

Developing Water Quality Monitoring Programs for Agricultural Runoff/Discharges in the Central Valley of California

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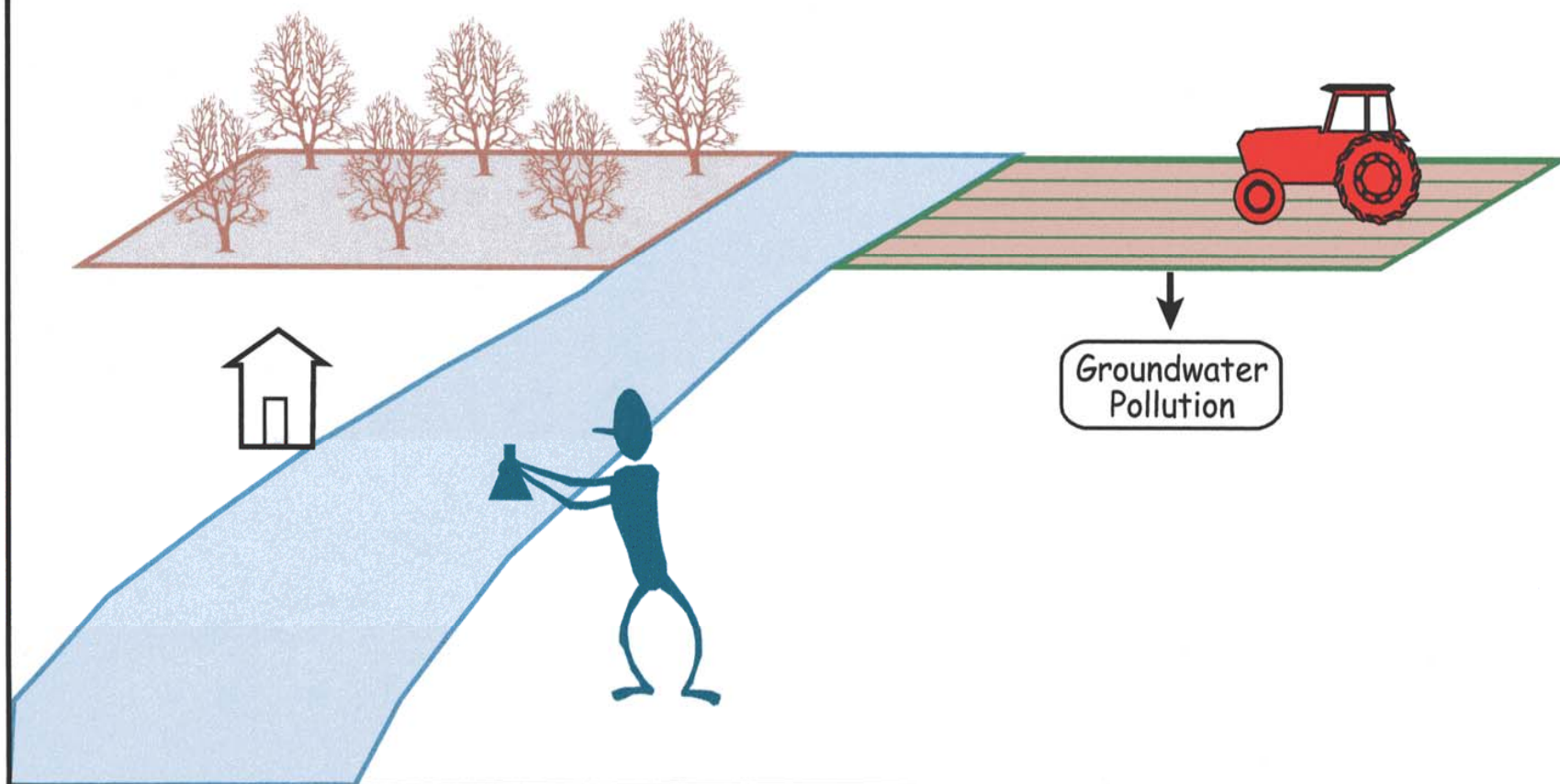
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- Overall Approach in Organizing Water Quality Monitoring Program
- Constituents of Concern, Frequency & Location of Monitoring
- Evaluation of Water Quality Impacts
- Addressing Exceedances of Water Quality Standards

