

# Assessing Water Quality Impacts of Stormwater Runoff

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## Conventional Water Quality Monitoring - Management Approach "Compliance Monitoring"

- Monitor Concentrations of Selected Regulated Chemicals in Runoff Water
- Compare Monitoring Results to Accepted Discharge Limits and Ambient Water Quality Standards
- If "Excessive" Concentrations (Loads) Found in Discharge, Reduce Discharge of Chemical Constituents to Achieve Regulatory Compliance with Water Quality Standards
- Focus of Conventional Approach Is Control of Chemicals in Discharge to Achieve Allowed Concentrations (Loads)
- Conventional Chemical Approach Not Technically Valid for Stormwater Runoff - Leads to Over-Regulation and Waste of Funds and/or Under-Regulation of Unregulated Constituents

## Management of Urban and Highway Stormwater Runoff

Stormwater Runoff NPDES Permit Holders Required to Control Pollution - Use-Impairment in Receiving Waters for Runoff to the Maximum Extent Practicable (MEP) through the Use of Best Management Practices (BMPs)

NPDES Stormwater-Permitted Discharges Must Meet Water Quality Standards in Receiving Waters for the Runoff

- However, Failure to Meet Standards Not Permit Violation

Current Water Quality Criteria/Standards Not Appropriate for Regulating Stormwater Runoff Water Quality

- Waste Public and Private Funds
- Lead to Over-Regulation of Runoff

Facts to Consider:

- Non-Toxic, Unavailable Forms

- Limited Exposure of Aquatic Organisms in Receiving Waters Due to Short-Term, Episodic Nature of Stormwater Discharges
- Non-Protective - Under-Regulation
- Does Not Address Unregulated Chemicals, e.g., Diazinon

### Stormwater Runoff Management Issues

Monitoring of Urban Area and Highway Stormwater Runoff Shows Concentrations of Some Chemical Constituents above Water Quality Criteria/Standards

- Does This "Exceedance" Lead to Pollution - Impairment of Designated Beneficial Uses?
- Water Quality Criteria/Standards Are Overly-Protective
- Do Not Properly Consider Aquatic Chemistry - Toxicology (Duration of Exposure)
- Few Documented Cases of Real Water Quality Use-Impairment Due to Urban Area and Highway Stormwater Runoff
- US EPA & Congress, as Part of Reauthorization of Clean Water Act, Recognize Over-Protective Nature of Water Quality Criteria/Standards When Applied to Stormwater Runoff
- Develop Wet-Weather Standards/Implementation Approach
- Exempt from Use-Attainment during Runoff Event

Conventional Stormwater BMPs Such as Detention Basins, Sand and Other Filters, Grassy Swales Not Reliable for Control of Real Water Quality Problems Due to Toxics, Nutrients, Pathogens, etc.

- Only Potentially Applicable to Control of Erosion - Silt
- Not a Problem in Most Established Areas

High Cost to "Treat" Stormwater Runoff to Achieve Water Quality Standards

- Cities, Highway Departments Have Limited Funds to Devote to Stormwater Runoff Quality Management

Must Use Funds Available to Control Real, Significant Water Quality Use-Impairments of Importance to Public

Current Stormwater Runoff Water Quality Monitoring Programs for Urban Areas and Highways Involving Monitoring Runoff for Suite of Chemical Constituents Provides Little New Useful Information

- Results Already Known from Past Monitoring of Similar Areas
- Provides No Information on Impact of "Excessive" Regulated Chemicals and Unregulated Chemicals in Runoff on the Receiving-Water Quality - Impairment of Designated Beneficial Uses
- Unregulated Chemicals May Be Most Important Causes of Receiving-Water Impacts
- e.g., Diazinon - Organophosphorus Pesticide Causes Stormwater Runoff to Be Toxic in Many Areas

- Issue: Is the Toxicity of Sufficient Magnitude and Duration to Impair Beneficial Uses of Receiving Waters?
- Regulate about 200 of the 60,000 Chemicals in Use Today

