

CENTRAL REGION INTEGRATED SCIENCE PARTNERSHIP FUNDS

Project Title: Reconnaissance for perchlorate in the environment (streams, groundwater, soils, plants, and aquatic organisms) in the Midwest and Southwestern United States

Principal Investigator: Steve Kalkhoff (Water)

Partners/Collaborators and Affiliations: Rich Wanty (Geology), Greg Linder (Biology), Purnendu K. (Sandy) Dasgupta, Paul Whitfield Horn Professor, Dept of Chem and Biochem, and other staff, Texas Tech University; various staff at EPA Regions 6,7,9; selected EPA approved State labs

Total Funding Requested: \$75,000 each of FY04 and FY05

Proposal Submission Date: December 4, 2003

Problem: Although perchlorate has been documented as a point-source contaminant in groundwater near areas where ammonium perchlorate is produced and where solid-fuel rockets, fireworks, and other explosives are manufactured or used, recent studies reported in the literature (references available) have found perchlorate in areas with no apparent anthropogenic sources and in areas where agricultural activities (fertilizers and irrigation) are prevalent. Recent small-scale studies have documented perchlorate in potash-bearing soils, evaporitic materials, some fertilizers, fish and invertebrates, Texas High Plains groundwater, southern California lettuce crops, vegetation, and selected dairy milk on supermarket shelves in Texas. USGS has results, which will be used in this study, from a few small studies that corroborate the occurrence of perchlorate in the southwest. Perchlorate is soluble in water and persists in soils and water for long periods. It is biologically active at relatively low-levels in the environment, and its role as an endocrine-disrupting chemical has been well characterized in some amphibians and fish. Uptake by plants has also been established. Known health effects include thyroid dysfunction and interferences with brain development. There are currently no national aquatic, drinking water, or consumptive standards for perchlorate, although eight States have set advisory standards ranging from 1-18 ppb. EPA has proposed a drinking water limit of 1 ppb in 2002, which is currently being reviewed by the National Academy of Sciences.

Objective: (1) Explore whether there is widespread occurrence of perchlorate in streams, groundwater, soils, plants, and aquatic organisms due to both natural and agricultural anthropogenic sources in the Midwest and Southwest. Reliably measuring occurrence at low levels (1-30 ppb) is possible only through a recent analytical method (Tian et al, 2003, in *Analytical Chemistry*, vol. 75, no. 3, pp 701-706) that can minimize interferences of other compounds that co-occur with perchlorate in arid and saline environments. This method is more robust, sensitive, and free from matrix interferences than the established USEPA method 314.0. (2) Compile available, relevant spatial coverages of soils, geology, irrigation, fertilizer and perchlorate-containing pesticide applications, and the occurrence of perchlorate for use in future research proposals. (3) Provide a preliminary evaluation of potential adverse biological effects of perchlorate to biological receptors. Preliminary findings suggest that although acute exposure to relatively low-level concentrations of perchlorate is not likely, effects of chronic exposure to low-level concentrations and risks associated with trophic transfer of perchlorate through aquatic and terrestrial food chains is poorly characterized.

Scope: Specific tasks to be accomplished include: (1) Contracting with Texas Tech or developing the method in-house in a Geology lab. (2) Sampling 100+ streams, sediments, groundwater, soils, plants, and aquatic biota as determined by a detailed study plan, including reference samples. This sampling will be done concurrently with other ongoing work, thus providing other relevant analytical data and reducing costs for this study. Samples may also be available from previously collected, archived samples. Programs that may provide samples and other relevant information include NAWQA, NASQAN, Toxics, numerous Water Cooperative Program projects, Contaminants (BEST and Amphibians), Fisheries and Aquatic Resources, Geochemical Landscapes, and the National Map. (3) Evaluating analytical data and develop assessments of occurrence and adverse biological effects. (4) Compiling available spatial information on soils, geology, irrigation, fertilizer and perchlorate-containing pesticide applications, and perchlorate occurrence. Sites will be selected in areas of the Midwest and the Southwest that have one or more of the following: long-term fertilizer applications, irrigation, arid soils, saline soils.

Approach: Samples will be collected in collaboration with other existing programs at minimal cost. Laboratory analysis will be done, including rigorous QA/QC, in collaboration with Texas Tech or by bringing up the new method with available instrumentation in a geology laboratory. Other available labs may be used for QC comparisons. Analyses of data, development and compilation of occurrence data base, and preliminary analysis of compilation into spatial data layers will be done by collaboration of the principal investigators.

Analysis of adverse biological effects of perchlorate to biological receptors in the field will be done primarily by biology.

Benefits: This proposal addresses the CR agricultural practices science priority and the Director’s Annual Program Direction for water for humans and ecological use. The USGS is in a unique position to investigate the occurrence of perchlorate in aquatic environments and soils at minimal cost by using its already established field sites and project networks for this additional work. There are important scientific and regulatory benefits that will result from development of an unbiased, scientifically integrated assessment of nonpoint-source perchlorate occurrence. Interested stakeholders include USEPA, DOD, USDA, water suppliers, and the public at large. Not only is the occurrence of perchlorate a concern, but the co-occurrence of perchlorate with other endocrine disrupting compounds is also of concern and part of a newly emerging field of science. This information can be a spring board for further research in defining areas that are vulnerable to perchlorate occurrence and risk. The results can be used for conducting more detailed research on occurrence, fate, transport, and risk in various settings, as well as in helping the regulatory community to set a priority for establishing perchlorate standards. This work falls squarely within USGS’s mission of serving the public and interested environmental and regulatory stakeholders. An integrated scientific approach has not yet been attempted and will be an important advance. We anticipate that these results will be as important and wide-ranging as previous USGS work on other compounds like MTBE, unregulated pesticides, antibiotics and personal care products.

Outcome/Products: A report outlining the results of the occurrence data and the preliminary evaluation of potential adverse biological effects of perchlorate to biological receptors will be completed, along with a data base of spatial information that can be used for future research. Additional journal articles and technical presentations may be completed outside of this budget.

Budget: A budget of \$75,000 for each of 2 years is requested. Following notification of acceptance, a detailed study plan will be developed. We anticipate being able to collect data from 100+ locations/media.

Timeline:

FY2004

O	N	D	J	F	M	A	M	J	J	A	S
Proposal accepted, do detailed study plan											
			Analytical method (+QA/QC)								
			Select sample areas and locations								
							Sample collection-----				
							Sample analysis-----				
								Data analysis-----			
								Risk analysis-----			
								Develop spatial data layers-----			

FY2005

O	N	D	J	F	M	A	M	J	J	A	S
Sample collection											
Sample analysis											
Data analysis-----											
Risk analysis-----											
Develop spatial data layers-----											
Data base compilation-----											
							Report writing and approval-----				