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Assessing Water Quality Impacts of Stormwater Runoff

G. Fred Lee, PhD, PE, DEE (Member)¹
Anne Jones-Lee, PhD (Member)

Abstract

Current "water quality" monitoring of non-point source runoff typically involves periodically measuring a laundry list of chemicals in the runoff waters. This approach, while satisfying regulatory requirements, provides little to no useful information on the impact of the chemicals in the runoff on the real water quality - designated beneficial uses of the receiving waters for the runoff. There is need to focus water quality monitoring on investigating the receiving waters in order to assess whether the chemicals in the runoff are adversely affecting beneficial uses. This paper presents an evaluation monitoring approach for monitoring receiving waters that determines whether the runoff is a significant cause of water quality - use impairments. For each type of use impairment, such as aquatic life toxicity, excessive bioaccumulation of hazardous chemicals, excessive fertilization, etc., highly focused site-specific studies are conducted to determine the use impairment that is likely occurring due to a stormwater runoff event(s) and the specific cause of this impairment.

Introduction

There is growing recognition that domestic and industrial wastewater and stormwater runoff "water quality" monitoring involving the measurement of a suite of chemical "pollutant" parameters in discharge/runoff waters is largely a waste of money. For stormwater runoff, such programs generate more data of the type that have been available since the 1960's on the chemical characteristics of urban area, highway and street runoff. It has been known since that time that runoff from these areas contains a variety of regulated chemical constituents and

¹President and Vice-President, respectively, G. Fred Lee & Associates, 27298 E. El Macero Drive, El Macero, CA 95618-1005. Ph: 916-753-9630; Fx: 916-753-9956.

waterborne pathogenic organism indicators that exceed water quality standards at the point of runoff discharge to the receiving waters. However, discharge monitoring provides little to no useful information on the impacts of the apparently excessive regulated chemicals and unregulated chemicals in the discharge on receiving water water quality - designated use impairment. As discussed by Lee and Jones (1991) and Lee and Jones-Lee (1994a, 1995a,b), many of the chemical constituents in urban stormwater runoff are in particulate, non-toxic, non-available forms. Further, the short-term episodic nature of stormwater runoff events means that significant exceedance of US EPA water quality criteria and state standards based on these criteria can occur in the receiving waters for the runoff without adversely impacting receiving water beneficial uses. These issues have recently been reviewed by Lee and Jones-Lee (1995c,d).

The failure of the US EPA and the states to properly assess real water quality use impairment associated with stormwater runoff from urban areas and highways has resulted in highly unreliable reporting of water quality problems in the nation's waters due to urban stormwater runoff (Lee and Jones-Lee, 1994b). Further discussion of the significant over-regulation that is occurring today in implementing water quality standards into permit discharge loads is provided by Lee and Jones-Lee (1995a,e).

In 1994, the Engineering Foundation held a Stormwater Quality Monitoring Conference to discuss current problems with conducting technically valid, cost-effective monitoring of urban stormwater runoff water quality. There was general consensus at that conference that a significantly different approach needs to be taken in monitoring stormwater runoff events from urban areas, highways, streets and industrial areas (Torno, 1994). While not addressed at that conference, the same situation applies to runoff from agricultural and rural lands. Additional information on why there is need for a different approach for assessing the water quality impacts of stormwater runoff as well as developing management approaches for chemical constituents in this runoff is provided in the Stormwater Runoff and Receiving Systems: Impact, Monitoring, and Assessment conference proceedings (Herricks, 1995).

The basic problem is that so little is known about the real adverse impacts of urban area and highway/street runoff that it is not possible to develop an appropriate runoff water quality monitoring program based on the measurement of water quality characteristics at the point of discharge of the runoff into the receiving waters. In order to develop a program of this type, it is essential that a well-defined, site-specific understanding of the relationship between concentrations of constituents measured in the runoff waters and the site-specific water quality impacts that these constituents have on the designated beneficial uses of the receiving waters for the runoff be developed.

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Technically valid, cost-effective stormwater runoff monitoring programs should focus on monitoring those constituents in the runoff that cause significant water quality use impairments in the receiving waters for the runoff. The first step to developing a technically valid stormwater runoff water quality monitoring program is the evaluation of the water quality impacts caused by the constituents in the runoff that adversely impact receiving water quality. Monitoring programs that fail to focus on water quality problem issues fail to provide the information needed to effectively manage stormwater runoff quality.

