Tri-Service

Ecological Risk Assessment Workgroup

ECO NEWSLETTER

Annual Update/Number 2/Calendar Year 2003

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About the TSERAWG ECO NEWSLETTER

The TSERAWG ECO NEWSLETTER is a yearly report of the proceedings of the Tri-Services Ecological Risk Assessment Work Group. It is published by the collaborative efforts of the editors. There are three types of articles appearing herein. They are either activity summaries or editorials written by TSERAWG members specifically for the publication or they are abstracts of presentations given during a Work Group meeting.

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Welcome to the Tri-Service Ecological Risk Assessment Work Group

Dr. Mark Johnson
U.S. Army Center for Health Promotion
and Preventative Medicine

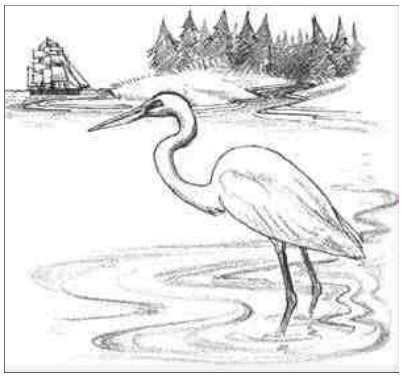
The Tri-Service Ecological Risk Assessment Work Group (TSERAWG) has been meeting since 1996. It was officially chartered in January of 1997 by the Tri-Service Environmental Support Centers Coordinating Committee. The Work Group is organized to share experiences and to coordinate and develop uniform technical guidance for the conduct of ecological risk assessments (ERA) within the military community. The TSERAWG also provides technical information transfer to member organizations regarding the latest on ERA applications and participates in technical reviews of various techniques and methods in ERA.

Figure 1. Tiger Salamandar (***Ambystoma tigrinum***)

Toxicity of 2,6-DNT and Picric Acid Degradation Products in a Marine Environment - Y0817 Project Overview

Karen Miller
Naval Facilities Engineering Service Center
Port Hueneme, CA
January 2003

Karen Miller (NFESC) gave a presentation on an overview of the results obtained from her project titled "Toxicity of 2,6-DNT and Picric Acid Degradation Products in a Marine Environment - Y0817 Project Overview". This project was a follow-on to a completed effort to assess the toxicity of ordinance compounds in coastal water and sediments to a variety of marine organisms. Based on the results of initial project, picric acid and 2,6-DNT were considered priority ordinance compounds for degradation and toxicity assessments, due to their presence in marine sediments in the vicinity of naval facilities. Both chemicals are toxic to marine organisms in marine water, porewater and sediment tests. Since their degradation products are suspected of contributing, or possibly enhancing toxicity (Carr & Nipper 2000), the focus of this follow-on effort was to assess the toxicity of picric acid and 2,6-DNT degradation products. This included determining the effect of sediment type (grain size distribution and organic carbon content) on the microbial degradation of 2,6-DNT and picric acid in marine sediments; evaluating the effect of UV light on their degradation; determining if degradation products generated by bio- and photo-degradation of 2,6-DNT and picric acid differ in their nature; assessing whether the degradation of 2,6-DNT and picric acid will proceed through mineralization given sufficient time; and determining if these degradation products are more or less toxic to marine organisms than the parent compound. A final report containing project results is expected to be available in March 2003 and will be posted on the NFESC Web site at http://enviro.nfesc.navy.mil/er.



