

Environmental Health in the U.S.-Mexico Border Region Work Plan for FY 2004

BACKGROUND:

The border region of the United States and Mexico encompasses a vast and diverse array of physical settings and habitats that include freshwater and marine wetlands, deserts, rangeland, mountains, and forests, which are unique in terms of the diversity of their water, mineral and biological resources. The socio-political culture that has developed in the region is also unique. Almost 12 million people reside within the border region, a ten-fold increase during the past 60 years. The population is predicted to double within the next 20 years. This rapid population growth and consequent economic development and land-use changes are pushing the limits of environmental sustainability and quality. The pace of infrastructure development has lagged behind the rapid growth of the region, resulting in a shortage of clean water for municipal, agricultural, and industrial purposes. These stressors threaten the quality of life in the region and raise concerns about the interactions between environmental quality and human health. To allow continued economic growth and protection of the area's natural resources, while maintaining a high quality of life, the U.S. and Mexico need a clear understanding of the threats of these anthropogenic changes to environmental quality, as well as threats to environmental health due to natural conditions.

The U.S. Geological Survey (USGS) will apply its core capabilities in geospatial earth and biological sciences toward understanding the complex environmental processes and changes, both natural and anthropogenic, that are impacting the region. This effort will bring about a better understanding of environmental conditions that are of interest to resource managers and public health officials.

KEY ISSUES:

The USGS has long contributed to understanding the implications of natural and anthropogenic processes to the status of the environment. In the past several years, concerted efforts have been made toward developing opportunities for collaborative research with public health agencies to improve our understanding of the linkages between the physical environment and human disease. These efforts have resulted in recognition by the biomedical and public health community of the significant potential for earth and biological sciences to assist in resolving a wide range of environmental health problems.

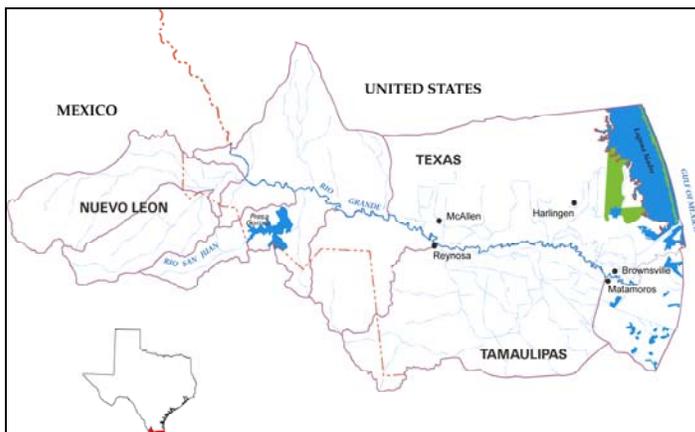
Development of major population centers causes significant changes in the environment. In turn, these environmental changes frequently result in negative impacts on the quality of life of residents. In addition, the well being of fish and wildlife resources that share those environments are threatened by development-related stressors such as raw and under-treated sewage, pesticide exposure, toxic metals in sediments, increasing salinities, and airborne pollutants. Resource managers and public health officials need ready access to accurate, impartial scientific information in order to strike a balance among human

needs for resource utilization, environmental quality, and human health. The collective abilities of the USGS are well suited for providing the needed information.

Issues of particular concern include: 1) organic contaminants in ground and surface water and biota as a consequence of industrial, agricultural and municipal uses; 2) airborne pollutants from energy utilization and dust and particulate dispersion; 3) inorganic and trace metal pollutants from historic and present mining activities and surficial mineral deposits; and 4) pathogens and other biological contaminants from untreated and under-treated sewage and related sources. Also of key interest are the natural and anthropogenic processes that affect the distribution and fate of these contaminants and their specific exposure pathways to humans and biota via water, air, soil, and food (e.g. fish, waterfowl/wildlife, plants).

GEOGRAPHIC EXTENT:

This project is envisioned to ultimately encompass the entire U.S.-Mexico border. Activity in FY 2004 will focus on the drainage basins along the Rio Grande/Rio Bravo beginning immediately below Falcon Reservoir and extending to the lower portion of the Laguna Madre of Texas and the near shore portions of the Gulf of Mexico. This region is physiographically characterized as Gulf Coastal Plain. It contains 11 basins that drain either to the Rio Grande/Rio Bravo, to the lower reaches of the Rio San Juan, or to the Arroyo Colorado in southern Texas. The area encompasses a total of 10,240 square



miles, of which 6,155 are in Mexico and 4,085 are in the United States. From Falcon Reservoir the Rio Grande/Rio Bravo flows approximately 275 river miles terminating in the coastal wetlands and marshes of the Gulf of Mexico. Among the unique habitats of this segment of the U.S.-Mexico border are the resacas (oxbow lakes) of the Lower Rio Grande Valley. In Texas, the primary population

centers are McAllen, Harlingen, and Brownsville; Reynosa and Matamoros are the major cities in Tamaulipas. The total population of these cities is estimated to be in excess of 1,500,000. As in other border areas, the water resources and associated plant, fish, and wildlife communities of the Lower Rio Grande Valley are increasingly subject to the pressures of human activities.

