APPENDIX C

ECOLOGICAL RISK ASSESSMENT BY OMEGA ENVIROSOLUTIONS INC

ECOLOGICAL RISK ASSESSMENT AND TOXICOLOGICAL EVALUATION ASSOCIATED WITH OIL EXPLORATION AND PRODUCTION ACTIVITIES

EAST WHITE LAKE FIELD,

VERMILION PARISH, LA.

In the matter of

VPSB v LOUISIANA LAND, et al

MARCH, 2014

PREPARED BY:

DR. WILLIAM J. ROGERS

OMEGA ENVIROSOLUTIONS, INC.

RISK ASSESSMENT AND TOXICOLOGICAL EVALUATION

Qualifications of Dr. William J. Rogers

I am a Full Professor and the program director and Senior Researcher in the Environmental Science Program at West Texas A&M University. I am the University Radiation Safety Officer and certified NORM surveyor. I have also served as the Associate Dean of Academic and Research Environmental Health, Safety and Compliance responsible for all aspects of student and research faculty and staff health and safety. As shown in my attached curriculum vitae, (Exhibit A), I have a doctorate in Fish and Wildlife Science specializing in environmental and ecological risk assessment and modeling of contaminant effects. I also have a Bachelor of Science degree in Biology and Master of Science degree in Biology. I am a member of the Institute of Hazardous Materials Management and a Certified Hazardous Materials Manager at the highest level (Masters Level # 1694). I am a member of the Society of Environmental Toxicology and Chemistry (SETAC), the Society of Risk Analysis, a scientific and technical reviewer and editorial board member for the journal *Ecotoxicology* and a working member of the Texas Commission on Environmental Quality (TCEQ) Ecological Risk Working Group. I am the principal investigator for the TCEQ effort to develop ecological "protective cleanup levels" for chemical contaminants in specific habitats found in Texas. I have provided support to the United Nations Environmental Program, World Bank and United Nations Food and Agricultural Organization on environmental cleanup, human health risk assessment and environmental monitoring in Azerbaijan, Argentina, Russia and Romania. I have served as an advisor to the Chlorine Manufactures Association Board addressing human health and environmental effects of "persistent toxic bio-accumulating chlorinated chemicals (PTBs)" and have written a position paper on the human health risk and cleanup of "persistent organic pesticides (POPs)" for the World Bank. I served as the southwest regional coordinator on the Secretary of Interior's Task Force on Selenium and Other Toxic Substances (with independent National Academy of Science panel oversight) and organized both screening level and detailed human health risk and environmental risk assessments for all Department of Interior water supply and irrigation projects in the Southwestern United States. I have managed large-scale human health and ecological risk assessments at such sites as the Department of Energy Pantex Nuclear Weapons Plant and Oak Ridge National Laboratory. I was the principal author of the Ecological Risk Assessment Program Plan for Evaluation of Waste Sites on the Department of Energy Savannah River Plant. I have over thirty years experience in virtually all aspects of environmental risk assessment, restoration, and protection. I have numerous publications and presentations that deal directly with human, environmental and ecological risk assessment. A listing of my publications and technical papers are included in my attached curriculum vitae. I have taught and continue to teach *Ecological Risk Assessment* at the university masters level and *Agricultural Human Health Risk Assessment* at the doctoral level.

I am familiar with the procedures, methods and models used in environmental, human and ecological risk assessment. I teach a course in *Environmental Sampling and Interpretation* and also am familiar with the procedures and methods related to laboratory analytical work and EPA accepted quality assurance and validation requirements. I am compensated at a rate of $150.00/hr for technical work and at a rate of $200.00/hr for testimony.