Advanced Risk Assessment Methods for Terrestrial and Aquatic Ecosystems

Igor Linkov, Ph.D.
ICF Consulting
January 2003

Dr. Linkov (ICF Consulting) gave a presentation on the overview of their risk assessment approach titled "Advanced Risk Assessment Methods for Terrestrial and Aquatic Ecosystems." Dr. Linkov used deterministic methods to assess risks from contaminants (COPCs: heavy metals, PCBs, pesticides) for the Army Superfund site, Natick MA; a hypothetical open water disposal site; and another site. At Natick the majority of contamination was in lake water and sediments. The approach involved the completion of EPA's Probablistic Risk Assessment's Tier I and II, then doing Tier III to model food chain interactions. Ecological receptors included shellfish (freshwater mussels) and 300 fish of 3 species (bass, bluegill, and American eel) and the endpoints were mortality and reproduction. The conceptual site model (CSM) receptors were raccoon, great blue heron, osprey, kingfisher, bluegill, largemouth bass, and sediment invertebrates. TRVs were taken from the US Army ERED, SETAC, and ORNL databases and distributions for probabilistic TRVs were graphed using whole body tissue (mg/kg). During Tier II, the area use factor (AUF) was 1, but values from the literature were used for more realistic AUFs in Tier III. After eliminating the other COPCs, only PCBs are anticipated to be used in the probabilistic risk assessment (PRA) but must be negotiated with regulators first. The field of risk assessment is rapidly changing in response to increased computing capabilities and ease of modeling. One of the most significant areas of research is incorporation into risk assessment of the spatial factor, such as the extent of contamination, receptor foraging or home ranges, and other receptor exposure patterns. Explicit treatment of uncertainties associated with model parameters and the separation of uncertainty and variability are also attracting increased attention from regulators and risk assessors. A third area of recent interest is optimal selection of risk and exposure models. This talk will discuss recent developments in these three areas and present examples of our recent practical implementation of some new approaches.

Bioavailability of Contaminants in Soils and Sediments: Processes, Tools, and Applications

Richard G. Luthy, Ph.D.
Department of Civil and Environmental Engineering
Stanford University, Stanford, California
January 2003

Dr. Luthy (Stanford University) gave a presentation on the overview of the NRC Report titled "Bioavailibility of Contaminants in Soil and Sediments: Processes, Tools, and Applications". The National Research Council recently produced a report on the use of bioavailability in soil and sediment management. The report begins by defining "bioavailability processes" and examining historical use of the term and concept. A chapter is devoted to demystifying the current use of bioavailability. The report discusses acceptable tools and models for bioavailability assessment; ranks the tools according to seven criteria; explores the intimate link between bioavailability and bioremediation and concludes with suggestions for moving bioavailability forward in the regulatory arena for both soil and sediment cleanup. The report concludes that the potential for the consideration of bioavailability to influence decision-making is greatest where certain chemical, environmental, and regulatory factors align. The first condition is that the contaminant whose bioavailability is under investigation must be and remain the risk driver at a site. Second, consideration of bioavailability could make a significant difference if the default assumptions made during risk assessment that affect the final cleanup goal are inappropriate. Third, experience has shown that considerations of contaminant bioavailability make sense where a significant change to remedial goals is likely, for example because substantial quantities of contaminated soil or sediment are involved. Fourth, bioavailability arguments should only be used to alter cleanup goals when site conditions are unlikely to change substantially over time. Finally, bioavailability concepts have not received widespread regulatory and public acceptance.

Pathway Ranking for In Situ Management (PRISM)

Bart Chadwick, Ph.D.
SPAWAR Systems Center
San Diego, California
January 2003

Dr. Chadwick (SPAWAR System Center, San Diego, CA) presented an overview of the data from the first demonstration site for the "Pathway Ranking for In Situ Management (PRISM)" project being done by SPAWAR Systems Center San Diego. The object of PRISM is to provide an integrated, field-based approach to assessment of the relative importance of contaminant transport pathways for sediment. Such processes include deposition, flux rates, diffusion, advection, erosion, resuspension, and biomobilization processes (Figure1). While each of these processes have been examined individually, this project is unique in that the processes were examined together so they could be ranked and compared to support in-place sediment management. The first demonstration site was at Paleta Creek, NAVSTA San Diego – a site contaminated with heavy metals.

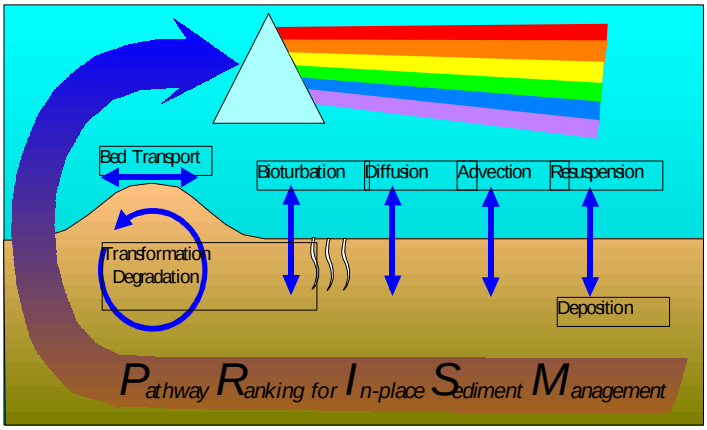


Figure 1. Diagram of contaminant pathways for sediment.