Background to Regulating Agricultural Stormwater Runoff and Tailwater Discharges

- California Regulations Allow for Regulating Irrigated Agricultural Runoff/Discharges That Cause Violations of Water Quality Standards
- Until Recently, These Discharges Have Received a Waiver from Waste Discharge Requirements
- CA Legislature Requires That the Regional Water Quality Control Boards Implement Pollution Control Programs for Irrigated Agriculture and Other Nonpoint Sources

Reliable Monitoring Is Key to Effective NPS Water Quality Management Program



Background to Presentation

- Lee, G. F. and Jones-Lee, A., *"Issues in Developing a Water Quality Monitoring Program for Evaluation of the Water Quality - Beneficial Use Impacts of Stormwater Runoff and Irrigation Water Discharges from Irrigated Agriculture in the Central Valley, CA,"* California Water Institute Report TP 02-07 to California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 157 pp, California State University Fresno, Fresno, CA, December (2002).

<http://www.gfredlee.com/Agwaivermonitoring-dec.pdf>

Constituents of Potential Concern

- Chemicals Added to Agricultural Lands to Enhance Crop Production
 - Pesticides/Herbicides, Fertilizers, Soil Amendments
- Chemicals Produced on Agricultural Lands
 - TDS, TSS, TOC
- Chemicals Present in Native Soils
 - Selenium, Boron
- Chemicals Derived from the Atmosphere
 - Lead, Nitrate

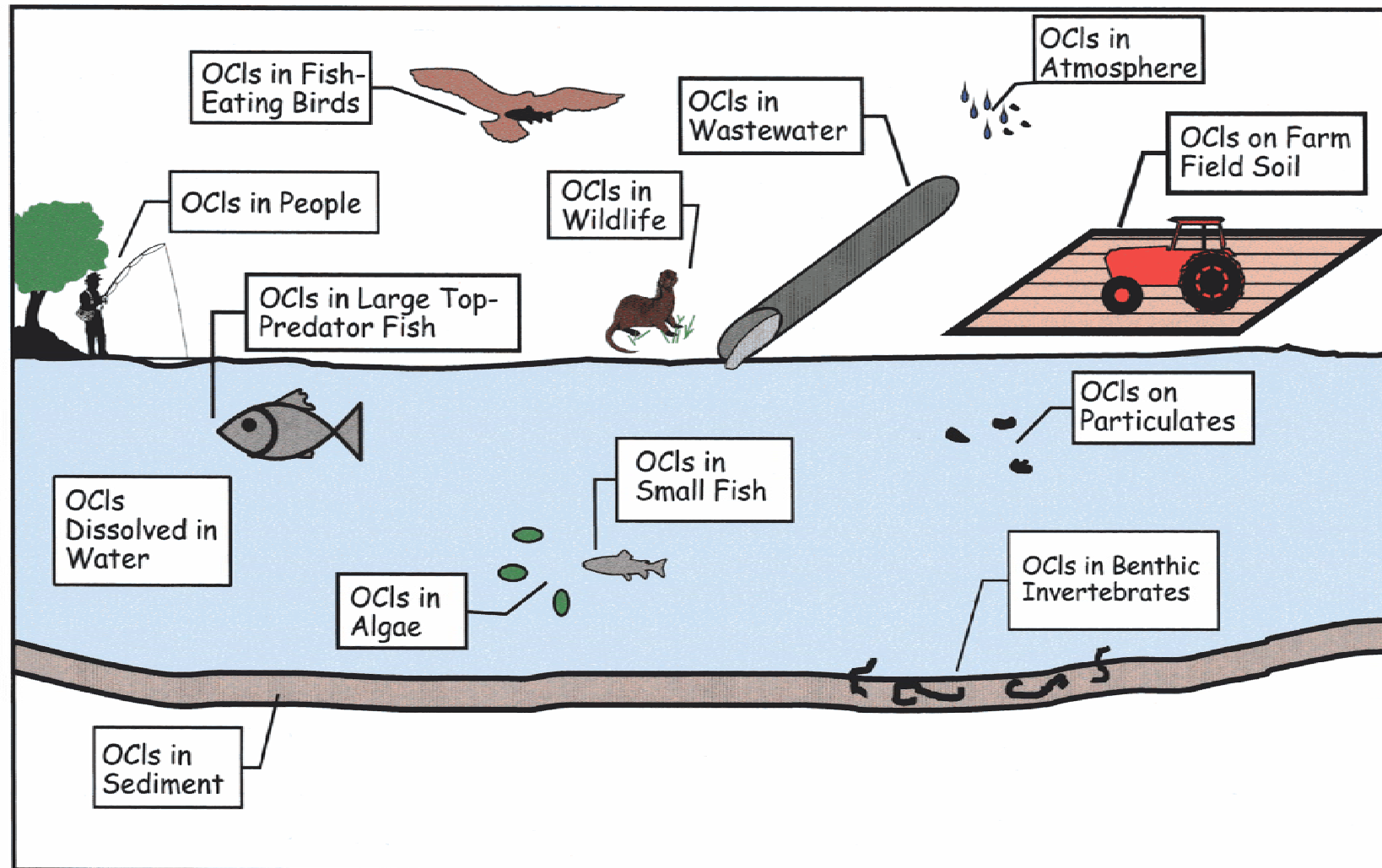
Constituents of Concern for Potential Violations of Water Quality Standards

