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Co-Occurrence Pesticide Species Tool (CoPST)

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Gerco Hoogeweg and Marty Williams (Waterborne Inc.)

Original Objective

- Identify the potential spatial and temporal co-occurrence of 40 pesticides with 12 threatened and endangered species
  - to guide future risk assessments (co-occurrence analysis piece)
  - Cited in the National Academy of Sciences on addressing pesticides to T&E species in the exposure section
  - Chapter in ACS on Pesticide Regulation and the Endangered Species Act

Current Analysis Objective

- To better understand the spatial and temporal distribution of 40 pesticides and their potential to cause toxicity (No co-occurrence species model runs)
- Enable state and federal agencies to identify and prioritize areas for refined assessments, monitoring, or mitigation.
- M^5 = monitoring, modeling, management, movement, and money

Original Model development Funded by CA Bay-Delta Science Program (CALFED)

Project Team

US EPA Region 9

Cramer Fish Sciences

Technical Advisory Panel

- US EPA Region 9
- CDPR
- CVRWQCB
- NOAA-NMFS
- SWRCB
- TDC Environmental
- USDA–ARS
- USDA-NRCS
- USGS

Study Area

Sacramento River
27,000 sq mi (69,930 km²)

Bay-Delta Estuary
4,500 sq mi (11,691 km²)

San Joaquin River
32,000 sq mi (83,000 km²)

Pesticide List

(s)-Metolachlor	Herbicide
Abamectin	Insecticide
Bifenthrin	Insecticide
Bromacil	Herbicide
Captan	Fungicide
Carbaryl	Insecticide
Chlomazone	Herbicide
Chlorothalonil	Fungicide
Chlorpyrifos	Insecticide
Copper Sulphate	Fungicide
Copper Hydroxide	Fungicide
Cyfluthrin	Insecticide
Cyhalofop-butyl	Herbicide
Cypermethrin	Insecticide
Deltamethrin	Insecticide
Diazinon	Insecticide
Dimethoate	Insecticide
Diuron	Herbicide
Esfenvalerate	Insecticide
Hexazinone	Herbicide
Imidacloprid	Insecticide
Indoxacarb	Insecticide
Lamda cyhalothrin	Insecticide
Malathion	Insecticide
Mancozeb	Fungicide
Maneb	Fungicide
Methomyl	Insecticide
Naled	Insecticide
Oxyflurofen	Herbicide
Paraquat dichloride	Herbicide
Pendimethalin	Herbicide
Permethrin	Insecticide
Propanil	Herbicide
Propargite	Insecticide
Pyraclostrobin	Fungicide
Simazine	Herbicide
Trifluralin	Herbicide
Ziram	Fungicide
Thiobencarb	Herbicide
Tralomethrin	Insecticide

Model Approach

Pesticide Loadings (2000-2009)

