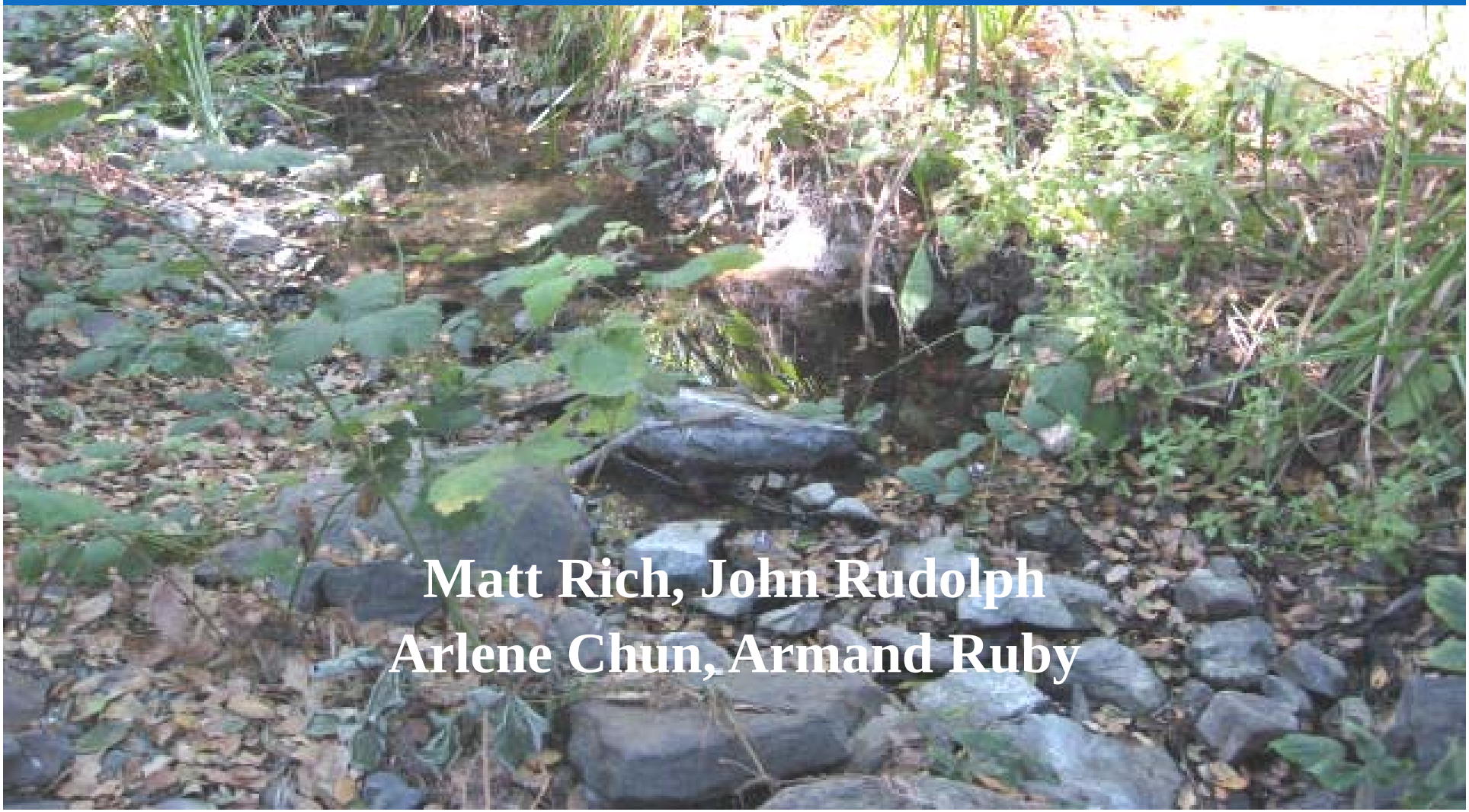
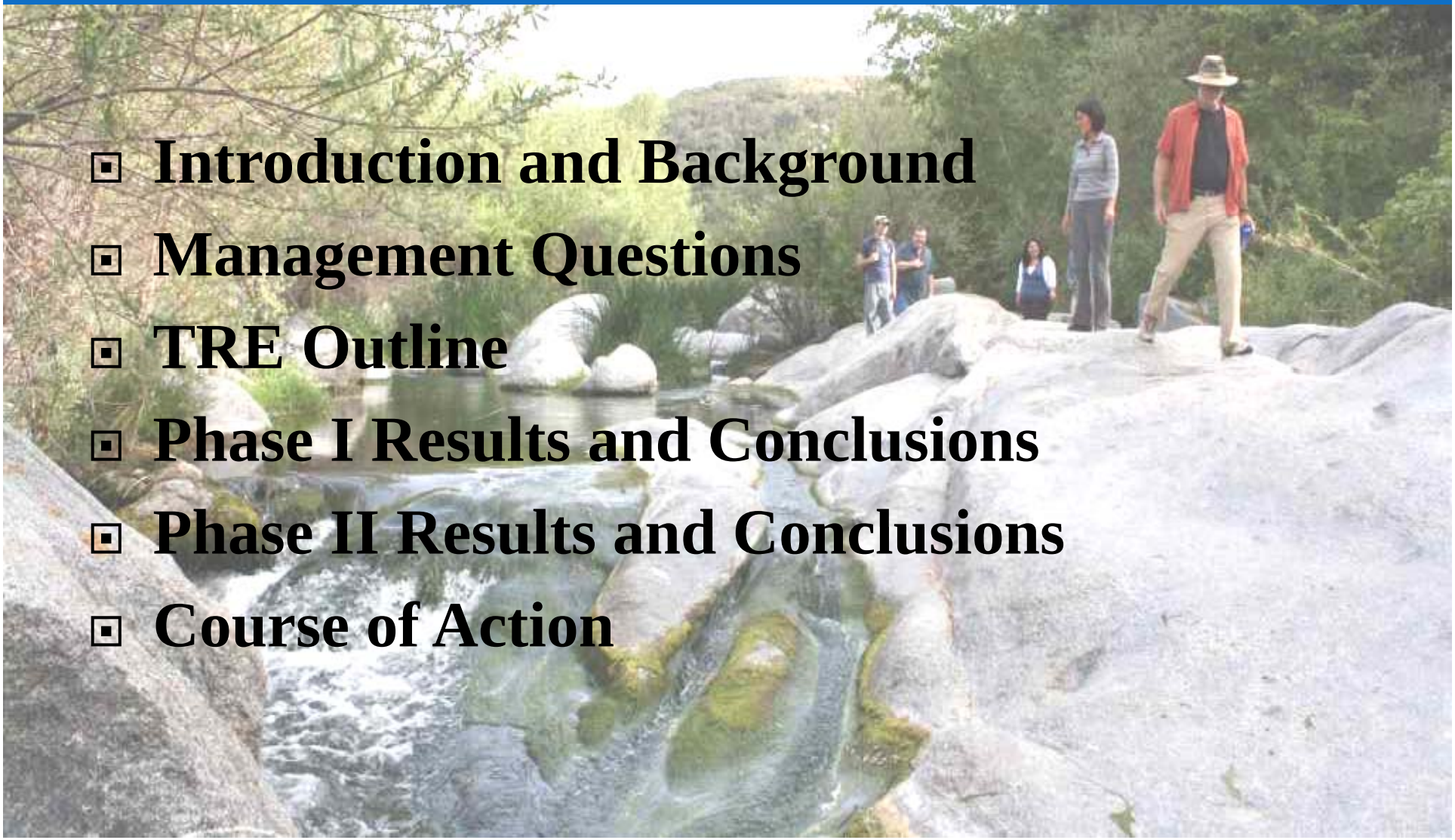
IDENTIFYING SOURCES OF TOXICITY TO *HYALELLA* IN THE SANTA MARGARITA WATERSHED