The Team deployed a sediment profile imaging (SPI) camera to collect bioturbation data; sediment traps and cores for sedimentation data; a benthic flux device and seepage meter to estimate flux rates and directional data; measured shear stress and collected data on other parameters to develop an integrated conceptual model of the site. Preliminary results indicate the importance of sedimentation and degradation for PAH burial and that diffusive and advective fluxes may be important in regulating the burial of some metals such as zinc. The information will be used to develop management strategies supported by a set of simple, normalized pathway indices. A second demonstration is planned at a Pearl Harbor site.

Optimization of Sediment PAH Data Collection and Analysis for Fingerprinting Project Update

Jim Leather, Ph.D.
SPAWAR Systems Center (SSC)
San Diego, California
January 2003

Dr. Leather (SPAWAR Systems Center (SSC) San Diego) presented an update on a project entitled "Optimization of Sediment PAH Data Collection and Analysis for Fingerprinting Project Update". A primary goal of the project is to optimize fingerprinting methodologies, and utilize fingerprinting to map multiple sediment contaminant sources in a cost-effective manner. This work is designed to attribute source identification, in hopes of determining attribution in situations where many polluters (i.e., sources) are responsible for contamination in sediments. Rapid Sediment Characterization (RSC) tools including modified immunoassays methods were used with detection limits are in the 50 to 500 ppb range to collect a large data set. Advanced chemical fingerprinting (ACF) of a selected subset of these sediment samples was used to identify distinct source "fingerprints". These methods were initiated on the Elizabeth River where multiple creosote plants existed. Basically, relative constituent changes (based on attenuation or weathering signatures) were used to determine which PRP is responsible for the contamination. The objective of combining RSC with ACF is to cost-effectively maximize the benefits of each method and to help offset the limitations of each method.

Ecological Risk Assessment of Arid Ecosystems

Jim Markweise
Neptune and Company, Inc.
Los Alamos, New Mexico
June 2003

Arid and semiarid environments are important, comprising almost one third of the earth's land surface and most of the western and southwestern United States. The evaluation of ecological effects in such environments needs to be technically defensible; a challenging proposal if risk assessment approaches developed for moist habitats is used. The lecture provided an overview of the tools and challenges for performing ecological assessments in dry lands and illustrates the overview with examples. To bring a full understanding of ecological effects characterization to the attendees, the lecture achieved several major goals: namely, demonstrate the special considerations of arid environments under Superfund's ecological risk assessment (ERA) framework; illustrate conceptual site model and problem formulation development through military firing range activities in the desert; describe how contamination effects in arid soils can be interpreted using standard and more site-specific toxicity tests; and, document the strengths and limitations of using arid ecosystem ERAs to support informed environmental decision making in southwestern and western states.

Working with Stakeholders for Range Sustainability

Jan Larkin
Office of the Secretary of Defense
Washington DC
June 2003

Ms. Larkin focused her presentation on decision-making and communication of risk. Her position is that information is readily available to anyone that can understand it. Therefore, the public is more involved in the decision-making process. A challenge found at the installations is the lack of credibility of the agency. She indicated that a risk communication policy is forthcoming that will address the issues of social amplification (i.e., information distribution), narrative versus numerical risk description, and addressing the lack of trust through communication.

Current Development of an Amphibian Toxicity Testing Protocol

John Bleiler
ENSR Consulting
January 2003

Mr. Bleiler (ENSR Consulting) gave a presentation on the Navy's project to develop an Amphibian Toxicity Testing Protocol. Amphibians are often considered a front-line indicator of possible adverse impacts to wetland ecosystems and considerable research has been dedicated to examining reported teratogenicity and overall declining populations. However, no standardized procedure exists to evaluate the potential toxicity of sediments to amphibians. Therefore, a project was conducted in conjunction with the U.S. Navy to develop a standardized approach for assessing potential risks to amphibians at selected Navy facilities. This work included a literature review, developing standardized laboratory testing techniques, validation of the toxicity testing using spiked sediments, developing amphibian screening values, and preparing a guidance manual for assessing potential risks to amphibians at Navy facilities. The guidance manual is expected to be available for review in late March 2003.

