

COMMUNITY OUTREACH CORE

Integrating Superfund Science and Traditional Environmental Knowledge:
A Tribal Regional Workbench Approach

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DESCRIPTION: State the application's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the application. If the application is funded, this description, as is, will become public information. Therefore, do not include proprietary/confidential information. **DO NOT EXCEED THE SPACE PROVIDED.**

Community Outreach Core

*Integrating Superfund Science and Traditional Environmental Knowledge:
A Tribal Regional Workbench Approach*

The Community Outreach Core is an environmental justice project involving the communication and sharing of SBRP-generated knowledge and tools with Tribal communities affected by hazardous waste sites and toxicants. We will use a Tribal Regional Workbench approach to enabling equitable environmental stewardship of Indian Reservations. The broad objective is to shift the emphasis from risk assessment as a disease paradigm to risk assessment as a wellness paradigm that embraces Tribal Traditional Lifeways. This new approach is identified as a high priority by the U.S. EPA's National Tribal Science Council, the National Tribal Environmental Council (NTEC), and Tribal environmental protection agencies. We will directly collaborate with Tribal communities both locally: (a) the Campo Indian Reservation, part of the Kumeyaay Nation; (b) the Tribal environmental lab located at the Twenty-Nine Palms Band of Mission Indians, and nationally: (c) the Superfund Project Group of NTEC. These communities include prominent Tribal scientists who will help us create a unique Tribal information system that will be called the Tribal Regional Workbench (modeled after the UC San Diego's SBRP Regional Workbench). The Tribal-RWB will be developed as a forum and an ensemble of datasets and information and knowledge integration tools to support online analysis, visualization and communication of environmental justice and quality of life issues explored within the Core's collaborative projects. The Community Outreach Core has five aims, grouped into two broad categories: (1) Communication and Environmental Justice, and (2) Knowledge Systems Integration. Specific aims include (1) (a) to build a Tribal Regional Workbench Web site; (b) to share SBRP-generated knowledge and tools; (2) (a) to host a regional gathering of tribal leaders and scientists; (b) to facilitate training opportunities for graduate and undergraduate students; and (c) to co-author a series of papers, articles, and other publications with Tribal partners.

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KEY PERSONNEL. See instructions. Use continuation pages as needed to provide the required information in the format shown below. Start with Principal Investigator. List all other key personnel in alphabetical order, last name first.

Name	Organization	Role on Project
Pezzoli, Keith, Ph.D.	UCSD, Urban Studies	Core Leader
Marciano, Richard, Ph.D.	San Diego Supercomputer Center	Co-Investigator
Pellow, David, Ph.D.	UCSD, Ethnic Studies	Co-Investigator

Community Outreach Core's Relationship to the Overall Program

The Community Outreach Core (COC) is designed to communicate the knowledge and findings from the SBRP with scientists and community leaders in Indian country for the purposes of facilitating their own efforts to locate, assess and remediate environmental hazards. An environmental justice approach to toxics in Indian country necessitates developing practices that document pollution and empower those populations most affected to pursue appropriate solutions. The ultimate outcome would be the strengthening of research methodologies in tribal communities and universities for the improvement of ecological and human health. Through collaborative/participatory research methodologies, the COC will analyze, categorize, present, and publish data from the SBRP integrated with data gathered from tribal authorities, scientists, and experts in Traditional Environmental Knowledge (TEK).

The COC team will work closely with the Research Translation Core (RTC) in applying aspects of UC San Diego's SBRP research on molecular mechanisms and models of exposure. By providing compelling (regionally significant and interesting) cases for field application, the RTC and COC together will stimulate interaction among the SBRP's projects and research support cores. To maximize this interaction, each SBRP project has been assigned to one or more of three categories targeted for research translation and community outreach: (1) Molecular biomarkers; (2) Biosensors/microtechnology; and (3) Bioremediation. Each of these categories has a well-defined set of prospective applications. Collectively, in face-to-face meetings over a several month period, our SBRP scientists defined these categories and mapped them to their prospective applications. A complete list of all SBRP projects and targeted applications is provided in the RTC section of this grant. All of the SBRP scientists have agreed to help meet the following overarching aims of the RTC and COC as an integrated whole: (1) Partnering with government agencies (applying toxicogenomic knowledge and biomolecular technologies to environmental monitoring, risk assessment, and watershed management); (2) Technology transfer (moving SBRP research from bench to demonstration to commercialization); and (3) Communicating with broad audiences (facilitating public participation and environmental justice in sustainability science). The COC builds upon and extends the work of the RTC by concentrating on the particular needs of Tribal Communities. As such, the COC serves as a rallying point for our efforts to think through and apply principles of environmental justice in the linkage of science to policy, planning, and sustainable community development. Together the RTC and COC provide real-life circumstances that will invite new ways for scientists to communicate and collaborate in the applied aspects of their work.

Community Outreach Core Plan

The Community Outreach Core is an environmental justice project involving the communication and sharing of SBRP-generated knowledge and tools with Tribal communities and organizations affected by hazardous waste sites and toxicants. The effort will take place primarily in the USEPA's region 9. Working with the SBRP and the Research Translation Core, the COC will share cutting edge science on chemical exposure and remediation technologies with tribal leaders. The real goal is to "*shift the emphasis from risk assessment as a disease paradigm to risk assessment as a wellness paradigm embracing tribal traditional life ways.*" (based on a personal communication from Dr. Bobby Smith to Keith Pezzoli. -- Smith is the EPA Region 9, Regional Science Technical Liaison to the Office of Research and Development (ORD) and co-Chair of the EPA Tribal Environmental Science Council). Together with our tribal partners, we will integrate these data with TEK in the form of graphic/visual and printed media for 1) use in workshops and a conference and 2) dissemination among policy experts, scholarly audiences, and the general public. From the outset, the Tribal communities will collaborate in the core's design and approach. We will directly collaborate with Tribal communities both locally: (a) the Campo Indian Reservation, part of the Kumeyaay Nation, (b) the tribal environmental lab located at the Twenty-nine Palms Band of Mission Indians, and nationally: (c) the Superfund Project Group of the National Tribal Environmental Council (NTEC). These communities include prominent

Tribal scientists who will help us create a unique Tribal information system, we are calling Tribal Regional Workbench (modeled after the UCSD Regional Workbench):

(a) Campo Indian Reservation. Main contact: Mike Connolly. Campo is the southernmost Reservation in San Diego County and shares ties with ancestral Kumeyaay communities now in Mexico. San Diego County has more Indian Reservations than any other county in the United States (see Figure 1. for a map of the Kumeyaay Nation). Connolly is the head of Laguna Resource Services, a prominent environmental consulting firm engaged in tribal environmental projects around the U.S. He is a national Native American environmental leader with over 13 years of environmental program management and consulting experience. He assists tribes in developing environmental programs and completing deliverables under their programs. His work includes the preparation and review of Environmental Assessments for a wide range of projects including waste facilities, gaming, housing, rights-of-way and health care facilities. Connolly is the former Director of the Campo EPA (one of our cases). He will serve as a technical liaison bridging our Community Outreach Core directly with the Campo Indian Reservation as we collaboratively develop a prototype (for the Campo Indian Reservation) of the Tribal Regional Workbench.

(b) Twenty-nine Palms environmental lab. Main contact: Dr. Marshall Cheung. This is the only State-certified tribal water lab in EPA Region 9. Created by the Twenty-nine Palms Band of Mission Indians, near Coachella in Southern California, this lab, led by EPA Coordinator Dr. Marshall Cheung, has received over one million dollars from EPA grants since 2000 and provides valuable services to Tribes throughout California. One of Dr. Cheung's specialties is technical work with biomolecular tools, so he will also be interacting with the Research Translation Core. We wish to enlist his wisdom and experience in crafting a Tribal Regional Workbench, including ideas concerning traditional tribal life ways and the intersection of Tribal science with Western science.

(c) National Tribal Environmental Council (NTEC). Main contacts: David Conrad and Lisa Gover. Conrad is the NTEC Director. Gover is the Superfund Project Manager for NTEC. NTEC was formed in 1991 as a membership organization dedicated to working with and assisting tribes in the protection and preservation of reservation environments. NTEC membership is open to federally recognized tribes throughout the United States, and currently has 108 member tribes. Gover is a Pawnee/Comanche. She will serve as a technical liaison bridging our Community Outreach Core with the NTEC Superfund Working Group. She is an expert in working with tribal, federal, state, local and international agencies concerning tribal government issues in subjects including Superfund/NPL sites, federal facilities, international environmental and human rights issues, water rights, tribal government gaming, welfare reform, and Tribal science. Gover will help lead the creation of the Tribal Regional Workbench, including the establishment of a searchable on-line database on phytoremediation and other technologies stemming from the "new biology" revolution in the environmental health sciences.

