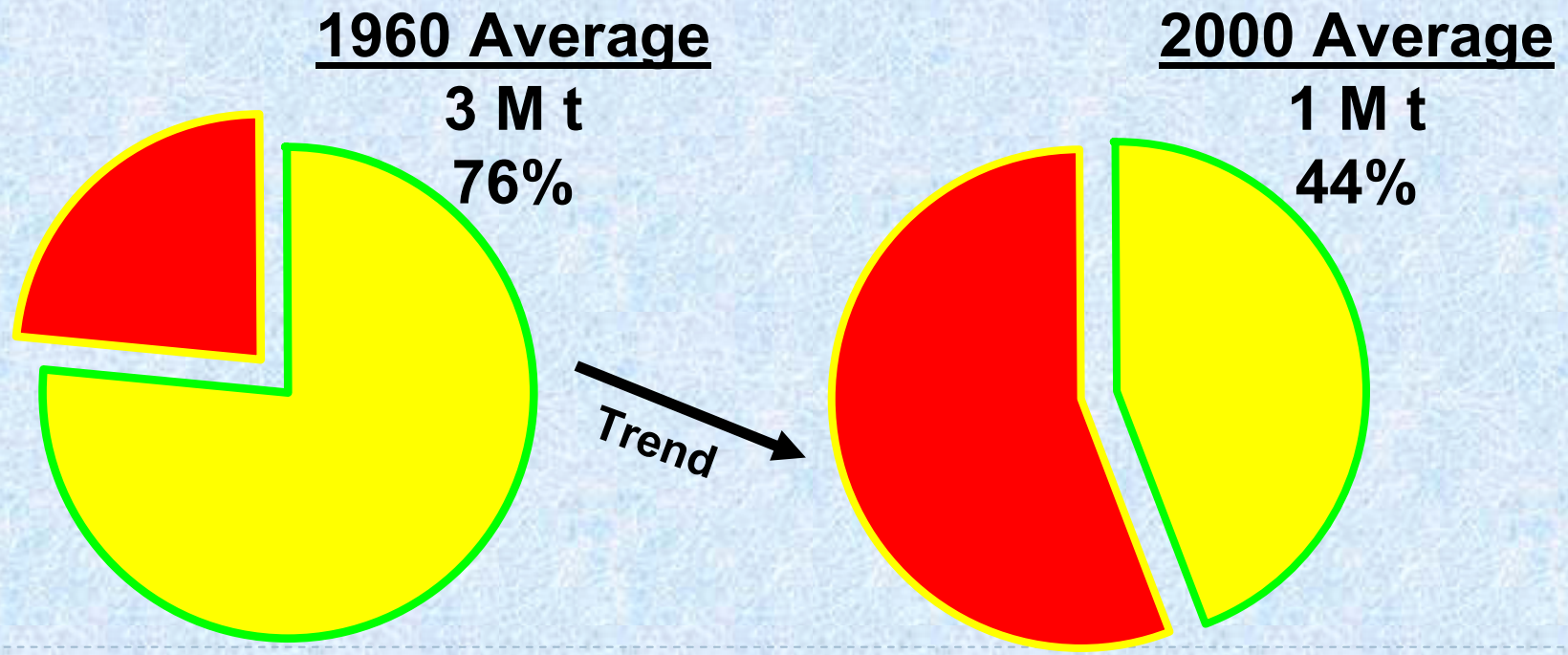
- Lewicki and McKee, 2009

RMP Bay Segment	Load (t/year)
Rivers	27,353
Suisun Bay	203,453
Carquinez Strait	25,693
San Pablo Bay	281,789
Central Bay	246,170
South Bay	270,202
Lower South Bay	214,940
Total	1,269,606
Central Valley (Sacramento River at Mallard Island) (McKee et al., 2006)	1,000,000