Wood frog (*R. sylvatica)*

Army National Guard Training Center Sustainability

Bruce Bodson
Westin Solutions
June 2003

Mr. Bodson (Westin Solutions) presented an overview of a current assessment being conducted by the Army National Guard (ARNG). The assessment provides Installation Commanders an environmental sustainment profile of their installations as well as the ability for ARNG to prioritize Training Centers based on environmental vulnerabilities. This assessment was in response to a requirement stated in the Defense Authorization Act (2002) that required a comprehensive assessment of unexploded ordnance, discarded military munitions, and munitions constituents located at current and former defense sites. The areas of focus were established after a review of the October through December 2000 Quarterly Readiness Report to the Congress and after a review of the unique challenges of ARNG Training Centers. The sustainability considerations include Hydrogeology, Urban Growth/Encroachment, T&E, Air Quality, Noise, and other areas of focus important to the sustainability of a Training Center. Data to support the sustainability evaluations were collected from various Army and NGB databases as well as numerous reports such as Range Development Plans, ICRMPs, and GIS sources. The information used from these sources includes the type of weapon system and number of rounds fired at each of the Training Centers' ranges; constituents and emissions of the munitions used; hydrogeology; soil, vegetation, rainfall, T&E, noise, encroachment, and regulatory compliance status. The system will consolidate the data and store it in a data warehouse that will provide query and report capabilities. The system will also provide ranking models that overlay operational activities on the environmental profile. The ranking models will allow decision makers to prioritize the Training Centers according to sustainability concerns where environmental vulnerabilities could impact training requirements. The ranking will then aid ARNG in focusing their resources to ensure the sustainability of the Training Centers. The applicable data to support the queries and sustainability evaluations will be displayed on GIS maps.

Distribution of Energetic Compounds in Soils at Training Ranges in the United States and Canada

Judy Pennington, Ph.D.
USACE-ERDC
Vicksburg, Missisippi
June 2003

Dr. Pennington (USACE-ERDC) described the results of a SERDP project that focused on the distribution of energetic compounds on ranges. This SERDP project was focused on identifying the types and concentrations of explosives and propellant residues in soils at various types of military training ranges in the U.S. and Canada because these residues serve as a potential source for groundwater contamination. Three types of military ranges were characterized: four hand grenade ranges (Ft. Lewis, WA; Ft. Richardson, AK; Ft. Wainwright, AK; and Ft. Leonard Wood, MO), five artillery ranges (Ft. Lewis, Yakima Training Center, WA; Camp Guernsey, WY; Ft. Bliss, NM; and CFB Shilo, Manitoba), and two antitank ranges (Yakima and CFB Valcartier, Quebec). The greatest challenges in characterizing firing ranges soils are the collections of representative samples in areas of extreme spatial heterogeneity, and the homogenization and splitting of samples into representative subsamples for analysis. These issues were a specific focus of the field sampling. At hand grenade ranges the top 10 cm accumulated residues of RDX and TNT, which are the major constituents of Composition B, the main charge in M67 hand grenades. The major source of these residues appeared to be low-order detonations and/or duds that were blown in place. Explosives residues in soils at artillery ranges were heterogeneously distributed and were generally in low ug/kg concentrations, except in areas where low-order detonations had occurred. In these localized areas, solid explosive was sometimes present in chunks and concentrations in soils reached percent levels. Initial characterization indicated that blow-in-place operations often do not consume the main charge. Surface soils near targets at antitank rocket ranges were contaminated with residues of HMX, the major constituent in octol, and the main charge in antitank rockets. The concentrations of HMX were as high as a thousand mg/kg next to the target and declined with distance from the target. TNT concentrations were only one one-hundredth that of HMX even though the ratio of HMX to TNT is 70:30 in octol. Overall the types of explosives residues, their concentrations, and distribution varied widely among ranges, but were quite similar for similar types of activities at different installations. Characterizing surface contamination will require carefully designed sampling protocols to overcome the extreme spatial variability on training ranges.

Are Dermal Exposures Important to Wildlife?