While NIEHS has funded several exposure and disease related studies that target American Indian groups [1], [2], our goal is to contribute to a shift in risk assessment away from a disease paradigm toward a wellness paradigm. This will require embracing the cultural content of Tribal Traditional Life Ways and a more holistic approach and access to Traditional Environmental Knowledge. Our five-year strategic plan will foster a Tribal Regional Workbench approach to enabling equitable environmental stewardship of Indian Reservations. This collaborative effort will link the SBRP Translation Core at UCSD to (a) local tribal communities, tribal labs, and tribal scientists, (b) transborder tribal networks, (c) regional and national tribal networks, (d) environmental justice networks.

Some of the technical assistance programs we will link to include the EPA Office of Environmental Justice, EPA Office of Pollution and Prevention and Toxics (OPPT) Tribal Program, and the ATSDR (Division

The Communication and Environmental Justice Component of the SBRP at the University of California, San Diego will feature innovative methods for community outreach and risk communication, with regard to environmental hazards in Indian country in USEPA’s Region 9. Through web-based technologies and face-to-face interactions at workshops in the region, investigators will translate and make available SBRP-generated data, maps, and tools for tribal communities and do the same with data and stories generated from tribal sources. The goal is the dissemination of critical data on Superfund-related toxic hazards and their impact on ecosystems and human health in the region among tribal leaders. The principle targets of this outreach will be leaders from Native communities in USEPA’s Region 9 (See Figure 2.). Region 9 includes Arizona, California, Hawaii, Nevada, the Pacific Islands subject to U.S. law, and more importantly approximately 140 tribal nations.

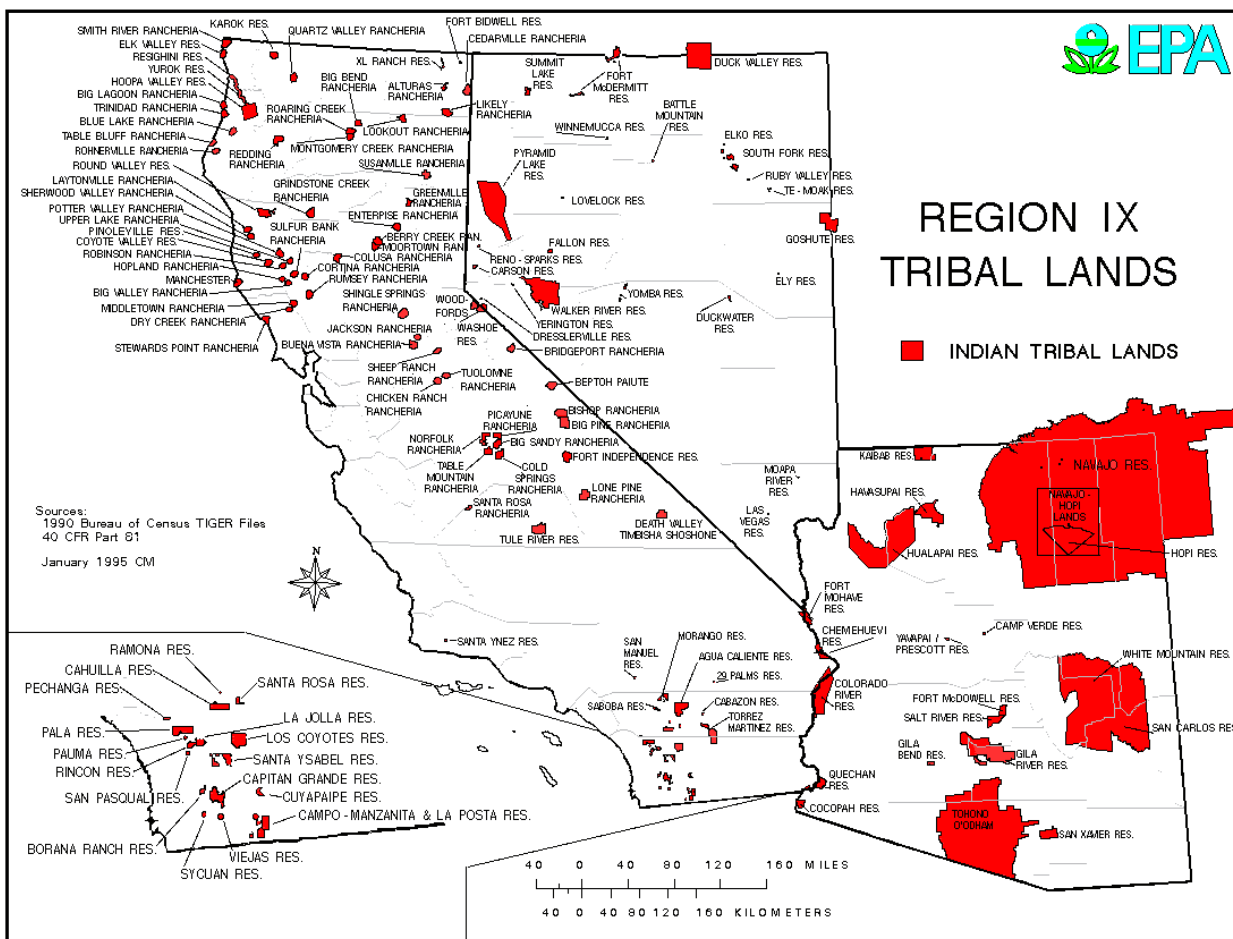


Figure 2: EPA Region 9 Tribal Lands

1] Build a Tribal Regional Workbench Web site in collaboration with the Campo Indian Reservation (San Diego County, Kumeyaay Nation), the Twenty-nine Palms Band of Mission Indians Tribal water lab, and the National Tribal Environmental Council’s Superfund Working Group to create a federated knowledge-based network for communicating data, maps, and stories in ways that effectively join cutting-edge environmental health science with tribal science, tradition, and cultural practices. The overall aim is to help build Tribal capacity to negotiate with entities of regional governance (where regional plan-making is underway to deal with hazardous waste management, water quality regulations, land conservation, economic development, etc.). This website will house a collection of studies, papers, and a range of other research documents and data files relevant to the project, making these materials accessible to all partners. The website will also feature the use of a web blog that allows for continuous and efficient communication and sharing of postings and updates among partners that are accessible, archived, and searchable. A major part of the Outreach is the need to document and

communicate the various environmental justice issues associated with Tribal communities. Specifically, Native lands are disproportionately impacted by a range of toxic facilities and pollution sources, creating a problem of environmental disparities many of these communities must confront.

One area we look forward to developing Tribal capacity is with “Tribal Master Planning”. The idea is to develop a master plan with a blending of Native American values in conjunction with Western science. The goal is sustainable development in a holistic manner for the tribes that develops and promotes new scales of economy badly needed on the reservations. Our partner in this endeavor will be Kenneth D. Bailey with the Bureau of Indian Affairs (BIA), Nashville Tennessee. Bailey has been promoting this theme to the Tribes in the Eastern, Midwest and Pacific Regions, and we propose to work with him and Campo to see how we can help develop infrastructure to help support Master Planning. This theme also connects with earlier work on Regional Planning Chronologies, where we looked at innovative ways to make use of information technology to provide integrated views of regional planning history (see section C 2] Progress Report).

2] Share SBRP-generated knowledge and tools for exposure monitoring, risk assessment, and environmental restoration (e.g., new methods of testing for toxicants in water/soil/sediment samples and phytoremediation) with Tribal communities affected by hazardous waste sites and transboundary flows of toxicants (including across the U.S.-Mexico Border). Interactively share SBRP-generated knowledge and tools for detecting, assessing and minimizing the effects of exposure to toxic substances.

Over the five-year grant period, we would like to host a series of university-tribal workshops focused on the San Diego-Tijuana city region, U.S.-Mexico border, and tribal lands in close proximity to Superfund sites nationwide. We will work with Tribal leaders and scientists to demonstrate and evaluate the practical utility of biomarkers, biosensors (biomolecules/nanoparticles), bioremediation, phytoremediation and model transgenic organisms (yeast, mice, plants, cell-based) as novel systems for improving exposure assessment, risk assessment, environmental monitoring and restoration. These regional workshops will improve the Tribal community's awareness and understanding of biomarkers, bioremediation and environmental health issues in ways that are sensitive to traditional and cultural practices. This will involve UCSD faculty as well as partners from the USEPA Office of Environmental Justice; EPA Border 2012; Environmental Justice Resource Center at Clark Atlanta University; Indigenous Environmental Network; Agency for Toxic Substances and Disease Registry (ATSDR) Office of Tribal Affairs (OTA); EPA Office of Prevention, Pesticides, and Toxic Substances (OPPTS); EPA Office Pollution Prevention & Toxics Tribal Environmental Network; and the Forum on State and Tribal Toxics Action (FOSTTA). The goal is to develop stronger tools for documenting the sources of environmental hazards in Indian country and targeting them for remediation. This is a critical resource because Native peoples in the U.S. have a greater likelihood of living near uncontrolled toxic waste sites and other ecologically compromised sites. This is illustrated in the Figure 3. where we examine the proximity of Superfund sites to Tribal Lands.