Matt Rich, John Rudolph
Arlene Chun, Armand Ruby

Identifying Sources of Toxicity to *Hyalella* in the Santa Margarita Watershed

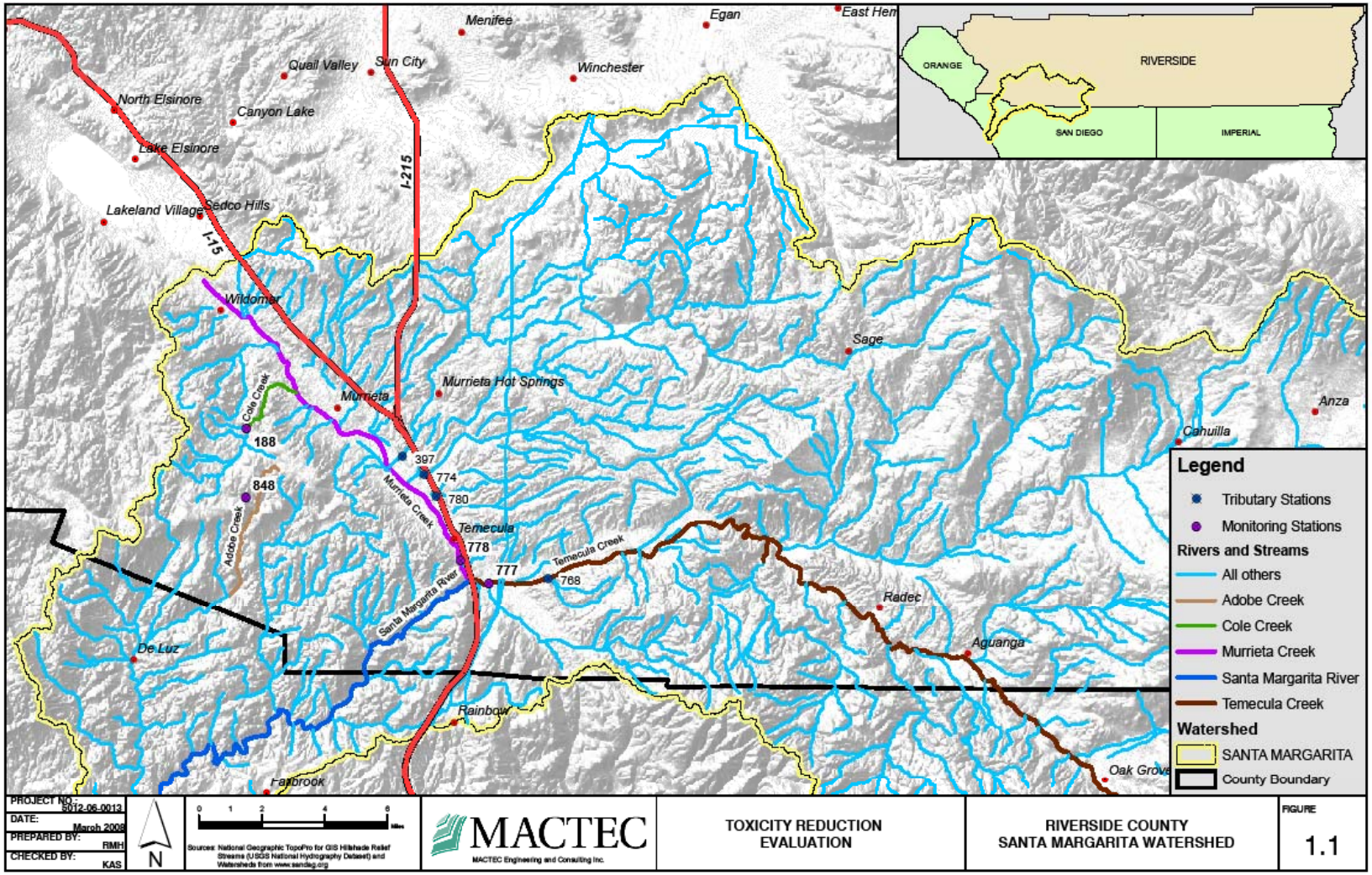


- **Introduction and Background**
- **Management Questions**
- **TRE Outline**
- **Phase I Results and Conclusions**
- **Phase II Results and Conclusions**
- **Course of Action**