1. Runoff from fields
2. Drift from spray
3. Discharges from rice paddies
4. Runoff from urban settings

Species of Interest

1. Eco-toxicological benchmarks
2. Life history assessment
3. Species distribution

Watershed Characteristics

1. Landscape patterns
2. Soils
3. Climate Conditions

Water Quality Monitoring

Spatial-Temporal Co-occurrence

Visualizations

1. Species Distributions
2. Pesticide Loadings
3. Hotspots

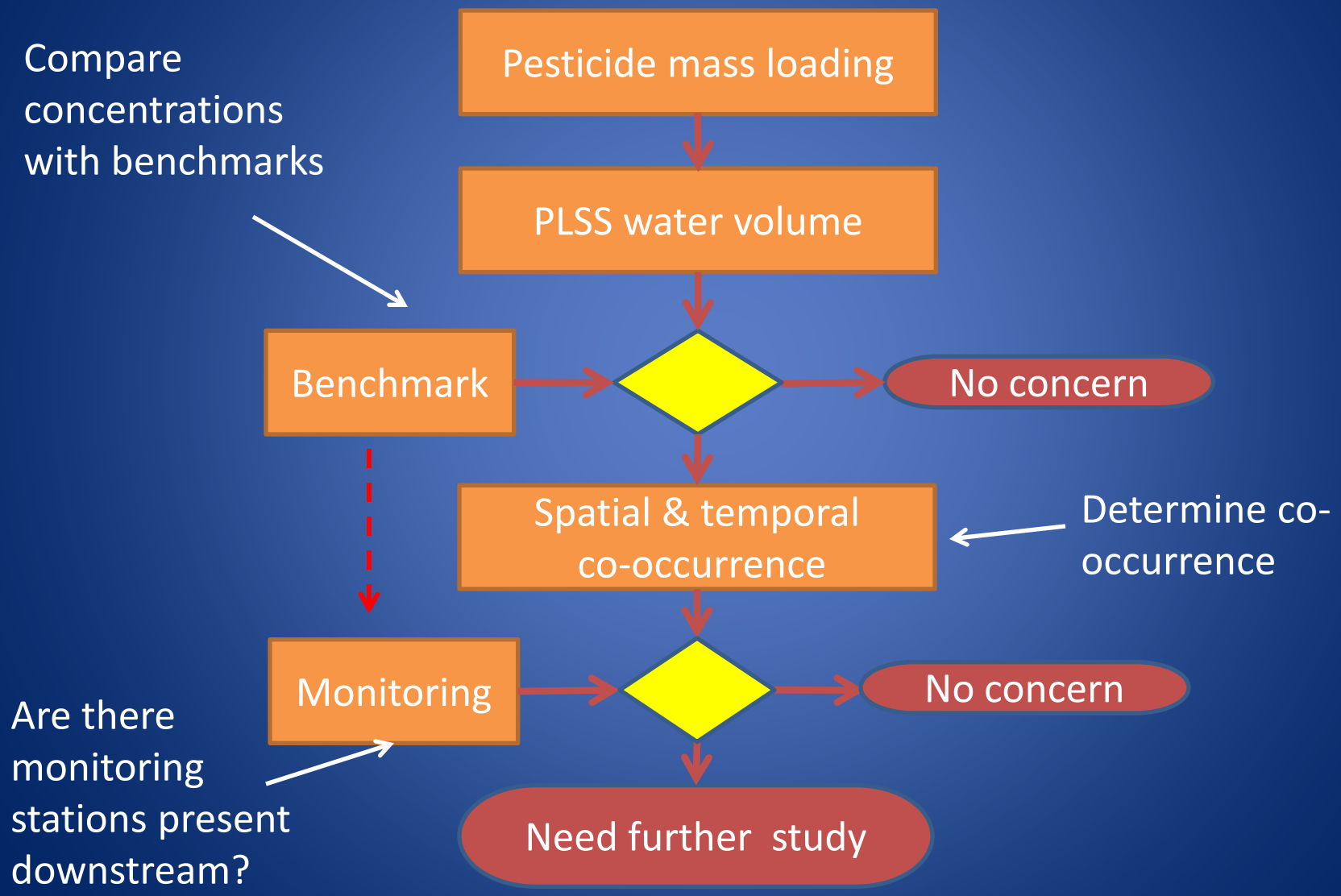
Reporting

1. Species Distributions
2. Pesticide Loadings
3. Hotspots
4. Areas of Concern
5. Recommendations

Goal of Modeling

- Estimate potential pesticide edge-of-field loadings into nearby water bodies considering important factors in chemical fate and transport:
  - Agricultural modeling
    - Pesticide Root Zone Model (PRZM)
    - Edge-of-field mass
  - Rice modeling
    - Rice water quality model (RICEWQ)
    - Water management /release
  - Urban modeling (4 pyrethroids)
    - Pervious and impervious areas with PRZM
    - Pyrethroid “Kd “calibrated to hard surface washoff studies
  - Drift estimates
    - Application location, date, rate, method
    - Pesticide mobility / persistence
    - Site conditions – crop (land use), irrigation, soil properties, weather