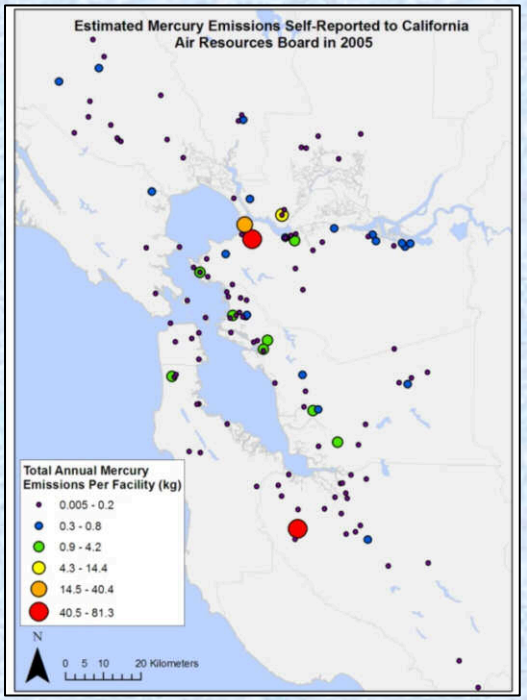
Present Sediment Story

- Lewicki and McKee, 2009
- McKee et al., 2006 (Journal of Hydrology)
- Bay sediment supply has switched from Central Valley dominated to **local small tributary dominated**



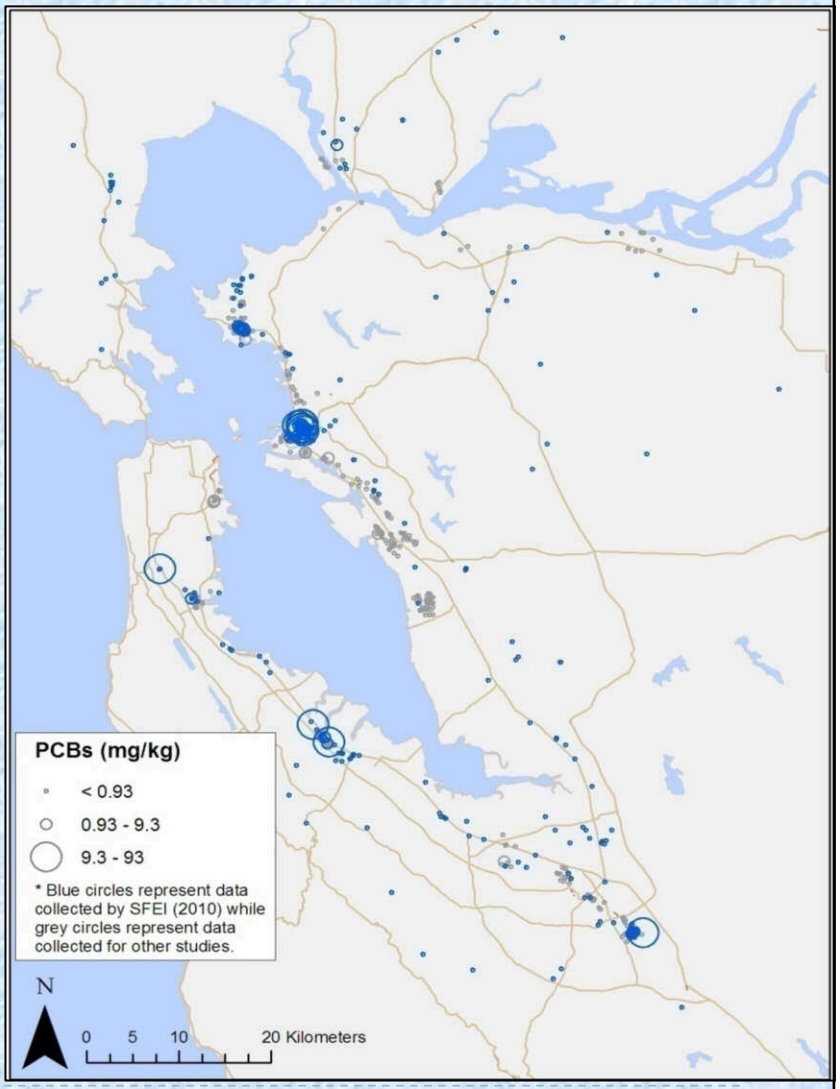
SFEI Source Tracking and BMP Support

- Data bases and GIS maps
  - Over 650 soil and sediment concentrations
  - PG&E facilities
  - Auto dismantler facilities
  - Known contaminated areas, spills and locations of Hg and PCBs-related regulatory actions
  - Historic railway lines
  - Historic and modern industrial land use
  - Over 250 mapped pump station facilities
  - Landfills
  - Hg Air emission point source estimates