Introduction

- Santa Margarita River (SMR) Watershed 750 square miles in southwestern Riverside and northern San Diego Counties – arid Mediterranean climate, dry weather flow primarily groundwater
- Riverside County Flood Control and Water Conservation District (District)
- NPDES Municipal Separate Storm Sewer (MS4) Permit
- Toxicity Reduction Evaluation (TRE) began 2007
- Lack of guidance relevant to storm/surface water. EPA guidance focused on WW treatment facilities

Santa Margarita Watershed



Management Questions

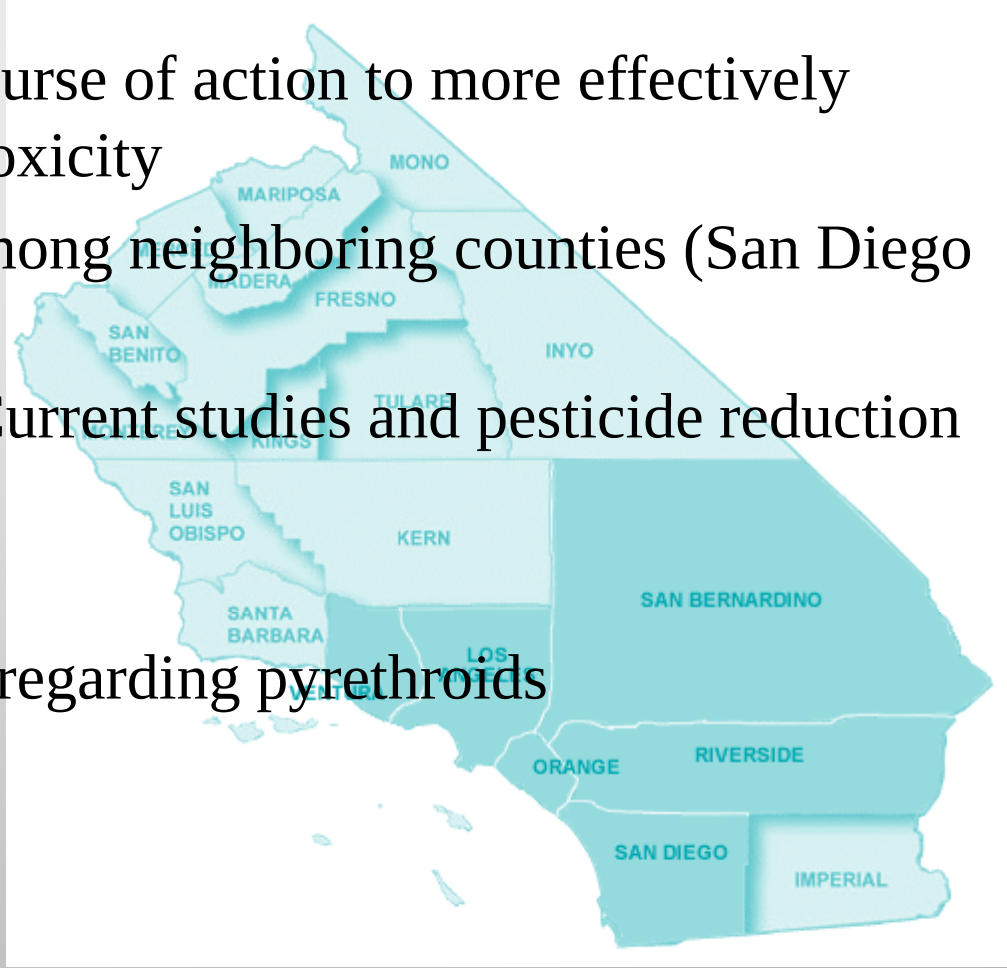
1) Is the pyrethroid toxicity persistent in Temecula Creek and Murrieta Creek?
2) Does the toxicity occur during dry weather?
3) Are there any obvious sources of illicit discharge of pyrethroids that can be abated?
4) What are the likely sources of pyrethroid toxicity in the SMR?
5) What potential management measures are available to the Permittees to mitigate the impacts of pyrethroid pesticide application?

TRE Outline

- Phase I
  - Hypothesis: pyrethroids causing toxicity to *Hyalella*
  - Toxicity Identification Evaluations
    - Initial
    - Confirmation
  - Land use surveys (GIS)
  - Sales records and literature review to identify likely sources and mitigation measures
  - Field survey
  - Phase II Work Plan

TRE Outline

- Phase II
  - Goal: Establish a course of action to more effectively control pyrethroid toxicity
  - Data comparison among neighboring counties (San Diego and Orange)
  - Literature review: Current studies and pesticide reduction BMPs
  - BMP analysis
  - Pending legislation regarding pyrethroids