In an effort to address the problems with current stormwater runoff water quality monitoring programs, the authors have developed what they term "evaluation monitoring." Evaluation monitoring focuses on highly selective, site-specific evaluation of the potential for chemical constituents and pathogenic organisms in the runoff waters to cause site-specific use impairments of the receiving waters for the runoff.

Principles of Evaluation Monitoring

The basic approach used in evaluation monitoring of stormwater runoff impacts is the determination of whether the chemical and other constituents in the runoff waters, either alone or in combination with other constituents in the receiving waters for the runoff, cause a significant adverse impact on the designated beneficial uses of these waters to require constituent control, including possibly treatment of chemical constituents in the runoff waters, to eliminate the impact. The initial focus of evaluation monitoring is not the traditional approach of measuring the concentrations of specific constituents in the runoff waters but is water quality - use impairment. For example, a number of the chemical constituents in highway/street and urban area runoff waters are of concern because of their potential toxicity to aquatic life in the receiving waters which could significantly alter the numbers, types and characteristics of desirable forms of aquatic life in these waters. In evaluation monitoring, rather than trying to estimate toxicity from chemical constituent concentrations, toxicity of the receiving waters is measured directly. Toxic effects of concern include acute and chronic toxicity which is manifested in death, impaired growth and impaired reproduction.

In addition to the classical toxic effects associated with chemical constituent impacts on aquatic life, there is also concern about chemicals and pathogenic organisms that cause adverse impacts on aquatic life through the growth of tumors, organ dysfunction - lesions, etc. While the classical toxic effects of heavy metals, etc. are usually manifested in a few days to a few weeks during sensitive life stages of the organism, the carcinogenic, teratogenic and mutagenic impacts on aquatic organisms typically take longer periods of time to develop.

Another potential water quality problem associated with highway/street and urban area runoff is the potential for chemical constituents in this runoff to accumulate within edible organism tissue to sufficient concentrations to be a health hazard to those who consume the organisms as food, i.e. cause the organisms to receive a human health advisory. Also of concern is the accumulation of chemical constituents in aquatic life to a sufficient extent to be adverse to higher trophic level organisms such as fish-eating birds and other wildlife.

Other water quality problems of concern associated with stormwater runoff include excessive fertilization of the receiving waters for the runoff which impairs the use of the waterbody for recreation and domestic water supply purposes. Also of concern is the presence of waterborne pathogenic organisms that can impact the sanitary quality of the receiving waters through impaired contact recreation (beach closings) and shellfish harvesting. Further, litter in highway/street and urban area runoff can impair recreational use of receiving waters. Page limitations on this paper preclude the presentation of detailed discussions of approaches for implementing evaluation monitoring.

The authors have developed an application of this approach for the development of the Eastern Transportation Corridor (ETC) which is a new toll road that is currently under construction located in Orange County, California. This approach is being used to develop technically valid, cost-effective stormwater runoff BMP's for this highway.

Evaluation Monitoring vs. Mechanical Monitoring of Receiving Waters

The traditional approach frequently used in ambient water water quality studies is to develop a sampling program where certain physical, chemical and biological parameters are mechanically sampled and analyzed for an arbitrarily developed period of time, usually one year. At the end of this time, attempts are made to try to discern from the data collected water quality impacts of certain discharges - runoff to the waterbody. Often studies of this type yield inconclusive results as a result of there being an insufficient number of samples taken and insufficient number of analyses made of the key parameters at appropriate times to reflect true water quality impacts of the runoff.

Lee and Jones (1983) have discussed the importance of not following the traditional approach of passively examining the data collected in the water quality monitoring program after collection for information on water quality impacts. This "passive" approach toward data review, while easily administered and carried out, frequently fails to provide key information on impacts during critical periods of the year at times when the primary water quality impacts occur. They recommend that "active" water quality monitoring programs be conducted where data analysis proceeds at the time of data collection in which the results of the

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recent sampling and analyses are used to determine the adjustments in the study program that need to be made as the study program is being carried out to utilize the funds available for the study in the most cost-effective, technically valid manner. The adoption of the evaluation monitoring approach described herein focuses the resources available on defining major real water quality impacts during the time and under the conditions where and when the impacts are most likely to occur.

Conclusions

It is now widely recognized that the monitoring of stormwater runoff from highway/street, urban areas, industrial properties and rural areas involving measurement of a concentration of a few chemical parameters in a few runoff events each year is largely a waste of money. There is general agreement that there is need to shift the monitoring to evaluation of impacts of stormwater runoff in the receiving waters for the runoff. The focus of the monitoring program should be devoted to biological effects-based parameters, such as aquatic life toxicity and bioaccumulation, and water quality - use impairment, such as closure of beaches and shellfish harvesting due to excessive coliform concentrations, etc. The monitoring of specific chemical constituents in the receiving water's water column and sediments should only be undertaken if the effects-based parameters, such as toxicity, show that the receiving waters for the stormwater runoff are experiencing significant impairment of the designated beneficial uses for these waters.