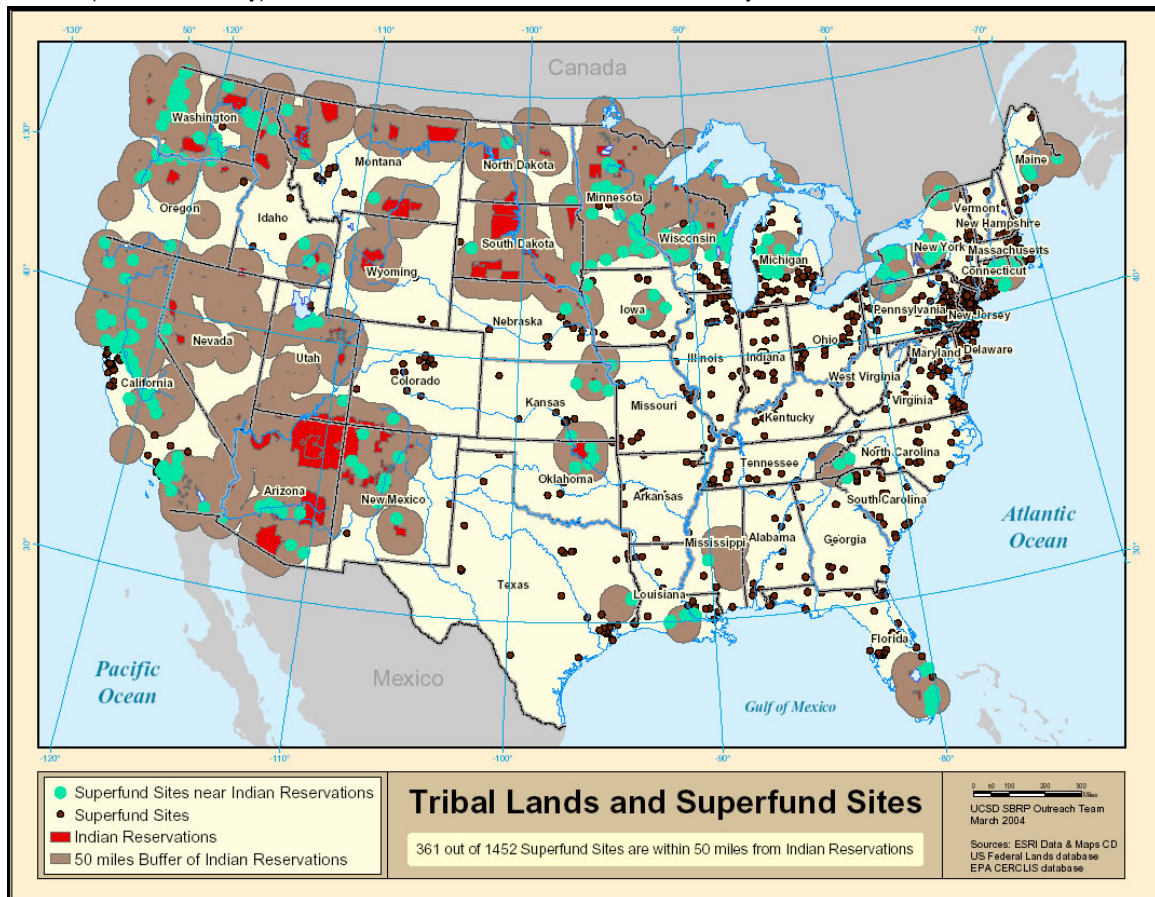


Figure 3: Superfund sites within a 50-mile buffer of Tribal Lands

A2] Knowledge Systems Integration Component

The Knowledge Systems Integration Component is a fresh approach to the age-old problem of conflicting and contrasting cultural worldviews between Western and Tribal experts over questions of science. The broad goal of this component is the integration of Western science and traditional environmental knowledge systems. Specifically, investigators will facilitate the development and dissemination of data and the research collaboration of scientists across these cultural divides for the purposes of strengthening tribal communities' ability to engage various institutions of environmental governance.

1] Host a regional gathering of tribal leaders and scientists on the theme of "Cross fertilizing science and tribal wisdom for environmental stewardship and environmental justice." Develop a model or a set of "best practices" for knowledge production, consensus-building, collaboration, and policy-making among tribal leaders, tribal and state EPAs, and the federal EPA. Create new approaches to doing science and environmental research—new epistemologies that bridge the divide between Western science and Tribal science, or traditional Native systems of environmental knowledge (TEK).

2] Facilitate training opportunities for graduate and undergraduate students at UCSD from the Environmental Systems, Urban Studies and Planning, and Ethnic Studies programs. Students would conduct individualized or group research endeavors with Tribal partners in order to gain expertise in documenting the interface between Tribal science and university approaches to environmental assessment and remediation.

3] Co-author a series of papers, articles, and other publications with Tribal partners, in the spirit of broadly disseminating the lessons learned and the most compelling and instructive case studies and stories we gather. Integrating the medical and biological sciences, social sciences, and Tribal Science will allow for the development of new knowledge and new approaches to research and policy on environmental justice concerns. The California Cultures in Comparative Perspective (UCSD) is a partner in the SBRP and will edit a book volume on this effort.

[B] Background and Significance

In this era of high technology and global economic systems, citizens of many nations are becoming more preoccupied with environmental and technological risk. The mere mention of places like Three Mile Island, Love Canal and Chernobyl produces an imagery of toxic technology run amok and a sense of insecurity about the next unnatural disaster that may hit without warning. There is an empirical and scientific basis for these concerns. Since the end of World War II the production and disposal of toxic (i.e. poisonous) chemicals in the U.S. and around the globe has increased exponentially [3]. Increasingly, this process disproportionately impacts low-income, ethnic, and indigenous populations.

To our knowledge there is very little effort on the part of federally funded SBRP centers around the United States to examine the links between environmental toxins and tribal lands. This is a need that we can address through the UCSD SBRP initiative. Risk communication and data sharing between universities and impacted communities are critical components of environmental justice.

The Tribal Regional Workbench approach we propose, will build capacity for tribal environmental stewardship. This approach fits the EPA's emergent emphasis on the Triad Approach [4]. EPA supports the adoption of streamlined approaches to sampling, analysis, and data management activities conducted during site assessment, characterization, and cleanup. Under the name of "the Triad approach," EPA is coordinating with other Federal and State agencies to develop an organized framework of work strategies that exploit new data collection and interpretation tools and advances in telecommunications to support real-time, field-based decision making.

B 1] Communication and Environmental Justice Component

The Community Outreach Core will build a Tribal Regional Workbench website for the communication of the SBRP's basic science and environmental data relevant to our target group. During the first grant cycle, we built the Regional Workbench [5], an award-winning technology-based cyber infrastructure for data communication and policy work. During the next grant cycle we would launch the next generation of this model and tailor it specifically for Tribal environmental concerns related to Superfund toxins. The tribal regional workbench would be the anchoring mechanism for bringing partners and target group together before, during, and after the workshops we will host in the region to communicate our latest findings, data, stories, and maps.

1] The Need for Tribal Information Systems. Figure 4, is from "EPA Region 9: Progress Report 2003" [6]. The figure shows that 90% of the 146 tribes of the Pacific Southwest now have their own environmental programs, compared with only 7.5% a decade ago. Campo EPA (one of our local partners) is an example of such a program. To precisely respond to this rapid growth in tribal environmental programs, we propose to build a workbench capability based on information integration, information sharing, and visualization. This capability will address the cumulative risks and impacts tribes are now facing. We will also work with the only State-certified tribal water lab in EPA Region 9, created by Twenty-nine Palms Band of Mission Indians, near Coachella in Southern California and the Superfund Group at the National Tribal Environmental Council (NTEC).