Results Processing



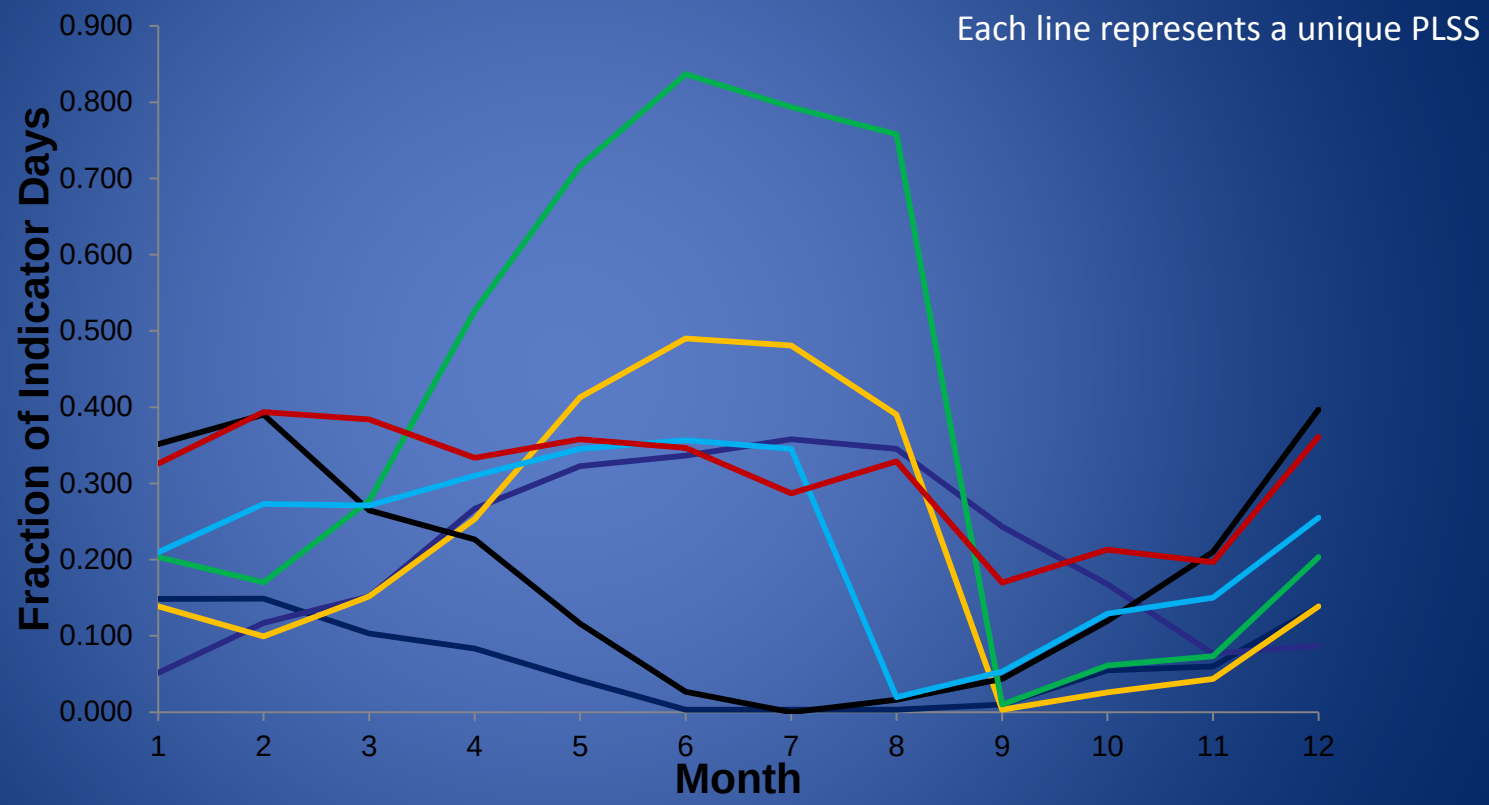
Uncertainty

- PUR precision / accuracy
- Pesticide properties
- Field-specific characteristics
- Hydrology / hydraulics
- Dissipation processes not represented
- Standardized assumptions

Edge of field predictions do <u>not</u> indicate adverse effects

Indicator Days

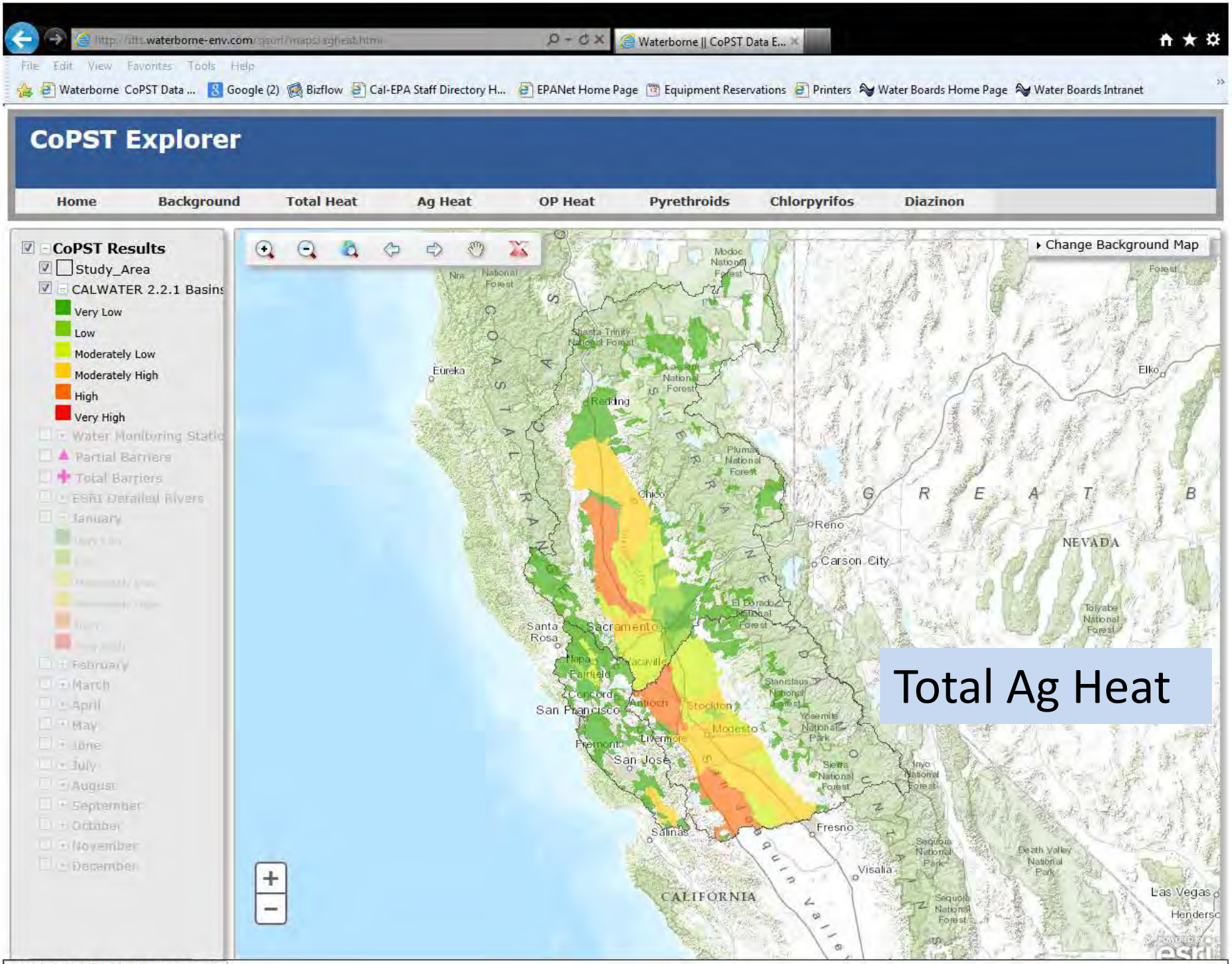
Distribution of Indicator Days for randomly selected PLSS Sections



