

MULTI – AGENCY REVISION AND DEVELOPMENT OF A STANDARDIZED TEMPLATE FOR ASSESSING OCCUPATIONAL, RESIDENTIAL, FUMIGATION AND SPRAY DRIFT EXPOSURE

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Master of Public Health
Capstone Project
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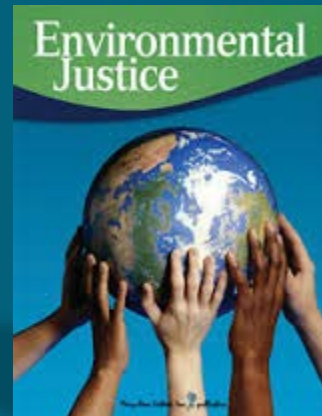
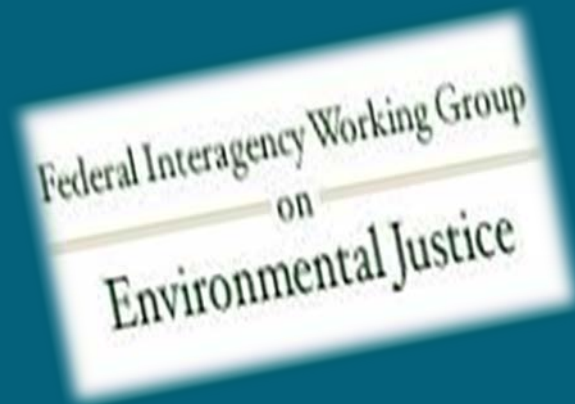
Outline

- ❑ Multiple Government Agency Externship
- ❑ Environmental Protection Agency Field Experience
- ❑ Capstone Project: Collaborative Agency Risk Assessment
 - *Occupational*
 - *Residential*
 - *Spray Drift/Fumigation*

Multiple Government Agency Externship

- ❑ Environmental Protection Agency
(EPA)
- ❑ Office of Chemical Safety and Pollution Prevention
(OCSPP)
- ❑ Office of Environmental Justice/Interagency Working Group
(OEJ/IWG)
- ❑ United States Department of Agriculture
(USDA)
- ❑ Food and Drug Administration
(FDA)

Federal Agency Externship Introduction





Environmental Protection Agency (EPA)

Mission: “Our mission is to protect human health and the environment.”

- ☐ Making a difference in the communities throughout the US.
- ☐ Address Climate Change: Improve Air Quality.
- ☐ Address Toxic Chemical Safety.
- ☐ Protect our Water Supply.
- ☐ Secure the State, Local and Tribal Relationships.
- ☐ Embrace Sound Science and Sustain Performance.
- ☐ Working Toward a Sustainable Future.



Office of Chemical Safety and Pollution Prevention (EPA/OCSP)

“OCSP regulates the manufacture and use of all pesticides (including insecticides, herbicides, rodenticides, disinfectants, sanitizers and more) in the United States and establishes maximum levels for pesticide residues in food.”

OCSP facilitates:

- ❑ New Pesticides Registrations.
- ❑ Special Local Needs and Emergency Registrations.
- ❑ Re-Registration.
- ❑ Pesticide Field Programs (certifications: Water/Pesticide safety).

Office of Environmental Justice/Interagency Working Group (OEJ/IWG)

- ❑ EPA*
- ❑ Departments of Justice*
- ❑ Defense
- ❑ Energy
- ❑ Labor
- ❑ Interior
- ❑ Transportation
- ❑ Office of Management and Budget
- ❑ Office of Science
- ❑ Domestic Policy Council
- ❑ Agriculture
- ❑ Housing
- ❑ Urban Development
- ❑ Commerce
- ❑ Health and Human Services
- ❑ Council on Environmental Quality
- ❑ Technology Policy
- ❑ Council of Economic Advisors



United States Department of Agriculture (USDA)

“The USDA deals specifically with establishing pesticide tolerances of imported and exported commodities with all international partners.”

- ☐ Food Safety
- ☐ Agriculture
- ☐ Economic development
- ☐ Research
- ☐ Natural Resource Conservation
- ☐ Import/Export Relationships with other Countries



Food and Drug Administration (FDA)

“FDA is responsible for protecting the public health/Safety.”

- ❑ Human and Veterinary Drugs
- ❑ Biological Products
- ❑ Medical Devices
- ❑ Nation's Food Supply
- ❑ Cosmetics
- ❑ Products that Emit Radiation
- ❑ CFSAN - “The Center for Food Safety and Applied Nutrition works to assure that the food supply is safe, sanitary, wholesome, and honestly labeled.”