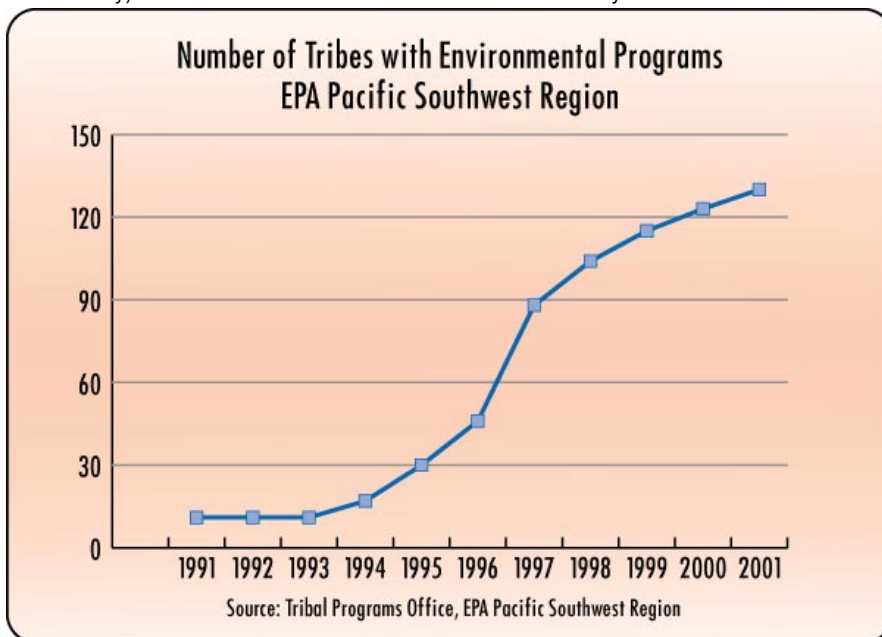


Figure 4: Increase in Tribal Environmental Programs in Region 9 over the last decade

As Tribal science has dramatically progressed and Tribal EPA programs sprouted over the last decade, the information technology infrastructure has not yet caught up. Moreover, there are no national initiatives to fund tribal technology infrastructure development per se. We propose to help build this capacity by leveraging existing work from a variety of nationally-funded technology initiatives (through the San Diego Supercomputer Center and the Regional Workbench Consortium). The Tribal information technology we propose to develop differs from other IT projects in the sense that it has to reflect the kinds of perspectives reflected in “Tribal Traditional Lifeways” [7], where health, well-being, and traditional knowledge and science come together.

What follows is a list of representative Tribal IT initiatives. Four are briefly noted below:

- Tribal GIS Systems
- TIMS :Tribal Information Management System
- INDIANnet (Tribal Information System Expansion Project)
- Tribal Knowledge Management System

(a) Tribal GIS Systems. Geographic Information Systems technology is well developed in many tribal settings. Indigenous land-use, establishing historical boundaries, and integrated resource management are common applications. Tribal GIS has been promoted through concerted efforts such as the Agua Caliente Band of Cahuilla Indians in Southern California, and through private American Indian companies and GIS Consulting services. Also, major GIS vendors have supported workshops and native GIS networks (see Tribal and Indigenous GIS [8]).

(b) TIMS:Tribal Information Management System. TIMS [9] is a web-based tool that provides a range of federal information about environmental conditions and features for the tribe of your choice. This application is provided by the U.S. EPA American Indian Environmental Office through the Indian Country Baseline Assessment Project.

EPA is integrating data management systems across all of its environmental programs. One large priority is to build a Tribal Information Management System that will measure the effectiveness of EPA programs in Indian country and assist EPA in identifying resource needs and justifying budget requests. This

system will be able to answer questions like, "how clean is the water, and what has EPA done about it?" specifically for Tribal lands.

For example, TIMS will show for a given Tribe, maps of discharges to water, superfund sites, hazardous waste, toxic releases, air releases, open dumps, underground storage tanks (Figure 5).

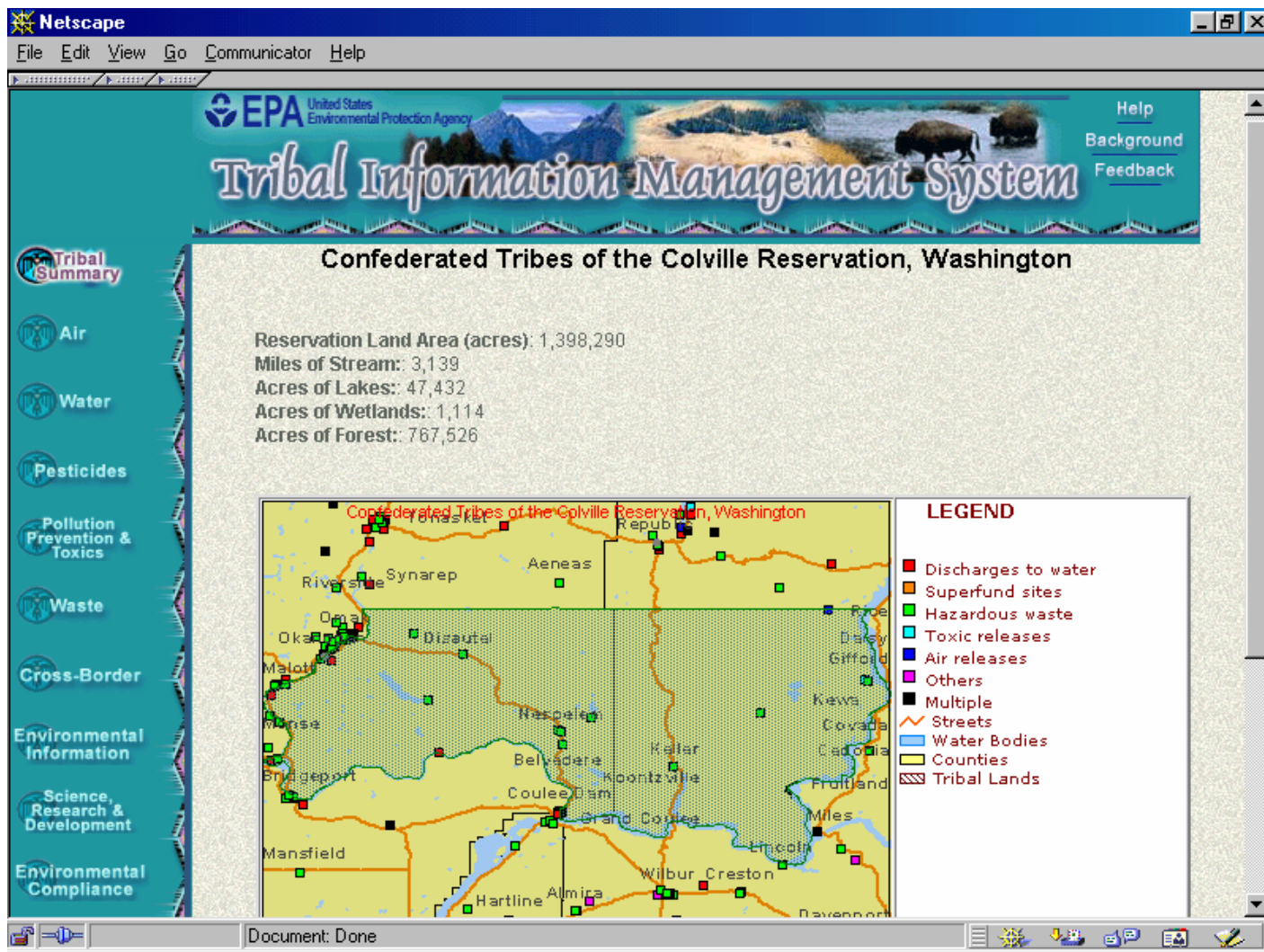


Figure 5: Tribal Information Management System (TIMS) Web Snapshot

(c) INDIANnet Tribal Information System Expansion Project [10]. The purpose of the project was to continue development of INDIANnet in order to allow tribes greater access to EPA. Mike Connolly was an EPA Advisory member to the project.

INDIANnet was a partnership for Indian Opportunity and Native America Public Telecommunications. This was an Indian-owned and operated network dedicated to establishing and developing affordable public access, computerized information, and communications services for American Indians and Alaskan Natives.

The objectives were to:

- Work with Tribal governments and all Indian communities, both urban and rural, to establish electronic access to public information.

- Develop "one-stop shopping" and Indian-friendly federal information, including 1990 Census information, necessary for effective Tribal decision-making.
- Ensure that this flow of operation is interactive so that Tribes can begin to develop electronic information about themselves.
- Work with Tribes to avoid electronic colonialism and empower Tribes and all Native Americans to be active participants in the information age.
- Help coordinate the many Indian, multi-media telecommunications activities currently taking place.
- Establish an Indian on- and off-ramp to the national information highway.
- Use technology for cultural preservation and education.

(d) Tribal Knowledge Management System. This is a typical example of a commercial venture [11]. This Encyclopedia effort called Tulalip and was designed to serve as a central repository for the Tribes' business, cultural and historical data. The system proposed is a content management system allowing the storing and organizing of historic documentation, photographs, video archives, recorded conversations with Tribal elders, and instruction in teaching and learning the Tribes' Lushootseed language.

2] The Need for Tribal Information Systems to Support Environmental Justice

Since the early 1970s, research has demonstrated that a community's racial composition was the best predictor of where hazardous waste sites would be located in the U.S., prompting the use of the term *environmental racism* to characterize these disparities. Scholars and policy makers quickly began to call for legislation to ensure *environmental justice*—the protection of all populations against environmental inequities.