Source Tracking - Sediment and Soils Patch Analysis (Draft – do not cite or quote)

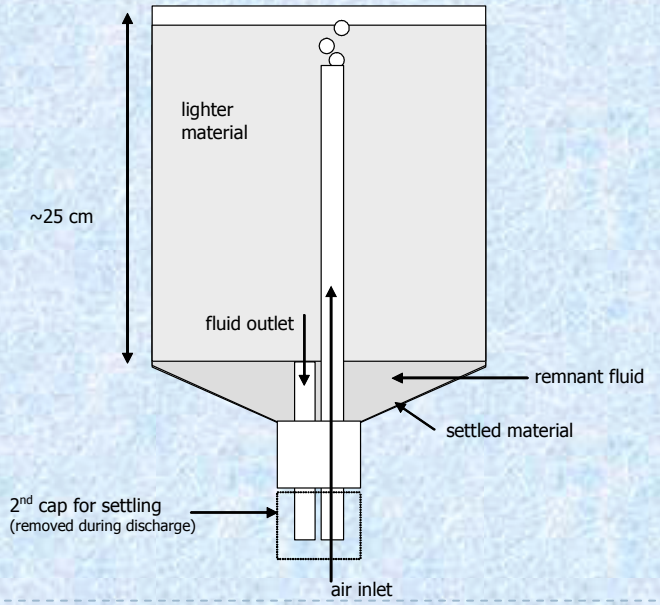
Patches Sampled	Number of samples with PCB ≥ 0.11 mg/kg	Portion of total number sampled
San Francisco	8	67%
Port of Oakland	9	53%
Vallejo	4	44%
Sunnyvale	4	44%
Oakland	11	39%
Richmond	15	38%
San Bruno	5	38%
San Carlos	15	38%
Emeryville	2	33%
Berkeley	4	31%
South San Fran	3	20%
San Leandro	5	13%
Hayward	3	8%
San Jose	2	3%



BMP Support

- Project examples:
  - E2100 tech support, design review, data base support
  - Senedor mine remediation (Santa Clara County Parks/URS)
  - SFEI, 2010 (in review). A BMP tool box for reducing Polychlorinated biphenyls (PCBs) and Mercury (Hg) in municipal stormwater.
  - Yee and McKee, 2010 (in review – do not cite or quote)

	Minimum	Maximum	Average
Hg			
<2 min	3%	12%	7%
<20 min	10%	28%	17%
PCB			
<2 min	14%	46%	31%
<20 min	27%	72%	53%



SFEI LID Assessment/Design

- Six projects presently underway:
  - **Green Infill-Clean Stormwater** (SFEP/Daly City)
  - **El Cerrito Green Street Pilot** (SFEP/City of El Cerrito)
  - **North Richmond Pump Station** (SFEP/Contra Costa County)
  - **Newcomb Ave Model-Block** (SFEP/City of San Francisco)
  - **Fitzgerald Mar. Res. LID Assessment** (County San Mateo/P84)
  - **Statewide LID Monitoring Framework** (SCCWRP/State Board)

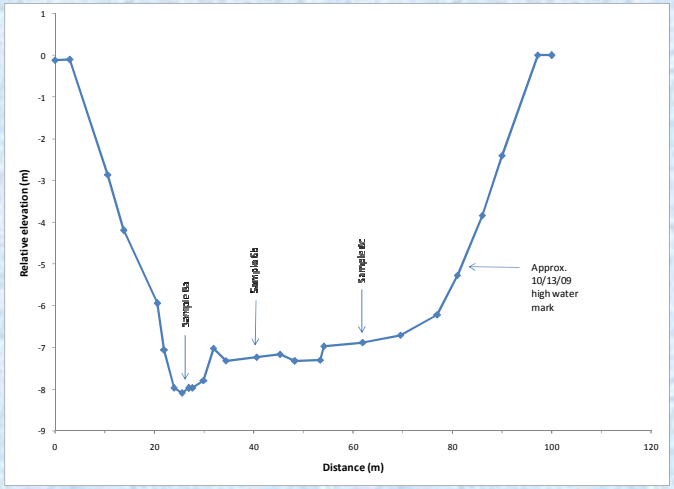
Green Infill-Clean Stormwater

- Preliminary Results – David et al., 2010 (in prep)
  (Do not cite or quote)