ENVIRONMENTAL PROTECTION AGENCY: FIELD EXPERIENCE



BACKGROUND



TITLE VI
Civil Rights Act

FIELD EXPERIENCE:

EPA – (OEJ/IWG, OCSPP, OPP), USDA, FDA





FIELD EXPERIENCE:

Goals

- ❑ **EPA** (OEJ/IWG): Learn Environmental Justice concerns/law and generate exposure assessment language for new template in adherence to “Title VI”.
- ❑ Study Calif. Dept. of Pesticide Regulation (CDPR) Spray Drift/Fumigation data generated by the **FDA** and **USDA** (Angelita C “Title VI” complaint).
- ❑ **EPA** (OCSPP/OPP): Analyze the existing Occupational/Residential Exposure Template and Science Advisory Panel exposure data.



THE OFFICE OF ENVIRONMENTAL JUSTICE/INTERAGENCY WORKING GROUP (OEJ/ IWG)

- ❑ "Title VI" of the Civil Rights Act of 1964 :
 - ✓ No discriminating against employees on the basis of sex, race, color, national origin, and religion."
 - ✓ Federal, State or Local governments that receive money from the federal government will operate their environmental protection programs in a non-discriminatory manner, with respect to race, color or national origin

<http://www.epa.gov/civilrights/>



Title VI : Angelita C. Complaint

- ❑ Complaint filed in June 1999 on behalf of children and parents who attend 6 California public schools.
- ❑ The Complaint : the California Department of Pesticide Regulation (CDPR) discriminated against Minority/Latino school children in California by allowing use of methyl bromide (MeBr) via Aerial/Fumigation applications near schools.

Law Suit Filed by:

- ❑ California Rural Legal Assistance, Inc.
- ❑ The Center on Race, Poverty & the Environment
- ❑ The California Rural Legal Assistance Foundation
- ❑ The Farm-worker Justice Fund, Inc.

Co-Exist.....





California Dept. Pesticide Regulation (CDPR): Methyl Bromide (MeBr) Field Study

Introduction

- ❑ Accumulate data generated by CDPR in their MeBr study (1995 – 2001).
- ❑ ICF Analyzed Modeled data.

Methyl Bromide (MeBr)

Facts

- ❑ Ozone depleting chemical.
- ❑ Toxic to the nervous system.
- ❑ Phase out time slated for 2005.
- ❑ Special exemptions were allowed until a replacement chemical could be used.
- ❑ Phosphine slated to be MeBr's replacement.

CDPR: MeBr Field Study

Parameters

- ❑ MeBr applied via Aerial (fixed wing aircraft).
- ❑ Cells of $\frac{1}{4}$ sq mi. / $\frac{1}{4}$ sq. mi. placed on a Grid.
- ❑ Cells included farm land sprayed with MeBr and schools.



Geographic Grids

- ❑ Data: MeBr concentrations from 8,000 public schools.
- ❑ Data includes 6 California schools named in law suit.
- ❑ Data generated: Daily MeBr concentrations at each School.



CDPR: MeBr Field Study

Specifics:

- ❑ Model Variables: For Predicting MeBr Concentrations.
 - ✓ Distance and Direction from Receptor Site.
 - ✓ Days between usage.
 - ✓ Concentration prediction (Application Rate).
 - ✓ Temperature of area.
 - ✓ Wind Speed.

Results:

See Table 1 “All schools” (following page).

Table 1 : Summarizes “maximize concentrations, exceedances” and the number of “affected” schools for ten different exposure scenarios. Each of these scenarios were assigned concentration benchmarks (35, 9, 5, 1, 1.3, 2.6 ppb) established by either the EPA/OPP or Cal EPA/CDPR over different time (days) durations.

Table 1. Details the number for predicted exceedances and affected schools post MeBr usage from various averaging periods and concentration benchmarks.

Criterion	Exceedances	Affected Schools	Benchmark Source & Type
> 35 ppb in 7 days	4	3	EPA/OPP, Intermediate
> 9 ppb in 42 days	102	44	Cal-EPA/CDPR, Intermediate
> 9 ppb in 30 days	214	69	Cal-EPA/CDPR
> 5 ppb in 30 days	868	145	Cal-EPA/CDPR, Intermediate
> 1 ppb in 42 days	5039	743	Cal-EPA/OEHHA, Intermediate
> 1 ppb in 30 days	7101	929	Cal-EPA/OEHHA, Intermediate
> 1 ppb in 182 days	866	168	EPA/OPP, Long-term
> 1.3 ppb in 365 days	287	91	EPA/OPP, Long-term
> 1.3 ppb 2x in 182 days in same year	162	64	EPA/OPP, Long-term
>1.3 ppb in 30 days (6 x the same year)	29	23	EPA/OPP, Long-term
> 2.6 ppb and > 1.3 ppb in 182 days in same year for 2 yrs. in a row	33*	21	EPA/OPP, Long-term and EPA/OPP x 2, Long-term
> 2.6 ppb 2x in 182 days in same year	222	71	EPA/OPP x 2, Long-term

1. Geographic information about farmland in California was obtained from three sources: the California Department of Conservation, the California Department of Water Resources, and the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP). All of these data bases include information about the locations of farmland and various types of land cover, and were merged to create an integrated database covering all of California. (ICF 2011).