Environmental justice concerns are particularly acute for tribal communities in the United States and globally. In the landmark study of the relationship between demographics and hazardous waste, researchers at the United Church of Christ found that 50% of Native Americans live in close proximity to one or more uncontrolled hazardous waste sites [12]. A host of other studies document the relationship between Native American communities and culturally devastating and ecologically harmful resource extractive practices by multinational corporations continues across the continent [13][14][15]. In a more recent empirical study, two sociologists found significant correlations between the location of Native reservations and known clusters of unexploded ordnance (UXO), other toxics, and the location of military bases [16]. This should perhaps come as no surprise given that tribal lands throughout the Americas and the Pacific have been repeatedly designated as sites for weapons testing by the U.S. military [17][18][19]. San Diego County is no exception. In addition, routine forms of urban planning, development, and sprawl are impacting Native communities, particularly in California. Figures from the "California Farmland Conversion Report, 1998-2000" indicate that urban development increased by 30% during this period, by comparison to the 1996-1998 period. More than 90,000 acres of rural lands were 'converted' to urban spaces during this time [20]. These dynamics produce stresses on Native lands, in the form of increased multi-media pollution and pressure to allow certain developments to locate on or nearby such lands.

Indian reservations present unique challenges for applying the principles of environmental justice. As defined by the USEPA, environmental justice means "The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." [21] The "fair treatment" component of the term means that "no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal and commercial operations or the execution of federal, state, local, and tribal programs and policies." [22] This definition includes Indian tribes because 1) tribes are minority groups that tend to be disadvantaged in socioeconomic terms (and therefore one of the populations the agency's programs seeks to protect from

disproportionate harm) and 2) tribes are sovereign governments, with the power and responsibility to carry out environmental protection programs. Thus, the challenges of environmental justice for Indian tribes are two-fold, which are discussed below.

First, Indian reservations tend to generally fit the definition of “environmental justice communities.” They are comprised of minority populations and tend to be socially and economically disadvantaged. Many reservation communities have suffered disproportionate impacts to their environments, some of which are the long-term impacts of “development” activities that occurred years or decades ago. Other reservation communities face the prospect of environmental degradation that would result from proposals intended to create jobs and generally improve socioeconomic conditions. Given the rural nature and broad geographic area of many reservations, the very idea of sharing the message of environmental justice to residents on some reservations is a particular challenge [23].

Second, Tribal governments are developing their own environmental programs. Federal environmental laws authorize tribes to operate regulatory programs similar to those administered by the states. The tribal provisions in the federal laws were not enacted, however, until a decade or two after the laws authorizing state programs. The neglect of Indian reservations by Congress in the first generation of federal environmental laws has resulted in less environmental protection infrastructure in Indian country (which can itself be an environmental justice issue). In recent years, many tribes have chosen to establish regulatory programs like those of the states, but they face enormous challenges, in part because tribes generally do not have non-federal sources of revenue for governmental operations comparable to the states.

Thus it is clear that Native communities face disproportionate environmental impacts and these populations require critical resources to meet these challenges. Tribal information systems can be a valuable tool in helping support environmental justice.

B 2] Knowledge Systems Integration Component

The Community Outreach Core will host a regional conference in order to formalize a conversation regarding the integration of Western scientific (and academic) knowledge and Tribal science concerning ecological harm and restoration. These workshops will bring together authorities on the subject from around the region and nation. Following this event, Core investigators and partners will facilitate the implementation of a research and training program involving university students documenting the points and possibilities for integration between these knowledge systems. During years 4 and 5, partners will collaborate on a series of papers, articles, and a book for publication and dissemination in print and electronic media. This will also involve the production of a DVD/CD that documents the process of integration through the use of data, maps, and stories in a culturally sensitive and rigorous fashion.

Research on the differences between traditional/indigenous knowledge systems and Western science has begun to move in the direction of integration. One scholar wrote two decades ago that "...the process of opening Western knowledge to traditional rationalities has hardly yet begun" [24]. But policy makers and indigenous leaders today concur that this integration is necessary for the development of any serious systematic effort to remediate existing (and to prevent future) ecological harm to indigenous populations. Canada's former minister of the environment wrote: "Our task is to integrate traditional knowledge and science." [25].

The lack of common understanding about the meaning of traditional knowledge is frustrating for those who advocate or attempt in practical ways to recognize and use traditional knowledge. For some, traditional knowledge is simply information that aboriginal peoples have about the land and animals with which they have

a special relationship. But for aboriginal people, traditional knowledge is much more. One elder calls it "a common understanding of what life is about" (ibid).

Western science has been defined as a systematic methodological approach to answering questions about the world. Science is equated with knowledge, and it is the development of knowledge that promotes the solution of problems. Aboriginal knowledge systems, particularly traditional environmental knowledge (TEK) are also systematic methodological approaches to answering questions. Traditional knowledge is the accumulated knowledge and understanding of the place of human beings in relation to the world in both an ecological and spiritual sense [26]. The integration of Western science with TEK must be a mutually beneficial and respectful enterprise: "Native people must be, and indeed want to be, involved. Traditional knowledge *is* science, and the sooner ... scientists make use of that traditional knowledge, the better it will be for their research" [26].

Western scientists are becoming more interested in indigenous knowledge systems in general and in Traditional Environmental Knowledge (TEK) in particular, when it concerns ecosystem protection and management. Scientists have demonstrated in case after case that, Native peoples "who have spent a large part of their life on the land possess as much (if not more) information about wildlife and fisheries ecology as western scientists" [27].

For example, the USEPA's current method of identifying and screening contaminated sites does not take into account tribal cultural knowledge or values. That approach must change, and the Outreach Core intends to provide an effective model of the integration of TEK and Western science. Specifically, the current Hazard Ranking System (HRS) the USEPA employs for listing sites on the National Priorities List (NPL) uses a mathematical scoring model that does not account for conditions that are often found in Indian country. Therefore these models do not accurately capture or reflect the level of risk that most Native populations face. First, most tribal lands are sparsely populated and therefore do not constitute large enough target populations to qualify for the HRS. Second, tribal populations make different use of natural resources when compared to non-tribal (largely metropolitan) populations. Tribal residents may use natural resources for medicinal, ceremonial, and subsistence living (fishing, farming, ranching) purposes, involving entirely different degrees of exposure to potential hazards. Incorporating these sorts of cultural realities from tribal lands will allow scientists and tribal leaders to construct risk models that more accurately reflect the true exposure pathways and level of risk to these populations, more and will better inform efforts to identify, screen, and prioritize sites for clean up. Integral to this process is a concerted effort to integrate public participation from impacted populations. This gap in knowledge at the EPA provides a major opportunity for the UCSD SBRP to intervene.

A knowledge systems integration approach would build on the growing popularity of university-community research collaborations [28]. Many scholars and community advocates are teaming up around the nation to do better science and policy relevant research collaboratively. Environmental justice offers an ideal terrain for this kind of union. For example, recent research on air quality and health in the Los Angeles Basin demonstrates the valuable role that university-community partnerships can play in generating scientifically valid research that can disentangle the complex causal linkages between disproportionate exposure to environmental hazards and the decline in the health and well-being among the poor and people of color in Southern California [29].

As a representative from the Centers for Disease Control and Prevention recently noted, two of the most powerful arguments in favor of community-university research collaborations are: 1) that this methodology will improve the *relevance* of scientific research and 2) it will improve the *quality* of research done on any given topic [30].

The UCSD Community Outreach Core will build on the rich history of university-community collaborations by pushing the state of the art in that area of inquiry much further. That is, rather than simply producing joint research endeavors and leaving it at that, we intend to problematize and explore the reason for the gaps between Western and Tribal science in order to bridge those gaps and bring these two epistemologies together.

This component of the Core fits nicely with recent developments at the Cal/EPA. In August 2003 the Agency published the draft strategic framework for incorporating environmental justice principles into their activities. The following month, the agency adopted a number of key goals concerning environmental justice in the state of California, including:

- ensure meaningful public participation and promote community capacity building to allow communities to be effective participants in the environmental decision-making process
- integrate environmental justice into the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies
- improve research and data collection to promote and address environmental justice issues related to the health and environment of communities of color and low-income populations

[C] Preliminary Studies/Progress Report

The UCSD SBRP Outreach Core consists of partnerships with key participants from local, transborder / regional and national tribal networks. We have already identified one or more partners in each of these areas. Over the last several months we have met with most of these partner organizations and worked collaboratively to develop the parameters and goals of the project. The aims of the Outreach Core are congruent with the missions of each partner organization and we have also included select letters of participation. The number of partners and modes of collaboration will vary on what additional funds we obtain, above and beyond this grant, as we will be seeking additional funds to add more functionality to make additional goals happen. This segment consists of 2 sections, C1] preliminary list of Outreach Core Partnership Networks (which includes partners who have committed), and C2] a preliminary list of relevant projects and related activities.