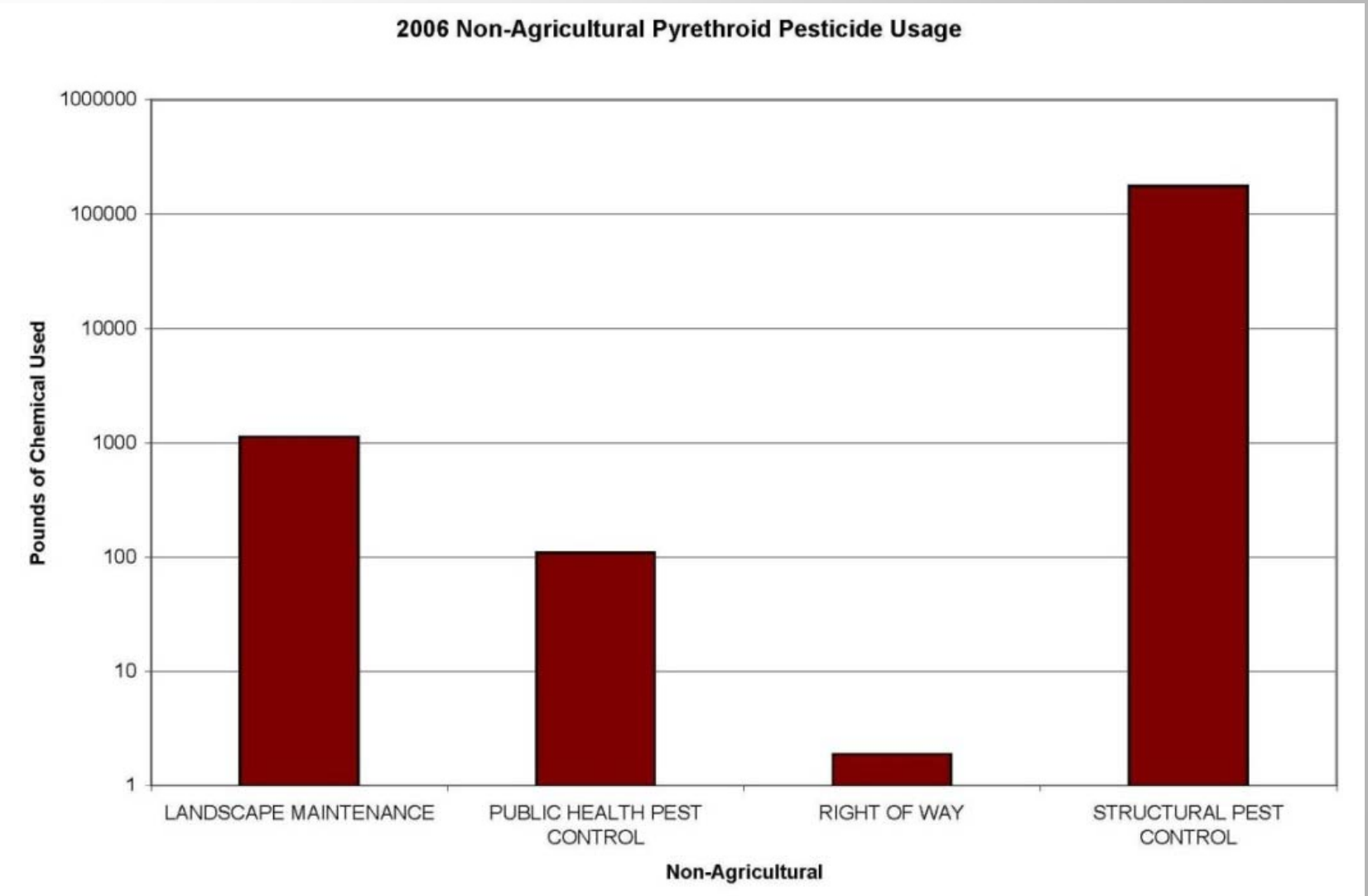


PHASE I

Applied Pesticides

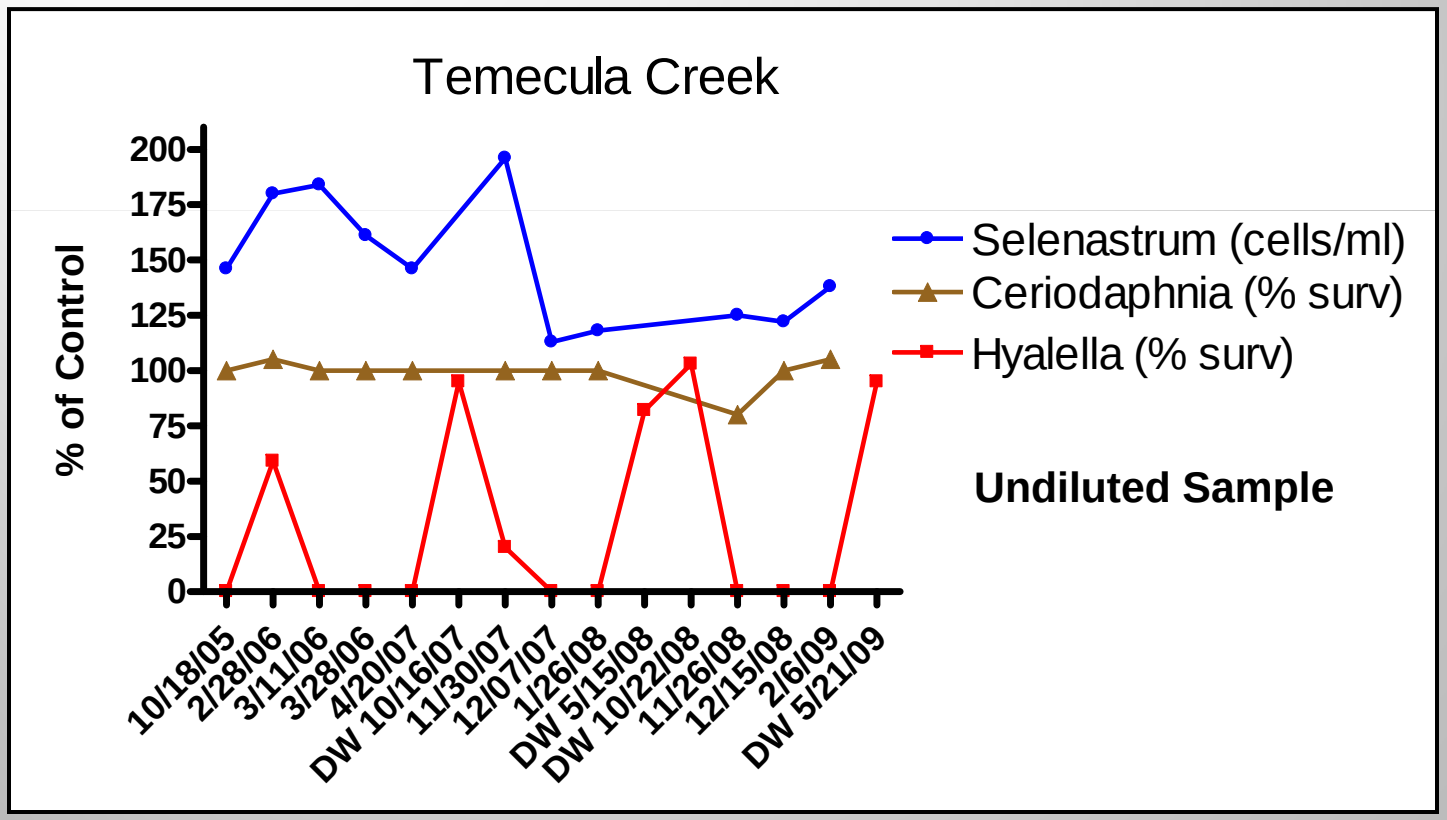
- 2:1 Ratio agricultural to urban land use
- 2006 pounds applied-
  - 11.5K agricultural
  - 176K structural
  - 1.3K landscape
- Most applied were permethrin and bifenthrin, also cyfluthrin (structural)
- Most of the SMR watershed is not regulated by the MS4 Permit