Function of which pesticide, when applied, method of application, soil properties, irrigation practices, rainfall patterns, etc.

Initial Finding: Certain Pesticides Need to be Monitored

- Abamectin
- Copper
- Mancozeb
- Maneb
- Pyraclostrobin
- Tralomethrin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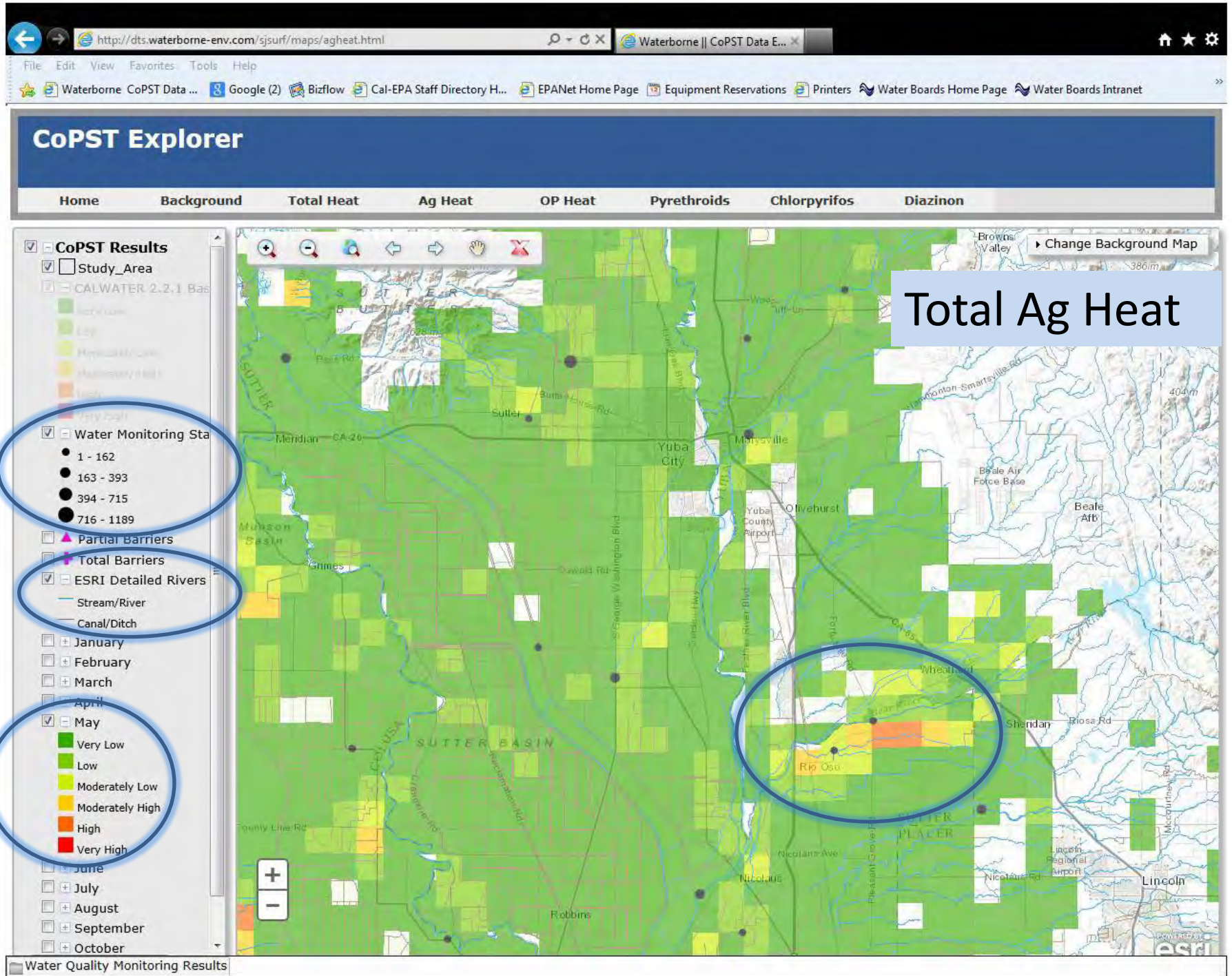
Waterborne CoPST Data ... Google (2) Bizflow Cal-EPA Staff Directory H... EPANet Home Page Equipment Reservations Printers Water Boards Home Page Water Boards Intranet
CoPST Explorer
Home
Background
Total Heat
Ag Heat
OP Heat
Pyrethroids
Chlorpyrifos
Diazinon
CoPST Results
Study_Area
CALWATER 2.2.1 Basins
Very Low
Low
Moderately Low
Moderately High
High
Very High
Water Monitoring Stations
Partial Barriers
Total Barriers
ESRI Detailed Rivers
January
February
March
April
May
June
July
August
September
October
November
December
Change Background Map
Total Ag Heat
Eureka
Redding
Chico
Reno
Carson City
Elko
Sacramento
Santa Rosa
Napa
Fairfield
Concord
San Francisco
Antioch
Stockton
Modesto
Fremont
Livermore
San Jose
Salinas
Fresno
Visalia
Las Vegas
CALIFORNIA
NEVADA
Water Quality Monitoring Results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CoPST Explorer
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Total Ag Heat
Change Background Map
CoPST Results
Study_Area
CALWATER 2.2.1 Bas
Water Monitoring Sta
1 - 162
163 - 393
394 - 715
716 - 1189
Partial Barriers
Total Barriers
ESRI Detailed Rivers
Stream/River
Canal/Ditch
January
February
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Very Low
Low
Moderately Low
Moderately High
High
Very High
June
July
August
September
October
Water Quality Monitoring Results
Yuba City
Marysville
Olivehurst
Beale Air Force Base
Beale Afb
Sutter
Meridian
Sheridan
Lincoln
Robbins
Nicolaus
SUTTER BASIN
Rio Oso
Wheatland
Browns Valley
Yuba County Airport
Lincoln Regional Airport
Riosa Rd
Nicolaus Ave
Pleasant Grove Rd
Feather River Blvd
George Washington Blvd
Dawson Rd
Grimes
County Line Rd
Reclamation Rd
Nicolaus Rd
Plumas Lake
Hammonton-Smartsville Rd
Butte House Rd
Pease Rd
Wells
Tuff-Un
Munson Basin
McCourtney
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http://dts.waterborne-env.com/sjsurf/maps/agheat.html