C1] Community Outreach Core Partnership Networks

The Community Outreach Core effort will link the SBRP Research Translation Core at UCSD to (a) local tribal communities, tribal labs, and tribal scientists, (b) transborder tribal networks, (c) regional and national tribal networks, and (d) environmental justice networks. A list of potential partners we expect to interact with during the course of the project is sketched below.

Other than the SBRP Research Translation Core network partner (Keith Pezzoli, RTC co-PI), we expect to work with local Tribal Communities, Labs, and Scientists. These include the Campo Band of Kumeyaay Indians EPA, Mike Connolly and Associates in particular, with Phil Green, Campo EPA. Mike Connolly is the former director of the Campo Environmental Protection Agency. His background includes 12 years in industry, including senior manufacturing and industrial engineer positions for aerospace, as well as 13 years of environmental program management and consulting. His education includes a bachelor's degree in manufacturing engineering. He assists tribes in developing environmental programs and completing deliverables under their programs. He currently works on a part-time basis for the Campo Band of Mission Indians and provides consulting services through Laguna Resource Services, Inc. This also includes the Environmental Lab at Twenty-nine Palms Band of Mission Indians, headed by Dr. Marshall Cheung. "The Twenty-nine Palms Band of Mission Indians in Coachella, California has developed a state accredited environmental laboratory that has been providing a much needed service to tribes throughout southern California and beyond. The lab, which has separate departments for microbiology, organic and inorganic

chemistry and pesticides analysis, includes an aggressive quality assurance program to ensure accuracy and integrity. The tribe also has signed a resolution that designates all funds received from laboratory analysis to be redirected to the environmental program for further development and implementation of the tribe's environmental programs. The tribe's leadership in the laboratory and quality assurance arenas has made a positive contribution to protecting the environment. Under the leadership of tribal EPA Coordinator Marshall Cheung, the Twenty-nine Palms Band of Mission Indians Laboratory has become a model facility. Last year, the model laboratory was honored with an award from EPA Region 9 as part of its 2001 Pacific Southwest Environmental Awards Ceremony in San Francisco." [31]. Another critical partner in the Community Outreach Core will be the Tribal Digital Village (TDV), a multi-Tribal network organized around data sharing via cyber-based portals and communication systems that model ancient native information exchange networks. The TDV might serve as the Tribal "mirror" for the university-based division of the project. Given that the infrastructure is in place at both UCSD and the TDV, this might make for a great partnership.

Among the Transborder Tribal Networks, we will work with SanDAG and their Borders Coordination: Tribal Governments Projects [32]. Rebecca Davis is their Associate Regional Planner. The Borders Chapter of the Draft Regional Comprehensive Plan discusses tribal government planning and coordination issues, and includes goals, policy objectives and actions focused on improving communication and collaboration with tribal governments in areas of regional importance such as economic development, transportation, housing and water supply. The RWBC also participates in her pending "environmental justice" program. Other very interesting networks we may interact with include the Border 2012 Tribes [33], under Dr. Eugenia McNaughton, Environmental Scientist, WTR-4 Region 9. Another group is the Cal/EPA Border Environmental Program and Tribal Lands [34]. There are twenty-six Tribes located on the California side of the border with Baja California, Mexico, in an area that extends approximately 136 miles from west to east and 62 miles north and south of the international boundary. Some of these Border Tribes have land that extends beyond the California/Mexico border into Baja California. Many of the Tribal lands have existing and/or emerging environmental programs in southern California and within the defined border region. The focus of Cal/EPA's Border Environmental Program is to address pollution issues in a multimedia approach that includes the participation and communication of all impacted communities, including Tribes. The Border Environmental Program seeks to protect the environment, conserve natural resources, and benefit the public's health. Finally, there are other relevant activities going on in the EPA Border 2012 – Tribal Border Caucus Meeting [35]. This group is trying to (a) establish Tribal leadership, participation and organization in the Border 2012: U.S.-Mexico Environmental Program, (b) integrate Tribal environmental border issues into the Border 2012: U.S.-Mexico Environmental Program, (c) Implement a Tribal outreach program to increase and ensure participation of Mexican Tribes in the border workgroups, regional workgroups and taskforces, and (d) develop a structural and concise system of engagement with border partners from both U.S. and Mexico: tribal, federal, state, local entities.

Of the many regional and national Tribal networks, we will interact with the National Tribal Environmental Council (NTEC) and work with Lisa Gover, NTEC Superfund Working Group Director. Most federally recognized tribes have little involvement with the Superfund program and therefore this group strongly encourages capacity building toward that end. To achieve this goal this working group recommends that tribes facing Superfund issues gain greater access to training and technical support. The training component includes the development of courses modified to incorporate tribal perspectives and the technical support component includes enabling tribes to identify, screen, and prioritize potentially contaminated sites. The UCSD Community Outreach Core proposes to do exactly that with the Campo Reservation in San Diego County. Currently, very little site discovery occurs in Indian country, so it is almost certain that the universe of contaminated hazardous waste sites is much greater than currently estimated. A further recommendation the working group makes is that tribes be given access to alternative cleanup methods for sites that cannot be addressed under the Superfund program. Again, through phytoremediation and biomarker technologies, the

UCSD COC will address these specific approaches. UCSD SBRP Research Translation and Outreach Core investigators were invited to make a presentation at their annual conference in April 2004. Other groups include the Tribal Environmental Science Council & Science Technical Liaison to the Office of Research and Development (ORD). This effort is led by Dr. Bobbye Smith, USEPA Region 9, Regional Science Technical Liaison to the Office of Research and Development (ORD) and co-Chair of the EPA Tribal Environmental Science Council. Another interesting group is the EPA Pacific Southwest Tribal Program Office, led by Michele Dineyazhe, Environmental Scientist, assisting Nevada and California tribes with developing and maintaining environmental protection programs, and resource for tribes. Another prominent group is the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR has launched an Office of Tribal Affairs. One of this office's major goals is to "Ensure ongoing communication with tribal governments, communities, and individual tribal members to define concerns about possible health impacts from exposure to hazardous substances." We are currently in conversation with this office to develop a partnership for the UCSD SBRP. Other interesting groups include the Forum on State and Tribal Toxics Action (FOSTTA). This is a partnership between the U.S. Environmental Protection Agency's (EPA) Office of Pollution Prevention and Toxics (OPPT) and State and Tribal leaders to increase understanding and improve collaboration on toxics and pollution prevention issues among the States, Tribes, and EPA. FOSTTA, created in 1991, is currently operated under a cooperative agreement with the Environmental Council of the States (ECOS) in cooperation with the National Tribal Environmental Council (NTEC). FOSTTA convenes these leaders twice each year to examine, among themselves and with Agency officials, the nature and direction of the Agency's chemical and prevention programs. In the past, FOSTTA committees or "projects" addressed chemical management, the Agency's Toxics Release Inventory, lead, pollution prevention, community-based activities, and Tribal affairs. FOSTTA members represent their own individual viewpoints on these issues, which do not necessarily reflect the official positions of their respective State or tribe. Finally, two EPA offices are would be wonderful resources. The EPA Office Pollution Prevention & Toxics (OPPT) Tribal Environmental Network [36] is meant to communicate its programs and activities and build more effective partnerships with Native American tribes in protecting and safeguarding the environment. The EPA Office of Prevention, Pesticides, and Toxic Substances (OPPTS) Tribal Activities [37] has expressed interest in consultation with Tribal Leaders as well as that Tribal input in decision-making and actions that concern Native Americans throughout Indian country.

There are also some very prominent environmental justice networks we plan on working with. The Indigenous Environmental Network (IEN) is an international network of advocates working on environmental justice concerns among native communities primarily in the Americas. Based in Bemidji, Minnesota, the IEN has played a critical role in the development of environmental justice policy for over a decade. IEN Executive Director, Tom Goldtooth, has served on the National Environmental Justice Advisory Council (NEJAC) and has researched and written a great deal on the subject of environmental policy and science in indigenous cultural contexts. Also, the USEPA Office of Environmental Justice was founded in the early 1990s in response to discussions with leading activists and scholars concerned with the US EPA's lack of a focus on this issue. Charles Lee has served as the Associate Director of this office for a number of years and is our contact there. He has collaborated with the Outreach Core PI on numerous projects over the last decade. Another very interesting group is the Environmental Justice Resource Center at Clark Atlanta University. The EJRC is the nation's premier university-based research institute on environmental justice concerns. For years, EJRC Director Robert Bullard has conducted research and published numerous books on hazardous waste, urban sprawl, transportation-related pollution, and many other critical environmental justice concerns facing communities of color across the U.S. The Outreach Core co-PI, David Pellow, has worked with Bullard and his Associate Director, Glenn Johnson, on a number of projects for many years. They specialize in consulting on university-community collaborations. Finally, the National Environmental Justice Advisory Council (NEJAC) has developed fourteen consensus recommendations in three major areas (1) community and Tribal involvement, capacity building, and partnerships, (2) more effective utilization of tools and programs, and (3) sustainable processes and products.