Applied Pesticides

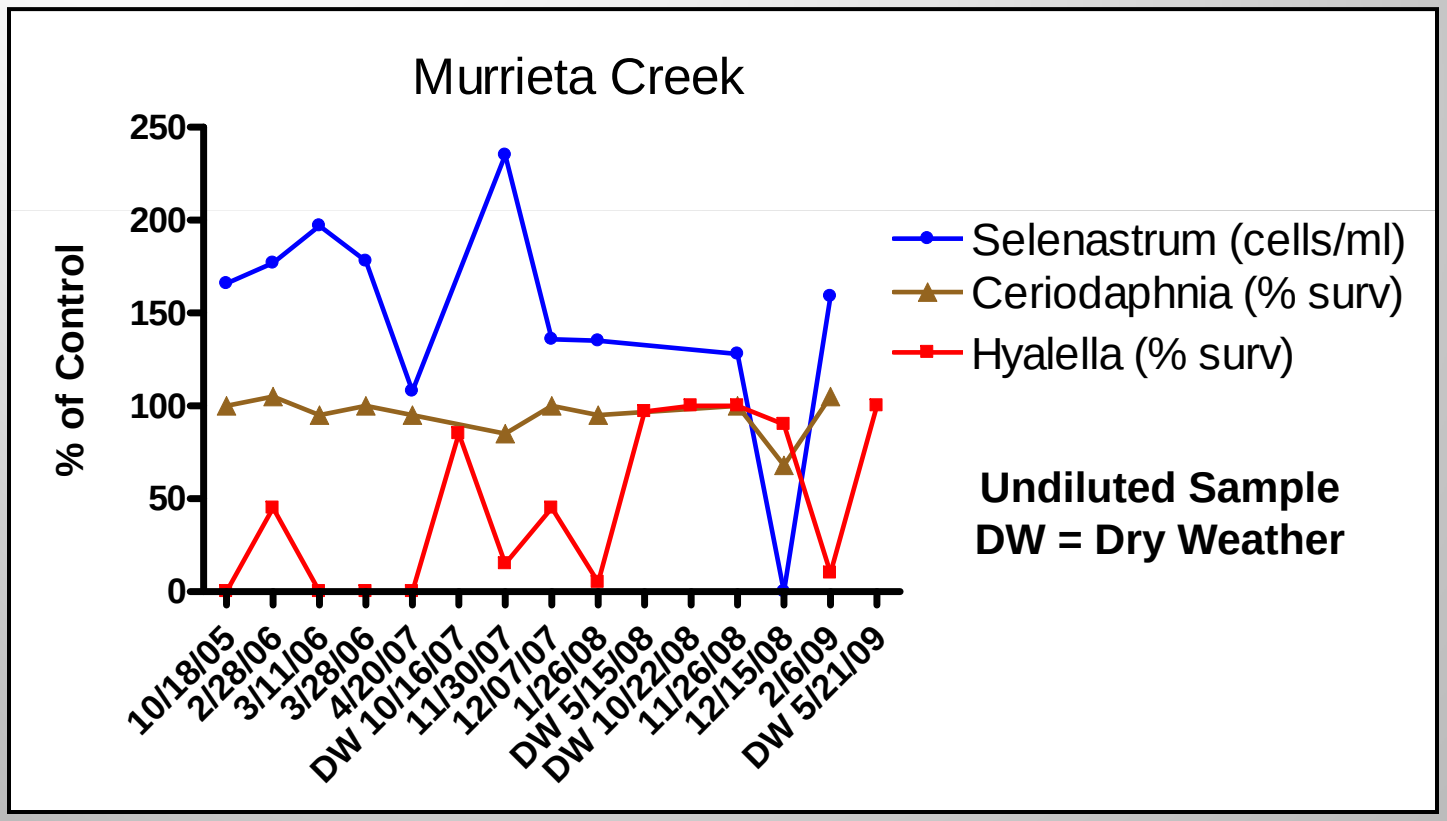


Toxicity and TIE Results

Wet and Dry Weather Toxicity