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CoPST Explorer

Home | Background | Total Heat | Ag Heat | OP Heat | Pyrethroids | Chlorpyrifos | Diazinon

- CoPST Results
  - Study_Area
  - CALWATER 2.2.1 Bas
  - Water Monitoring Sta
    - 1 - 162
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  - May
    - Very Low
    - Low
    - Moderately Low
    - Moderately High
    - High
    - Very High
  - June
  - July
  - August
  - September
  - October

Change Background Map

Copper, Esfenvalerate, Maneb, Permethrin

Pesticide Heat

PLSS Section: 51M13N05E18
Total Heat Units: 379
Month: May
Heats by Chemical
Abamectin: 0
Bifenthrin: 0
Bromacil: 0
Captan: 0
Carbaryl: 0
Chlorothalonil: 0
Chlorpyrifos: 20
Clomazone: 0
Copper_hydroxide: 123
Copper_sulphide: 7
Cyfluthrin: 0
Cyhalofop_butyl: 0
Cypermethrin: 1
Deltamethrin: 0
Diazinon: 9
Dimethoate: 0
Diuron: 0
Esfenvalerate: 82
Hexazinone: 0
Imidacloprid: 0
Indoxacarb: 0
Lambda_cyhalothrin: 5
Malathion: 0
Mancozeb: 0
Maneb: 43

Zoom to

Esri, HERE, DeLorme, TomTom, USGS, METI/NASA, NGA, USDA, EPA

http://dts.waterborne-env.com/sjsurf/maps/agheat.html

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  - October

Sample Date	Sample Time	Matrix Name	Analyte Name	Result	Units	Qual. Code
8/10/2004	1:00:00 PM	Sample Water	Permethrin		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Chlorpyrifos	0.04	ug/L	=
8/10/2004	1:00:00 PM	Sample Water	Esfenvalerate		ug/L	ND
7/27/2004	2:20:00 PM	Sample Water	Cypermethrin		ug/L	ND
8/24/2004	11:20:00 AM	Sample Water	Esfenvalerate		ug/L	ND
8/10/2004	1:00:00 PM	Sample Water	Cypermethrin		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Carbaryl		ug/L	ND
8/24/2004	11:20:00 AM	Sample Water	Malathion	0.04	ug/L	DNQ
7/13/2004	11:20:00 AM	Sample Water	Chlorpyrifos	0.042	ug/L	=
9/7/2004	11:40:00 AM	Sample Water	Methomyl		ug/L	ND
8/10/2004	1:00:00 PM	Sample Water	Captan		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Diazinon	0.005	ug/L	=
9/7/2004	11:40:00 AM	Sample Water	Thiobencarb		ug/L	ND
8/24/2004	11:20:00 AM	Sample Water	Permethrin		ug/L	ND
7/13/2004	11:20:00 AM	Sample Water	Carbaryl		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Esfenvalerate		ug/L	ND
7/27/2004	2:20:00 PM	Sample Water	Dimethoate		ug/L	ND
8/24/2004	11:20:00 AM	Sample Water	Cypermethrin		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Cyfluthrin		ug/L	ND
8/10/2004	1:00:00 PM	Sample Water	Thiobencarb	0.035	ug/L	DNQ
7/13/2004	11:20:00 AM	Sample Water	Diazinon		ug/L	ND
7/27/2004	2:20:00 PM	Sample Water	Bifenthrin		ug/L	ND
7/13/2004	11:20:00 AM	Sample Water	Lambda cyhalothrin		ug/L	ND
7/27/2004	2:20:00 PM	Sample Water	Diuron	0.04	ug/L	=
8/24/2004	11:20:00 AM	Sample Water	Captan		ug/L	ND
7/13/2004	11:20:00 AM	Sample Water	Esfenvalerate		ug/L	ND
9/7/2004	11:40:00 AM	Sample Water	Captan		ug/L	ND
7/13/2004	11:20:00 AM	Sample Water	Cyfluthrin		ug/L	ND
7/27/2004	2:20:00 PM	Sample Water	Carbaryl		ug/L	ND
7/13/2004	11:20:00 AM	Sample Water	Malathion		ug/L	ND
8/24/2004	11:20:00 AM	Sample Water	Simazine		ug/L	ND
8/10/2004	1:00:00 PM	Sample Water	Dimethoate	0.04	ug/L	DNQ
8/24/2004	11:20:00 AM	Sample Water	Dimethoate		ug/L	ND

Change Background Map

Water Quality (1 of 2)

Monitoring Station: 515XXCS10
Station Name: Yankee Slough at Swanson Road
Sample Period Start: 2004-07-13
Sample Period End: 2004-09-07
Number of Samples: 75
Detections (fraction): 0.00386

Zoom to

Wheatland
Sheridan
Nicolaus Rd

Esri, HERE, DeLorme, TomTom, USGS, NGA, USDA, EPA, NPS

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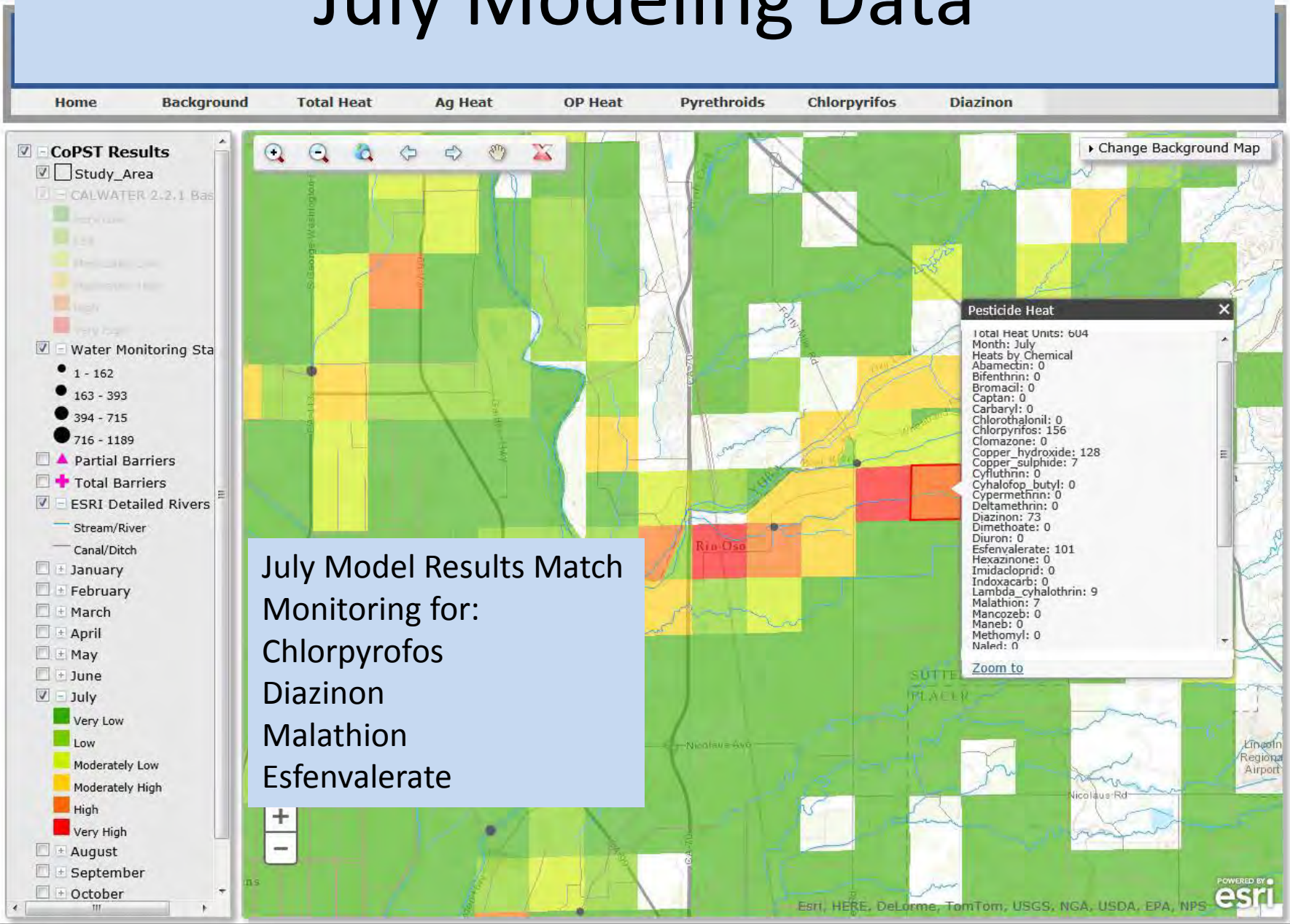
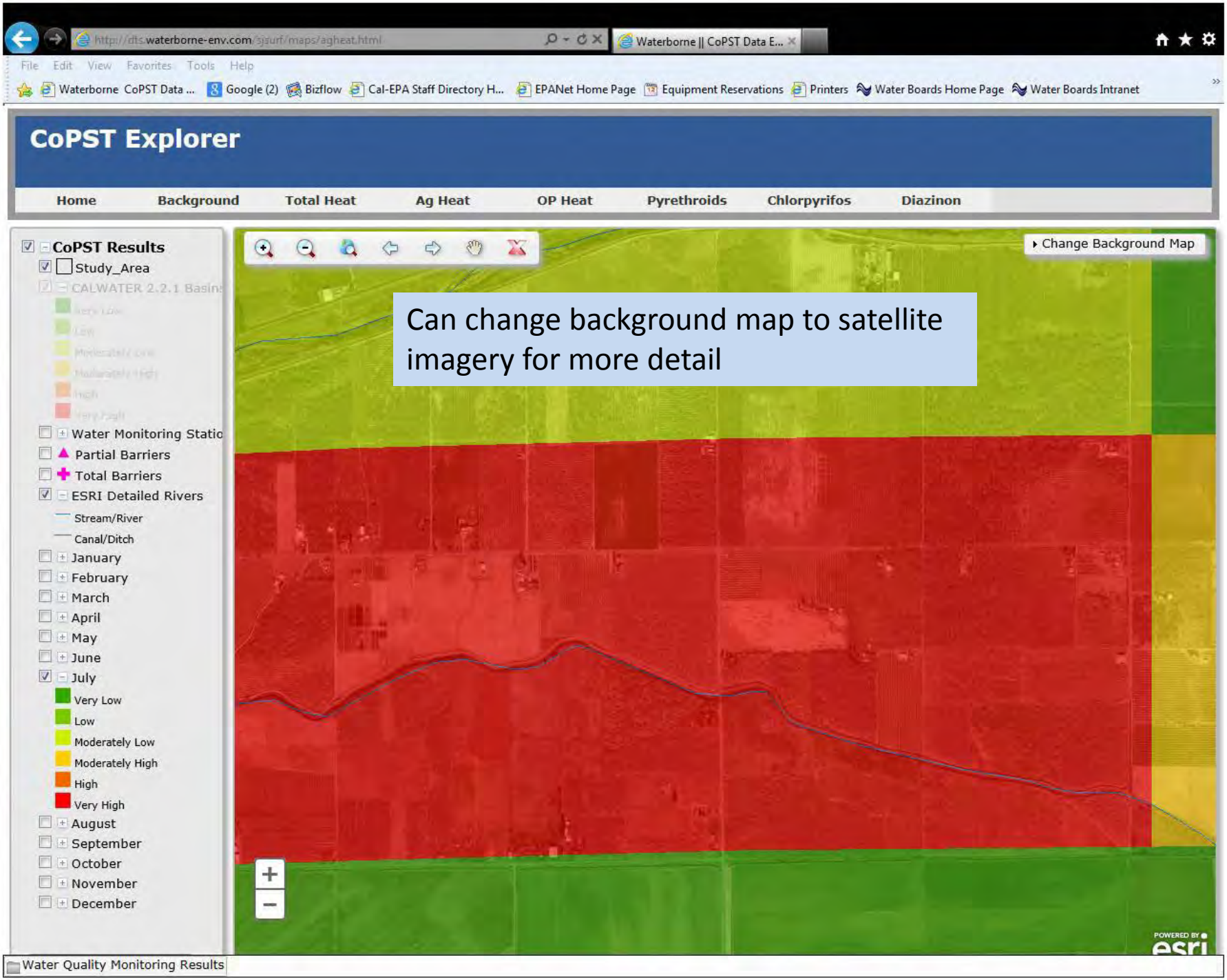
Reasons why Monitoring and the Model May not Match

- Monitoring data for May not in historical record
- Parameters monitored may not match the 40 pesticides modeled (i.e. fungicides)
- Analytical method resolution may not be at the environmentally relevant concentration
- Model may over predict potential toxicity
- Edge-of-field pesticide concentration may be present but may not get to receiving water
  - BMP's in place
  - Natural barriers
  - Chemical or physical degradation occurring

July Modeling Data



July Model Results Match Monitoring for:
Chlorpyrofos
Diazinon
Malathion
Esfenvalerate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Change Background Map
Can change background map to satellite imagery for more detail
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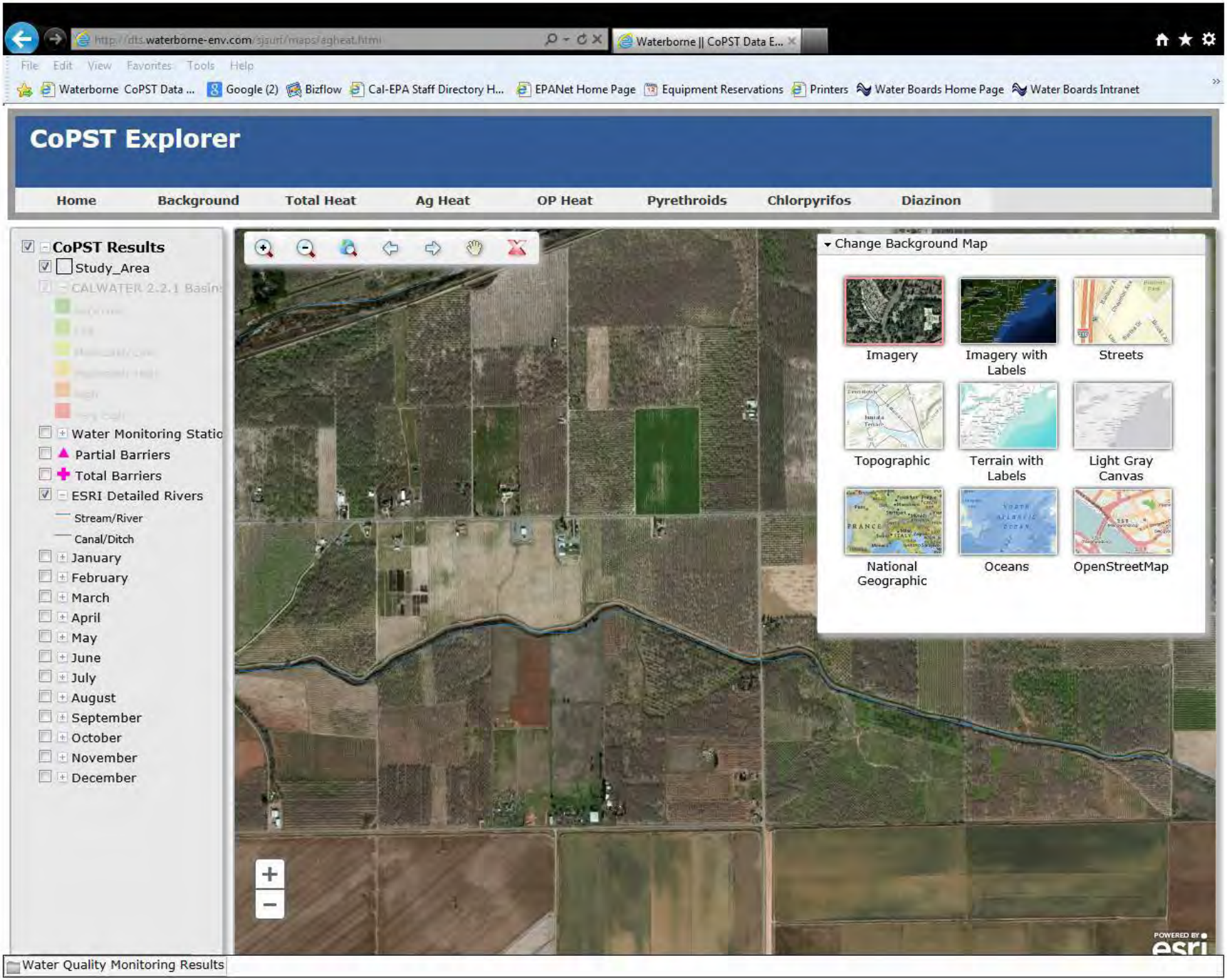
Water Quality Monitoring Results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December
Change Background Map
Imagery
Imagery with Labels
Streets
Topographic
Terrain with Labels
Light Gray Canvas
National Geographic
Oceans
OpenStreetMap
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Water Quality Monitoring Results

Uses of the Tool
(Model plus Map layers)

- Identify temporarily and spatially, priority sections, areas and watersheds for further investigation
- Examine current water quality monitoring sites, frequency, and parameters for relevancy
- Identify areas as priority for BMP development and funding
- Aid in developing plans to improve ecosystem quality and water quality

What's Next?

- Outreach to NRCS and Waterboards
- Building up
  - Adding more pesticides as they emerge as a concern
  - Updating PUR data, and model runs
- Building out
  - Other geographic areas (Central Coast water board)

Contact Information

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To download report and see overview of project:

http://www.waterborne-env.com/projects_featured.asp