Mark S. Johnson, Ph.D.
U.S. Army Center for Health Promotion and Preventative Medicine
Aberdeen Proving Ground, Maryland
September 2003

Dr. Johnson (Army CHPPM, APG, Maryland) presented some of his more recent data and results of his studies focusing on the toxicity of dermal exposures of explosives on terrestrial organisms, specifically the Red-backed Salamander (Plethodon *cinereus*). This species of salamander covers a wide geographical area, and are exposed to soil toxicity from explosives such as RDX and 2,4-Dinitrotoluene (DNT). Studies included a 28-day testing period for both RDX and DNT. Adverse effects in Plethodon *cinereus* are similar to the ones found on mammals. In the studies of RDX exposure on P. *cinereus*, adverse effects included convulsions, lethargy, hyperactivity, and tremors. After exposure of DNT on P. *cinereus*, results from tests included acute, sub-chronic, and chronic toxicological effects. Acute effects included ataxia, loss of coordination, rigidity of hind legs, decreased appetite, and weight loss. Sub-chronic effects included anemia, hemosiderosis, methemoglobinemia, and decreased spermatogenesis. Chronic effects included anemia, hemosiderosis, and neuropathy. Dr. Johnson showed in his studies that the effects from exposure are similar to mammals regardless of exposure route. Differences between exposures and histology were presented as well as other data for RDX and DNT. His studies showed that dermal route is important to terrestrial salamanders. In conclusion, ecological sublethal effects included olfactory inhibition and overload, mate recognition and success, feeding efficiency, and territoriality.

Figure 1. Red-backed Salamander (*Plethodon cinereus*)

Toxicity of Explosives to Wildlife: ERA Applications

Mark S. Johnson, Ph.D.
U.S. Army Center for Health Promotion and Preventive Medicine
Aberdeen Proving Ground, Maryland
June 2003

Dr. Johnson (Army CHPPM, APG, Maryland) presented some of his more recent data and results of his studies focusing on the toxicity of explosives on terrestrial organisms including birds and amphibians. Physiological differences between birds, mammals, and amphibians can result in significant variations in response from exposure to the same toxicant. Sub-acute to sub-chronic effects from exposure to 2,4,6-trinitrotoluene (TNT), an important soil contaminant at many US Army installations, was evaluated in Northern Bobwhite (*Colinus virginianus*), Common Pigeon (*Colima livia*), white-footed mice (*Peromyscus leucopus*), and in a microcosm design with tiger salamanders (*Ambystoma tigrinum*) (Figure 1). While the hematological effects in *P. leucopus* were consistent with other mammals (i.e., indicators of anemia), they appeared more tolerant than in other laboratory rodents (e.g., *Mus ssp*.). Interestingly, in studies with *C. virginianus*, only mild liver effects were noted at concentrations of 1500 mg TNT/kg feed (98 mg/kg-d). Further, there were no significant effects on red blood cell (RBC) parameters in birds exposed up to 3,000 mg/kg, suggesting that the nucleated RBCs were more resilient from exposures to TNT. However, four fatalities occurred while exhibiting symptoms consistent with CNS effects. Mortality levels of TNT in *C. livia* were consistent with *C. virginianus*, (at >120 mg/kg-d) however, other organ effects were noted at lower concentrations (e.g., ovary, liver, and kidney effects). Blood effects were different from controls at levels exceeding 70 mg/kg-d, yet they were within published reference ranges. No adverse *tigrinum* exposed to soil concentrations of > 59 mg/kg. Theses data suggest that TNT-induced erythrolysis observed in mammals may be due, in part, to the physiological differences between the enucleated RBCs of mammals and the nucleated RBCs of amphibians and birds. Differences between exposures and histology were presented as well as other data for RDX. These data were used to develop Toxicity Reference Values (TRVs) consistent with the Wildlife Toxicity Assessment format developed by US CHPPM for use in ecological risk assessments. See the following web site for more details: http://chppm-www.apgea.army.mil/erawg.

Figure 1. Tiger Salamander (*Ambystoma tigrinum*)

Update on Perchlorate Issues and SW Method 314.0 for Perchlorate Drinking Water

Doris A. (Andy) Anders, Ph.D.
PhD, USAF/AFCEE
Brooks AFB, Texas
September 2003

Dr. Anders (Brooks AFB) presented an update on perchlorate issues and SW Method 314.0 for perchlorate in drinking water. DoD's Environmental Data Quality Workgroup (EDQW) and U.S. EPA's Federal Facilities Restoration and Reuse Office (FFRRO), are working together to develop perchlorate sampling, analyses, and reporting under existing DoD policy. Currently, only the U.S. EPA has an approved method for analysis of perchlorate in drinking water. The existing SW 846 Method 314.0 is only reliable to 4 ppb in drinking water, and has matrix-interference deficiencies that allow false positives. Both the EDQW (DoD) and Intergovernmental Data Quality Task Force (IDQTF), made up of U.S. EPA, DoD, and DoE, are working together to set data quality guidelines and procedures.