CDPR MeBr Study:

School Locations

Figures 1, 2 and 3 are maps that show the Central and Northern California Schools monitored for MeBr exposure.

- ❑ 8,000 schools represented in the study including the schools named in the Title VI complaint.

Figure 1: Central California - Oxnard-Camarillo

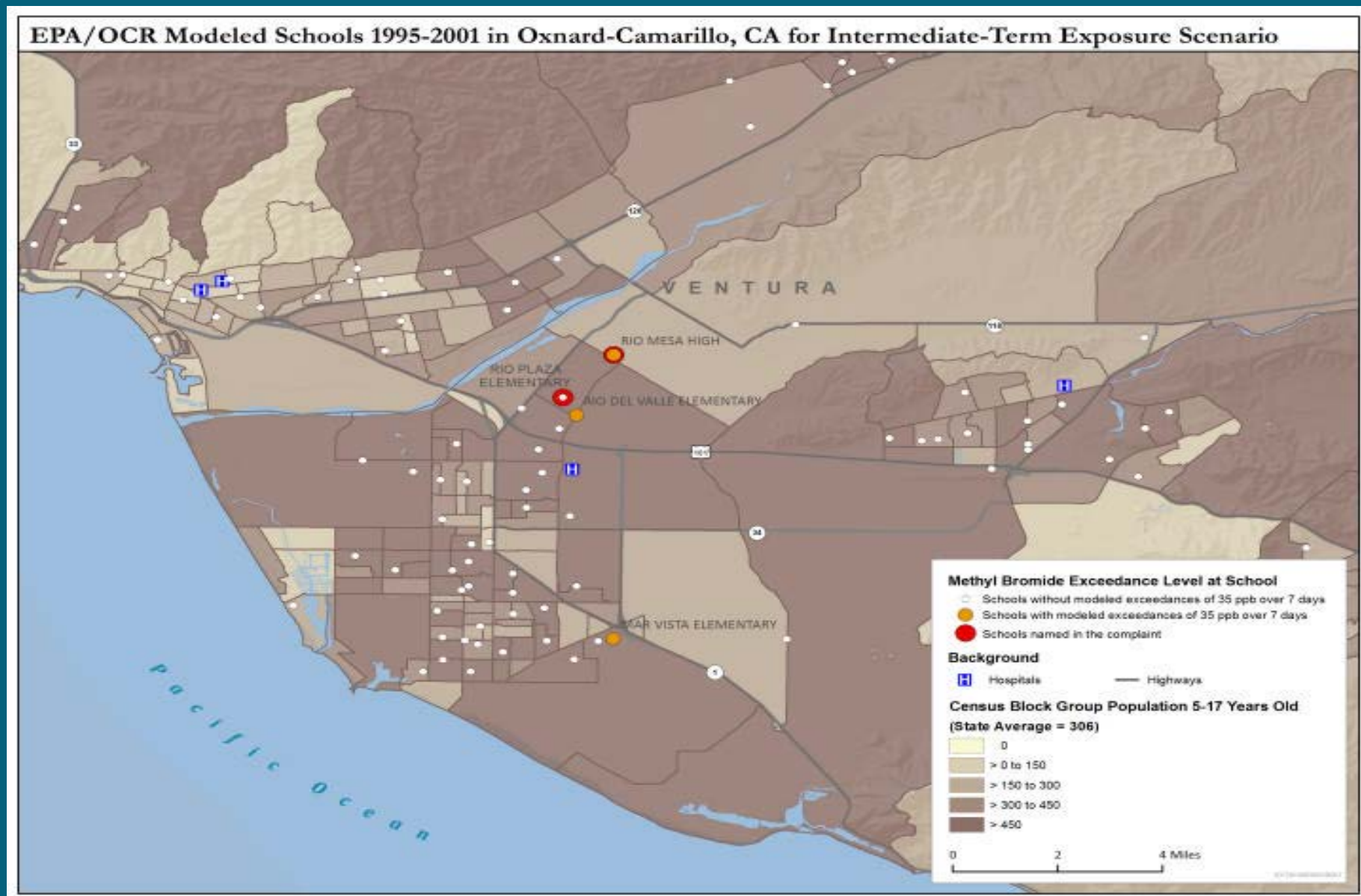


Figure 2: Northern California - Central Coast

EPA/OCR Modeled Schools 1995-2001 in North Central Coast, CA for Long-Term Exposure Scenarios