When such impairments are found, then site-specific studies directed toward determining the cause of the impairment including the specific chemical forms or organisms responsible for it, as well as the specific sources of those chemical forms or organisms that cause the use impairment in the stormwater runoff should be conducted. Best management practices should be developed to the maximum extent practicable to control real pollutants associated with stormwater runoff. An evaluation monitoring program of the type described in this paper provides the technical base of information necessary to develop technically valid, cost-effective control of real water quality problems associated with urban and rural stormwater runoff.

Additional Information

Cited in the text and listed in the references are a number of reports developed by the authors which provide background information important to developing valid evaluation monitoring programs. Copies of the authors' papers and reports on this topic, including the specific application of evaluation monitoring to the Eastern Transportation Corridor highway in Orange County, California, are available from them upon request.

References

Herricks, E. E., (ed.), Stormwater Runoff and Receiving Systems: Impact, Monitoring, and Assessment, CRC Press, Inc., Boca Raton, FL (1995).

Lee, G. F. and Jones, R. A., "Active versus Passive Water Quality Monitoring Programs for Wastewater Discharges," *Journ. Water Pollut. Control Fed.*, 55:405-407 (1983).

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 Tech Pub Series TPS-91-4, AWRA, Bethesda, MD, pp. 139-151 (1991).

Lee, G. F., and Jones-Lee, A., "Deficiencies in Stormwater Quality Monitoring," IN: Proc. of an Engineering Foundation Conference, American Society of Civil Engineers, New York, NY pp. 651-662 (1994a).

Lee, G. F. and Jones-Lee, A., "Unreliable Reporting of Water Quality Impairment by the US EPA's National Water Quality Inventory," Submitted for publication, Water Environment Federation, October (1994b).

Lee, G. F. and Jones-Lee, A., "Stormwater Runoff Management: The Need for a Different Approach," *Water/Engineering & Management*, 142:36-39 (1995a).

Lee, G. F. and Jones-Lee, A., "Stormwater Runoff Management: Are Real Water Quality Problems Being Addressed by Current Structural Best Management Practices?" *Public Works*, Part 1, 125:53-57, 70-72 (1994). Part Two, 126:54-56 (1995b).

Lee, G. F. and Jones-Lee, A., "Independent Applicability of Chemical and Biological Criteria/Standards and Toxicity Testing," *The National Environmental Journal*, 5:60-63, January/February (1995c).

Lee, G. F. and Jones-Lee, A., "Appropriate Use of Numeric Chemical Concentration-Based Water Quality Criteria," *Human and Ecological Risk Assessment*, 1:5-11 (1995d).

Lee, G. F. and Jones-Lee, A., "Implementing Urban Stormwater Runoff Quality Management Regulations," *Water/Engineering & Management*, 142:38-41 (1995e).

Torno, H. C., editor. *Stormwater NPDES Related Monitoring Needs*, Proc. of an Engineering Foundation Conference, American Society of Civil Engineers, New York, NY (August 1994).

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G. Fred Lee, Ph.D., P.E.
Anne Jones-Lee, Ph.D.

G. Fred Lee & Associates
El Macero, CA

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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

Orange County Area Highway Stormwater Runoff Chemical Characteristics Caltrans District 8 & 12 (1994)

Parameter	Detection Units	Chapman Ave (I-5, PM34.7)	Walnut Ave (SR-55, PM14.2)
Total Suspended Solids	mg/l	85	100
Total Dissolved Solids	mg/l	12	12
Chemical Oxygen Demand	mg/l	42	24
Oil and Grease	mg/l	5.3	2.5
Fecal Coliform	ml	<2/100	50/100
pH	unit	7.0	9.1
Total Residual Chlorine	mg/l	0.45	<0.20
Nitrate	mg/l	0.43	0.37
Nitrite	mg/l	0.051	0.042
Ammonia	mg/l	1.3	0.9
Total Kjeldahl Nitrogen	mg/l	0.89	1.4
Total Phosphorus	µg/l	120	130
Dissolved Phosphorus	µg/l	130	120
Sodium	µg/l	3000	1500
Cadmium	µg/l	<5	8
Copper	µg/l	24	22
Lead	µg/l	48	160
Chromium	µg/l	<10	<10
Zinc	µg/l	180	140
Iron	µg/l	3400	3400
Nickel	µg/l	<32	<32
Magnesium	µg/l	1300	1300

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.