Specific Qualifications: I have specific experience in both human health and environment and ecological risk assessment from exposure to heavy metals, chlorinated organic compounds including PCBs, Dioxins/Furans and pesticides, hydrocarbons, radiation, chlorides/salts and exploration and production (E&P) substances. Specific work includes testing and evaluation, development of "protective cleanup levels" and site remediation of those chemicals. I worked in the oil and gas industry specializing in production water quality issues such as corrosion, scaling and bacterial corrosion as well as issues in deep well disposal of produced waters. I have published a book on environmental compliance for the oil industry.

Approach: I have reviewed selected historical documents on the property as well as documents that provide needed background information on the site land use, surrounding area land use, habitats found on site and expected aquatic and terrestrial species. I have also used standard scientific methods and procedures in the analysis of potential for human health and environmental and ecological adverse risks that can be or have the potential to be attributable to contaminants found on and associated with oil and gas production activities at the site. I have reviewed peer-reviewed studies and toxicity testing and rely in part on the results of those studies. I have utilized specific literature sources from state, federal and scientific sources as referenced throughout the report. I have also relied on the reports prepared by Gary C, Barbee and Castille Consulting Services LLC. (Castille and Castille, April 15, 2010), Supplemental Toxicological Evaluation Report by Dr. Gary Barbee (November, 2, 2010), ICON Environmental Services, Inc. (ICON, March, 2010) and study results from a study I conducted on and near the property on samples collected on October 16-17, 2010. I have also used shallow groundwater and accepted soil/sediment ecological screening values as well as screening values as recommended and included in the Louisiana Department of Environmental Quality's Risk Evaluation and Corrective Action Program (RECAP) remediation standards (RS) and Statewide Order 29B. I also reviewed defendant's expert supplemental reports submitted to me on 3/10/2014.

Introduction:

At the request of the Talbot, Carmouche and Marcello Law Firm, investigations were undertaken by Gary C. Barbee, Ph.D. and George J. Castille, Ph.D., and ICON Environmental Services to review the potential impact of oil field contamination in the vicinity of the East White Lake Oil and Gas Field in Section 16, Township 15 South, Range 1 East, in Vermilion Parish, Louisiana. I was asked to review defendant's rebuttal reports as well as their review of the study and sampling that I conducted on October 16-17, 2010 and subsequent analysis of crab tissue samples collected in the project area.

The study area is located within the White Lake drainage basin, which falls between the coastal Chenier Plain and the elevated Pleistocene prairie terrace area further north. The Chenier Plain is comprised of a series of beach ridges or cheniers, which appear as generally east-west oriented linear bands that project above the surrounding marsh. The elevated bands represent old beach ridges that were stranded inland as the shoreline accreted from long term deposition along the coast. As is typical of modern beaches along the Vermilion Parish coast, these ridges are composed primarily of sand, mixed with a variety of other components, including shell fragments, clay, and silt.

The site has been altered with canals for access and servicing of oil and gas production facilities. These canals drain into Schooner Bayou which drains directly into White Lake. The LAC 33:IX segment is 050703 and has designated use as (A) primary contact recreation, (b) secondary contact recreation, (C) fish and wildlife propagation and (F) agriculture. The segment has designated water use criteria of CL (250), SO_4 (75), DO (5.0), pH (6.5-9.0), BAC (1), °C (32) and TDS (500). The water quality criteria for the receiving water segment includes a limit of 250 mg/L for chlorides and 500 m/L for total dissolved solids. The project site and the immediate canal and Bayou are considered freshwater. The site can be characterized as freshwater wetlands and marsh, low-lying uplands and low-lying uplands adjacent to the drainage features, and oil production facilities. Notable wildlife observed were deer tracks, raccoon droppings, blue crabs, herons, and various shore birds. Evidence of trot line fishing in the onsite canals was observed as well as crab trap markers in Schooner Bayou