pH	Biochemical Oxygen Demand
Color	Temperature
Taste & Odors	Organophosphate Pesticides
Total Suspended Solids	Organochlorine Pesticides
Total Dissolved Solids	Herbicides
Turbidity	Other Potentially Toxic Chemicals
Nitrate	Unknown-Caused Toxicity
Nitrite	Sediment Toxicity
Ammonia	PCBs
Total Kjeldahl N	Dioxins
Biostimulatory Substances	Furans
Phosphorus	Total Organic Carbon
Boron	Dissolved Organic Carbon
Total & Fecal Coliforms	Heavy Metals (Cu, Zn, Pb, Cd, Ni, Cr)
E. Coli	Mercury
Dissolved Oxygen	Selenium

Usually Most Important Water Quality Parameters

- **Pesticides/Herbicides** ♦ Aquatic Life Toxicity
 - Water Column and Sediments
- **Nutrients** ♦ Excessive Fertilization
- **Sediments** ♦ Turbidity, Shoaling
- **TDS** ♦ Domestic and Agricultural Water Supply
- **TOC** ♦ Domestic Water Supply THMs
- ***E. coli*** ♦ Contact Recreation & Domestic Water Supply
- **Organochlorine Pesticides** (Chlordane, Toxaphene, DDT, Dieldrin) ♦ Excessive Bioaccumulation in Fish, Human Health Hazard

Conceptual Model of OCl Bioaccumulation



Lee, G. F. and Jones-Lee, A., ***“Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance,”*** California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December (2002).

<http://www.gfredlee.com/OCITMDLRpt12-11-02.pdf>

Organizing a Water Quality Monitoring Program

- Typical Water Quality Monitoring Program Often Waste of Time & Money:
 - Arbitrary Budget Established
 - Periodic Sampling Conducted for Limited Suite of Parameters for a Year,
 - At the End of the Year, Data Examined
- There Is Need to Properly Develop and Organize a Water Quality Monitoring Program If the Data Are to Properly Define the Water Quality Impacts of Runoff/Discharges from Agricultural Lands

Organizing a Water Quality Monitoring Program

- Clearly Establish Objectives of the Monitoring Program
- Understand the Nature of "Water Quality," Water Quality Concerns, Beneficial Uses, and Their Assessment for the Waterbodies of Concern
- Select the Parameters to Be Measured and Justify Potential Significance of Each Parameter Selected
- Examine Previous Studies to Understand Variability in Each Area of the Waterbody to Be Monitored
- List Factors That Can Influence Results of the Monitoring Program and How Each May Influence the Results
- Determine the Level of Confidence at Which the Objective Is to Be Achieved

Organizing a Water Quality Monitoring Program

- For Each Area of Each Waterbody to Be Monitored, Determine Number & Location of Samples to Be Collected
- If No Data Available from Previous Studies or If Existing Data Inadequate to Define Variability and Other Characteristics Needed to Establish a Reliable Monitoring Program, Conduct a Pilot Study of Representative Areas to Define the Characteristics of the Area That Are Needed to Develop a Reliable Water Quality Monitoring Program
- If the Purpose of the Monitoring Program Is to Determine Changes in Water Quality Characteristics, Select the Magnitude of Change That Needs to Be Detected and Design the Monitoring Program Accordingly
- Select Sampling Techniques and Methods of Analysis to Meet the Objectives and Level of Confidence Desired