### Develop Alternative Approach for Assessing Stormwater Runoff Impacts and BMP Development

#### Mechanical/Routine Monitoring of Receiving Waters for Stormwater Runoff

- Very Expensive
- Will Not Likely Detect Stormwater Runoff Impacts

#### Focus Stormwater Runoff Monitoring on Runoff Events

#### Should Shift Monitoring to Receiving Waters for Runoff

- Evaluation Monitoring

#### Focus Monitoring Funds on Finding Real Water-Quality/Use-Impairments - Pollution - in Waters Receiving the Runoff, That Are Caused by the Runoff

### Types of Potential Water Quality Impacts Use-Impairment - Pollution

- Drinking Water Use-Impairment - Surface and Groundwater
- Aquatic Life Toxicity in Water Column and/or Sediments
- Excessive Bioaccumulation - Human Health &/or Wildlife
- Suspended Sediment - Turbidity - Siltation - Habitat Impacts
- Excessive Fertilization/Eutrophication - Nutrients - N & P
- Pathogenic Organism Indicators
- Low Dissolved Oxygen
- Aesthetics -- Litter, Debris, Oil Sheen, etc.

#### Questions That Should Be Addressed

- Is There Significant Toxicity in the Receiving Waters That Is Associated with Runoff Events?
- Are There Closed Shellfish Beds, Swimming Areas, etc.?
- Is There Excessive Algal/Aquatic Weed Growth?
- Is There Litter and Debris?
- Do the Fish and/or Shellfish Contain Excessive Concentrations of Hazardous Chemicals?
- Is the Water Turbid? Is There Shoaling, Burial of Spawning Areas, Shellfish Beds, etc.?
- Are Domestic Supplies Experiencing Treatment Problems, Excessive Costs?

Define the Most Important Water Quality Use-Impairments in the Receiving Waters That Are Potentially Due to Stormwater Runoff

### Evaluation Monitoring

Stormwater Dischargers Work with Regulatory Agencies, Point-Source Dischargers, Potentially Impacted Public Such as Water Utilities, etc. and Others as Appropriate to Determine If the Receiving Waters for the Stormwater Runoff Experience Real, Significant Water Quality Use-Impairments Due to Stormwater Runoff - Use Watershed Approach

Develop Evaluation Monitoring Program That Focuses the Financial and Other Resources Available on Funding Real Water Quality Problem Identification and Management Associated with Stormwater Runoff

Rather Than Focus on Chemicals, Focus on Chemical Impacts  
Potentially Toxic Chemicals vs. Toxicity

Use Toxicity Tests to Integrate All Potentially Toxic Chemicals (for Both Regulated and Non-Regulated Chemicals) in the Receiving Waters

### Development of New Stormwater Runoff BMPs

If Water Quality Use-Impairment Found in Receiving Waters for Stormwater Runoff Determine If This Use-Impairment Likely Due, to Significant Extent, to Urban Area or Highway Runoff

If Real, Significant Water Quality Use-Impairments Found That Are Associated with Stormwater Runoff

- Determine Cause - Chemical Toxicity Identification Evaluation (TIE)
- Determine Source - What Is the Origin of the Specific Chemical Constituent That Causes the Use-Impairment for the Urban Area - Highway Runoff?

Develop BMPs to Control Cause of Use-Impairment to the Maximum Extent Practicable - Focus on Source Control BMPs

If Stormwater Runoff Causes Real, Significant Water Quality Use-Impairment, Determine If Chemical or Pathogens Can Be Controlled at the Source to Urban Area - Highway That Leads to Stormwater Runoff That Causes Pollution in the Receiving Waters

If Chemical, Pathogens, Litter, etc. Cannot Be Controlled at Source, Develop *Site-Specific* Treatment Approaches If Economically Feasible

Repeat Evaluation Monitoring Program Every 5 Years to Detect:

- New Water Quality Use-Impairments Due to Increased Loads and/or New Pollutants in the Stormwater Runoff

- New Information on Assessing Water Quality Impacts for a Chemical
- Evaluate Effectiveness of BMPs in Improving Receiving Water Water Quality

#### Overall

- Find a Real Water-Quality/Use-Impairment
- Determine Its Cause and Source
- Develop Site-Specific BMPs to Achieve Control to MEP
- Technically Valid, Cost-Effective, Common Sense Approach That Leads to Wise Use of Public Funds

### Water Quality Use-Impairment Problem Identification

#### Consider the Following Types of Possible Impairments:

- Impairment of Domestic Water Supply Water Quality
- Aquatic Life Toxicity
- Excessive Bioaccumulation of Hazardous Chemicals
- Sediment Toxicity That Impairs Water Quality
- Eutrophication - Excessive Fertilization
- Sanitary Quality Impairment of Contact Recreation and Shellfish Harvesting
- Oil and Grease Accumulation
- Significant Dissolved Oxygen Depletion
- Litter Accumulation
- Siltation - Excessive Sediment Accumulation

#### Drinking Water Impairment

- Determine Chemical Constituents Impacting Raw Water Quality That Increase Cost of Treatment and/or Adversely Affect Finished Water Quality
- Determine Sources of All Constituents That Impair Domestic Water Supply Water Quality

#### Bioaccumulation of Hazardous Chemicals

- Determine If Edible Aquatic-Life Tissue Contains Concentrations of Hazardous Chemicals That Impair Its Use as Food
- If Excessive Bioaccumulation Occurs, Determine the Significance of Runoff as a Source of the Chemical Bioaccumulating

#### Aquatic Life Toxicity

- Measure Toxicity in Runoff Water at Point at Which Runoff Enters Receiving Water and in Waterbody in Which Mixing Occurs
- If Toxicity Found, Determine if of Sufficient Magnitude and Duration in Receiving Waters to Require Control
- Conduct Runoff-Water Discharge-Plume Toxicity Studies
- Determine Areal Extent and Duration of Persistence of Toxicity

- Use Ambient-Water Toxicity Test
- Larval Fish, Shellfish
- Assess Death, Abnormal Growth and Reproduction
- If Significant Toxicity Found:
  - Determine Cause through TIE Studies
  - Trace Toxicity to Source

#### Sediment Toxicity

- Determine If Sediments Are Sufficiently Toxic to Impair the Beneficial Uses of the Runoff Receiving Waters
- If Significant Sediment Toxicity Exists, Determine If It Is Due to Runoff

#### Sanitary Quality Use-Impairment

- Determine If Sanitary Quality - Fecal Indicator Organism Use-Impairment of Contact Recreation and Shellfish Harvesting Is Occurring in the Waterbody of Concern
- Determine If Runoff Is Possibly a Significant Source of Fecal Indicator Organisms That Are Impairing the Use of the Waterbody for Recreation and/or Shellfish Harvesting

#### Eutrophication - Excessive Fertilization

- Determine If Excessive Algal and/or Aquatic Weed Growth Occurs That Impairs the Uses of the Receiving Waters for Runoff
- Determine Limiting Nutrient/Condition Controlling Maximum Algal/Aquatic Weed Biomass in Waterbody When Eutrophication-Related Water Quality Impairment Occurs
- Determine Sources of Limiting Nutrient for the Waterbody with Particular Emphasis on the Role of Runoff as a Relative Source of N or P
- Focus the Evaluation Monitoring Program on Available Forms of the Limiting Nutrient
- Determine Reduction of Available Nutrient Load Needed to Achieve Improved Eutrophication-Related Beneficial Uses of the Waterbody

#### Dissolved Oxygen Depletion That Impairs Aquatic Life

- Determine If Excessive DO Depletion Occurs in the Waterbody of Concern
- If DO Problems Are Occurring, Evaluate Characteristics of Diel and Spatial DO Depletion to Determine Cause of Depletion during Times of Runoff and Non-Runoff Events
- Determine If Runoff Is a Significant Contributor to the DO Depletion

#### Oil and Grease Accumulation

- Determine If Significant Oil and Grease Accumulation Is Occurring in the Receiving Waters for Runoff

#### Litter Accumulation

- Inspect the Receiving Waters for Runoff-Derived Litter

#### Siltation - Excessive Sedimentation Accumulation

- Determine If Particulate/Erosional Material Is Impairing the Designated Beneficial Uses of the Receiving Waters -
- Is Turbidity, Suspended Solids and/or Sediment Accumulation Altering Aquatic Life Habitat and/or Impairing Beneficial Uses of the Waterbody - Navigation - Promoting Weed Growth

For Further Information on Problems with Current Stormwater Monitoring Approach and BMP Development as Well as the Development of Environmental Monitoring Programs Consult the Following:

Lee, G. F. and Jones, R. A., "Suggested Approach for Assessing Water Quality Impacts of Urban Stormwater Drainage," In: Symposium Proceedings on Urban Hydrology, American Water Resources Association Symposium, November 1990, AWRA Technical Publication Series TPS-91-4, AWRA, Bethesda, MD, 139-151 (1991).

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Lee, G.F. and Jones-Lee, A., "Evaluation Monitoring of Stormwater Runoff Water Quality Impacts: Initial Screening of Receiving Waters," Report of G. Fred Lee & Associates, El Macero, CA, 24pp, June (1995).

Lee, G. F. and Jones-Lee, A., "Approach for Developing BMP's to Control Pollution from Highway, Street and Urban Stormwater Runoff," Report of G. Fred Lee & Associates, El Macero, CA, 23pp, June (1995).

## Application of Evaluation Monitoring Approach for ETC Stormwater Runoff Water Quality Management

- For Each Segment of Eastern Transportation Corridor (ETC) That Drains to a Different Waterbody, i.e., Upper Newport Bay, Santa Ana River, Santiago Creek, or Irvine Lake, Review Designated Beneficial Uses of the Waterbody Relative to Composition of Highway Runoff
- For Each Designated Use, Estimate if the Stormwater Runoff from ETC Would Be Expected to Significantly Impair the Use
- If No Potentially Significant Water Quality/Use-Impairment Expected for Regulated Chemicals, Conduct Field Studies to Determine If Unregulated Chemicals Cause Water Quality/Use-Impairment
- Measure Toxicity, Bioaccumulation, Waterborne Pathogenic Indicator Organisms, Excessive Algal Blooms, Siltation, Oil and Grease, etc.
- Develop Arrangements with Regulatory Agencies and Others as Appropriate Such as OCEMA, Santa Ana Regional Water Quality Control Board, Caltrans, Orange County Water District, Serrano Irrigation District, Dept. of Fish and Game, Other Dischargers, etc. to Introduce the Evaluation Monitoring Approach and Its Implementation
- Work with Regulatory Agencies in Refining Study Program Approach, Program Implementation, Data Interpretation, and Formulation of Follow-up Studies
- Basically, Shift the Funds Normally Devoted to Monitoring Stormwater from Runoff Monitoring to Evaluation Monitoring
- Get All Stormwater and Point Source Dischargers, Regulatory Agencies, Environmental Groups and the Public to Pool Funds to Conduct Evaluation Monitoring
- Based on Funds Available/Unit Time, e.g., One Year, Prioritize Potential Water Quality Problems in Receiving Waters for Funding for Evaluation Monitoring
- May Be Necessary to Acquire Additional Funds from All Dischargers for Complex Situations
- Refine Minimum Study Program for Each Potentially Significant Impact
- If No Expected Impact and There Are Adequate Data on Overall Water Quality Characteristics of Receiving Waters, Use Funds to Confirm Applicability of Past Data on Receiving Waters
- If Adequate Data Not Available, Conduct Evaluation Monitoring to Obtain the Necessary Background Data on the Characteristics of the Receiving Waters for the ETC Stormwater Runoff

### General Aspects of ETC Evaluation Monitoring Stormwater Runoff BMP Development

Evaluation Monitoring Is an Evolutional Program of Water Quality Evaluation and Management in Which the Most Important, Readily Apparent, Significant Water Quality Problems Are Addressed First to the Extent That Funds Permit

Priority for Selection of Most Significant Water Quality/Use-Impairments Has Been Determined on Initial Basis and May Be Further Refined by a Stormwater Runoff Quality Evaluation Monitoring Guidance Committee Representing Regulatory Agencies, Potentially Impacted



Agencies and Entities Such as Domestic Water Supplies, Dept. of Fish and Game, Public, and Others as Appropriate

Where Real Water Quality/Use-Impairment Is Found in Receiving Waters for ETC Stormwater Runoff, Determine Cause and the Specific Source of Constituents That Cause Use-Impairment

Develop New BMPs to Control Use-Impairment Focusing on Source Control

Repeat Evaluation Monitoring Program for Each Waterbody at Least Once during Each 5-yr NPDES Permit Period

- Detect New Water Quality/Use-Impairments
- Incorporate New Information on Evaluation of Water Quality Impacts of Chemicals
- Evaluate Improvements in Receiving Water Quality Due to Implementation of Source Control BMP

Appoint a Stormwater Runoff Quality Evaluation Monitoring Technical Advisory Panel to Provide Guidance on Technical Issues

- This Panel Should Consist of Individuals Who Are Familiar with the Latest Developments in the Water Quality Evaluation and Management Field with Particular Emphasis on Aquatic Toxicology, Aquatic Chemistry, Surface Water Hydrology, Point-Source Discharges to Waterbody of Concern, etc.

Silverado to Provide Framework to Work with Responsible Agencies and Interested Parties to Refine Evaluation Monitoring Approach

Start Evaluation Monitoring Implementation Approach in 1996

Use Upper Newport Bay and Santa Ana River as Focal Points for Development of Approach

#### Focus of Evaluation Monitoring Program

At This Time, the Focus of the ETC BMP Development Program for Upper Newport Bay Will Be on:

- Excessive Algal Growth
- Bioaccumulation
- Sanitary Quality
- Aquatic Life and Sediment Toxicity
- Litter and Oil/Grease Accumulation

For the Santa Ana River:

- Domestic Water Supply Water Quality
- Oil/Grease and Litter Accumulation

## Overall Approach

Find a Real, Significant Water Quality Problem in Receiving Waters Due to ETC Stormwater Runoff, and Control Problem in Technically Valid, Cost Effective Manner

Different from Traditional "End-of-Pipe" Approach - *Yes*

In Accord with Federal & State Regulatory Requirements - *Yes*

Use of Good Science and Engineering in Public Policy Formation - *Yes*

Reduces Potential for Arbitrary, Technically Invalid Approaches - *Yes*

Implementable under Current Regulatory Requirements - *Yes*

This Approach Is Technically Valid, Cost-Effective and Far More Protective of Beneficial Uses of Receiving Waters Than Current Approach

## Source Control BMP's

Brute Force - Mechanical Approach Not Appropriate

- Assume All Copper from All Sources Presumed Equally Adverse to Beneficial Uses of Receiving Water
- Ignores Aquatic Chemistry, Toxicology, Water Quality
- Auto Brake Copper/Water Quality Issue Common Ground for Environment Misdirected Effort

First: Find Real Water Quality Problem (Use-Impairment) Caused by Copper in Receiving Water

Next: Where Problem Found, Determine Specific Source of the Copper Responsible for the Use-Impairment

Then: Control Copper Appropriately at Source

If Brakepads Prove to Be the Source, Require Substitution with Material That Has Been Properly Evaluated

## Conclusions

Current Water Quality Monitoring & BMP Development for Stormwater Runoff from Highways Not Technically Valid

Significant Over-Regulation of Stormwater Runoff - Wasting Public Funds

Must Shift End-of-Pipe Runoff Monitoring to Receiving Water Evaluation for BMP Development

Should Focus Financial Resources Available for Monitoring on

- Finding Real Water Quality/Use-Impairment in Waters Receiving Stormwater Runoff from Highways
- Developing Site-Specific BMP's That Control Specific Constituents Responsible for Water Quality/Use-Impairment