My risk assessment and toxicological evaluation focuses on ecological risk as required by the Louisiana RECAP (2003) guidance which includes detailed evaluation steps required to evaluate potential human health risks using the methodology and process and screening tables included in the Louisiana RECAP (2003). The RECAP guidance requires a separate ecological risk assessment (ERA). While the Louisiana RECAP addresses in detail screening options and management options that are "protective of human health and the environment" those screening tables and management options "do not address ecological risks" (RECAP, 2003). RECAP requires that an Appendix C, "RECAP FORM 18 ECOLOGICAL CHECKLIST" be completed to address present and past uncontrolled constituent releases to determine if "the AOI may pose a risk to ecological receptors" (RECAP, 2003). If the Form 18 indicates a potential risk to ecological receptors, the RECAP requires that an ecological risk assessment be conducted as outlined in Section 7.0 of RECAP. The required questions on the Form 18 were completed on March 12, 2014 and based on those required responses, it was determined that further ecological evaluation was required on the site. The completed RECAP Form 18 is included as an appendix to this ERA report (Appendix I-1). I have also addressed human health in regard to potential for biomagnification of contaminants up the food chain and ultimately to both human and wildlife higher trophic level consumers.

RECAP requires that the "Ecological Risk Assessment (ERA)" process follow the approach outlined in current USEPA guidelines (*Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments,* USEPA, 1997). In the screening phase of the ERA, RECAP requires that the EPA guidance *Ecological Soil Screening Level Guidance* (USEPA, 2005) be used. These documents as well as guidance referenced in these required documents have been used in this ERA which is attached to this report (Appendix I). "Ecological risk assessment" (ERA) is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors" (RECAP, 2003).

The ERA presents a qualitative and quantitative appraisal of the actual or potential impacts on plants and animals, other than humans and domesticated animals. As in the case of human health risk assessment, ecological risk occurs if (i) the chemicals of concern are inherently toxic to plants and or animals, and (ii) such chemicals come in contact with the plants and or animal species for a sufficiently long period of time and at sufficient intensity to cause adverse effects. In the absence of any one of these two factors, namely toxicity and exposure, no ecological risk will occur. The toxicity of a chemical depends on the chemical and the species of interest whereas the exposure primarily depends on site specific factors. The magnitude of risk will depend on the magnitude of toxicity and the magnitude of exposure.

This investigation concluded that contamination of site media from oil production activities has occurred, particularly in surface soil and sediments, surface water, and shallow and deep groundwater. The contaminants have the potential to be consumed by humans and wildlife. The contamination, including salts, heavy metals, hydrocarbons, PCBs and possibly other chemicals used during primary and secondary oil extraction operations (e.g., oil pumping, salt water disposal, injection for oil recovery operations, and the associated use of unlined pits), are at concentrations that pose unacceptable risks to the health of the site ecosystem (i.e. habitats and its resident ecological populations of flora and fauna).

The contamination has the potential to affect human populations as well by exposure to contaminated site media through direct contact via direct contact with contaminated surface water and soils/sediments, and/or through ingestion of wildlife, and other biota that have been exposed to contaminated site media. My study (Rogers, 2010) in conjunction with conclusions drawn by Barbee (2010) concluded that heavy metals found in blue crab tissue exceeded protective levels for arsenic, barium, mercury and TPH when considering a subsistence level of consumption which is appropriate for this area in Louisiana. In addition, blue crabs were not found in an area of high contamination (C-7) even after extensive trapping effort (i.e. 36 trap hours). This site provided suitable habitat, so the lack of crabs indicates either a potential lack of forage to attract and hold crabs or potential avoidance to the area due to contamination. My study also has importance to the ecological risk assessment due to the potential for direct consumption of the contaminated prey by upper trophic level animal predators and the potential for the contaminants to biomagnify as prey are consumed by successively higher trophic levels (i.e. crabs to fish and then fish to alligators and fish and alligator to man). Potential adjacent land use is considered as recreational and commercial fishing as well as recreational hunting (i.e. hunting in the upland and wetland areas), and recreational and commercial fishing (crab and alligator harvesting and fishing) in the onsite open water drainage ditches, bayous and ponds and in adjacent and offsite water bodies, and White Lake.