Organizing a Water Quality Monitoring Program

- Verify That Analytical Methods Are Appropriate for Each Area of the Waterbody and at Various Seasons
- Conduct Studies to Evaluate Precision of Sampling and Analytical Procedures and Technique, Reliability of Preservation, and Variability of the System
- Critically Examine the Relationship between Present and Past Studies
- Determine How the Data Will Be Analyzed with Respect to Compliance with Water Quality Standards, Using Existing Data or Synthetic Data That Are Expected to Be Representative of the Site
- Screen/Evaluate Data as They Are Collected
- Analyze, Interpret and Store Data, and Report on the Results of the Analysis and Interpretation

Water Quality Monitoring Locations

- Main Stem and Major Tributary Mouths
- Secondary Tributary Mouths
- Edge of the Field for Representative Agricultural Practices, Chemicals Used, Soil Types and Land Characteristics
- For Evaluation of Some Narrative Water Quality Standards, such as Excessive Fertilization (Biostimulatory Substances), There Is Need for Downstream Studies to Determine if Water Quality Problems Are Occurring

Groundwater Quality Monitoring

- In Addition to Surface Runoff/Discharges, Groundwater Quality Should Be Assessed through an Early Warning System
 - Measure Transport of Potential Pollutants through the Vadose Zone using Vacuum Cup Lysimeters
 - Top of Saturated Zone Should Be Monitored