SCIENCE OBJECTIVE:

The primary objective of this project is to develop an integrated, web-based, environmental-resource database for display and further analysis within a geographic information system (GIS) framework. This information system will provide the needed

data and tools for furthering our understanding of the occurrence and distribution of disease-causing agents in the environment and their specific exposure pathways in water, air, biota, and soil. A desired outcome of this effort will be an enhancement of opportunities for collaborative research efforts with public health agencies and biomedical researchers as a result of the identification of information gaps. To accomplish this objective, the following tasks will be undertaken:

Task 1: Identify, prioritize, evaluate, and assemble pertinent existing data into a geospatial internet map service (IMS), such as ArcIMS.

Task 2: Produce and distribute a USGS Fact Sheet and demonstration products describing the availability and utility of the IMS product.

Descriptions of the activities to be undertaken within each of these tasks follow:

Task 1: Data Assimilation and Development of IMS.

Initial efforts in FY 2004 will focus on cataloguing of pertinent core datasets and development and design of the architectural framework for the IMS. The USGS has built a strong geospatial foundation that will be used to analyze relations between the biophysical landscape and the human health elements of the project area. Through various interdisciplinary partnerships in Texas, Mexico, and specifically the Brownsville/Matamoros area, the USGS has access to a large variety of biologic, geologic, hydrologic, and base mapping datasets that will be integrated to form a bi-national geographic information system. Pertinent project related datasets from the USGS and cooperators will be linked to this GIS to help analyze causal factors between environmental conditions and human health issues. As a final product for public access, USGS will develop an ArcIMS (Internet Map Service) to display the findings of this project. Where applicable, datasets will be incorporated into *The National Map* – a seamless, continuously maintained set of public domain geographic base information that will serve as a foundation for integrating and sharing data.

Examples of existing datasets that will be evaluated for incorporation include:

- Biologic themes, such as contaminants in biota, identification of species and habitats at risk, and identification of environmental stressors.
- Geologic themes, such as bedrock and surficial geologic mapping, soil and stream sediment geochemistry, and magnetic and radiometric data.
- Hydrologic themes, such as stream flow, ground-water data, sediment quality data, and water-borne pathogen data.
- Base mapping themes, such as satellite and airborne imagery, elevation data, transportation and planimetric data, land-use and land cover (including proximity to agriculture), and hydrologic networks with watershed boundaries.

Existing relationships with sister federal agencies in Mexico will facilitate access to relevant datasets for the Mexican portion of the project area. For example, the USGS and the Mexican mapping and census agency, Instituto Nacional de Estadística, Geografía, y

Informática (INEGI) have a pending agreement to cooperatively build geospatial Internet map services for cities along the border. Previously the two federal agencies developed methodologies and standards to bi-nationally integrate their digital mapping data along the U.S.-Mexico border. For this project, the USGS will acquire and enhance critical bi-national geospatial datasets to eventually assist environmental health modeling applications.

The USGS collaborative research partnership with the University of Texas Center for Space Research (UT-CSR) to develop a flood hazard model for the Brownsville-Matamoros metropolitan area will contribute current data obtained using leading-edge technology. As part of this project, the University has acquired satellite imagery such as Aster, Landsat, Quickbird and HyMap multi-spectral data, and will be collecting high-resolution LIDAR elevation data. USGS and UT-CSR have forged working relationships with U.S. and Mexican local universities, city planning departments, public utilities, and public health entities on both sides of the border. Several of these entities, such as the Public Utilities board of Brownsville, Junta de Aguas y Drenajes – Matamoros, the University of Texas- Brownsville, and the Universidad de Tamaulipas - Tampico have current local infrastructure datasets that can be integrated into the geospatial database and used to enhance the project. Inclusion of various social economic datasets, such as the U.S. and Mexican census data and the Texas Attorney General's colonias database, would enable users in the public health community to incorporate human health datasets to analyze trends among the human population sectors.