Developing a Strategy for Ecological Risk Assessment in the Banana River Lagoon at Cape Canaveral Air Force Station, Florida

Ron Porter, Ph.D.
Mitretek
San Antonio, Texas
September 2003

Dr. Porter (Mitretek) gave a presentation on developing a strategy for ecological risk assessment (ERA) in the Banana River Lagoon at Cape Canaveral Air Force Station, Florida. Cape Canaveral Air Force Station, Florida is approximately 15,000 acres and is located between the Atlantic Ocean and Banana River Lagoon. The first rocket launches were in 1950 after the USSR's successful launches. Industrial areas at CCAFS include approximately 350 acres that include contaminated sites. System of surface water canals insure unrestricted access to mission-essential sites. In the 1950-80's, industrial solvents (TCE, Freon) were used to clean rocket components. There are two basic types of groundwater contamination: DNAPL and dissolved plumes of Volatile Organic Compounds (VOCs). Dissolution of DNAPL areas and flow create groundwater plumes that sometimes intersect and discharge into canals (Figure 1). In the 1980's, NASA implemented a voluntary environmental program. Currently, CCAFS is cleaning up under RCRA with a solid waste management unit approach restricted to the base proper. Dr. Porter pointed out the problem with that approach is that the contaminants are likely migrating from the base to the receptors in the lagoon. Several threatened, endangered, and sensitive species have been identified. Dr. Porter stated three important goals that will be necessary for focus on ERA in the Banana River Lagoon. One of the goals is to develop a process to evaluate whether adverse impacts to aquatic ecological receptors of concern in the portions of the Banana River ecosystem adjacent to CCAFS have occurred and, if so, whether the impacts are being effectively mitigated. Another goal is to assess the potential for CCAFS RCRA hazardous wastes to migrate into the aquatic environment surrounding the installation and to evaluate the likelihood for adverse impacts to ecological receptors and degradation of the abiotic environment. In addition, another goal is to develop a long-term monitoring and assessment strategy that allows the management of biotic and abiotic resources within context of the mission of CCAFS.

Figure 1. Typical canal at CCAFS, Florida.

Supporting the DOD Operational Range Sustainment Program and Building the Military Munitions Response Program

COL John Selstrom
Office of the Secretary of Defense
Washington DC
June 2003

COL Selstrom discussed the military munitions response program. This is an effort that focuses on the lifecycle (design, use, and closure) of ranges and military compounds. It includes a programmatic sectioning of facilities into munitions response areas (the base) and munitions response sites (the area with UXO or MC). The Defense Authorization Act has specific considerations for these types of areas. The military munitions response program is currently developing a report that should be available shortly.

DOD's Sustainable Ranges Initiative

Bruce Hill
Westin Solutions
Office of the Secretary of Defense
Washington DC
June 2003

Bruce Hill (Office of the Secretary of Defense, Washington DC) gave a presentation on the importance of training and testing to the military. He supported the value of the U.S. unique position to conduct realistic training with live rounds and realistic conditions. Range sustainability is to continue supporting these activities. His presentation focus included encroachment and encroachment pressures and the need for integrated solutions that balance relationships between test and training requirements, natural environments and stewardship, communities and stakeholder interests, and legislative and regulatory framework. His approach on range sustainability included the following elements: leadership and organization, legislation and regulation, policy, programs, and outreach.

Bioconcentration Factors for TNT in Terrestrial Systems

Elizabeth Ferguson
Louisville District
Louisville, Kentucky
June 2003

Ms. Ferguson presented a summary of an assessment conducted at OBG. The site was a previously used Army facility that was contaminated with metals and explosives as a result of open burning. The site is around 120 acres and is primarily in the floodplain of the MS River. One of the assessments was to evaluate the trophic transfer of the contaminants from earthworms to the short tailed shrew. The remedy is to dig out the contaminated soil and replace the soil with clean soil at an expected cost of around 65-80 million dollars. Once remediated, the site will be transferred to the Lost Mound Refuge System.