Contaminant	Load (g/day) pre	Load (g/day) post	Reduction (%)
Total Mercury	0.004	0.002	50
Copper	15.9	1.42	91
Zinc	244	9.26	96
Lead	1.31	0.424	68
Nickel	5.28	1.26	76
Cadmium	0.209	0.012	94
PAH	1.31	0.108	92

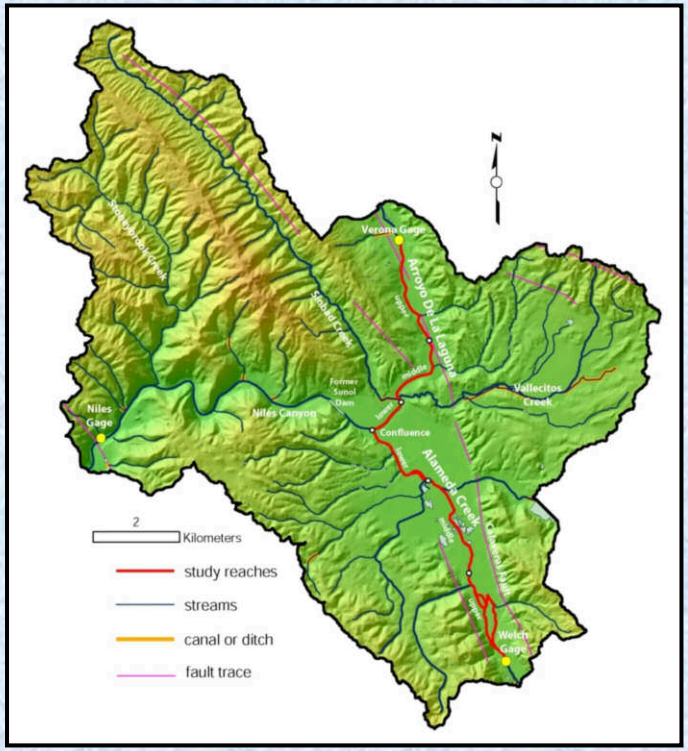
SFEI Alternative Floodplain Management/ Geomorphic Assessments

- Example projects (3 of many*):
  - Decision Support in the Napa River Watershed
  - Coyote Creek Watershed Historical Ecology – Laguna Seca
  - Alameda Creek Management Support (PWA/ ACFC&WCD)
    - Sediment Budget
    - Low Flow Turbidity Assessment
    - Dry Creek Sediment Source Evaluation
    - Sediment Grainsize Assessment