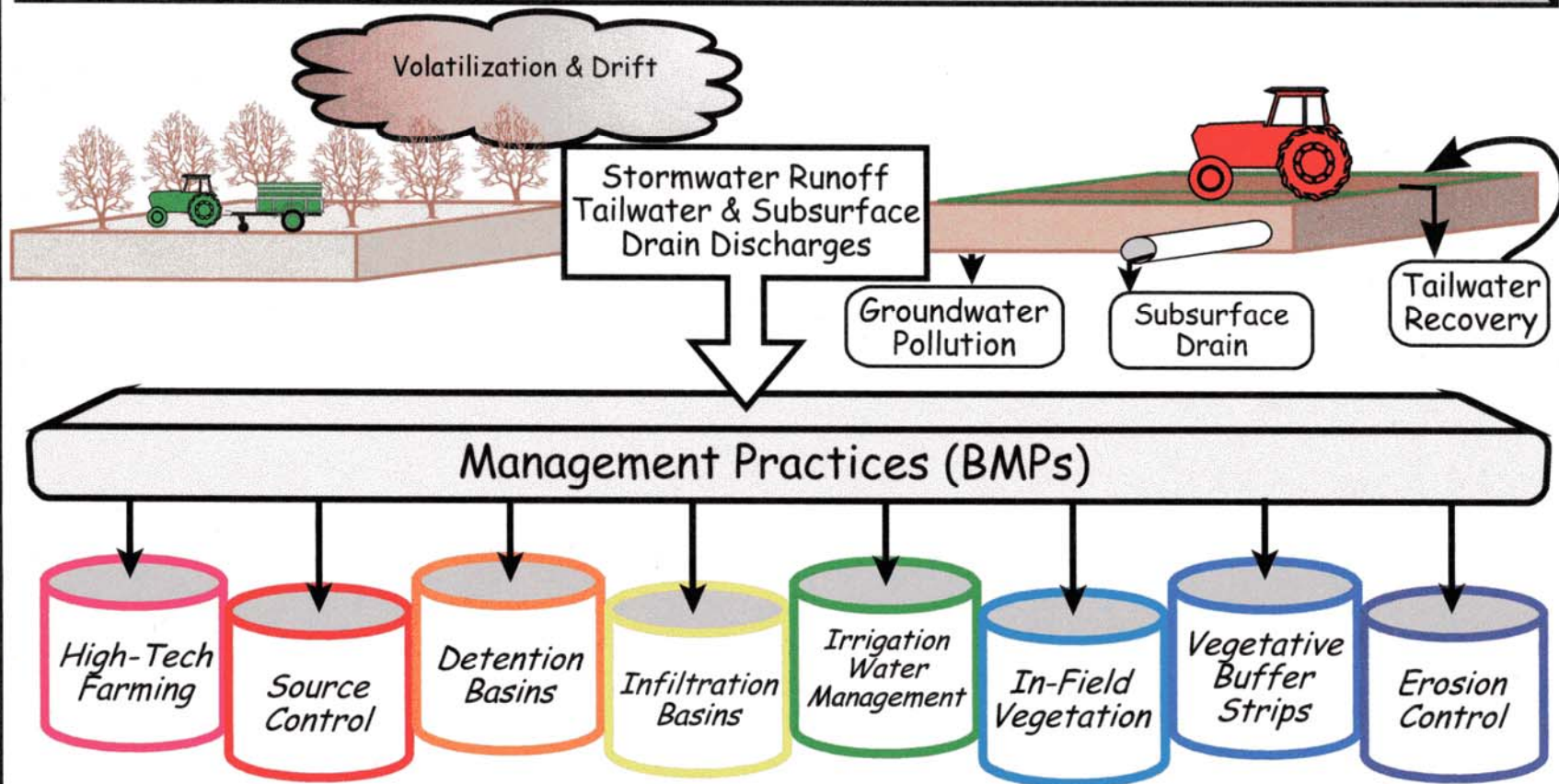
Active vs. Passive Monitoring Programs

- Typical WQMPs Are **Passive**
 - Data Collected for a Year or so, and Then an Attempt Is Made to Analyze the Data
 - Usually, This Approach Fails
- Should Conduct an **Active** Program Which Includes
 - Data Examined as Collected
 - Adjustments Made in Program
 - Follow-up Monitoring
- Periodic Sampling (e.g., Weekly, Biweekly, Monthly)
- Event-Based Sampling Should Also Be Conducted
 - Associated with Discharges/Runoff and/or the Application of Chemicals to Agricultural Land

Data Interpretation

- Evaluate Whether Exceedances of Water Quality Standards at the Point of Monitoring and Downstream Represent Real Impairments of Designated Beneficial Uses of the Waterbody or “Administrative” Exceedances
 - US EPA Water Quality Criteria and State Standards Based on Those Criteria Are Based on Worst-Case Approaches for Evaluating Water Quality Impacts
 - This Approach, if Mechanically Applied to Some Agricultural Runoff-Derived Constituents, Can Lead to Overregulation of Agricultural Discharges/Runoff
 - Need for Site-Specific Studies to Develop Appropriate Water Quality Standards for Agricultural Runoff

Chemicals Added to Aid in Crop Production (Pesticides, Fertilizers, Soil Conditioners/Amendments) and Pollutants Produced in the Field (TDS, TOC) Contribute to Water Pollution by Irrigated Agriculture in Central Valley, CA



All BMPs Need Evaluation in the Central Valley Setting to Assess Efficacy & Cost-Effectiveness in Protecting Beneficial Uses of Central Valley Waterbodies

Water Quality Monitoring as Part of Evaluation of Management Practice

- Water Quality Monitoring as Part of “BMP” Evaluation Requires a Greatly Expanded Monitoring Program to Obtain Reliable Results

Lee, G. F. and Jones-Lee, A., *“Review of Management Practices for Controlling the Water Quality Impacts of Potential Pollutants in Irrigated Agriculture Stormwater Runoff and Tailwater Discharges,”* California Water Institute Report TP 02-05 to California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 128 pp, California State University Fresno, Fresno, CA, December (2002).

http://www.gfredlee.com/BMP_Rpt.pdf

Conclusions

- Typical Water Quality Monitoring Programs Used for Surface Waters, Involving Periodic Sampling of the Waters and Measurements of Selected Parameters, Does Not Adequately and Reliably Characterize the Water Quality Characteristics of the Runoff/Discharges
- There Is Need to Significantly Improve the Technical Quality of Water Quality Monitoring Programs to Define the Real, Significant Water Quality Problems for Which There Is Need for Agricultural Interests to Implement Management Practices to Control Pollutants in the Runoff/Discharges

Further Information
Consult Website of
Drs. G. Fred Lee and Anne Jones-Lee



<http://www.gfredlee.com>