C2] Progress Report

In this section, we wish to illustrate sustained collaborations between Community Outreach Core (COC) PI and co-PIs and American Indian groups as well as examples of relevant technology collaboratives.

Co-PI Richard Marciano helped put together (with Mike Connolly) the Tribal History and New Technology Conference: Preserving American Indian Culture, May 12, 1999. This workshop looked at "Tools for Preserving American Indian Culture" and aimed at promoting dialogue between American Indian researchers and the local UCSD community. Planning work was conducted in conjunction with the UCSD Center for the Humanities, UCSD Center for the Study of Race and Ethnicity, Ethnic Studies Dept., Visual Arts Dept. - UCSD American Indian Faculty Staff Association, Leaders from San Diego's American Indian Community. Four panels tackled issues of (a) native landscapes in geographic information systems, (b) strategies for communication and language regeneration, (c) recording tribal archives and history through interactive technology, and (d) telemedicine and educational proposals. Also, a touring art exhibit called Tolerance Zones, Jan. 2000 to Apr. 2000, was developed. This started at the San Diego Main Public Library, and travelled to local community branch libraries (creating and showcasing the integration of demographic, economic, and historical data, including Tribal data). Participants include COC co-PI Richard Marciano, and Rosemarie McKeon, Midi Cox (economist), Poyin Tse (artist), Carrol Waymon (community activist), and Lynn Whitehouse (San Diego Public Library curator). A seminal symposium took place recently at San Diego State University, called, The Spirit of the Land Environmental Symposium [38], Feb. 13-14, 2004. Among the presenters was Mike Connolly, who gave presentations on two panels. The first panel was *Clash of Emerging Economies: Tribes, Environment and Planning* [39]. San Diego County is home to more reservations than any other county in the United States. Confronted by a rapidly growing population of over 2.5 million persons, San Diego County tribes are at the forefront of dealing with difficult conflicts over environment, economics, and the concept of "community character." Panelists explored these issues in our rapidly changing society. The second panel was called *Environmental Regulation on Reservations*. Environmental regulation on Indian lands is intrinsic to the very existence of Indian Nations. The exercise of tribal environmental regulatory authority was explored from the basis of legal authority, national policy and program implementation. Also, COC PI, Keith Pezzoli, attended and presented at the 11th Annual National Tribal Environmental Council (NTEC) Conference, Apr. 19-22, 2004, held in Myrtle Beach, South Carolina. Finally, COC PI, Keith Pezzoli, will be sponsoring the development of a video by Marc Chavez, UCSD Native Scholar (Summer 2004), where students will map pollution and toxic levels in San Diego County Tribal land regions and illustrate Tribal Science.

Relevant technology collaboratives include the Regional Workbench Consortium (RWBC) EXPO, May 29, 2003, organized by Keith Pezzoli. A broad spectrum of participants, including academic (88 people), government (34 people), community-based/non-profit (29 people), and industrial/private sector representatives (37 people) registered for the event. UCSD participation included seven departments, three programs, several Centers and Institutes, as well as library, community outreach, education and media professionals. Participants also registered from San Diego State University, four Mexican-based universities, and a host of other academic institutions in the region. Likewise there was a wide spectrum of participants from government (city council members, deputy mayor, district directors, water authorities, planners), community-based/non-profit organizations (foundations, environmental NGOs, policy studies, technology and economic development corporations), and industry (consultants, trade associations, legal services, urban and architectural design, resource conservation, environmental management). Four demos were given: (a) watershed planning support systems, (b) online interactive mapping of superfund toxicants and quality of life indicators, (c) 3D regional canvas for the Californias, and (d) regional planning chronologies. In the *Watershed Planning Support Systems* demo, we demonstrated a watershed-scale partnership that extends the information and visualization innovations of university research to a group of local and regional government agencies and private companies,

all seeking to address crucial problems in sustainable economic and regional development. The partnership's overarching goal is to work together in building an integrated watershed-based information system and set of visualization tools that can help break down barriers to effective planning and environmental management at a regional/watershed scale. In the *Toxicants and Quality of Life Indicators Online Interactive Mapping of Superfund* demo, online interactive mapping applications of the San Diego/Tijuana are shown as a means of providing democratic access to environmental and social geographic information. These applications allow citizens, researchers, and professionals to be able to build a better holistic "picture" of the current state of the entire region. The goal of this project is to provide online, user-friendly access to environmental and social data on a regional scale. It is hoped that the data provided in this project spurs community/policy change and improvement in terms of environmental justice, planning, and equity in the entire San Diego/Tijuana region. In the *3D Regional Canvas for the Californias*, we integrate a digital elevation model of land and sea floor for the Southern California-Northern Baja California region merging data from US and Mexico sources that include San Diego County, Colorado River Delta, Imperial Valley, Salton Sea, down to Ensenada, Baja California. The continental shelf and slope to the Pacific Ocean basin is included, the best available data for the regional scope is procured, and a solid terrain model of the regional canvas is constructed. Finally, in the *Regional Planning Chronologies*, we take the "long look" at equity through the official, invisible, and visionary planning histories of San Diego. We look at innovative ways to make use of information technology to provide integrated views of regional planning history. The main goal is to provide online access to primary regional historical planning sources that inform citizens, academics and community groups, as well as planners and decision-makers. Another relevant technology collaborative is the Planning Support System Development, with Rob Hutsel, Keith Pezzoli, Richard Marciano, and Jyo Purohit. This project is a collaboration with the San Diego River Conservancy, through the San Diego River Park Foundation, and the San Diego Regional Water Quality Control Board. The goal is to create a "detailed historical record" of the health of watersheds and rivers. Finally, we wish to mention the "Community Models" for Data Management [40] project. This is led by Richard Marciano, San Diego Supercomputer Center. The Persistent Archives Testbed (PAT) project is a collaboration between the SDSC and several archival institutions across the United States. The goal is to conduct case studies that test the ability to implement SDSC's Storage Resource Broker (SRB) data grid technology using a variety of archival collections. This is an optimal opportunity to test a community model for electronic records management, with archival and technological functions practically and appropriately allocated in a distributed network. These kinds of networked data sharing environments can potentially be applied to the building of a federated Tribal RWBC.

Finally, we will continue to collaborate with TELESIS. TELESIS is non-profit corporation specializing in Regional Quality of Life indicators. They have developed significant visualization and GIS capabilities that could be used to leverage our Tribal Regional Workbench approach. They have developed health-related databases for San Diego County and incorporated data from the United States Mexico Health Commission.

D. Design and Approaches

D1] Communication and Environmental Justice Component

1] Build a Tribal Regional Workbench Web site. Building on the work already completed on the UCSD Regional Workbench, this effort would involve modifying and improving the technologies used in that earlier project to reflect recent advances in information technologies to build and maintain a more effective cyber infrastructure. This project would be done in collaboration with Native leaders and would help create a network for communicating data, maps, and stories in a culturally appropriate fashion and is accessible and useful to all partners on a continuous basis. This does not mean simply disseminating Web information but rather understanding the entire eco-cultural system (people and the environment interlocked in a system) and finding ways to integrate, organize, and share knowledge. The following paper "Using Eco-Cultural Dependency Webs

in Risk Assessment and Characterization of Risks to Tribal Health and Cultures” [41], for example, discusses dependency webs to help identify the resources, uses, functions, and services associated with a resource or area that is at risk from contamination. It appears that such web-centric approaches can also lead to new ways of communicating.

2] Share SBRP-generated knowledge and tools for exposure monitoring, risk assessment, and environmental restoration. This type of communication would be done in a series of regional workshops at UCSD or other appropriate sites in Region 9. Through technology-driven presentations all major partners will have a formal opportunity to present their vision and how their expertise will facilitate the development of improvements in detection and remediation of Superfund-related environmental hazards in the region. UCSD faculty Keith Pezzoli, David Pellow, and Richard Marciano will lead these workshops.