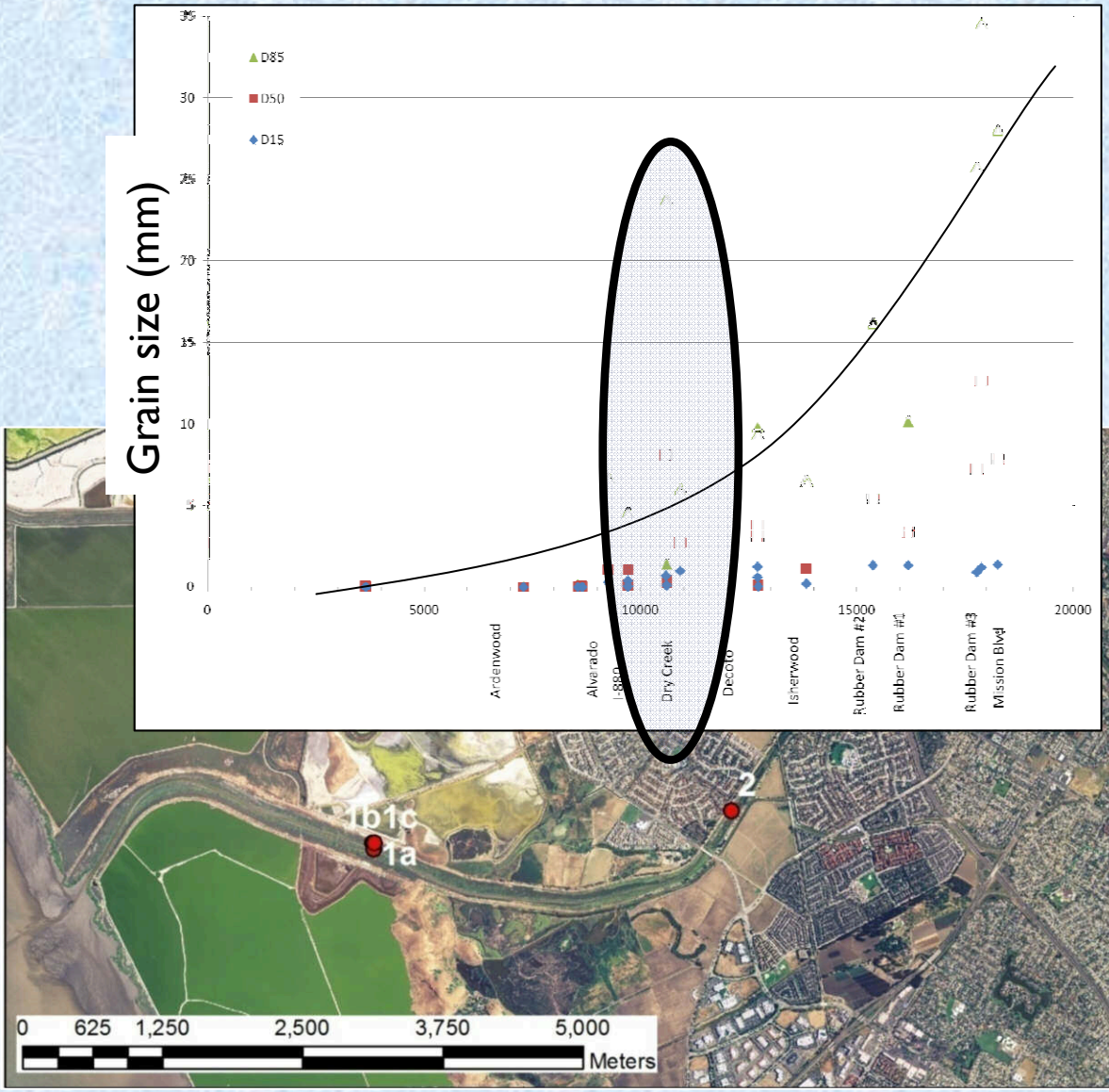


Geomorphic Assessments – Alameda Sediment Budget

Area	Sediment Yield (Metric t/year)	% of Total
ADLL at Verona Gage	104,000	63
Alameda Ck near Welch Ck	3,400	2
Arroyo de La Laguna Reach	8,400	5
Alameda Creek Study Reach	320	0.2
Ungaged areas	47,908	29
All Areas above Niles Gage	164,000	
Alameda Creek at Niles Gage	156,000	



Geomorphic Assessments – Alameda Flood Channel Grainsize



Alternative Floodplain Management – Alameda Creek

- Facilitate Alameda Creek flood control channel **Goals** stakeholder group
  - ACFC&WCD, RWQCB, USACE, CDFG, USFWS, and BCDC, the Alameda County Water District, and the Cities of Fremont and Union
  - Agree upon channel attributes that meet all the Agency needs
  - Carry out geomorphic, engineering and biological assessments
  - Develop conceptual channel designs
  - Document agreed pathways and times lines

Opportunities for Collaboration

- Hydromodification
- LID Assessment/design
- Modeling
  - Targeted BMP applications
- Emerging contaminants in stormwater
- Cross-media linkages
- Stormwater toxicity

Questions?

Goals for Today's Presentation

- Summarize Research Priorities
  - Statewide issues
  - Regional issues
- SCCWRP & SFEI Stormwater Research
  - Areas of overlap
  - Areas of divergence
  - Opportunities for additional collaboration
- Future Directions

Key Drivers of Stormwater Research

- What is the condition of our rivers and streams?
- Are conditions getting better or worse?
- What are the stormwater loads to harbors, bays, and estuaries?
- What contaminants are of most concern?
- What are the key sources of contaminants?
- How close (or far) are we from regulatory or management targets?
- What are the most effective management approaches?

Opportunities for Collaboration

- Emerging contaminants in stormwater
- Low impact development effectiveness & monitoring
- Approaches for estimating regional pollutant flux
- Cross-media contamination
  - Stormwater reuse
- Design storms/numeric sizing tools