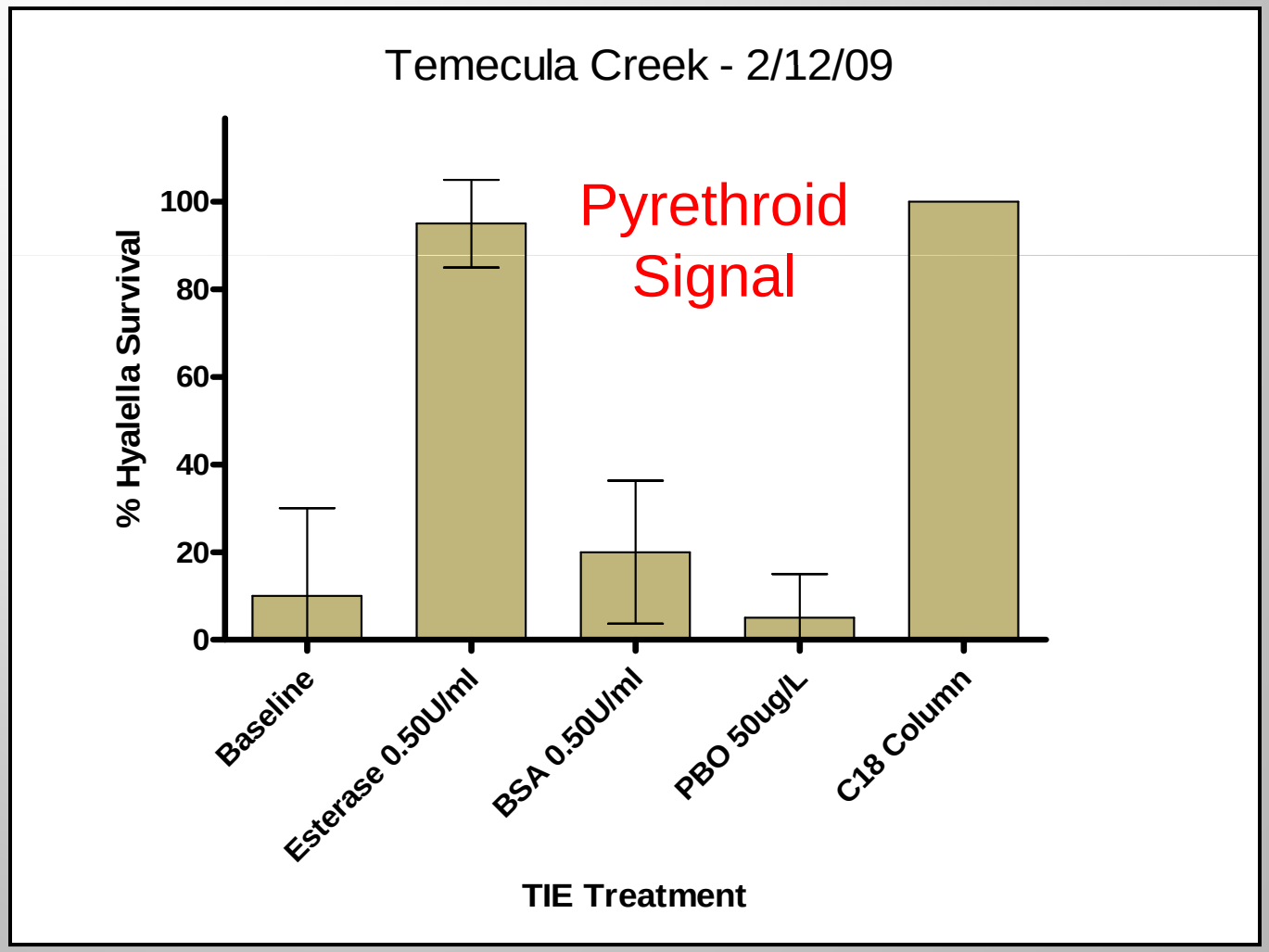
Wet and Dry Weather Toxicity



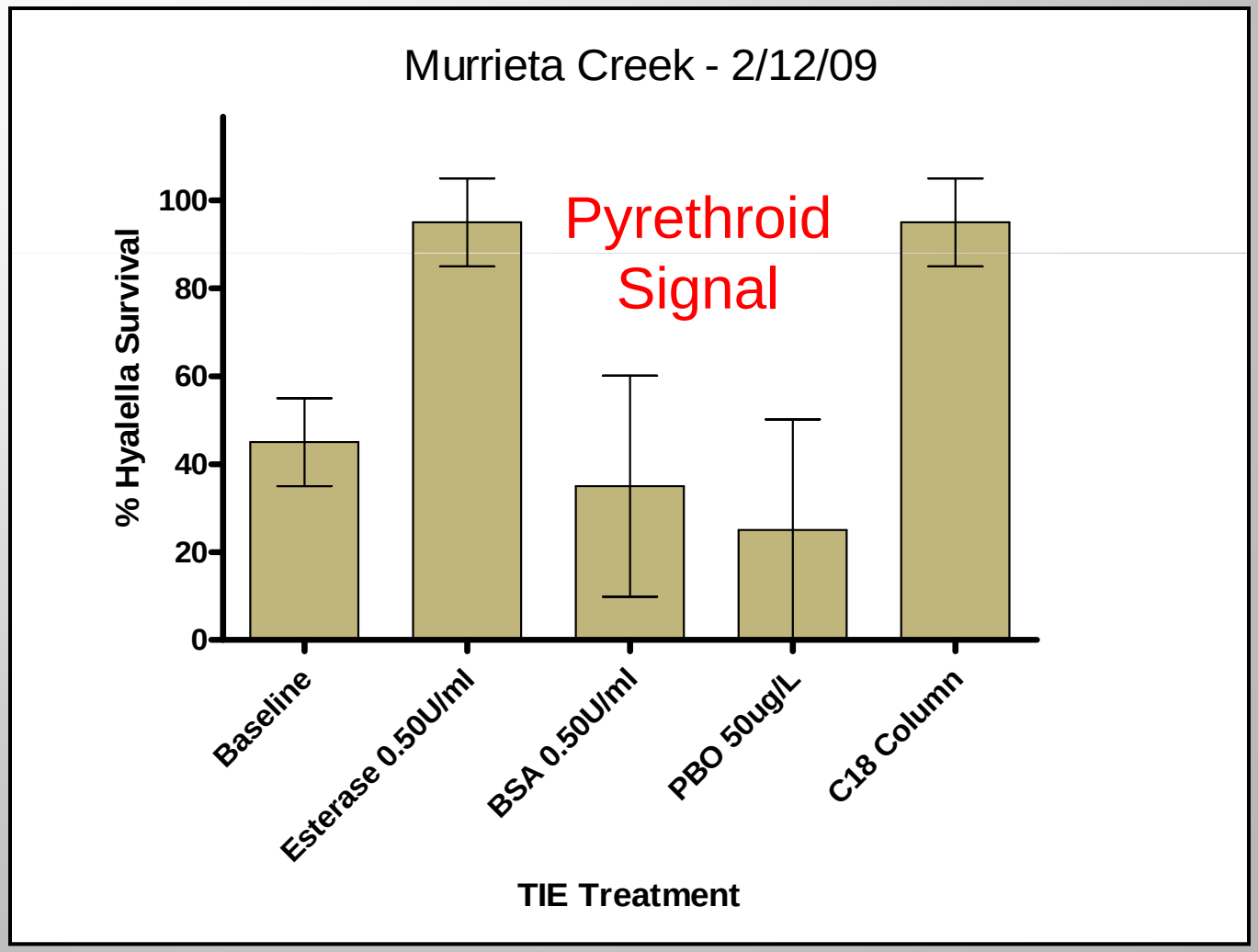
Toxicity Identification Evaluation Treatments