Environmental contamination as a result of naturally occurring surficial mineral deposits and deposition of airborne contaminants and toxins is a concern in the border region. As a result, there is a need for geologic mapping of the study area in order to provide a framework and context for geochemical, hydrologic, and biologic data from the surface and shallow subsurface geologic environment. Mining of mercury, lead, zinc, copper, manganese, gold, and silver in the border region upstream of the Brownsville-Matamoros area have left exposed mine dumps and tailings that can be sources of hazardous airborne particulates and water contaminants. Environmental pollutants may also be introduced as a result of the recent increase in mining and utilization of border coal deposits. Public attention has focused on coal fired power plant emissions in Texas and Mexico as a potential detriment to air quality in some border areas. To date, however, there has not been a systematic evaluation of the contaminants that potentially result from mineral and coal mining and use. Mapping and geochemical analyses of soils, exposed mining spoils, and border coal deposits, will provide the data necessary for assessing the environmental and health related risks associated with these sources. The USGS will collaborate with colleagues in the Consejo de Recursos Minerales (CRM) and the Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) to compile existing stream sediment and soil geochemical data in the Mexico portion of the study area.

Experts within SEMARNAT and at Mexican Universities will also be identified for potential collaboration in the identification and assimilation of biological data for the study area. Information of particular interest will include data on the nature and extent of both anthropogenic and natural contaminants in biota and aquatic sediments, and the

distribution of plant and animal species and the condition of their habitats in the study area.

The geospatial database foundation created will enable scientists and health organizations to attach their specific scientific datasets. Where available, integrated bi-national datasets will be structured in a networked database format for ease of analysis and long-term maintenance. Historical and current partnerships with Mexican federal, local, and university entities will aid in the task of acquiring Mexican data for the project area. The USGS will develop and maintain the ArcIMS Internet web service for public access and develop the final web-based product, present a display with user-friendly access to the data, and, most importantly, create relevant and wide-ranging query capabilities that will effectively respond to the needs of the professional health community.

Task 2: Production and Distribution of USGS Fact Sheet and Demonstration Products.

The primary product of this project (an IMS that provides environmental data in a geographic framework, coupled with advanced query tools), will allow scientists and health professionals to analyze possible linkages between the physical environment and human health issues and identify data gaps. An anticipated outcome of the system's use will be an increased opportunity for collaboration with the biomedical and public health community. Such collaborations will result in the identification of new research thrusts that will ultimately provide new insights into the interdependence of human health and environmental quality. However, opportunities for collaborations will only arise as a result of widespread awareness of the existence of our product. Early in this project, demonstration products will be prepared. A pilot GIS system, a PowerPoint presentation, and a brief information sheet describing the system's intended utility will be developed. These products will be used in conjunction with stakeholder meetings to introduce potential partners and end-users to the project in order to solicit their support, and receive feedback concerning the utility of the final product. Potential U.S. partners include NIEHS grantees in academic institutions, state and local public health departments, state water and natural resource agencies, the United States-Mexico Border Health Commission, Department of the Interior bureaus, and the International Boundary and Water Commission. Upon completion of FY 2004 activities, a USGS Fact Sheet describing the availability and utility of the IMS product will be produced and distributed.

INTERACTION WITH MEXICO:

This effort is intended to be of binational scope and value, and will include significant input and involvement of counterparts in Mexico. As a first step, our team will be tasked with identification of appropriate Mexican federal, state, academic, and private entities that could serve as collaborators on this project. Such entities would be important contributors to the project as sources of pertinent data and as partners in study design, implementation, and interpretation.

RECOMMENDATION FOR FUNDING DISTRIBUTION:

8335 – Biology, Columbia Environmental Research Center	\$123,500
8653 – Water, Texas District Office	\$123,500
8929 – Geology, Central Region Earth Surface Processes Team	\$123,500
8815 – Geography, Rocky Mountain Mapping Center	\$123,500
TOTAL	\$494,000

TIMELINE FOR FY 2004 PROJECT COMPLETION:

Activity/Product	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter
Modify Existing Work Plan	12/19/03			
Recommend Funding Distribution	12/19/03			
Develop Detailed Integrated Work Plan		01/15/04		
Obtain Sample Data Sets		01/15/04		
Develop Data Framework Guidance		02/15/04		
Stakeholder Meetings (U.S. and Mexico)				
Populate Contact/Partner Matrix				
Compile and Integrate Data Sets				
Develop Beta ArcIMS				08/04
Develop Final IMS				09/04
Draft Fact Sheet				07/04
Final Fact Sheet				09/04