Based on historical records and data collected by ICON (2010), such contamination exists today and has persisted on the property and is potentially ongoing for current practices and will continue to persist and be a source of exposure to human and ecological populations and biota for a significant time in the future. Contaminants detected in site surface soils and sediments were initially very concentrated in localized areas at produced oil and water (brine) discharge points, but with time have dispersed (but not entirely) both horizontally and vertically. The contaminant concentrations in surface soils and sediments and groundwater exceed levels that are considered safe for ecological populations. In addition, contaminants are continuing to disperse throughout the property and to the offsite adjacent property, and can be taken up by biota, since neither the source(s) of the release(s) nor the dispersed contaminants have been mitigated.

Soils
ICON (2014) compared soil sample data to closure requirements listed in Title 43. XIX.313 (Statewide Order 29B) for elevated wetland environments and/or the limiting LDEQ RECAP screening standards. Exceedances were identified as follows:

Summary of Site Soil Values to Regulatory Standards (RECAP Screening Standard/29B)

Constituent	Reg. Standard*	Max. Site value	X Exceed.
Arsenic	**12/10.0**	**50.2**	**4.2/5.0**
Barium	**550/na**	**15,700**	**28.6/na**
Chromium	**100/500**	**501**	**5/1**
Lead	**100/500**	**179**	**1.8/.4**
Mercury	**2.5/10**	**16.7**	**6.7/1.7**
EC mmhos	**16/8***	**92.5**	**5.8/11.5**
TPH-DRO	**65/na**	**152,432**	**2,345/na**
TPH-ORO	**180/na**	**23,500**	**130.6/na**
PCB	**.11/na**	**.204**	**1.9/na**
Leach. Chlor.	**na/500**	**4,790**	**na/9.8**

***Elevated wetland environments**

The 29B elevated wetland standards were based on agricultural use of the soil and protection of plant health so they are included in this section.

As reported by ICON (2014) soil contamination existed and includes seepage from former pits, spills, leaks and surface breaches.

Ecological Risk Assessment (ERA)

As required under RECAP, a "RECAP Form 18 Ecological Risk Assessment Checklist" (ERA Level I) was prepared to determine if ERA was warranted for the site. The required responses indicated that further ERA was warranted. Prior to beginning the ERA, I compared site concentrations to background concentrations levels in samples collected by ICON (2010) in accordance with LDEQ (2003) *Risk Evaluation / Corrective Action Program* guidance. In the next step (Level II), of the ERA process the site constituents were compared to ecological screening benchmarks to identify "Contaminants of Ecological Concern (COECs)". A Level III ERA was conducted to determine the potential risk to site ecological receptors from the contaminants. The ERA is included in the attached Appendix I.

Based on the Step 2 ERA the following COECs at the site exceeded the screening levels and harmful effects to the ecological receptors cannot be ruled out:

Arsenic (mammals, plants, benthic invertebrates)

Barium (invertebrates, mammals, plants, microbes, benthic invertebrates, aquatic life[gw,sw])
True & Total Barium (invertebrates, mammals, plants, benthic invertebrates)
Cadmium (birds, mammals, benthic invertebrates, aquatic life [gw])
Chromium (birds, invertebrates, mammals, plants, microbes)
Lead (birds, mammals, plants, benthic invertebrates, aquatic life [gw])
Mercury (invertebrates, plants, benthic invertebrates)
Zinc (birds, invertebrates, mammals, plants, microbes)
Strontium (aquatic life [gw])

[gw] Groundwater samples exceeded freshwater screening levels
[sw] Surface water samples exceeded freshwater screening levels

Due to a lack of screening levels for wading birds and waterfowl, several COECs (e.g., arsenic, barium, true & total barium, cadmium, chromium, lead, mercury, selenium and zinc) were carried through to the Level III ERA for these species. Finally, for some COECs, no screening levels were available for birds (i.e., mercury, barium, true and total barium) or mammals (mercury), so these COECs were carried through to the Level III ERA.