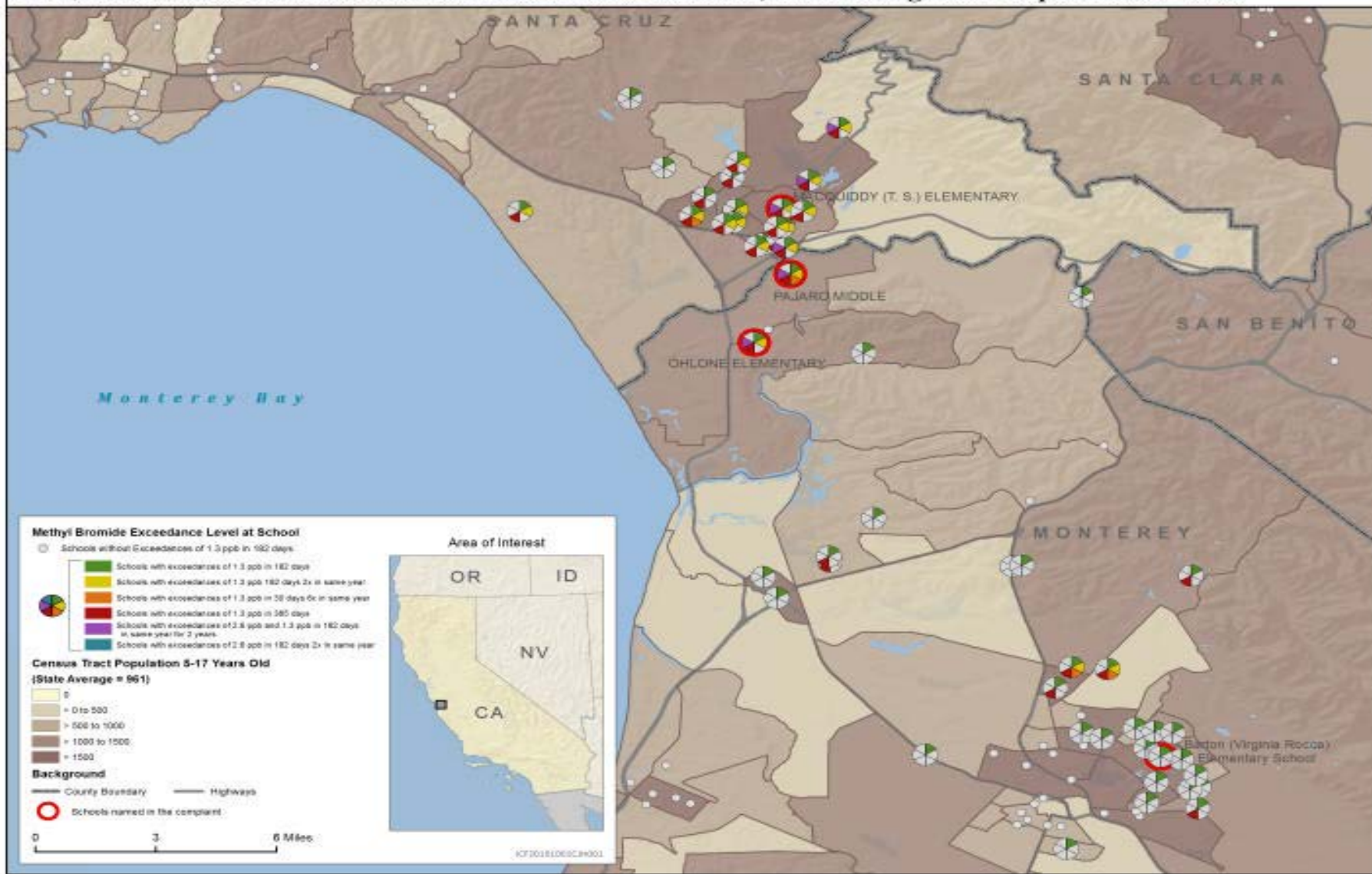
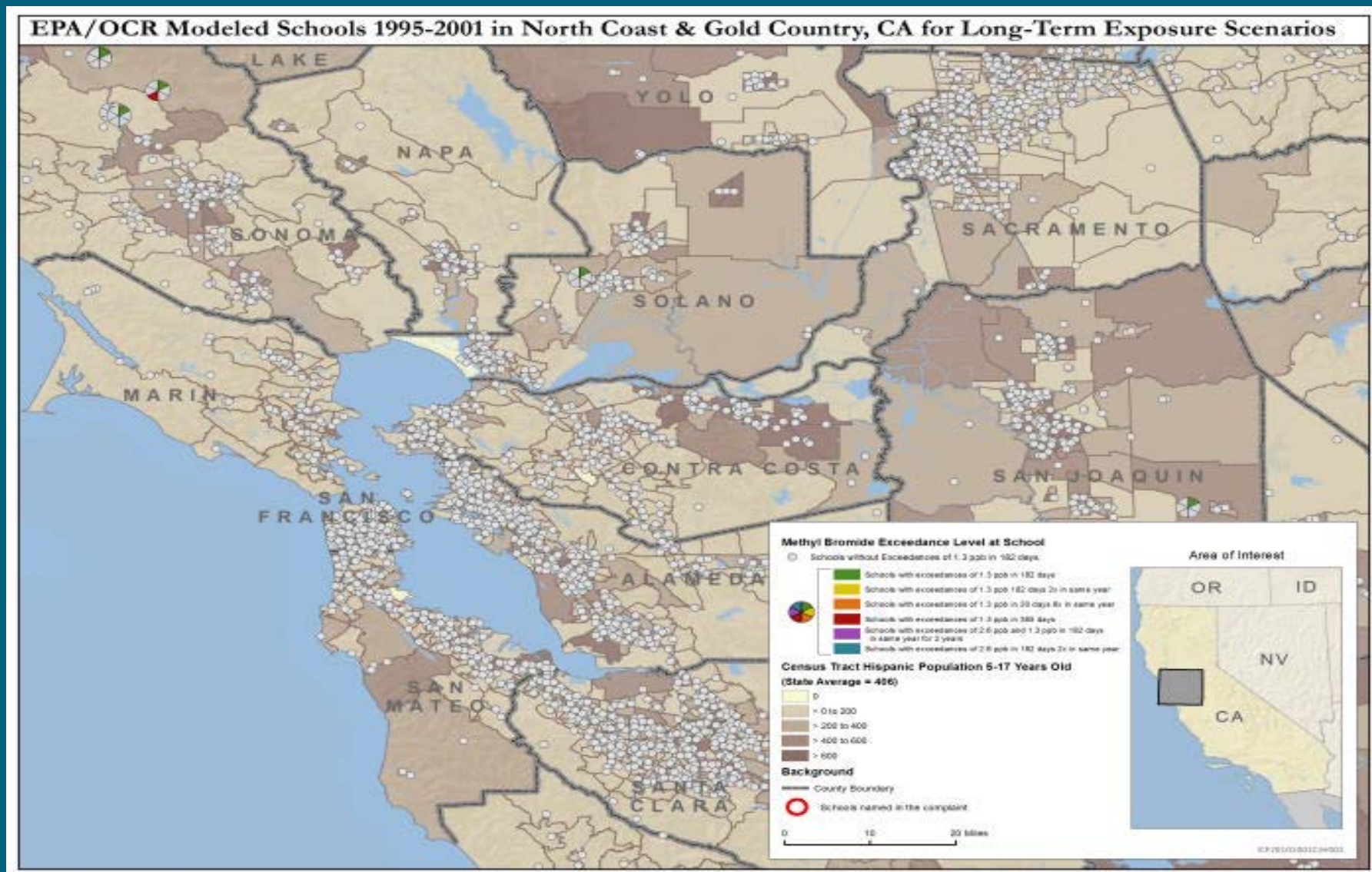


Figure 3: Northern California - North Central Coast/ Gold County



Note: For extensive map information, see CDPR's pesticide Usage Report-(Cal-EPA/CDPR 2000, 2002).

CDPR: MeBr study

☐ Schools named in the law suite:

- ✓ Rio Mesa High School
- ✓ Pajaro Middle School
- ✓ MacQuiddy Elementary School
- ✓ Rio Plaza Elementary School
- ✓ Ohione Elementary School
- ✓ Barton Elementary School

Table 2. Includes the Exposures of MeBr monitored and the proportion of Hispanic students in each of the Schools named specifically in the Title VI complaint. This table shows minority population % and MeBr level benchmarks.

Criterion	School					
	Rio Mesa HS	Pajaro MS	Mac Quiddy ES	Rio Plaza ES	Ohlone ES	Barton ES
County	Ventura	Monterey	Santa Cruz	Ventura	Monterey	Monterey
Proportion of Students who were Hispanic (1995-2001)	64%	94%	91%	88%	96%	98%
> 35 ppb in 7 days (# in 7 years)	2	0	0	0	0	0
> 9 ppb in 42 days (# in 7 years)	12	4	1	3	2	0
> 9 ppb in 30 days (# in 7 years)	15	6	5	8	5	0
> 5 ppb in 30 days (# in 7 years)	19	17	15	15	17	0
> 1 ppb in 42 days(# in 7 years)	25	24	21	26	25	18
> 1 ppb in 30 days(# in 7 years)	35	30	28	33	32	25
> 1.3 ppb in 182 days (# in 7 years)	12	13	11	10	13	3
> 1.3 ppb in 365 days (# of years)	6	6	6	6	7	0
> 1.3 ppb in 182 days, 2x in a year (# of years)	5	6	4	3	6	0
> 1.3 ppb in 30 days, 6x in a year (# of years)	1	1	0	1	0	0
> 2.6 ppb and > 1.3 ppb in 182 days in same year for 2 yrs in a row (# of pairs of consecutive years)	4	3	1	1	3	0
> 2.6 ppb in 182 days, 2x in a year (# of years)	4	0	0	1	0	0



THE OFFICE OF ENVIRONMENTAL JUSTICE/INTERAGENCY WORKING GROUP (OEJ/ IWG): “CDPR MeBr Field Study Ramifications”

Summary

- ❑ EPA- Office of Civil Rights determined that a “disparity analysis” was warranted.
- ❑ Hispanic student being affected was higher than that of a non Hispanic student by a factor of “18.3 to 1”. (Cohen et al. 2011)
- ❑ Decision determined “not racially motivated.”

Action Steps

- ❑ Design/implement Spray drift calculations for revised Occupational and Residential exposure risk assessment template.
- ❑ Draft Environmental Justice language to insert into template concerning fumigation/spray drift potential exposure concerns.



THE OFFICE OF CHEMICAL SAFETY AND POLLUTION PROTECTION (OCSPP):

“OCSPP works to prevent pollution with the goal to reduce waste, save energy and natural resources and to help maintain safety standards in our residential and occupational settings”.

- ❑ June 2012 - Science Advisory Panel : Current risk assessment template was out dated due to newly submitted studies reflecting the **Title VI Disparity/MeBr** complaint.
- ❑ April 2014 – Occupational exposure portion evaluated.
- ❑ May 2015 – Occupational and Residential **Roadmap** created.

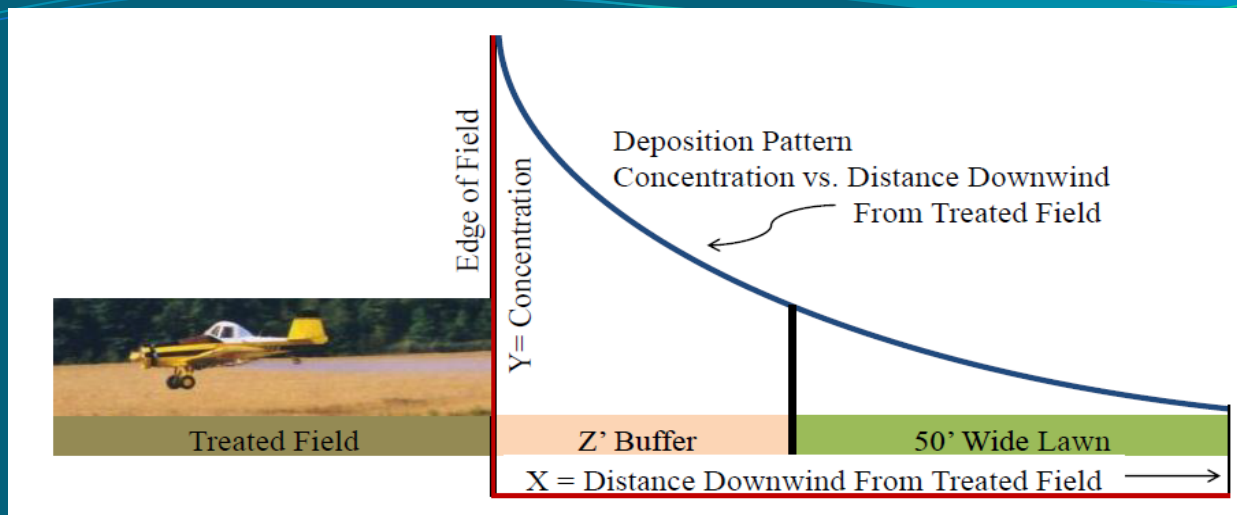
Risk Assessment Road Map

Update:

- ☐ Occupational (Handler and Post-Appl.) Risk Assessment.
- ☐ Occupational Risk Characterization.
- ☐ Residential (Handler and Post-Appl.) Risk Assessment.
- ☐ Residential Risk Characterization.

Design and Implement:

- ☐ Environmental Justice (Spray Drift Characterization /Fumigant Assessment).



Spray drift profiles can be directly impacted by many factors including:

- ❑ Application equipment (airplane, helicopter, airblast or groundboom) which directly depends on the crop being treated.
- ❑ Environmental conditions (wind direction and speed, fog, weather patterns such as rain or temperature and atmospheric stability).
- ❑ Site characteristics (big open field or small field surrounded by homes).



Environmental Justice

(Spray Drift Characterization/Fumigant Assessment)

- ❑ Analyze Spray Drift data from EPA SOPs Nov. 2013 .
- ❑ Models used (SOFEA, Ag DRIFT, and PERFUM)

Areas of Specific Focus: “Spray Drift Characteristics”

- ❑ Aerial Pesticide Applications.
- ❑ Buffer Zones (area between treated field and home/school).
- ❑ Spray Drift Language.



CAPSTONE PROJECT: COLLABORATIVE AGENCY RISK ASSESSMENT (EPA, OCSPP, USDA, FDA, OEJ, AND EJ/IWG)

- ☐ Occupational Handler and Characterization
- ☐ Occupational Post-Application and Characterization
- ☐ Residential Handler and Characterization
- ☐ Residential Post-Application and Characterization
- ☐ Spray Drift/Fumigation Considerations

OCCUPATIONAL EXPOSURE: RISK ASSESSMENT CONSIDERATIONS



I. OCCUPATIONAL HANDLER : PESTICIDES “APPLICATION”

- ❑ Handlers: Professional applicators who may be exposed while mixing, loading, and/or applying pesticide products to crops, lawns, or indoors.
- ❑ New data and worker activity updates, especially with new “fumigant” research and application techniques for emerging fumigation market needs.



❑ Three major inputs were revised in the occupational handler algorithm calculations.

1. Application rates (lbs active ingredient/Acre).
2. Amount of area treated which depends on the types of application equipment.
3. Unit Exposures (mg/lbs ai or ug/lb ai): Depends on the formulation of the pesticide (solid or liquid) and PPE worn.

Algorithm:

Exposure (mg/day) = Application Rate x Area Treated x Unit Exposure.

II. OCCUPATIONAL POST-APPLICATION : “ENTERING AFTER”

- ❑ Post-application: professionals who enter previously treated fields, buildings or ship hulls.
- ❑ New data and post-application worker activity updates, especially with new “fumigant” research and application techniques for emerging fumigation market needs.

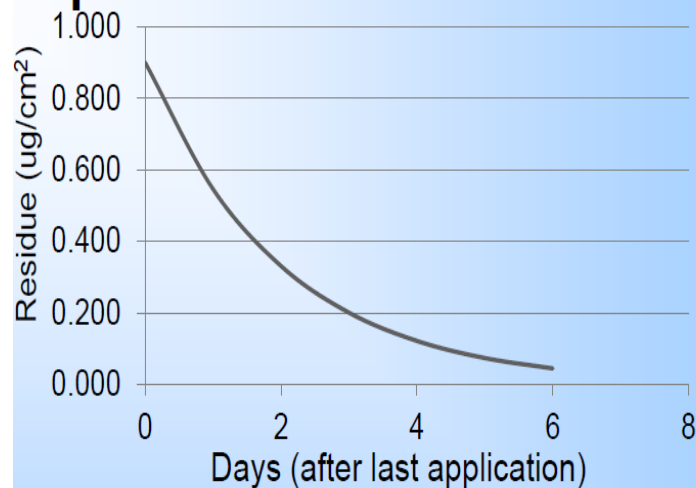


Four major inputs were revised in the occupational post application algorithm calculations.

1. Dislodgeable Foliar Residue (DFR) or Turf Transferable Residue (TTR). Amount of Pesticide “transferred” to worker

Table 4. Example of DFR and TTR dissipation rate for chemical XX

Input 1: DFR/ TTR



Input/Parameter	Crop XX	Crop XX
Application Rate (lb ai/A)	1	1
Day 0 Residue ($\mu\text{g}/\text{cm}^2$)	0.9	1
Slope	- 0.5	-0.6

❑ Revised Inputs in the occupational post-application algorithm calculations.

1. (DFR) or (TTR). “Plant or Turf”
2. Transfer coefficient (TC) (cm²/hr). “Depends on Activity.”
3. Exposure Duration (hours/day).
4. Inputs: Type of which dictates activity.

Algorithm:

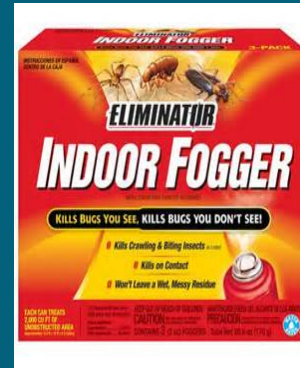
Exposure (mg/day) = DFR or TTR (μg/cm²) x TC (cm²/hr) x Est. Time (hrs./day)

RESIDENTIAL EXPOSURE: RISK ASSESSMENT CONSIDERATIONS



III. RESIDENTIAL HANDLER: PESTICIDES “APPLICATION”

- ❑ Residential Handlers: homeowner/consumer applicators who exposed while mixing, loading, and/or applying pesticide products (at home) indoors or outdoors.
- ❑ New data for homeowner activity.



- ❑ Three major inputs were revised in the residential handler algorithm calculations.
 1. Application rates (lbs active ingredient/ft² or gallon).
 2. Amount of area treated which depends on the types of application equipment.
 3. Unit Exposures (mg/lbs ai or ug/lb ai): Depends on the formulation of the pesticide (solid or liquid) and PPE worn.

Algorithm:

Exposure (mg/day) = Application Rate x Area Treated x Unit Exposure.

IV. RESIDENTIAL POST-APPLICATION: “ACTIVITIES AFTER”

- ❑ Post-application: that occur after applications in residential settings (e.g., homes, parks, schools, athletic fields, hotels, and others)
- ❑ New data and post-application activity updates, especially with Children and Sentinel (1 < 2 yrs. Old) populations.
- ❑ Sentinel Populations: (hand to mouth/object to mouth/soil ingestion)

Adults:



Children: (>3 yrs.)



Sentinel: (1 < 2 yrs.)



❑ Residential Post-Application (Adult/Child/Sentinel)

Exposure Scenarios

A. Dermal Exposure (Adult/Child/Sentinel).

- Inhalation Exposure (Adult/Child/Sentinel).

B. Non-dietary Ingestion Exposure (Child/Sentinel only).

C. Hand to Mouth (Child/Sentinel only).

D. Object to Mouth (Child/Sentinel only).

- Incidental Soil Ingestion (Child/Sentinel only).
- Episodic Granular Ingestion (Child/Sentinel only).
- Dust Ingestion.



Algorithms

- ❑ The residential post-application algorithms are the same as the occupational post-application.
- ❑ Different inputs for child/Sentinel specific behavior.

Table 5. Inhalation Exposure.

Table 6. Incidental Oral.

Algorithm inputs:

Table 5. Residential Inhalation Exposure

Air concentration (C)
Inhalation rate (IR)
Air changes per hour (ACH)
Air velocity (AV)
Volume of treated space (V)
Exposure Time (ET)

**Table 6. Residential Non-Dietary Ingestion
“Incidental Oral” Exposure**

Surface area of one hand (SAH)
Saliva extraction factor (SE)
Fraction of ai on hands (Fai hands)
Fraction mouthed (FM)
Exposure Time (ET)
Replenishment Intervals per Hour (N_Replen)
Hand-to-Mouth events per hour (Freq_Replen)

SPRAY DRIFT/FUMIGATION: RISK ASSESSMENT CONSIDERATIONS



V. SPRAY DRIFT/FUMIGATION

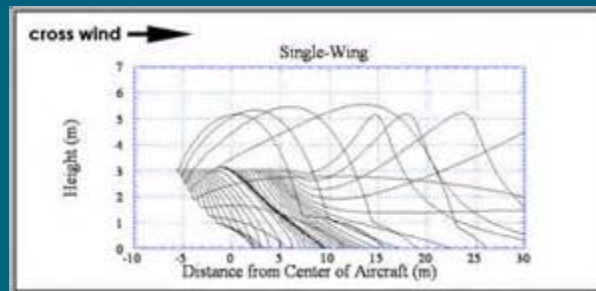


Exposure questions:

1. What crop(s)/pest(s) are treated with the pesticide?
2. Pesticide formulation: solid or liquid?
3. What types of equipment is used in the application of the pesticide?
4. Are applications soil-directed or foliar?
5. Do product labels contain specific language related to spray quality (e.g., types of nozzles to be used or the size of droplets that are allowable)?

CALCULATION METHODS

- ❑ Spray Drift calculations – AgDrift Model
- 1. The AgDrift model : applications made by aircraft, airblast orchard sprayers, and groundboom sprayers.
- 2. Language for three different possible options.





LANGUAGE

❑ Language for three different possible Scenarios.

Scenario 1: If the chemical has no uses that would result in spray drift.

Scenario 2: If the chemical has a turf use, use that data.
(i.e., turf use is protective for spray drift).

Scenario 3: Quantitative spray drift assessment is required



Capstone Project Results:

SUMMARY OF ACTIONS

- ❑ Analyze the data from the field spray drift study.
- ❑ Construct parameter inputs.
- ❑ Institute calculation methods using the AgDrift model.
- ❑ Construct and inserted legal notification stating that spray drift occurs and the proper steps have been designed to assess the exposure and characterize potential spray drift risks.

Field Experience Activities:

As they relate to the MPH program learning objectives

- ❑ My experience involved mining data in areas such as; epidemiology, pesticide food tolerances, occupational and residential exposure, fumigant bystander exposure and environmental law with the task of bridging these different aspects into an inter-agency pesticide risk assessment.
- ❑ By understanding multiple scientific languages combined with biostatistics, epidemiology, food law, and many other aspects taught in the MPH program, I was able to navigate the process along with my other task force workmates. Environmental health and epidemiology risk concepts really helped in dealing with the USDA, EPA, and FDA.

Field Experience Activities:

As they relate to the MPH program learning objectives

- ❑ Bio-statistics was the main tool used in the studies I reviewed, especially the OEJ spray drift study as it dealt with risk populations and pesticide exposure. Food law and global trade understanding was particularly helpful while dealing with fumigations (gas applied to food) in ship hulls coming from other countries to control mold and burrowing pests.
- ❑ Lastly, the food science/chemistry was beneficial in dealing with the FDA in setting pesticide food tolerances. This experience greatly enhanced my education dealing with multiple government health agency dynamics, protocols, territory responsibilities, and overall public health role. I am grateful to all of the people and agencies that allowed me to participate in this policy making forum.

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