Types of Potential Water Quality Impacts Use-Impairment - Pollution (continued)

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

(continues)

Development of New Stormwater Runoff BMPs (continued)

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

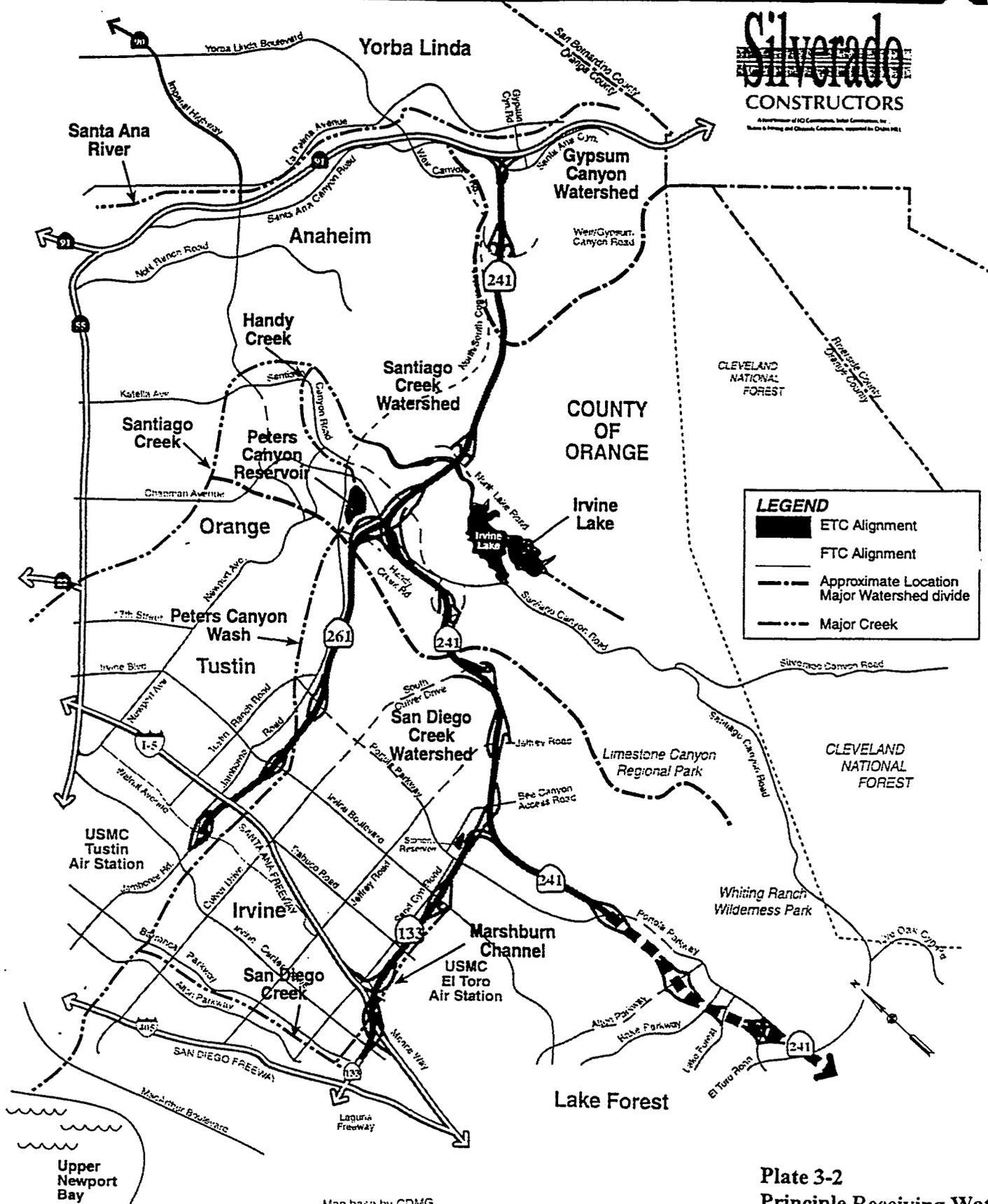
◀ Problem Identification ▶

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

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EASTERN TRANSPORTATION CORRIDOR State Route 241 & 261