Based on these assumptions, the Scientific Management Decision Point (Step 2) was to progress to a Level III ERA. Based on a review of the COECs it was determined that the potential for bioaccumulation from site sediments and surface water into blue crabs (*Callinectessapidus*) and ingestion by resident wildlife and human populations warranted further evaluation. This evaluation is presented in Step 7: Risk Characterization.

Level III Ecological Risk characterization

A Level III ERA was conducted to further evaluate the "contaminants of ecological concern" (COECs) at the VPSB site. "Ecological risk assessment (ERA) is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors" (RECAP, October 20, 2003). In the ERA Level III assessment site specific exposure data is used to further evaluate the likelihood of adverse ecological effects and to decrease the uncertainty of the evaluation. The ERA is included as a separate appendix to this report (Appendix I).

Potential Exposure Pathways

In this evaluation the site specific potential exposures are identified. Considering the potential site use for recreation (i.e.; hunting and fishing) in the freshwater swamps, marshes, lake and canals the following exposures were considered:

- Bioconcentration of contaminants at depth from soils and sediments (i.e. <4 feet) in plant roots and accumulation in the roots and transport and bioconcentration in the above ground vegetation and ingestion by invertebrates, herbivorous mammals and birds (i.e. earthworms, mallards, rabbits)

- Deposition of contaminated plant tissues (detritus) in subsurface and surface soils (i.e. assumes rooted depths from surface to 48")
- Bioconcentration of contaminants in aquatic habitats at depth into benthic invertebrates (midges, aquatic worms, shellfish) and fish and ingestion by shorebirds (i.e. spotted sandpiper and snowy egret)
- Ingestion of contaminated soil during feeding and grooming
- Ingestion of contaminated prey by omnivorous and carnivorous predators (robin, woodcock, least shrew and fox)
- Bioconcentration into blue crabs and ingestion by carnivorous and omnivorous predators (e.g. Great blue heron and American mink)

Based on these predicted pathways and exposures and a review of the species expected to be found at the site, the ecological indicator species selected for detailed Level III evaluation of COECs were as follows:

- Least shrew
- American robin
- Red fox
- Spotted sandpiper
- Swamp rabbit
- American woodcock
- Mallard
- Snowy egret
- American mink
- Great blue heron

A review of the COECS and HQs as well as the potential for the selected COECs to provide a reasonable risk estimate resulted in the following COECs for detailed evaluation in Step 7 of the ERA:

- Aluminum*
- Arsenic
- Barium
- True and Total Barium
- Cadmium
- Chromium
- Copper*
- Lead
- Mercury
- Nickel
- Zinc

*COEC not analyzed in sediment but detected in crab tissue analyses.

Hazard quotients (HQs) for these constituents exceeded one (1) for one or more of the screening receptor groups (avian, invertebrates, mammals, plants, microbes, benthic/aquatic organisms; Attachment 1-2) or were detected in blue crab (*C. sapidus*) tissue warranting further evaluation for wildlife.

Based on exposure point concentrations and adjusted PCLs (i.e. protective levels) the Level III ERA resulted in hazard quotients greater than >1 for the following constituents:

COEC	Indicator Species	Final HQ
Aluminum	American Mink	6.8*
Arsenic	Snowy Egret	7.1
	Least Shrew	2.1
Barium	American Robin	17
	American Woodcock	18
	Spotted Sandpiper	221
	Mallard	25
	Snowy Egret	31
	Least Shrew	10
	Swamp Rabbit	3.4
	Great Blue Heron	5.7*
	American Mink	1.6*
True & Total Barium	American Robin	1.2
	Spotted Sandpiper	20
	Mallard	2.5
	Snowy Egret	3
Cadmium	American Woodcock	1.3
	Least Shrew	4.1
Chromium	American Robin	5.6
	American Woodcock	8.0
	Spotted Sandpiper	8.2
	Snowy Egret	4.3
	Least Shrew	14.1
Copper	Great Blue Heron	1.1*
Lead	American Robin	3.2
	American Woodcock	4.6
	Spotted Sandpiper	5.3
	Snowy Egret	3.2
	Least Shrew	2.5
Mercury	American Robin	6.2
	American Woodcock	7.5
	Spotted Sandpiper	9
	Mallard	1.6
	Snowy Egret	11.2
	Least Shrew	174
	Swamp Rabbit	18
Selenium	Spotted Sandpiper	6.1

	Snowy Egret	4.0
	Least Shrew	2.9
Zinc	American Woodcock	1.1
	Spotted Sandpiper	1.6
	Least Shrew	1.6

*HQ based on dose calculated using blue crab tissue data.

It is important to remember that the indicator species were selected to represent a group of species with similar feeding behavior and occupying the same trophic level. As such, HQs in excess of one indicate a potential effect to the represented group rather than just to the indicator species. For example, the barium HQ for the Spotted Sandpiper indicates a concentration over 220 times the calculated protective level based on the TRV for probing shorebirds. Furthermore, the presence of multiple contaminants with HQs exceeding one likely increases the overall risk to these species.

These HQs represent a potential ecological risk as the site if a management option is not implemented.

Crude Oil Effects on Ruminants

The effects of crude oil on cattle can be used to evaluate potential adverse effects on other ruminant mammals such as white-tailed deer found on the site. Mammals exposed to high levels of crude oil and its products can experience acute and chronic effects. Acute (severe) bloat can occur shortly after consumption of petroleum hydrocarbons and result in animal death, but does not happen in all cases. It is more common after consumption of highly volatile petroleum products. Affected mammals may appear thin or lethargic within 24 hours of exposure and lasting up to two weeks depending on the dose and content. Rumen motility (movement) slows within the first day after ingestion. Normal digestive function may not return in some cattle, leading to a chronic wasting condition. Manure pats may appear excessively dry.

Ingestion of large volumes of crude oil results in vomiting and aspiration into the lungs. Nervous system damage is usually associated with inhalation of petroleum-based products. Excitability, depression, shivering, head tremors, vision disruption, and in-coordination can arise following lung absorption of petroleum hydrocarbons. Yet the most serious consequence of breathing in these hydrocarbons is pneumonia. Severe pneumonia, coughing, rapid shallow breathing, reluctance to move, head held low, weakness, dehydrated appearance, and oily nasal discharge can be seen in animals that breathe in highly volatile mixtures. Death often follows within days.

Discussion:

The appropriate future land use scenario for the property should include recreational/commercial fishing, hunting and fishing and hunting camps, thus the use scenario is based on the following:

1. The presence of elevated topography on the property has allowed the development of infrastructure such as canals to allow access to the property, and would allow the construction of camps and other inhabited structures on the property.

2. The near-surface groundwater is a potential domestic water source for wildlife and potentially livestock,
3. Nearby areas and on site oil field operations have electricity, so power could be readily supplied to residential property,
4. Contaminant exposures to upper trophic levels of wildlife and residents potentially would occur through ingestion of contaminated fish and wildlife, and dermal contact with, contaminated surface soil and water, and contaminated groundwater.

The culture and living habits of rural populations in Louisiana is unique in that many tend to "live off the land" more than other metropolitan populations of Louisiana. Thus, residents of all ages from this community are more likely to be exposed than the average Louisiana citizen to contaminants by ingesting biota from on-site, and from exposure to contaminants potentially migrating from the property.

CONCLUSIONS

1) The site and adjacent property has the potential and is currently being used for recreational purposes (deer and small game hunting) and recreational and commercial fishing.
2) The subject property and adjacent property is now used primarily for oil and gas production as well for recreational hunting and fishing.
3) Both commercial and recreational fishing (crabs and fin fish) are occurring in the canals that drain the property as well as in the onsite canals.
4) Sampling of the subject property by ICON revealed several areas of extensive contamination. However, this does not mean that other areas of contamination, or other contaminants, might not have been present despite the best efforts of ICON to detect them.
5) Contamination of site media, particularly surface soil and shallow groundwater has resulted from oil and salt water handling operations. Residual contaminants from those operations, including metals, salts, and hydrocarbons pose an unacceptable health risk to human and ecological populations.
6) The resistance to natural degradation processes of metals, hydrocarbons and salts allow these constituents to remain in the soil and groundwater posing a risk to human and ecological populations for a long period of time.
7) As a result of frequent rainfall inundation, any contamination exposed at or near the ground surface is subject to spreading into the surrounding environment via a direct hydrologic connection. The fact that the property and adjacent property are being used for hunting, shell and fin fishing poses a risk to humans who utilize those properties. Any contamination that gets into the local food chain has the potential to be ingested by hunters, fishermen, and others who frequent the property and adjacent properties and consume wildlife that are harvested there. The chance of contaminated wildlife ingestion is further increased by the presence of commonly consumed game animals and other forms of wildlife, all of which can be found on and adjacent to the property.
8) Contamination of surficial soils exceeded protective levels for waterfowl, small game and other wildlife, indicating a potential threat to these populations.

(9) Concentrations of contaminants may be found at much higher levels at those sites and as such, once available, the risk calculations in this report will require updating and revision.

(10) Field sampling results at sample site C-7 did not result in any blue crab captures, indicating potential avoidance of the area to the high levels of contamination found at the site.

EXHIBIT A: CURRICULUM VITAE OF WILLIAM J. ROGERS

WILLIAM J. ROGERS

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Research and Expertise: Environmental assessment decision support modeling, human health and ecological environmental risk modeling, toxicology, environmental remediation, waste management and handling with emphasis on oil production, industrial and agriculture related natural resource and environmental quality issues.

Education:	1999	Texas A&M University College Station, Texas Ph.D Wildlife and Fisheries Sciences Dissertation: Development and Application of the Weight-of-Evidence Ecological Risk Assessment Model
	1976	West Texas State University Canyon, Texas M.S. Biology Thesis: A Biotelemetry Study of Winter Activity Patterns of Scaled Quail (*Callipepla squamata*) in the Texas Panhandle
	1974	West Texas State University Canyon, Texas B.S. Biology

Certifications:
Certified NORM (Naturally Occurring Radiological Materials) Surveyor
Certified Hazardous Materials Manager, Institute of Hazardous Materials Management #1694 Masters Level
1988- Instructor OSHA 40-hr Hazardous Waste Site Worker, 8-hr annual refresher and 8-hr supervisors training.
Certified FWS Instreamflow (IFM)
Certified Habitat Evaluation (HEP)

Societies, Committees and Boards:
Society of Environmental Toxicology and Chemistry
Society of Risk Analysis
Executive review board member and technical reviewer *Ecotoxicology*
Topic Editor *Encyclopedia of Water Science*
Member *Institute of Hazardous Waste Management*
Member Texas Commission on Environmental Quality Ecological risk assessment working committee

Awards:
2010: Profession Service Excellence Award for 2009-2010 awarded by the College of Agriculture, Science and Engineering College of Agriculture, Science and Engineering, West Texas A&M University.
2009: Meritorious Paper Award for presented paper entitled, Superfund Site Analysis Using Web 2.0 Technologies Association of Information Technology Professionals.
2004: Exceptional Leadership in Teaching Environmental Science. Texas Commission on Environmental Quality.

2003: Awarded the Deleos Pugh - Outstanding Member Award. Zeta Kappa Chapter.
2002: Awarded the Deleos Pugh - Outstanding Member Award. