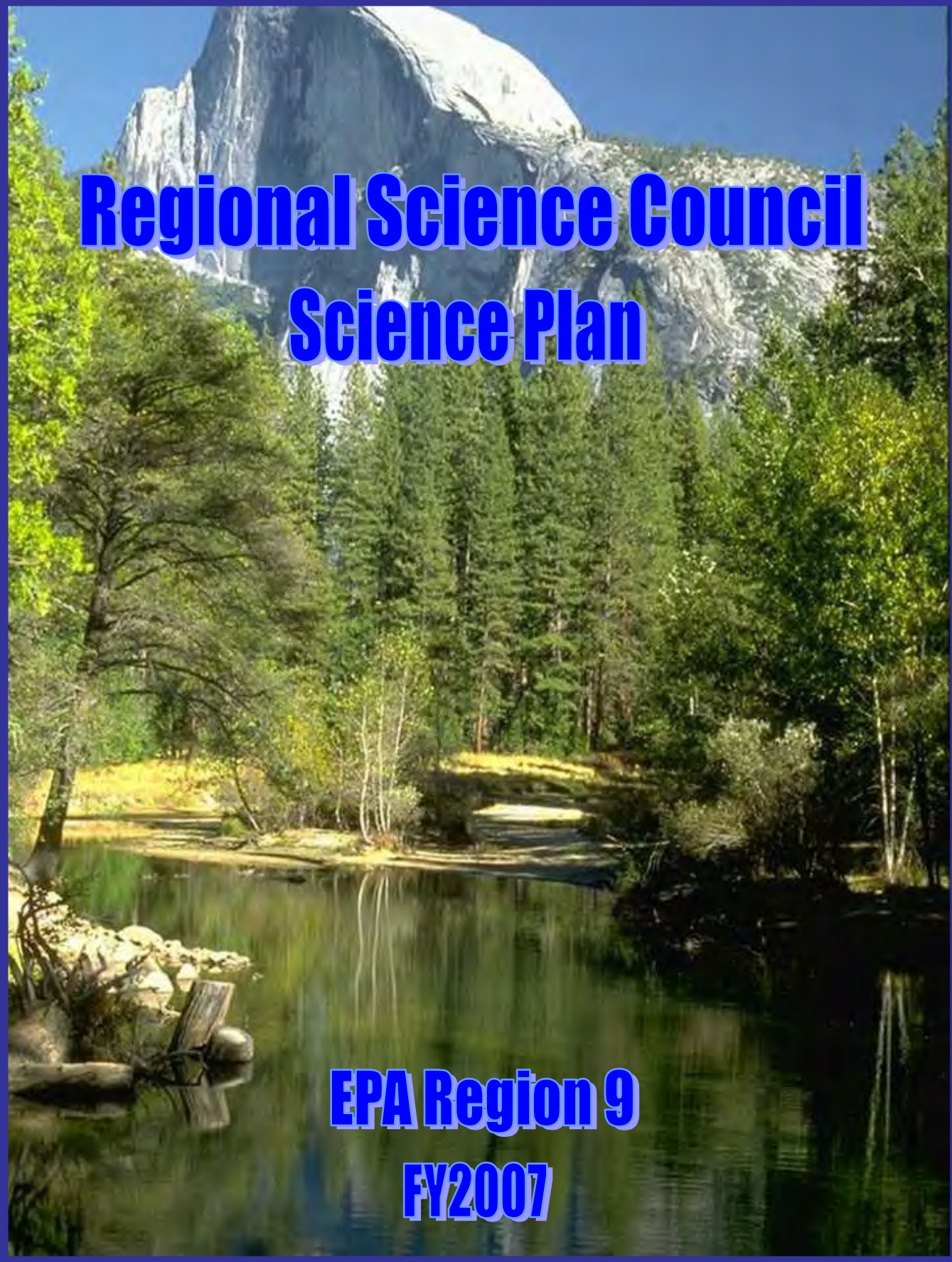


US EPA ARCHIVE DOCUMENT



# Regional Science Council Science Plan

**EPA Region 9**  
**FY2007**

## Region 9 FY07 Science Plan

This is the first Region 9 Science Plan and should be considered a living document that brings together in one place a description of the critical science priorities and the key activities that can advance top Program priorities. It was developed by the Regional Science Council in cooperation with divisional staff and managers. It is divided into chapters that align with the Agency's five strategic goals, and it concludes with a summary of key science support resources in the Region. Each of the five goal chapters includes a section on key science priorities and another section on key activities. The science priorities represent the 2 to 5 highest priority science needs. Efforts will be taken during FY07 to obtain the needed resources and expertise to help address these priority needs. In most cases, efforts are already underway to improve our science associated with these priorities, but more effort is needed. This Plan will also be used to communicate Region 9 science needs outside of Region 9 to promote collaborations with ORD, other federal agencies, states and tribes, and academic institutions. The science activities sections describe specific, ongoing activities such as RARE projects with active investments of regional resources and specific planned outcomes expected over the next year or two. The following key science priorities are outlined in this document:

### AIR

- VOC air emissions from dairies
- Pesticide (fumigant) reactivity in ozone formation
- Ambient air monitoring of acrolein
- Simpler methods to monitor and speciate mercury in air and after ground deposition
- Methods for determining pollutant ratios for interpollutant trading (IPT)

### WATER

- Improved tools to assess air deposition of toxic pollutants to land and migration to water bodies in support of total maximum daily loads (TMDL)
- Microcystis blue green algae bloom in Klamath River and potentially the SF Bay Delta
- Biocriteria/bioassessment to support the watershed approach
- Improve the understanding of the occurrence of *Naegleria fowleri* in groundwaters throughout Region 9 and develop an effective means of treatment

### LAND

- Vapor intrusion
- Asbestos human health risk assessment issues
- Groundwater remediation
- Perchlorate: Investigating human exposure routes

### COMMUNITIES AND ECOSYSTEMS

- Methodologies to identify and evaluate cumulative impacts/risks, esp. vulnerability
- Improved understanding of mercury fate and transport and better mercury source control and remediation technologies

### ENVIRONMENTAL STEWARDSHIP

- Identify alternatives to chlorinated solvents and ways to reduce use of chlorinated solvents
- Improved process for identifying, prioritizing and addressing emerging pollutants



# AIR

Region 9 experiences some of the worst air quality problems in the nation, which are compounded by our unique geography and climate, rapid populations growth, and distinct mixes of agricultural, rural, and urban sources. The science priorities and activities below are a reflection of these unique and significant air pollution challenges.