LEGEND

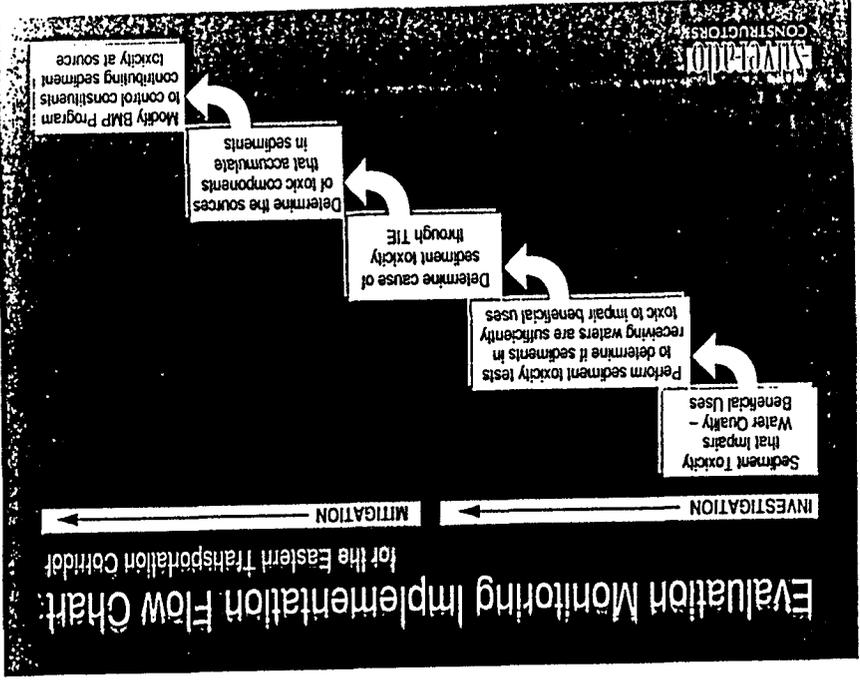
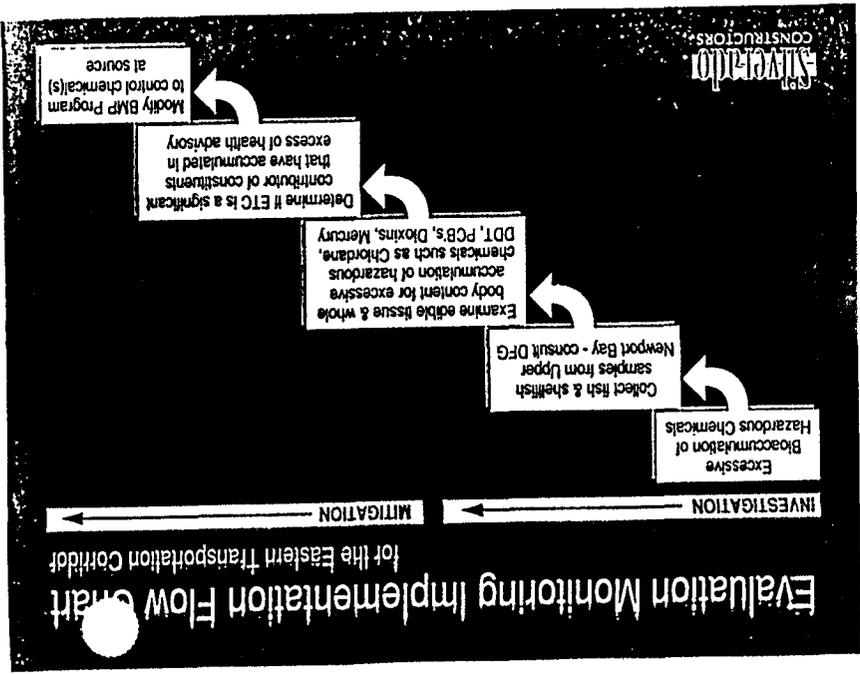
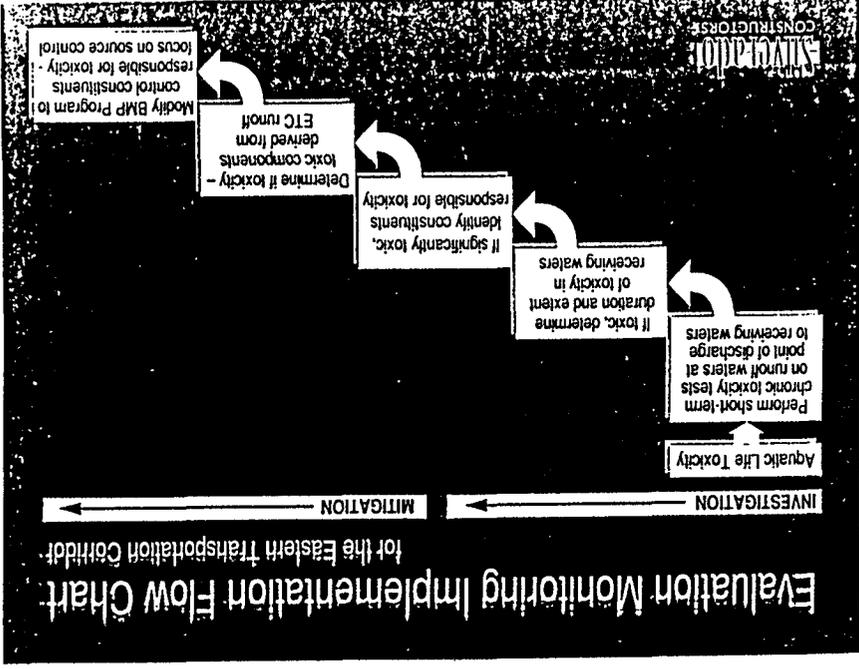
