

# Methodology for Screening Pesticide Products with High Exposure Potentials to Marine/Estuarine Organisms



Yina Xie, Yuzhou Luo, Nan Singhasemanon, and Kean S. Goh  
 Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA

## Introduction

- ❖ Determination of toxicity endpoint is a critical aspect in characterizing the risk of pesticide use on sensitive aquatic species.
- ❖ The use of some pesticide products in California may merely pose adverse aquatic risks to freshwater species, while the use of other products, in contrast, may pose risks to both marine/estuarine and freshwater species.
- ❖ This study develops a methodology to identify pesticide products that have high exposure potentials to marine/estuarine species as well as freshwater species and provides basis for endpoint determination in risk assessment.

## Overview

- ❖ Pesticide exposures to marine/estuarine aquatic systems can be contributed by both local and remote sources.
- ❖ **Local sources** refer to pesticide uses within coastal areas (outlined in orange in Figure 1) that are associated with a high likelihood of runoff movement to adjacent receiving waterbodies (i.e., high risk use patterns). Those pesticides could be identified by use pattern analysis.
- ❖ **Remote sources** refer to pesticide uses that may not be significant within the defined coastal areas but associated with potential for long-distance transport within the stream network in California. Those pesticides could be identified by chemical properties of product active ingredients (AIs).

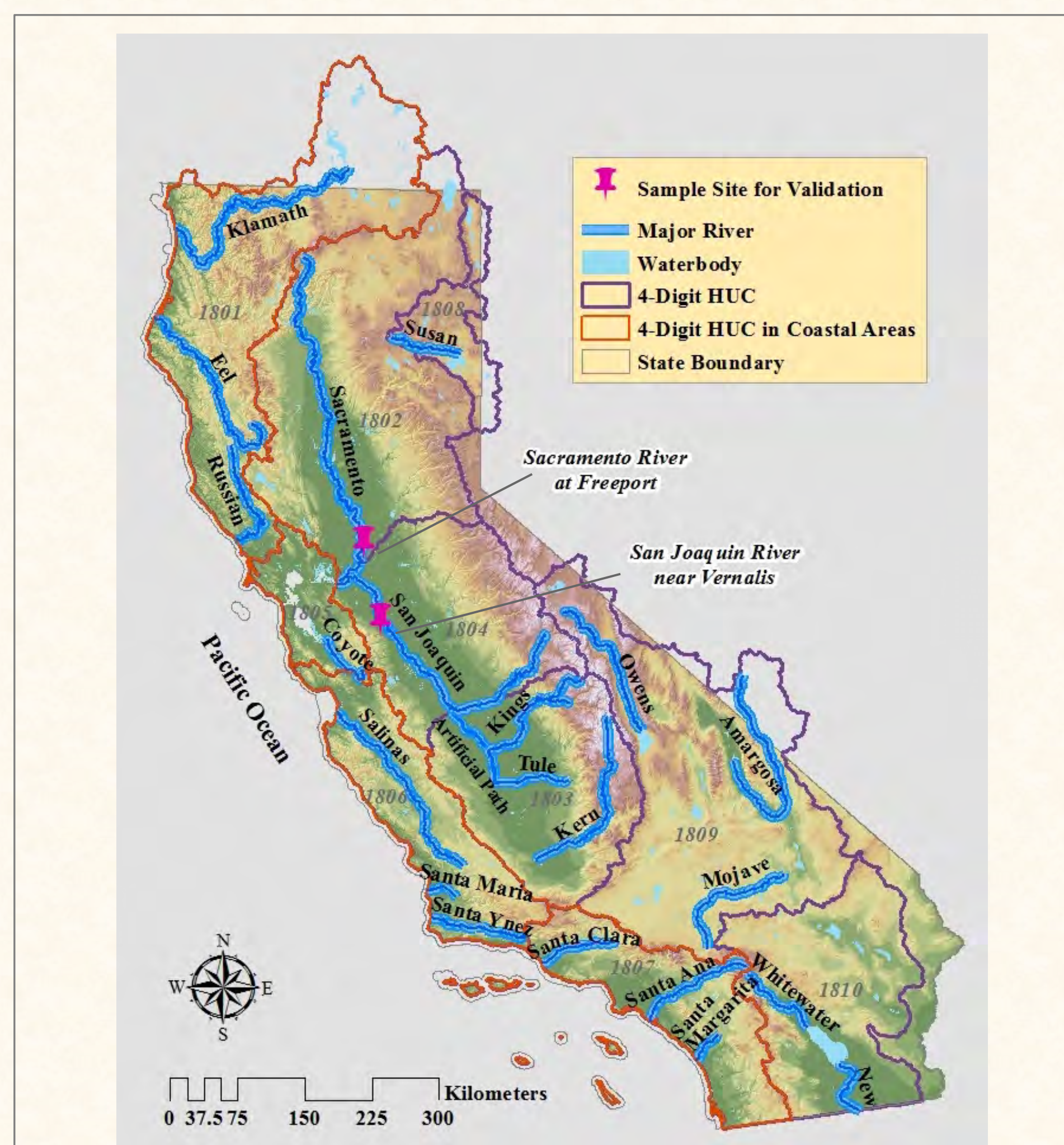


Figure 1: Location of 4-digit HUCs, major streams and waterbodies in each HUC, and water quality sample sites used for validation. Source: National Hydrology Dataset.

## Methodology Development

- ❖ The screening method is composed of two components – use patterns of a pesticide product and chemical properties of the product AI.
- ❖ Figure 2 demonstrates the decision flowchart.

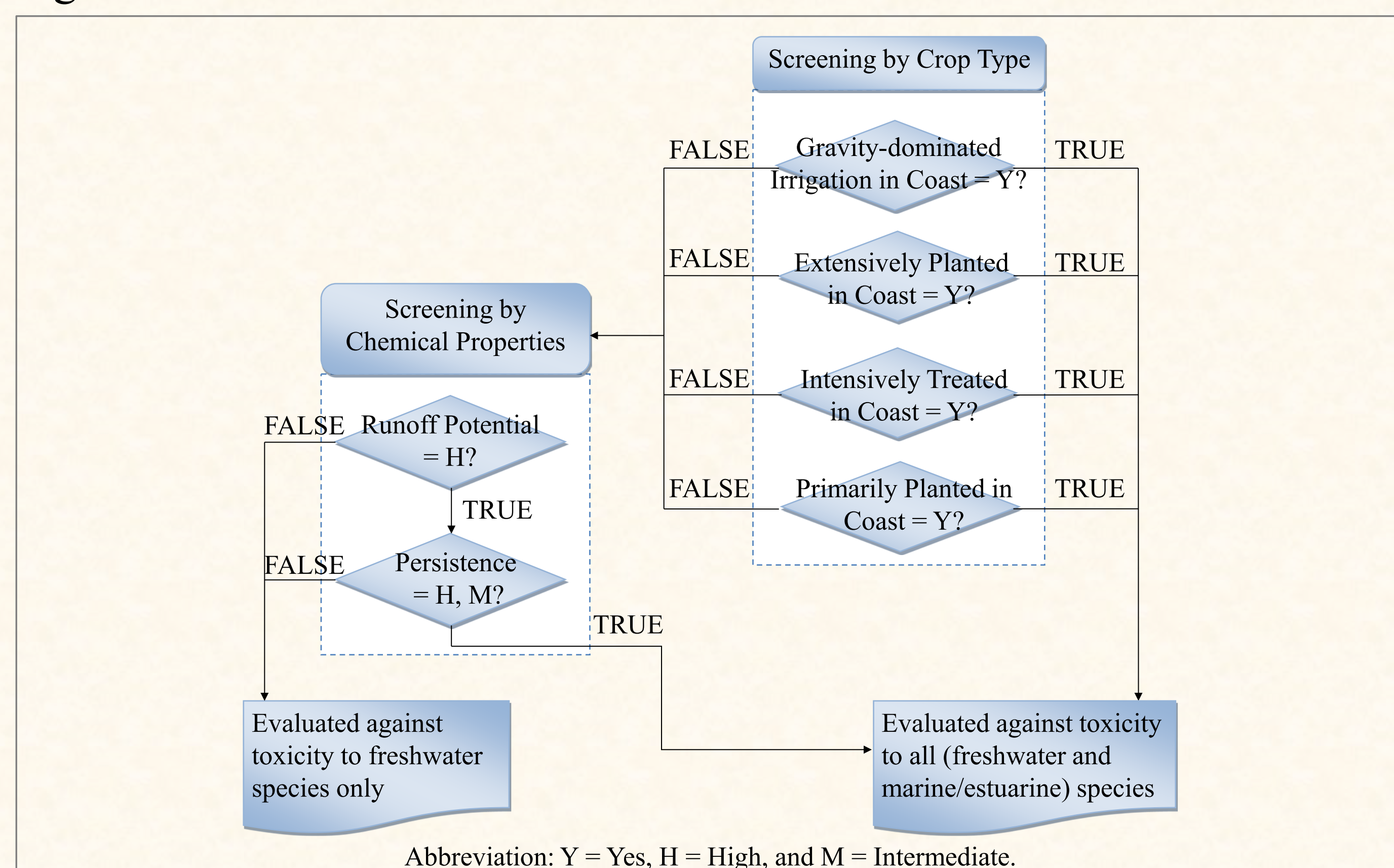


Figure 2: Decision flowchart to determine which pesticides are subject to evaluation against toxicity to marine/estuarine species in addition to freshwater species.

- ❖ **Use pattern analysis** prioritizes pesticide use patterns based on the potential dominance and risks of the target commodities. Urban uses are always considered as a high risk use pattern due to the proximity of many urban areas to the coast. Crops associated with high risk use patterns are identified.
- ❖ **Chemical property analysis** rates the transport potential of a pesticide based on its soil-runoff potential and aquatic persistence.

## Results

- ❖ **Screening by Crop Type.** Pesticides to be applied to crops receiving gravity-dominated irrigation, extensively planted or intensively treated with pesticides in coastal areas, or primarily planted in coastal areas relative to other parts of California are considered associated with high risk use patterns (Table 1).

Selected Crop	Gravity-Dominated Irrigation in Coast	Extensively Planted in Coast	Intensively Treated in Coast	Primarily Planted in Coast
<b>Grain and hay crops (G)</b>				
Barley		✓		✓
Oats		✓		
Other Hay/Non Alfalfa		✓		
Spring wheat				✓
Winter wheat		✓		
<b>Field crops (F)</b>				
Corn	✓			
Cotton	✓			
<b>Alfalfa/Pasture (P)</b>				
<b>Truck, nursery and berry crops (T)</b>				
Broccoli			✓	
Caneberry				✓
Celery			✓	
Lettuce			✓	
Nursery (Outdoor)			✓	
Strawberry			✓	✓
Tomatoes	✓			
<b>Vineyards (V)</b>				
Mint (M)		✓	✓	✓

Data sources: California Department of Water Resources Irrigation Survey 2010 (CDWR, 2010), Cropland Data Layer 2007-2013 (USDA-NASS, 2014a, 2014b), California Pesticide Use Report (PUR) 2007-2012.

- ❖ **Screening By Chemical Properties.** Any pesticides that are rated as high

Criteria rating soil-runoff potential	Rating
<b>Pesticide solution-phase runoff potential</b> (SOL ≥ 1 and FD > 20 and KOC < 1×10 <sup>5</sup> ) or (SOL ≥ 10 and KOC ≤ 2000)	High (H)
<b>Pesticide adsorbed-phase runoff potential</b> (FD ≥ 15 and KOC ≥ 4×10 <sup>4</sup> ) or (FD ≥ 40 and KOC ≥ 1000) or (FD ≥ 40 and KOC ≥ 500 and SOL ≤ 0.5)	High (H)
<b>Criteria rating aquatic persistence</b>	Rating
HLw/HLd ≥ 100	High (H)
30 ≤ HLw/HLd < 100	Intermediate (M)

Notes: Adopted from Table 2 and 3 of Luo and Deng (2012). SOL = water solubility (mg/L), FD = field dissipation half-life (day), KOC = organic carbon-normalized soil adsorption coefficient (L/kg[OC]), and HL = aquatic half-life in water (day, i.e., HLw) or in sediment (i.e., HLd).

soil-runoff potential and high/intermediate aquatic persistence are considered having high transport potentials to the marine and estuaries. Rating criteria, validated by comparing selections with detections in two long-term water quality monitoring sites (pins in Fig.1), are given in Table 2.

## Demonstration

- ❖ Eight pesticide products evaluated for registration application by DPR's Surface Water Protection Program in 2013 and 2014 are presented below to demonstrate the use of the proposed method to determine toxicity endpoint for product registration evaluation.

AI and Product Info.	Screening by Crop Type					Screening by Chemical Properties					Does the Product meet the screening criteria?			Recommendation (Evaluation with toxicity to)		
	G	F	P	T	V	M	SOL	KOC	FD	HLw	HLd	Crop	Chem. Prop.	Water Sed.	Solution-phase	Adsorbed-phase
1 Clothianidin (insecticide, rice)							327	345	282	999	27	No	Yes	-	ALL species	-
2 Cyantraniliprole (insecticide, seed treatment)							12.3	128	50	2.9	14	No	No	-	Freshwater species ONLY	-
3 Cyantraniliprole (insecticide)	✓						12.3	128	50	2.9	14	Yes	No	-	ALL species	-
4 Etofenprox (mosquito adulticide)	✓	✓					0.02	17757	4.8	1.7	15	Yes	No	No	ALL species	ALL species
5 Fenazaquin (insecticide)			✓				0.22	28950	44	19.5	267	Yes	No	Yes	ALL species	ALL species
6 Penflufen (fungicide, seed treatment)	✓	✓	✓				10.9	342	62	157	86	Yes	Yes	-	ALL species	-
7 Picoxystrobin (fungicide)	✓	✓					3.1	965	64	36.7	86	Yes	Yes	-	ALL species	-
8 Sulfoxaflor (insecticide)	✓	✓	✓				965	54	1.6	43	189	Yes	Yes	-	ALL species	-

Notes: See Table 1 and 2 for interpretation of abbreviations under Screening by Crop Type and Screening by Chemical Properties. Water = solution-phase and Sed. = adsorbed-phase. Adsorbed-phase evaluation is only performed for AIs with KOC over 1000.

## Selected References

- CDWR. (2010). Statewide Irrigation Methods Survey (<http://www.water.ca.gov/landwateruse/surveys.cfm>) Retrieved 11/10, 2014.
- Luo, Y., and Deng, X. (2012). *Methodology for Evaluation Pesticides for Surface Water Protection I: Initial Screening*. (<http://www.cdpr.ca.gov/docs/emon/surfwtvr/review/report1.pdf>). California Department of Pesticide Regulation, Sacramento, CA.
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