## AIR PRIORITY SCIENCE NEEDS

### VOC Emissions from Dairies

**Background:** The San Joaquin Valley has some of the nation's worst air quality for both ozone and particulate matter. According to a CARB study in 2004, livestock operations in the San Joaquin Valley contribute approximately 63% of the statewide VOC emissions (about 29 tons per day), most of which are emissions from dairies. In addition, the species of VOCs emitted from dairies vary widely in type and in their reactivity for ozone formation. Substantial gaps in our knowledge of VOC emissions from dairies remain, including:

- 1) quantity of emissions from various portions of the dairy,
- 2) transport within the Valley, and
- 3) chemical species and their reactivity to form ozone.

**What is Needed:** Research is needed that will supplement the planned National Air Emissions Monitoring Study (NAEMS) for animal feeding operations since this study will exclude the measurement of VOC emissions from land application of manure and manure composting operations. Research to develop a comprehensive understanding of VOC emissions from each part of the dairy, i.e., cows, feed, manure, lagoons, barns, corrals, compost, and land application as well as the various chemical species of VOC emitted from dairies is also needed. In addition, a better understanding of the atmospheric fate and transport of the dairy VOC emissions in the San Joaquin Valley and the reactivity of these emissions needs to be developed. California ARB also has two projects underway to study dairy emissions. The scope and results of these studies need to be considered in further research planning.

### Pesticide (fumigant) Reactivity in Ozone Formation

**Background:** As ozone SIPs are developed for the San Joaquin Valley and other agricultural areas in California, a better understanding of the impacts of pesticides on ozone formation is needed. The ozone reactivity of many pesticide VOCs is not well known. Experimental measurements have been made for only a few of the pesticide VOCs most commonly used nationally. Experimentally determined reactivity factors for ozone formation will improve air quality modeling as well as the development of scientifically defensible control strategies for pesticides. The California Air Resources Board is currently funding atmospheric chamber research at UC Riverside on a limited set of pesticide active ingredients to evaluate the reactivity and ozone forming potential of these compounds. However, these studies are focused solely on the pesticide active ingredient and not on the entire pesticide product.

**What is Needed:** VOC research must include the “inert” compounds or “carriers” included in formulated pesticide product since many of these compounds may react to form ozone in the

atmosphere. In addition, tank mixes of multiple ingredients also need to be addressed for ozone-forming potential. The development of reactivity factors for ozone formation using environmental chamber irradiation experiments for the most commonly used pesticide formulated products is also needed. Compounds most likely to be measured include the major inert ingredients or carriers in pesticide products containing the active ingredients chlorpyrifos, thiobencarb, EPTC, PCNB, and DCPA. A validated approach to address composite reactivity to address multiple constituents in formulated products and tank mixes should also be developed. Potentially relevant research has recently been funded by California ARB at UC Riverside that needs to be evaluated.

### **Ambient Air Monitoring of Acrolein**

**Background:** Acrolein is a respiratory irritant defined as a hazardous air pollutant (HAP) by the 1990 Clean Air Act. According to the 1999 National-Scale Air Toxics Assessment (NATA), acrolein poses the greatest relative hazard for non-cancer impacts nationally. Approximately 220 million people in the United States are exposed to acrolein concentrations above the reference concentration. Eighty-one of the top one hundred census tracts for acrolein concentrations in the country are found in California all of which have modeled concentrations in excess of thirty times the reference concentration. However, ambient air concentrations of acrolein are poorly understood due to the lack of a routine monitoring method and potential inconsistency among measurements. Acrolein in the air is largely due to combustion from mobile sources, such as on-road cars and diesel trucks and operations at seaports and airports. Typical method detection limits are several times the acrolein reference concentration.

**What is Needed:** Further research is needed to make measurements of acrolein increasingly reliable over the range of conditions anticipated nationally. Ideally, this research would lead to method detection limits below the reference concentration for respiratory impacts,  $2 \times 10^{-5}$  mg/m<sup>3</sup>. It is necessary to verify the modeled NATA ambient air concentrations for acrolein by local-scale monitoring. Monitors should be placed in the vicinity of acrolein sources and in locations representative of regional background concentrations, to better understand potential impacts. Anticipated improvements in monitoring methods and model validation should be summarized, such as via a white paper, so that it is most useful for informing voluntary and regulatory reduction activities in California and throughout Region 9. Some recent work has been performed by UC Davis on measurement methodologies for acrolein; this work needs to be part of an evaluation of new monitoring options.

### **Simpler Methods to Monitor and Speciate Mercury in the Air and After Ground Deposition**

**Background:** The Gold Mining operations in northwestern Nevada emit a significant amount of mercury. While the mercury emissions have been reduced about 80% in the last several years through a voluntary mercury reduction program with the four mining facilities responsible for more than 95% of the total mercury emissions in that area, an estimated 4,000 lb/yr is still emitted. It is believed that the vast majority of the mercury emissions from these mines is in the form of elemental mercury. However, little is known about the conversion of elemental mercury in the near vicinity of emission sources. Current models predict that elemental mercury contributes to the global pool as opposed to having localized impacts. It has been hypothesized that there could be some atmospheric conversion and hence impact within a 100 mile distance from the sources. There is also little known about the dry deposition of mercury and the amount of this mercury that may be transported by runoff to the local water bodies. There is a great deal of concern from the neighboring States that these emissions are

contributing to excess levels of mercury in their nearby water bodies and are a cause of mercury fish consumption warnings in some of the reservoirs.

**What is Needed:** Development of a simpler, less expensive approach to mercury speciation in the air and the conversion of elemental to reactive mercury after dry deposition will assist in development of TMDLs to reduce mercury in impacted water bodies. An easily deployable sampling system may be used to determine mercury speciation in air, characterize total atmospheric mercury and reactive gaseous mercury concentrations. An understanding of the potential for dry deposition of mercury in western ecosystems and its retention and availability for transport to water bodies is also needed.

### **Methods for Determining Pollutant Ratios for Interpollutant Trading (IPT)**

**Background:** The use of emission reductions of one pollutant to meet requirements for reducing emissions of another pollutant has been used in the Air Program such as New Source Review (NSR) and the Economic Incentives Program (EIP), and it is being considered in other program areas such as general conformity. However, there has been little study or guidance on methods to determine the appropriate ratio between pollutants. Given the interest in IPT, the Air Program would greatly benefit from research aimed at assessing and comparing different methods for determining appropriate ratios between pollutants.

**What is Needed:** Methods for determining the appropriate ratios between pollutants could be done by modifying inputs to existing air quality model applications for ozone and/or PM<sub>2.5</sub> State Implementation Plans (SIPs). Variations to examine would include: source location, source size, episode type, alternative calculation methods, and alternative metrics (such as ozone peak, population exposure, etc.). The goal would be to assess the ability of various methods to provide robust interpollutant ratios that are consistent with policy objectives and to help EPA in developing guidance on IPT.

## **AIR SIGNIFICANT SCIENCE ACTIVITIES**

**Advanced Monitoring Initiative Project - Use of satellite data to evaluate PM<sub>2.5</sub> formation and transport in San Joaquin Valley, California** – The SJV Air Basin experiences frequent and broadly distributed high PM<sub>2.5</sub> concentrations during the winter. These high concentrations of PM<sub>2.5</sub> in SJV result from the combined effects of geography and local sources, as well as specific climate conditions (i.e., cold and humid) which are favorable to secondary particulate matter formation. The proposed project has the capacity to contribute to a better understanding of the complex PM<sub>2.5</sub> issues in the region and thereby aid in the development of effective control strategies to reduce PM<sub>2.5</sub> concentrations, alleviating the economic and health impacts associated with poor air quality. We are also seeking further partners within ORD, ARB, and California EHTP to implement the integration of health and environmental monitoring data during seasonal changes in air pollution.

**Advanced Monitoring Initiative Project - Ground-Level Ozone Concentrations Based on Satellite Observations and Ground Surface Monitoring Data in Support of Environmental Health Decisions U.S. - Mexico Border 2012 Program** - The U.S.-Mexico border is a dynamic region extending more than 3,100 kilometers from the Gulf of Mexico to the Pacific Ocean, and 100 kilometers on each side of the international border. Environmental pressures at the border have been attributed to increased development, industrial and population growth, the increase in the number of old vehicles, topographic and meteorological conditions. The most recent air quality data indicates

that approximately three million people live in Border counties in where ozone concentrations exceeded health-based air quality standards. This project seeks to supplement existing surface monitoring network with satellite-derived observations to support environmental decisions through a more complete understanding of ozone pollution.

**Characterization of PM 2.5 and Air Toxics Emissions from Jet Aircraft Related to Los Angeles**

**Airport Operations** - It has been estimated that aircraft emissions account for approximately 97% of the total overall emissions of chemicals listed as toxic air pollutants at the Los Angeles Airport (LAX). However, data on speciated hazardous air pollutants in gaseous and particulate phases of emissions from commercial aircraft has been difficult to develop. Several efforts are underway to gather more comprehensive data on aircraft exhaust. EPA (OAR, ORD, and Region 9), State of California, FAA, and academic scientists continue to collaborate on ongoing efforts to address this concern. After developing a partnership with NASA and securing the use of Edwards Air Force base as the location for the aircraft engine tests, the research group measured aircraft emissions to simulate take-offs. In ongoing efforts working with industry partners and the California Air Resources Board, measurements were recently obtained near Oakland, CA airport for taxiing aircraft.

# WATER

The water quality challenges associated with both the arid southwest ecosystems and pacific island ecosystems are especially challenging and unique relative to the rest of the nation. Much of the Agency-level science developed for water quality has a bias toward the environments of the eastern U.S. These science priorities and activities address issues that reflect the unique character of the environments in Region 9 and which address some significant public health concerns.

## WATER PRIORITY SCIENCE NEEDS

### Improved Tools That Assess Air Deposition of Toxic Pollutants to Land and Migration to Water Bodies in Support of Total Maximum Daily Loads (TMDL)

**Background:** Several studies have implicated air deposition as a major source of toxic pollutant delivery in urban environments and subsequent delivery to impaired waterways. Likely sources are both mobile and stationary sources, and include local, regional, and far-field sources. Depending upon the form of toxicants deposited, local climate conditions, and proximity to waterways, different percentages of air-deposited toxicants reach impaired waterways. The TMDL process provides the principal framework under the Clean Water Act through which pollutant sources are targeted for reductions needed to restore and maintain water body uses. However, managers of urban stormwater conveyance systems object to receiving TMDL wasteload allocations (allocations of responsibility) that create responsibility for air-borne contaminants over which they have no regulatory authority. Estimation of air deposition of toxicants is difficult because monitoring is limited and modeling tools are not well established. Complicating the analysis is the lack of proven tools to evaluate the fate of air-deposited toxicants and their transport to waterways. The limitations in currently available tools and monitoring programs has made it difficult to complete several high profile TMDLs addressing metals and organic toxicants in northern and southern California. Public and discharger acceptance of TMDLs would be improved if tools were available that address air sources of toxicants and support the assessment of the relative importance of air sources.

**What is Needed:** Improved air deposition monitoring for toxicants is needed in a broader range of land uses for longer periods of time, to assist in evaluating air deposition variability over time and space. Support is needed to compile and analyze available air deposition data for toxicants, and develop and validate use of air deposition and pollutant fate models to support estimation of air deposition and subsequent runoff in unmonitored areas. In addition, research is needed to better understand and characterize the fate of different forms of air-deposited toxicants (e.g., sediment-bound and wet vs. dry deposition) to different land surfaces (e.g., permeable vs. impermeable) and their likelihood of being transported to waterways.

### Microcystis Blue Green Algae Bloom in Klamath River and Potentially the SF Bay Delta

**Background:** The Karuk tribe, Yurok tribe and FWS conducted monitoring during the summer of 2005 that showed microcystis blue green algae in high concentrations in the Klamath River, up to 1600 times the World Health Organization guidelines for probable health effects. Algal blooms and water recreation activities were observed to occur during the summer and early fall months. Microcystis is a liver toxin that could cause significant health effects to recreational users of the Klamath River. CalFed is studying the effect of lower concentrations of microcystis in the Bay Delta system for its possible impacts on fish and drinking water supplies.



**What is Needed:** Additional monitoring, QA/QC of monitoring data and possible methods development/review is needed. Assistance in evaluating existing health effects literature and developing scientifically defensible trigger levels for posting advisories is needed as well as access to our national experts. Assistance in designing appropriate health effects monitoring protocols and determining needs for additional research/studies and priorities would also be useful.

### **Biocriteria/bioassessment to support the watershed approach.**

**Background:** The Clean Water Act charges EPA with restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. Water quality standards, NPDES permit limits, and decisions concerning water quality-limited segments are currently determined almost exclusively based upon chemical measures. Improved biological assessment methodologies and metrics will help EPA meet the mandate of the Clean Water Act since biocriteria and bioassessment directly address the biological integrity goals and integrate physical habitat metrics. In addition, biocriteria generally are better integrative measures of the status and condition of waters because inferences can be made about all factors affecting water quality.

**What is Needed:** More work is needed to ensure that meaningful metrics are developed and consistently applied. Specifically, additional tolerance value work to better correlate stressors to community metrics, evaluation of the comparability between bioassessment methods, and comparison of predictive versus multi-metric indicators is needed. In addition, training of staff and managers so they better understand the technical factors and methods of bioassessment approaches and metrics is needed. Work is also needed to support biocriteria development for Pacific coral reefs. Recent workshops identified the following needs for coral biocriteria: pilot testing the EPA Rapid Bioassessment Method for Stony Corals in high diversity Pacific reefs; compilation of existing coral bioassessment data and development of methods for identifying sensitive metrics and defensible biocriteria; and evaluation of comparability between bioassessment methods for corals.

### **Improve the Understanding of the Occurrence of *Naegleria fowleri* in Groundwaters Throughout Region 9 and Develop an Effective Means of Treatment.**

**Background:** *Naegleria fowleri* is a waterborne parasite that is found in soil and water. In late October 2002, two fatal cases of primary amoebic meningoencephalitis (PAM) in previously healthy five-year old boys in Arizona were linked to *N. fowleri*. The public water supply system was the apparent source of the infections. Infection by *N. fowleri* may occur when water is forced up the nose during swimming, diving, or bathing.. Preliminary occurrence data collected by researchers in Arizona indicates that the pathogen *Naegleria fowleri* is found in approximately 10% of groundwater supply wells sampled throughout the state. It is not known whether *N. fowleri* occurs in groundwaters elsewhere in Region 9. The scientific literature also suggests that *N. fowleri* is fairly resistant to chlorine based disinfection. Additional work is needed to determine occurrence of *N. fowleri* in other areas of the Region and to determine effective means of treatment.

**What is Needed:** Occurrence data for *N. fowleri* in groundwater in other warm weather areas of Region 9 should be developed. Regional staff should be involved in organizing sampling events. More basic research to determine effective means of treating groundwater to inactivate *N. fowleri* cysts and trophozoites is also needed, as well as research to assess the risk posed by *N. fowleri* in groundwater supply systems. In addition, the development of a public health message to water suppliers that have had *N. fowleri* detected in their groundwater supply sources would be helpful.

## WATER SIGNIFICANT SCIENCE ACTIVITIES

### **Marine and Freshwater Contaminated Sediments Workgroup for National Regional Science Council**

Regional staff have been actively involved with the workgroup formed by the National Regional Science Council and ORD to identify and address short term science needs related to contaminated sediments. This group has worked with ORD to clarify the issues, collaborated with an existing OSWER working group on the contaminated sediment issues related to remediation, and is currently focusing on identifying the Water Program issues with contaminated sediments.

### **Pharmaceuticals and Personal Care Products (PPCPs) Team for National Regional Science Council**

Regional staff from the Water Program and P2 groups have been actively involved in this cross-Regional workgroup which has worked with ORD on various activities, including broadening the scope of a 2005 ORD Conference/workshop to include issues relevant to Regions, identifying appropriate Regional sites for ORD research into the fate and transport of PPCPs, and most recently, developing a webinar that will raise awareness in EPA, States, Tribes, and local agencies of the issues around PPCPs.

### **Full-Scale Development of Ballast Water Treatment on Ships Workgroup for the National Regional Science Council**

Regional Staff from the Water Program are involved in this workgroup that has been enlarging the scope of the original issue and moving beyond ballast water treatment to include the invasive species issues relating to ballast water. This team will identify the long term and short term research needs relating to this issue and work with ORD to facilitate placing them within the ORD planning process.

### **RARE Project: Methods Development and Preliminary Application for Leptospira Spirochetes**

Leptospirosis is the sixth most common zoonosis in the world and is increasingly important in Hawaii and the Pacific Trust Territories. Since the beginning of 2004, there has been a fivefold increase in the number of cases since the same time last year. Hawaii and the Pacific Trust Territories recently had three deaths attributed to leptospirosis and a CDC epidemiological study of American Samoa showed 17.0 % of the sample population had been exposed to Leptosira. The project goal is to develop a method to sample environmental waters and detect specific pathogenic serovars of Leptosira.

### **RARE Project: Preparation of an Updated Design and Performance Guidance for Municipal Wastewater Stabilization Pond (Lagoon) Systems: A Multi-Regional Project**

Finding cost effective and sustainable solutions to wastewater treatment needs is a continuing challenge for small communities nationwide and especially in the rapidly expanding U.S.-Mexico Border Region. Waste stabilization ponds have a proven record, but the implementation of new effluent standards and doubts as to whether ponds can meet them, have led many communities to avoid ponds in favor of unnecessarily expensive and operationally infeasible mechanical treatment plants. This project will:

- 1) Review and evaluate data related to the advances in waste stabilization pond design and advances in pond performance;
- 2) Incorporate this information into a new and revised pond design manual; and
- 3) Develop training materials and outreach strategies to publicize the manual.

## Activities on Biocriteria Metrics

### **RARE Project: Determination of Protective Dietary Selenium Benchmarks to Assist in the Development of Wildlife Criteria for the San Francisco Bay-Delta**

- As U.S. EPA is proposing to publish national acute and chronic criteria for selenium, Region 9 must develop California specific criteria, including site-specific criteria for the San Francisco Bay-Delta region, as required by agreements made in consultation with U.S. Fish & Wildlife Service (FWS) in response to concerns regarding the California Toxics Rule. The U.S. Geological Survey (USGS)–Menlo Park has been contracted to provide guidance as to the range of concentrations that would be protective of wildlife for Region 9 to develop acute and chronic water quality criteria in the San Francisco Bay-Delta.

### **RARE Project: Field Verification of Toxic Threshold Concentrations of Selenium in Mallard Eggs, Part I**

- The U.S. Fish & Wildlife Service (USFWS) position that U.S. EPA's chronic water quality criterion of 5 ug/L is not protective enough is based on mallard duck feeding studies performed during the 1980s and 1990s to determine a toxic threshold point, based on reduced egg viability (California Toxics Rule Biological Opinion). Since that time, industry consultants have argued that the data do not support such a low threshold, based on alternative statistical treatment and data screening. The original studies do lack statistical power because the sample sizes of the original feeding experiments were small. However, Region 9 has an opportunity to resolve this controversy by conducting an analysis and determination of hatchability of a large number of mallard eggs for three seasons. This will produce a statistically powerful, field-based set of data, which can be used to determine a more definitive toxic threshold upon which EPA could base a protective chronic water quality criterion.

### **RARE Project: Field Verification of Toxic Threshold Concentrations of Selenium in Mallard Eggs, Part II**

- Through the RARE Grant Program, EPA has provided funding to FWS for three sampling seasons (2002-2005). This has supported the collection of a more statistically robust, field-based data set to better determine the toxic threshold of selenium for mallards, which are a widely distributed and selenium-sensitive species of aquatic-dependent wildlife,. This would provide EPA with an improved basis for criteria recommendations. The final phase of this work, data analysis and interpretation, will provide a report documenting the findings of the field study and laboratory analyses.

**RARE Project: Testing of Dust Suppressants for Water Quality Impacts** – The use of dust suppressants not only enhances dust control but can also significantly reduce the amount of water needed to effectively control dust. Application of dust suppressants may impact the quality of underground water and surface water bodies through infiltration or storm water runoff. This research proposal intends to investigate the potential impacts from dust suppressant application. This research will address needs identified by EPA, local air quality districts in Arizona and Nevada, as well as the regulated communities that are subject to fugitive dust controlling requirements in these areas.

### **RARE Project: Identification and Characterization of Microbial Communities within Warm Water Aquifers**

- In late October 2002, two fatal cases of meningioencephalitis in previously healthy 5-year old boys in Arizona were linked to the amoebic parasite, *Naegleria fowleri*. The two cases, related both temporally and spatially, comprised an extremely rare event, prompting an investigation by the Centers for Disease Control and Prevention (CDC). During the investigation of the outbreak, split sampling of the groundwater source, and of water within components of the water distribution system, confirmed the presence of *Naegleria fowleri* in the municipal public water supply system, but

it is still unclear where the contamination of the water supply originated. A water sample from a wellhead at a neighboring water supply system, before chlorination or entry into the distribution system, showed the amoeba, and suggests that *Naegleria fowleri* may exist within the aquifer material or well bore area. *Naegleria fowleri* is a free-living thermophilic amoeba commonly found in soil and that thrives best in waters ranging from 78 to 80o F. Based on a recent sampling episode, it is estimated that over 75% of the wells in the area of Arizona where the two *Naegleria fowleri* deaths occurred produce water over 78o F in temperature. Elevated groundwater temperatures can occur in areas where vulcanism has produced hot springs or other geothermal features. If the risks associated with warm water aquifers are to be understood, it must be determined whether pathogenic microorganisms, including *Naegleria fowleri*, can be found within aquifer material or whether they must be introduced into the drinking water system through flaws in the well bore or other parts of the delivery system.

**RARE Project: Western Tolerance Values Expert Panel Workshop** - Western states and other federal agencies have gathered a tremendous amount of biological data but are struggling with their ability to interpret it. This inability affects the states' use of biological data in making aquatic life use determinations and leads to an under-utilization of biological data. Refined Tolerance Values would allow better use of biological data in determining whether a water is impaired and can serve as a weight of evidence for making determinations of aquatic life use attainment. This proposal focuses on the development of Tolerance Values for macroinvertebrates where sediment is the primary stressor as the product of a panel of Experts and Practitioners from the Western U.S., especially Region 9 States.



# LAND

Hazardous waste cleanups in Region 9 have often taken on environmental problems over large geographic regions with unique technical challenges. The science needs and priorities identified below represent important science issues associated with several of our largest and most significant land cleanup challenges as well as recurring technical issues impacting both large and small sites. These issues involve large scale concerns in Region 9, such as naturally occurring asbestos and perchlorate contamination, as well as recurring challenges associated with our many groundwater remediation sites and an increasing concern associated with vapor intrusion of contaminants into buildings.

## LAND PRIORITY SCIENCE NEEDS

### Vapor Intrusion

**Background:** Vapor intrusion is the migration of volatile chemical vapors in buried waste or contaminated groundwater that may migrate through subsurface solids and into air spaces of overlying buildings. In extreme cases, the vapors may accumulate in dwellings or occupied buildings to levels that may pose near-term safety hazards, acute health effects or aesthetic problems. Contamination of homes, offices or other occupied buildings by vapor intrusion is a relatively new, but increasingly common pathway of concern at CERCLA, RCRA and UST cleanup sites. The technical complexities associated with this pathway have resulted in significant challenges and uncertainties in conducting proper site investigations, characterizing risks, and selecting an appropriate remedy. Mathematical modeling is being used to better understand the potential for vapor intrusion and the factors affecting it. An uncertainty and sensitivity analysis of the primary model is currently underway at ORD, but that analysis is not completed.

**What is Needed:** There is a short term research need for improved methods for vapor intrusion pathway site investigation. Also, there is a need for better conceptual models and improved mitigation technologies. Additional vapor intrusion data compilation and analysis by HQ with regional involvement is needed, especially of field data from sites with potential vapor intrusion concerns. The conceptual models need to establish protocols for a rational approach to investigating sites. The model sensitivity analysis should be supported and continued by ORD with regional involvement. The goal should be to try and make the models more predictive, based on the type of data, the existing Johnson and Ettinger Model (with validated assumptions) and knowing how to deal with preferential pathways. We need a better understanding of the groundwater to capillary fringe to vadose zone mass transfer and more innovative tools for measuring vapor flux (flow and concentration) in the subsurface. Additionally, training of staff and managers is also needed so they can better understand the technical factors that impact cleanup decisions associated with vapor intrusion.

### Asbestos Human Health Risk Assessment Issues

**Background:** Asbestiform minerals occur naturally in rock and soil as the result of natural geologic processes, often in veins near earthquake faults in the coastal ranges and the foothills of the Sierra Nevada mountains and in other areas of the country. Naturally occurring asbestos (NOA) can take the form of long, thin, separable fibers and there is no health threat if these fibers remain undisturbed and do not become airborne. However, natural weathering or human disturbance can break NOA down to microscopic fibers, easily suspended in air. When inhaled, these thin fibers irritate tissues and resist

the body's natural defenses. Asbestos, a known carcinogen, causes cancers of the lung and the lining of internal organs, as well as asbestosis and other diseases that inhibit lung function. Region 9 is conducting assessments of airborne asbestos exposure in California's El Dorado Hills and Clear Creek Management Area. With recent increased development pressures in some of these areas, the soil does become disturbed and asbestos exposure chances are increased. Scientists do know that long-term exposure to relatively high concentrations of airborne asbestos is a potential cause of disease.

**What is Needed:** There are a number of research needs which critically impact Region 9's ability to make sound, scientifically-defensible public health judgments regarding exposure to the naturally-occurring asbestos (NOA) which is prevalent within the Region. These issues include:

1. Clarification of the cancer potency of amphibole-type asbestos in comparison to chrysotile. There is scientific consensus that amphiboles are more potent carcinogens, but the quantitative extent has not been clarified to the point of being useful for risk assessment.
2. Determination of the toxicity, if any, of short asbestos fibers. There is suggestive evidence that shorter (less than 5 microns) fibers significantly contribute to non-cancer disease, in contrast to the current view that they are relatively non-toxic.
3. Determination of the relative toxicities of fiber-like cleavage fragments versus true asbestos fibers. Some scientists, mainly geologists, claim there should be a significant difference in toxicity between these similar asbestos structures, although there are no biological/toxicological studies which directly address this issue. ATSDR has recently asked the National Toxicology Program to address this question; EPA should enthusiastically endorse this effort.
4. Determination of the relative toxicity of intermittent, short-term exposures (typical of outdoor activities) versus the continuous exposure health data underlying the current EPA risk assessment methods. Because of the persistence of asbestos structures in body, intermittent short-term exposures may create a disproportionately higher health risk (on a time-weighted basis).

### **Groundwater Remediation**

**Background:** There are many contaminated groundwater aquifers in Region 9, mostly under either the Superfund or RCRA cleanup programs. Much of the contamination is from chlorinated solvents. Pump and treat systems and other active remedies have been implemented at many of the sites. While there has been some effort to optimize existing systems, they are not always effective at cleanup due to a number of reasons, including incomplete characterization and hydrogeologic limitations. The challenges in particular for Region 9, are often because of the presence of DNAPLs, a subsurface made up of fractured bedrock, or the presence of extremely long plumes (e.g. San Gabriel). Mines are also prevalent in Region 9 and remain one of our biggest groundwater cleanup challenges.

**What is Needed:** Short term research needs include more research in the fields of DNAPL characterization and remediation, alternatives for offgas treatment that do not have the chance of dioxin formation, and more study in the general optimization of existing systems. Electronic "toolboxes" (previously proposed in other programs) could assist the project managers with the design and analysis of capture zones and estimation and analysis of aquifer parameters. Innovative treatment technologies for NAPLs, chlorinated solvents, chlorinated pesticides, dioxin, wood treated wastes and metals also top the list of needs. Research related to mining includes sound mine waste management,

determination of lead ore concentrate bioavailability rates, determination of the long term stability of phosphate stabilized lead, and contaminated soils and mining waste.

### **Perchlorate: Investigating Human Exposure Roots**

**Background:** EPA's Office of Research and Development formally adopted a reference dose for perchlorate in 2005 and published the dose on the Integrated Risk Information System (IRIS). However, the National Academy of Sciences Perchlorate Report, which formed the basis for EPA's reference dose, raised a number of scientific questions complicating the use of this number for cleanup decisions. The NAS committee suggested that the health-protective oral exposure for humans is approximately 0.7 microgram per kilogram body weight per day, or about 50 micrograms per day for a 70 kilogram (150 pound) adult. If all the perchlorate exposure came only from contaminated drinking water, this dose would translate to between 20 and 25 micrograms per liter (ppb), using a standard assumption of an adult consuming 2 liters per day. The January 26, 2006, memo from OSWER Assistant Administrator Susan Bodine confirmed this calculation as 24.5 ppb.

**What is Needed:** Continued collaboration between the experienced Regional scientists and the research community is essential. Considerable scientific evidence shows that perchlorate is present in many foods consumed by Americans (for example, see the special issue of the journal *Analytica Chimica Acta* devoted to perchlorate: Volume 567, Issue 1, May 2006). Region 9 scientists and project managers have been collaborating with academic and government scientists to provide an objective estimate of the exposure to perchlorate from non-drinking water sources. Most of the effort has involved formal and informal advisory roles, such as with Santa Clara Valley Water District, the Interstate Technology and Regulatory Council, ATSWMO, and various academic and professional conferences. Some financial support is being provided to university and federal researchers in a pioneering effort to provide a site-specific exposure estimate as recommended in the OSWER guidance, capitalizing on an existing Superfund Basic Research Program study and state-of-the-science analytical methods developed by ORD and the National Center for Environmental Research.

## **LAND SIGNIFICANT SCIENCE ACTIVITIES**

### **Mine Waste Management Techniques Using Automated Treatment Systems and Remote Telemetry Monitoring Techniques Workgroup for the National Regional Science Council** –

Regional staff has been actively involved in this group. They have discussed with ORD how to better identify and transfer ORD information from the Mining Program out to the Regions. The group has also discussed developing a pilot project that would link a passive remediation technology at a mining remediation site with remote monitoring and/or telemetry to determine how well this approach would work in ensuring that remote or seasonally inaccessible sites could operate year-round. A pilot study has been developed that would evaluate the components needed to build an onsite system that could monitor specific parameters and communicate the results via telemetry to offices far removed from mine sites. The goal is to provide the information that project managers would need to build an “off the shelf” monitoring system that provides critical monitoring information from the mining site to their desktops.

### **RARE Project: Green Cleanup Practices: Using Renewable Energy and Cleaner Diesel Equipment at Waste Cleanup Sites** -

This project will finalize an inventory of renewable energies and cleaner diesel-powered equipment for use at hazardous waste sites. In 2006, an energy and diesel equipment needs assessment will be conducted at all Region 9 Superfund sites and assistance provided

to the Superfund Program Office in developing the criteria for a special services contract mechanism that can be widely implemented. The utility of the energy and diesel equipment needs assessment and the criteria for a special services mechanism will be pilot tested at a minimum of two Region 9 Superfund sites. A “Renewable Energy & Clean Diesel Equipment Implementation Resource Guide” will be developed as a guide for other EPA programs in Region 9 and nationally, as well as States and industry.

**RARE Project: Modifying EPA Method 314.0 for Analysis of Perchlorate in Aqueous Samples Containing High Total Dissolved Solids** - The ultimate goal of this project is to modify EPA Method 314.0 so that aqueous samples high in total dissolved solids (TDS) can be analyzed for perchlorate contamination at 1 ppb or less. Low levels of perchlorate (4-16 ppb) have been detected in the Colorado River and Lake Mead in Nevada. These source waters produce drinking water for over 12 million people in Nevada, California and Arizona. This project includes performance of necessary testing to publish a rapid inexpensive field procedure/approach for measuring perchlorate in water.

### **Activity Related to Vapor Intrusion Need**

**Compile and Analyze Existing Vapor Intrusion Data and Evaluation Methods Workgroup for the National Regional Science Council** – Regional staff has been actively involved in this group but also were instrumental in writing the original issue paper. This workgroup is reviewing new guidance being developed by ORD for vapor intrusion (U.S. EPA document, “Uncertainty and the Johnson-Ettinger Model for Vapor Intrusion Calculations”) with the author, identifying information from ORD that could be transferred to the Regions, identifying long and short term research needs, and looking at ways to improve training of regional staff on vapor intrusion related issues and improving the transfer of ORD information and technologies out to the Regions.



# COMMUNITIES & ECOSYSTEMS

The populations of Region 9 are among the most diverse in the nation and include large segments of population that are uniquely impacted by environmental pollution or which are underserved by basic environmental infrastructure. Our ecosystems are also uniquely diverse and varied from the rest of the nations. The science priorities and activities below reflect these unique characteristics and challenges facing Region 9.

## COMMUNITIES & ECOSYSTEMS PRIORITY SCIENCE NEEDS

### Better Methods to Identify and Evaluate the Most Vulnerable Communities and the Cumulative Impacts and/or Risks These Communities May Face

**Background:** EPA's *Framework for Cumulative Risk Assessment* laid out several key concepts to address cumulative risks from environmental pollution within communities. The National Environmental Justice Advisory Council (NEJAC) embraced this Framework and provided EPA with specific recommendations on how to begin addressing this issue. NEJAC recommended the development and adoption of an interim approach to identify communities with higher pollution burdens and where risk reduction activities could be initiated while other scientific tools are being developed. A "Pollution Burden Matrix" (PBM) approach was proposed that offers a suite of proxy indicators of neighborhood-scale cumulative emissions, exposure and health effects. Region 9's Environmental Justice (EJ) Program has begun the development of a tool, based on PBM, to identify overburdened communities in Region 9, but they lack the expertise to evaluate vulnerability, as defined by NEJAC. This definition presents the idea that disadvantaged, underserved, and overburdened communities start with pre-existing deficits of both a physical and social nature which make the effects of environmental pollution more burdensome.

**What is Needed:** Better methodologies are needed to help EPA staff evaluate the multiple, aggregate and cumulative risks and impacts experienced by environmental justice communities. Most critical is research to better understand vulnerability and, more specifically, what vulnerability factors, such as effects of aging, discrimination, poor nutrition, poor community services, etc. are most important to understanding the links between environmental exposures and adverse health outcomes.

### Improved Understanding of Mercury Fate and Transport and Better Mercury Source Control and Remediation Technologies

**Background:** Mercury has been recognized as a potentially serious environmental contaminant for more than a century. Mercury is an element (and therefore doesn't degrade in the environment) that bioaccumulates as it moves up the food chain, and it is a significant neurotoxin. World-wide releases of mercury to the environment are increasing, and mercury concentrations in fish are likewise increasing. It is becoming increasingly clear that widespread mercury contamination may be having public health and environmental consequences. Further, the public is expressing increasing concerns about the health implications of mercury exposure. Releases of mercury come from a variety of sources, including gold mining, coal fired power plants, chlor-alkali plants, cement plants, waste incineration plants, and from electrical switches and relays.

**What is Needed:** In order to effectively address this global issue, there is a need to better understand the sources of mercury, its fate and transport in the environment, and mercury control and remediation technologies. Specifically, additional mercury data compilation and analysis, including an improved global emissions inventory is needed. More basic research into the factors that affect mercury fate and transport, mercury source control technologies, mercury remediation strategies and technologies is needed. In addition, training for staff and managers to improve understanding of mercury fate and transport, and mercury source control and remediation is also needed

## COMMUNITIES & ECOSYSTEMS SIGNIFICANT SCIENCE ACTIVITIES

**RARE Project: Transport Pathways of Invasive Species Across Pacific Estuaries** - The proposed research aims to determine whether the San Francisco Bay is acting as a local source for secondary invasion events across other Pacific estuaries. Studies suggest that invasion events may follow a stepping stone model, where invasive species are introduced to new habitats from recently invaded areas. San Francisco Bay is the likeliest launching pad for invasive species since it is the most highly invaded estuary in North America, if not the world. The proposed research will test the hypothesis that the Bay has acted as a source pool of invasive species that are already established in the Bay and other Pacific estuaries. We will also determine whether regional shipping originating from San Francisco Bay is a predominant transport vehicle moving invasive species to other Pacific estuaries.

**Development of Standard Procedures for Pyrethroids** - Region 9 garnered funding through the Regional Method Program for an IAG with USGS to develop standard procedures for pyrethroids. Pyrethroids have replaced diazinon and chlorpyrifos as the most common pesticides in the urban marketplace. Pyrethroids have also increased in usage in many agricultural applications of diazinon and chlorpyrifos. Since pyrethroids are highly toxic to aquatic organisms and researchers have detected pyrethroids in ambient surface water toxicity and (more frequently) in sediments, more agencies are seeking to routinely test for pyrethroids at environmental relevant concentrations in their routine monitoring programs. At present, there is a need for a standard procedure for collecting, transporting, storing, and handling surface water and sediment samples that are to be tested for pyrethroids and pyrethroid-related toxicity. Losses of pyrethroids on sampling equipment and sampling and testing container walls may be as high as 50%, confounding interpretation of analytical and toxicity test results. Determining the optimum procedures and types of containers and disseminating a uniform and validated standard operation procedure (SOP) to laboratories and surface water monitoring programs will ensure that data collected will be as meaningful as possible. The main objective is to develop a standard written procedure for surface water and sediment sample collection, storage, and handling appropriate for samples containing pyrethroids and validate these methods to ensure minimal losses of pyrethroids on sampling equipment and container surfaces. The research approach involves literature review, study design to address priority information gaps, conducting a study to optimize the procedures and address information gaps, prepare draft procedure, submit draft procedure for peer review, and preparation of final procedure.

### Activities on Community Vulnerability

**RARE Project: How Vulnerability Indicators Affect the Association between Adverse Birth Outcomes and Air Pollution and Traffic Exposures** – This project allows EPA to participate in a project that will examine whether vulnerability indicators have an impact on the potential association between outdoor air pollution exposure and adverse birth outcomes such as low birth weight and infant mortality. This RARE proposal would fund two add-ons to an ongoing current project. One is a traffic

exposure add-on. and the other is a collaboration with the California Environmental Health Tracking Program to obtain geocoded address level data for the birth outcomes.

**Landscape-Scale Analysis of Cumulative Environmental Impacts in Arizona's Rapidly-Urbanizing Arid Watersheds** - Several large-scale developments (5,000 acres and greater) in the Hassayampa and San Pedro River watersheds are presently moving through the CWA and NEPA regulatory processes. Of these two watersheds, the upper San Pedro has an existing rich dataset of habitat and land-use geographical information and is likely to face acute environmental crises related to ground and surface water resources and habitat conservation over the next 20-50 years. EPA Region 9, EPA ORD Landscape Ecology Branch, and USDA Agricultural Research Service will perform a pilot project in the San Pedro River watershed to support improvement of federal environmental analyses pursuant to NEPA and CWA Sec. 404. Using GIS tools, the demonstration study will analyze alternative development options relative to their impact on surface-water conditions (*e.g.*, surface runoff and sediment yield) and potential habitat for selected species. Hydrological outputs and predicted habitat changes will be estimated for the baseline year 2000 using the Southwest Regional GAP Analysis Project spatial information. Watershed condition in 2020 will then be extrapolated as a demonstration of how new geospatial modeling tools can be used to evaluate impacts associated with urban growth patterns on surface-water hydrology and biodiversity. The project is scalable, and if successful would be exported to analyze the ~100,000-acre development envelope presently planned for the lower Hassayampa River watershed.

# ENVIRONMENTAL STEWARDSHIP

Region 9 has been on the forefront of identifying several emerging environmental contaminants over the past several years and has been an active voice for pollution prevention. Identified below are science concerns associated with better identifying emerging pollutant concerns and development of safe, non-toxic alternatives to hazardous chemicals.

## ENVIRONMENTAL STEWARDSHIP PRIORITY SCIENCE NEEDS

### Identify Alternatives to Chlorinated Solvents and Ways to Reduce Use of Chlorinated Solvents Improved Process for Identifying, Prioritizing and Addressing Emerging Pollutants

**Background:** Over the last century many chlorinated solvents have been developed and their usage has become ubiquitous. Unfortunately, vast amounts of these solvents have been released to the environment. Because of the known toxicity of chlorinated solvents, it would be environmentally beneficial to develop non-halogenated alternative solvents to replace existing chlorinated solvents. While many chlorinated solvents are highly effective, they have three significant disadvantages: they are 1) more toxic, 2) more persistent in the environment, and 3) in general, much more difficult to remove from soils and ground water than their non-halogenated analogue compounds. .

**What is needed:** More basic research into alternatives to chlorinated solvents, educational and/or training materials necessary to promote the alternatives and encourage users to switch from the chlorinated solvent to the alternative solvent, and outreach strategies to affect the changeover to alternative solvents is needed.

### Improved Process for Identifying, Prioritizing and Addressing Emerging Pollutants

**Background:** Over the last three decades a number of new contaminants have emerged to become significant health and environmental concerns. Among these are MTBE, perchlorate, 1-4 dioxane, PCBs, dioxins/furans and brominated flame retardants. This phenomenon is the result of advances in knowledge about contaminants and their effects, new chemicals, and new applications of “old” chemicals, as well as improvements in the amount and kinds of information that is readily available. Given the history of newly emerging pollutants, we can anticipate that there will always be new pollutants of concern that will need to be addressed. Work needs to be done to develop more efficient methods to quickly identify and address these emerging contaminants so that regulators are no longer placed in the position of having to make important decisions about usage with minimal health effects and exposure information. A more efficient system is needed to identify significant contaminants of concern, prioritize their significance, and gather exposure and health effects data.

**What is needed:** Develop more effective ways to identify and monitor significant environmental contaminants as part of a more formalized “early warning system”. Develop more efficient ways to identify health threats, exposure pathways and gather toxicological data on compounds that are being released in significant quantities. The goal should be rapid identification and prioritization of high risk chemicals, and the funding of key studies. While there are programs to compile and evaluate information on compounds being released to the environment, their efficiency needs to be improved. Try to identify patterns that could allow compounds to be addressed by groups/categories (and even standard mixtures) instead of individually.



## Activity on Chlorinated Solvent Alternatives

### **Viability Alternatives to Chlorinated Solvents Workgroup for the National Regional Science**

**Council** – Regional staff are working with this NRSC workgroup. Several ORD computer programs exist which may help Regions identify alternatives to chlorinated solvents. Discussions are underway to determine how best to determine which approach may work best and transfer the appropriate techniques to the Regions.

## REGION 9 SCIENCE SUPPORT

### Region 9 Science Staff:

EPA’s science staff is a core resource to the successful accomplishment of the Agency’s mission. Of the 875 positions currently in Region 9, there are 285 scientist and engineer positions. These 285 positions are divided among 8 job series as follows:

Environmental Scientists	129
Environmental Engineers	117
Life Scientists	24
Toxicologists	5
Chemists	7
Geologists	0 (4 Hydrogeologists included in Env Sci)
Cartographers (GIS)	1
Industrial Hygenists	2

### Regional Science Council:

The Regional Science Council (RSC) is part of a network of RSCs across the Regions. The RSC provides focused leadership on science in Region 9 to strengthen science resources available to Region 9 and to expand the science knowledge of staff in the Region. The current RSC program representatives are as follows:

Co-Chairs:	Jan Baxter Allan Ota
Management Science Lead:	Tom Huetteman
Air Division:	Sean Hogan, Periann Wood
Communities & Ecosystem Division:	Debbie Lowe
Regional Laboratory:	Brenda Bettencourt Christopher Cagurangan
QA Program:	Carl Brickner Eugenia McNaughton
Science Advisors:	Jan Baxter Bobbye Smith (RSL) Winona Victory
Water Division:	Allan Ota
Waste Division:	Mary Blevins Matt Small
Superfund Division:	Harry Ball Mike Gill (HSTL)

**Region 9 Laboratory Program:**

The Region 9 Laboratory in Richmond, CA is a full service, state-of-the-art facility specializing in chemical analysis, biological analysis and field sampling services. The laboratory performs more than 10,000 analyses a year of air, water, soil and biota samples (avian, fish and occasionally mammalian tissue).

**Quality Assurance Program:**

The Region 9 Quality Assurance Office's primary mission is to effectively oversee and carry out the EPA Region 9 Quality System and Quality Management Plan, and project-level quality assurance and quality control (QA/QC) activities. The Office's primary responsibilities include providing training and information on data quality; conducting Quality System oversight of EPA Regional programs, grantees (states, tribes and locals), contractors, other federal agencies, and the regulated community; conducting project level QA/QC oversight; providing QA and technical support to Regional Programs, States, Tribes, and local governments; and carrying out programs to ensure quality laboratory testing.