Stormwater Treatment	Purpose / Target Constituent
Baseline Toxicity	Unmanipulated; Evaluate treatment effectiveness
Column Extraction (C18)	Removes nonpolar organics
Piperonyl Butoxide (PBO)	Metabolic inhibitor Blocks OP pesticide toxicity Enhances pyrethroid pesticide toxicity
Carboxyl Esterase (CEE)	Hydrolyzes pyrethroid pesticides making them nontoxic
Bovine Serum Albumin (BSA)	Method control for CEE protein matrix

Toxicity Identification Evaluations



Toxicity Identification Evaluations



Hyalella Pyrethroid Sensitivity

Temecula Creek

Pyrethroid (ng/L)	11/26/08 storm	12/15/08 storm	2/6/09 storm	LC50 (ng/L)
Bifenthrin	533	164	293	5.8
Cyfluthrin	87	15	56	3.0
Cypermethrin	105	74	41	5.0
Danitol	2.4	ND	ND	
Esfenvalerate	4.3	0.6	0.7	6.5
Fenvalerate	6.1	2.0	1.6	
L-Cyhalothrin	21	ND	6.8	0.94
Permethrin-cis	34.3	ND	85	30
Permethrin-trans	123	ND	110	

Hyalella Pyrethroid Sensitivity

Murrieta Creek

Pyrethroid (ng/L)	11/26/08 storm	12/15/08 storm	2/6/09 storm	LC50 (ng/L)
Bifenthrin	ND	6.1	22	5.8
Fluvalinate	1.5	ND	ND	
L-Cyhalothrin	ND	ND	1.1	0.94

Phase I Conclusions

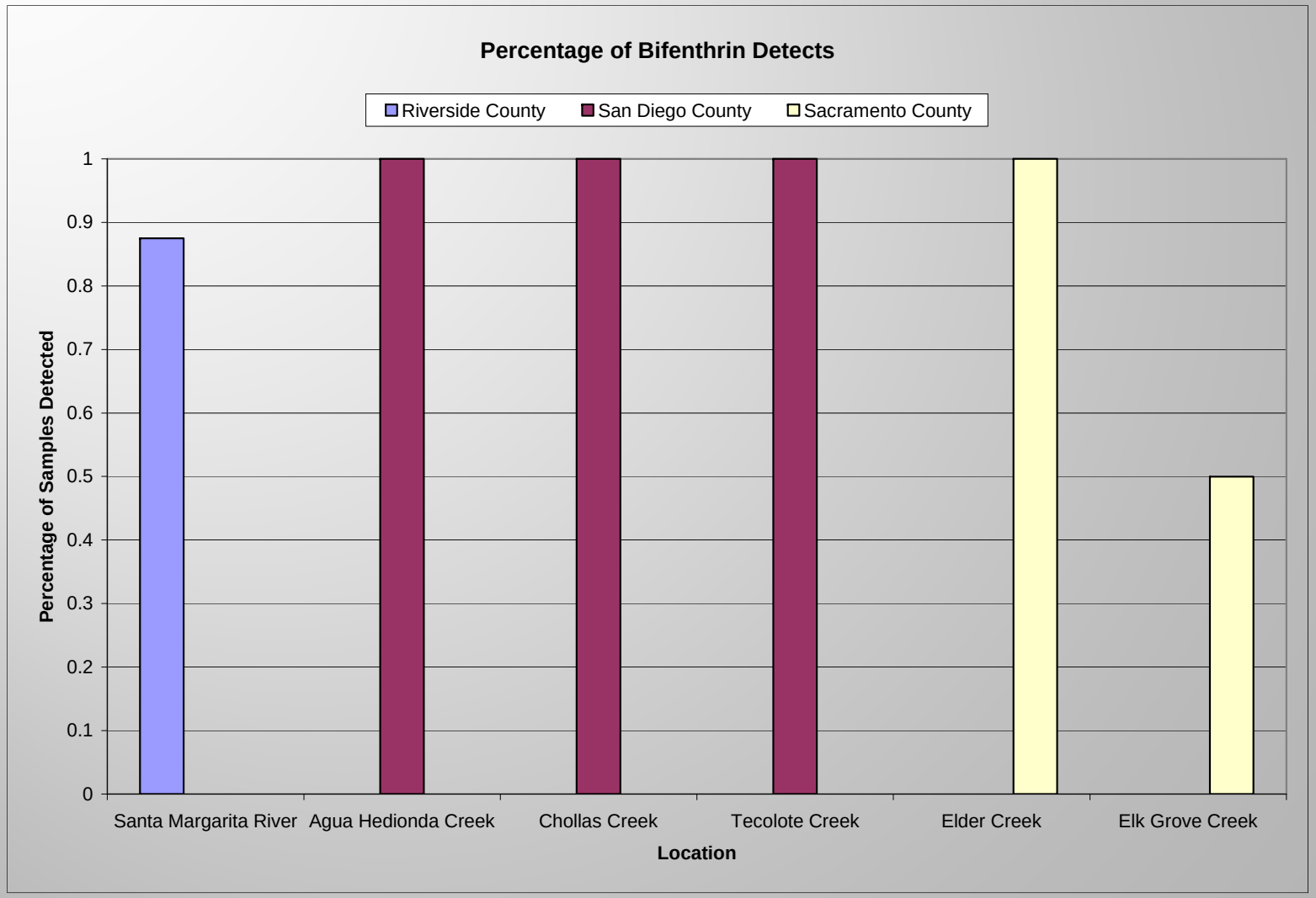
- Persistent toxicity to *Hyalella* in wet weather
- Toxicity not a significant dry weather problem
- Permethrin and bifenthrin are primary concerns
- Structural control applications are leading source of pyrethroids observed in MS4