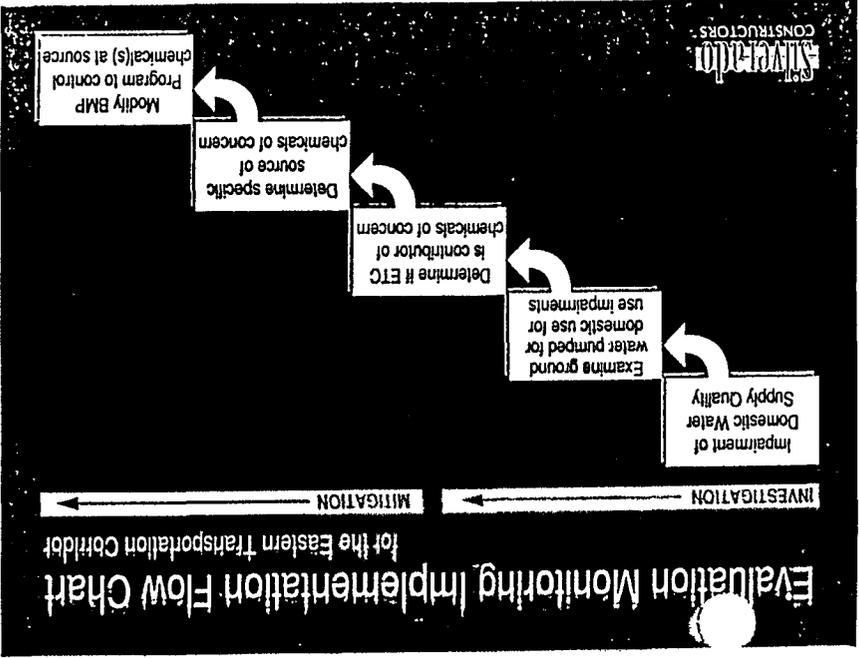
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- FTC Alignment
- Approximate Location Major Watershed divide
- Major Creek

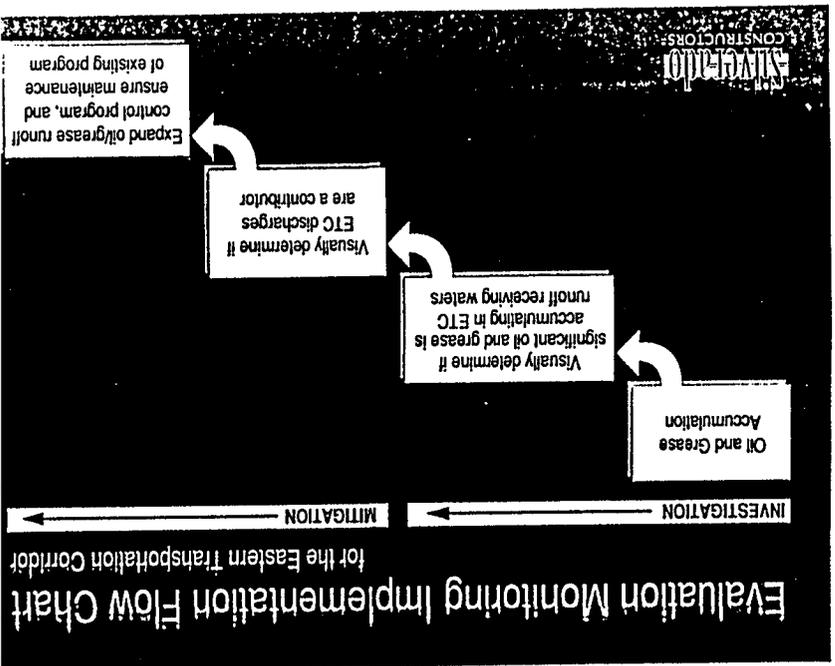
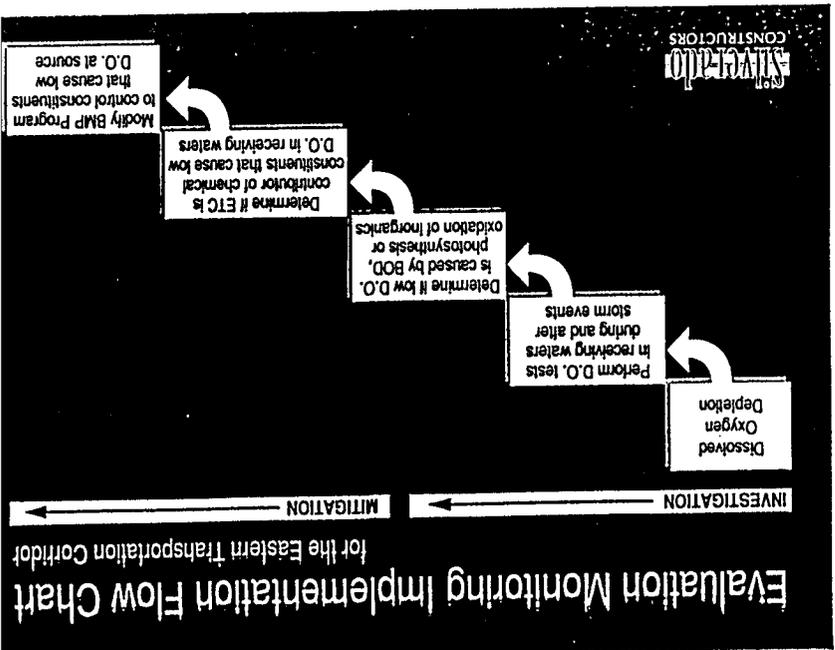
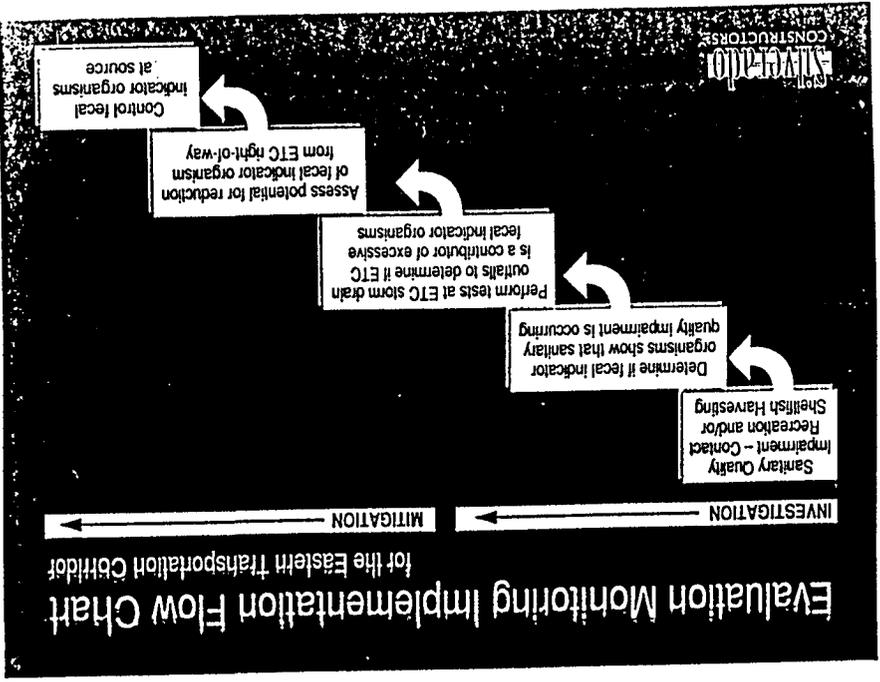
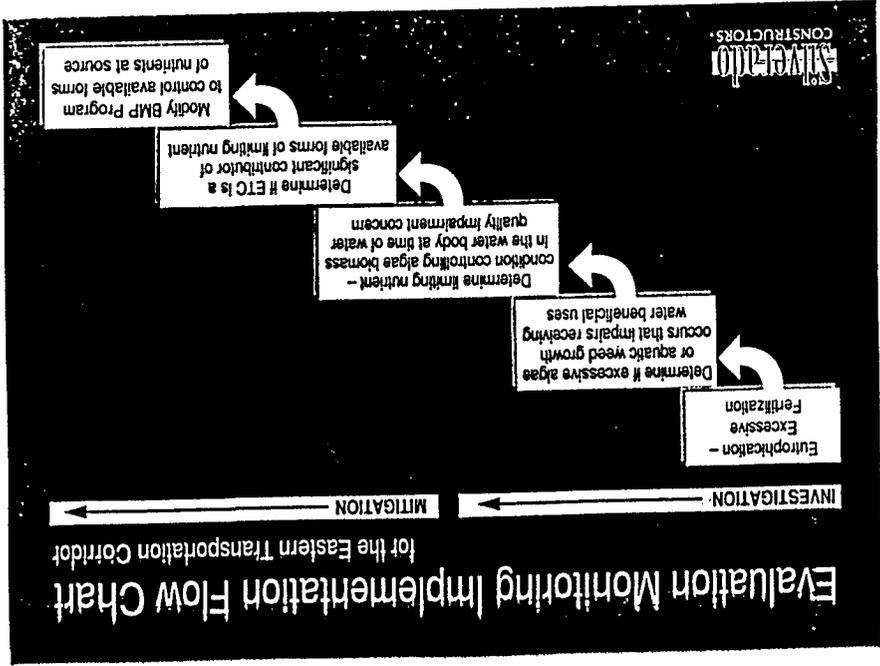
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Map base by CDMG

Plate 3-2
Principle Receiving Wat
Runoff Management Plan

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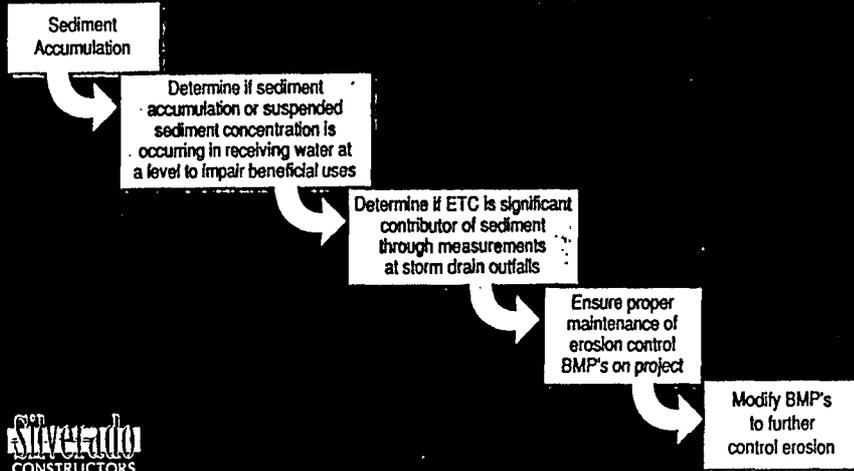
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Evaluation Monitoring Implementation Flow Chart

for the Eastern Transportation Corridor

INVESTIGATION → MITIGATION →



Water Quality Use-Impairment Problem Identification (continued)

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

Water Quality Use-Impairment Problem Identification (continued)

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

**Water Quality Use-Impairment
Problem Identification (continued)**

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 Spacial 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 on 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).

Lee, G. F., and Jones-Lee, A., "Stormwater Runoff Management: Are Real Water Quality Problems Being Addressed by Current Structural Best Management Practices? Part 1," Public Works, 125:53-57,70-72(1994). Part Two, 126:54-56 (1995).

Lee, G. F., and Jones-Lee, A., "Deficiencies in Stormwater Quality Monitoring," IN: Proc. of an Engineering Foundation Conference, American Society of Civil Engineers, New York, NY pp. 651-662 (1994).

Jones-Lee, A., and Lee, G. F., "Achieving Adequate BMP's for Stormwater Quality Management," Proceedings of the 1994 National Conference on Environmental Engineering, "Critical Issues in Water and Wastewater Treatment," American Society of Civil Engineers, New York, NY, pp. 524-531, July (1994).

Lee, G. F. and Jones-Lee, A., "Stormwater Runoff Management: The Need for a Different Approach," Water/Engineering & Management, 142:36-39 (1995). "Implementing Urban Stormwater Runoff Quality Management Regulations," Water/Engineering & Management, 142:38-41 (1995). "Issues in Managing Urban Stormwater Runoff Quality," Water/Engineering & Management, 142:51-53 (1995).

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