A regional workshop might include the following sessions:

Session 1: Introduction to the UCSD SBRP

- Science
- Research Translation
- Community Outreach

Session 2: Introductions and Descriptions of All Major Partners

Session 3: Biomarkers, Biosensors, and Phytoremediation (Pezzoli)

Session 4: Data, GIS Maps, Supercomputers, Websites, and Stories (Marciano)

Session 5: Tribal Governance and Key Environmental Issues in Indian Country

Session 6: Environmental Justice and University-Community Partnerships (Pellow)

Session 7: Next Steps

- Integrating Western and Tribal Science
- Collaborative Research and Publication

D2] Knowledge Systems Integration

1] Host a regional gathering of tribal leaders and scientists on the theme of "Cross fertilizing science and tribal wisdom for environmental stewardship and environmental justice." Knowledge systems integration is becoming more popular in policy networks and academic circles, but few scholars and Tribal science leaders are actually engaged in such practices. This conference would be a follow-up to the workshop series, which laid the groundwork for the vision of bringing together the best environmental science from academia and Tribal communities to produce intellectual synergies and new directions for research and policy. Sessions in the workshop might include:

Introduction to Collaborative Research Methodologies (Pellow)

Western Science: Advances and Limitations (Pezzoli)

Tribal Science and Traditional Environmental Knowledge

Knowledge Integration as Key to Environmental Justice Policy-making (Marciano)

This would be more than a gathering and a stimulating conversation. Participants would be developing strategies for applying this knowledge to the continued efforts for detection and restoration of environmentally compromised areas in Region 9's tribal lands.

2] Facilitate training opportunities for graduate and undergraduate students at UCSD from the Environmental Systems, Urban Studies and Planning, and Ethnic Studies programs. UCSD students have shown a consistent and growing interest in the needs of communities facing environmental inequities and toxic threats. For example, many UCSD undergraduates have interned at or conducted research with various NGOs and governmental agencies focused on environmental justice concerns in the region. Students would be engaged in individual or group projects involving cooperation with Tribal scientists and NGOs to examine the points of contention and similarity between traditional environmental knowledge and Western science vis-à-vis environmental assessment and clean up. In addition to collecting excellent field-based data on the best ways to integrate these knowledge systems, we would be training future scientists for careers in universities, government, and NGOs where they would put these findings into action and test innovative questions most researchers would never think to ask.

3] Co-author a series of papers, articles, and other publications with Tribal partners. This goal follows directly from the workshops and conference, both of which deal specifically with the need for university-community collaboration and the integration of different knowledge/cultural systems. Adapting methodological approaches from the growing literature on these subjects, the partners would collaborate on publishable (on the web and in print) writings that explore the process and outcomes of these cooperative projects. Written work would focus also on the stories, case studies, visual data gathered and analyzed (maps, etc.) and eventually be published in a book.

Building on the sections above, the purpose the Community Outreach Core is to facilitate community-driven research through a collaborative framework that provides technical assistance and structured institutional support for the research needs of local tribal communities. The system will be based on a university-community partnership, linking Tribal communities and leaders with UCSD faculty and researchers, as well as graduate and undergraduate students in various field-based programs related to the relevant topics of research, thus enriching the community's own assets with resources available through the university system. It will concentrate on Native communities in the border region that are negatively impacted by hazardous pollution and regional development initiatives and whose health and well-being may be systematically disregarded by planning professionals, government agencies, and corporate interests.

A major component of the project involves integrating Western science and technology with traditional knowledge systems. One of the most innovative approaches to this goal is through the marriage of GIS and other digital mapping technologies with Indian cultural and oral history data. One of the Principal Investigators, Richard Marciano, has a great deal of experience in this area of research and data integration. For example, we will combine data on topographic features, watersheds, flora, and fauna with sacred areas and spaces used for particular cultural purposes to produce a context specific mapping system that reflects traditional and western knowledge systems. Also critical to this project will be the use of mapping technologies to consider the ongoing and potential impact of off-reservation activities, including road systems, development plans, water ways, zoning designations, etc., much of which can be gathered through aerial photo databases that we have used.

Such data will allow for project participants to develop a more complete model of the universe of factors impacting environmental quality on tribal lands, i.e., transboundary issues affecting multiple ecological media. Many tribal leaders report that their constituents tend to be spatial reasoners, so these sorts of data sources and their use in this context would be that much more appropriate and effective. The use of spatial data from both western and tribal sources, along with oral history data from tribal members, will be a powerful and robust analytical tool for pinpointing environmental hotspots, exposure pathways, and effective remediation strategies.

The Outreach Core leader will work closely with the Translational Research Core leader to ensure that communication of all science applications developed in the SBRP is accurate, timely, and effective. Tribal partners understand fully that the science is still in progress and will take time for each stage to advance and that this is a collaborative effort. The Outreach Core leader will meet regularly with the leaders of the Administrative Core as well, and file written progress reports to ensure that all researchers and campus partners are up to date on various developments.

Outcomes and Evaluation

We have chosen a range of Tribal partners based on their level of expertise in the area of environmental health and regulatory frameworks related to Superfund and other hazardous waste concerns. All Tribal partners are extraordinarily knowledgeable and nationally respected by peers and colleagues in Indian country, universities, and state and federal agencies. They have all indicated an eagerness and willingness to work with the UCSD SBRP.

In order to produce reliable empirical evaluative measures of progress throughout the grant cycle, the Outreach Core leader will administer surveys to all partners to assess the level of baseline knowledge at the start and end of the project. We will do the same for all participants at the public forums, workshops, and conferences held during the grant cycle. This will allow us to create a knowledge management system (using software like MS Project or Excel) to measure and control for performance evaluation.

We will also gather data to chart the level of partnership involvement and to what degree this has created value added in each unit. For example, we will measure how many hours partners collaborate and with which of the three Cores. We will also measure the extent to which partners have incorporated any new knowledge gained from the research into their work. We will document where and how technology transfer and knowledge integration takes place. Measurements will occur on a quarterly basis and comprehensive analyses on an annual basis. Results will be disseminated among all partners and cores for consideration, feedback, and learning and strategic planning that will influence the next cycle.

Proposed 5 Year Time Table: Communication and Knowledge Integration Components

01- Communication: Begin construction of the Tribal Regional Workbench website. Host Workshop #1 to share existing data and tools with partners. Administer partner surveys and analyze results for feedback and integration into year two.

Knowledge Integration: Begin training program for UCSD students to study the points of integration between Tribal science and UCSD science research

02- Communication: Workshop #2: Presentation of Tribal Regional Workbench. Communicate and share findings with Tribal partners. Administer partner surveys and analyze results for feedback and integration into year three.

Knowledge Integration: Partners Meet for student and Outreach leader presentations on training program and knowledge system integration.

03- Communication: Workshop #3. Partners communicate and share findings from SBRP. Includes update on Tribal Work bench and GIS presentations. Administer partner surveys and analyze results for feedback and integration into year four.

Knowledge Integration: Student training program continues and any necessary changes are made, based on the previous year's evaluation.

04- Communication: Administer partner surveys and analyze results for feedback and integration into year five.

Knowledge Integration: Host a regional gathering of experts from Tribal communities in Region 9, with select participation from environmental justice leaders, policy makers, and scientists across the U.S. for knowledge systems integration. Begin implementation of environmental remediation measures.

05- Communication: Workshop #4 for all partners to present research findings and policy updates. Develop a model for implementing the UCSD SBRP project in other locations in the U.S. and Mexico.

Knowledge Integration: Publication of several articles, papers, CD/DVD, and a book detailing the collaborative process and the lessons learned from the SBRP.

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39. Connolly M, **Clash of Cultures, Emerging Tribal Economies in San Diego County**, Presented Feb. 13, 2004, San Diego, CA, Spirit of the Land Conference, San Diego State University, Campo Band of Kumeyaay Indians.
40. **Storage Resource Broker** [<http://www.npaci.edu/DICE/SRB>]
41. Harris S., Harper B., **Using Eco-Cultural Dependency Webs in Risk Assessment and Characterization of Risks to Tribal Health and Cultures**, *ESPR Environ. Sci. & Pollut. Res.* Special Issue 2 (2000): pp. 91-100

Letters of Commitment: Community Outreach Core

The following organizations and representatives have submitted letters expressing their commitment to the aims of our SBRP's research translation and community outreach plans. All letters are attached.

From the University of California, San Diego

Dr. Fran Berman (Director, San Diego Supercomputer Center)

State, Regional and Local Government

Terry Taminnen, Agency Secretary, Cal/EPA

John Robertus, Executive Director, San Diego Regional Water Quality Control Board

Ron Morrison, Chair, San Diego Association of Governments (SANDAG)

Honorable Dick Murphy, Mayor of San Diego

Tribal

Michael Connolly, Laguna Resources, Campo Indian Reservation

Ralph Goff, Tribal Chairman, Campo Indian Reservation

David Conrad, Director, National Tribal Environmental Council (NTEC)

Dean Mike, Tribal Chairman, 29 Palms Tribal EPA

Ken Bailey, Bureau of Indian Affairs

Community-based Organizations

Rob Hutsel, Director, San Diego River Park Foundation

David Cleveland, President, Telesis Corporation

Mexico

Mexico's Federal EPA (Delgación Federal en Baja California, Subdelegacion de Gestión para la Protección Ambiental y Recursos Naturales).