PHASE II

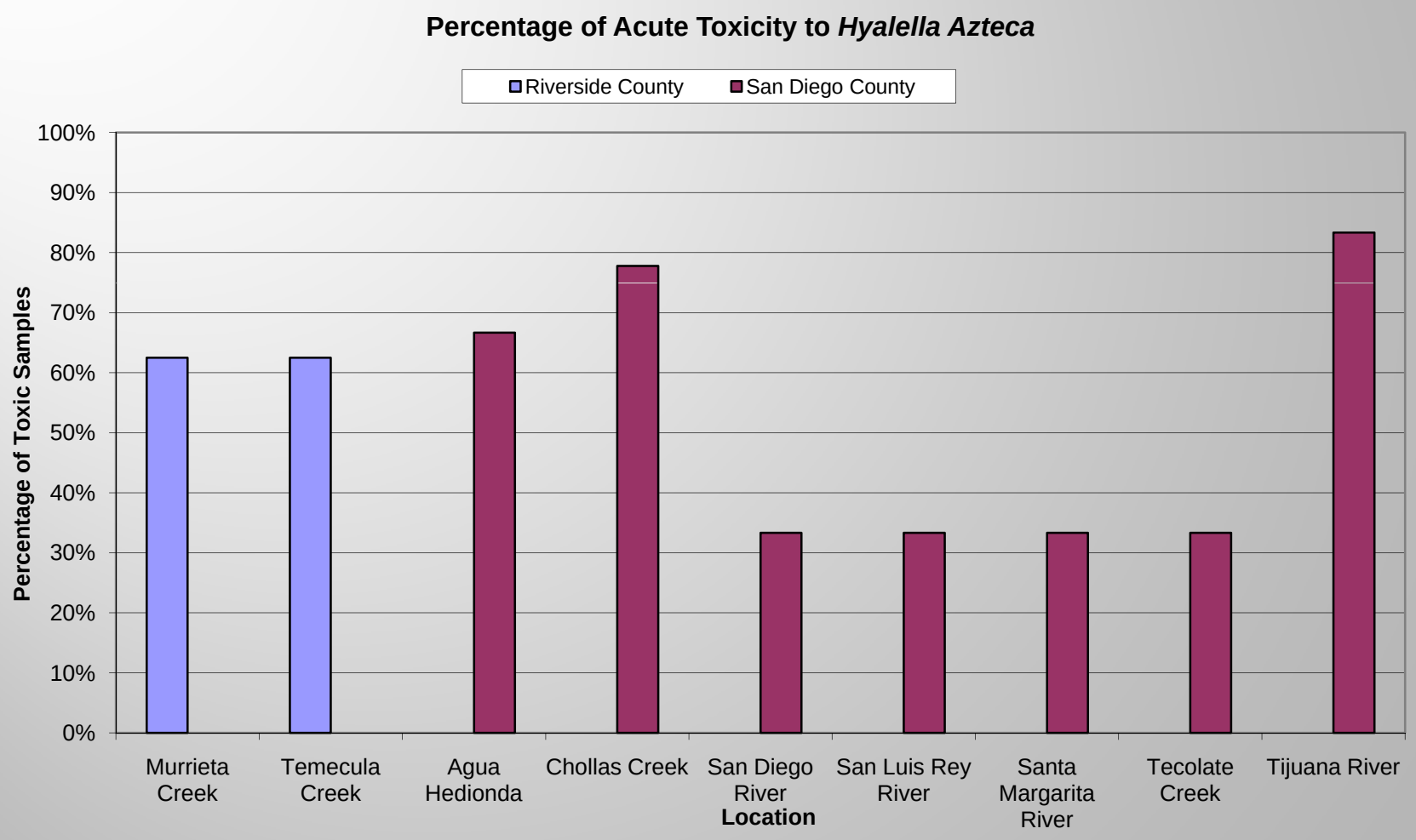
Data Comparison

- Pyrethroids and toxicity to *Hyalella* frequently observed since 2004 in Orange and San Diego counties
- Most existing work is on sediment
- Sediment trends comparable to storm and surface water results

Data Comparison



Data Comparison



BMP Review

- Source Control BMPs
  - Lower cost
  - Higher potential effectiveness
- Examples:
  - Regulatory Action (proven effective for DDT, diazinon, etc.)
  - Integrated Pest Management (IPM)
  - Public Outreach and Education
  - Low Impact Development (LID)

BMP Review

- Treatment Control BMPs
  - Higher cost
  - Long-term maintenance
  - Low effectiveness for pyrethroids
- Examples:
  - Pervious Pavement
  - Media Filter
  - Extended Detention Basin
  - Infiltration Basin or Trench

Pending Legislation Affecting Pyrethroid Use

- No pending state legislation. California recently regulated dormant season insecticide use.
- No pending Federal legislation.

Regulatory Initiatives

- **Regulatory Initiatives**
  - CA Department of Pesticide Regulation (DPR) - Pyrethroid Re-evaluation
  - USEPA: Office of Water and Office of Pesticide Programs "Harmonization" Effort
- **CA Pyrethroid Reevaluation**
  - Covers all commercially-available pyrethroid products, for agricultural and urban uses
  - Goal is to mitigate environmental effects of pyrethroids on surface waters
  - DPR is working with manufacturers (Pyrethroid Working Group) and CA stormwater and wastewater agencies
  - Multi-year process; research/studies ongoing
- **USEPA OW/OPP Harmonization**
  - Ongoing issue: EPA (OPP) approves products for use under FIFRA
  - Then, when exposed to rainfall, approved pesticides run off into surface waters and cause environmental harm
  - Clean Water Act kicks in once receiving water standards are not met (OW)
  - EPA announced harmonization effort in letter to stakeholders 11/20/08
  - EPA held a series of workshops and solicited input early 2010

Permittee Authority

- Addressing illegal disposal
- Promoting public education
- Setting the example
- Coordinating with state and federal pesticide regulators

Phase II Conclusions

- Pyrethroid toxicity is a common problem in Riverside, San Diego and Orange counties
- Comparable methods to address pyrethroids in Southern California
- Many source control BMPs are currently implemented
- Treatment control BMPs are expensive and pyrethroid removal effectiveness is unproven
- **Regulatory change has the highest potential for reducing pyrethroid toxicity in the SMR**

Proposed Course of Action

- Pursue regulatory change

CASQA
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Dedicated to the Advancement of Stormwater Quality Management, Science, and Regulation

- Implement source controls targeted at urban pesticide use
- Assess effectiveness
- Implement additional controls, including treatment controls, as necessary
- Re-evaluate annually

QUESTIONS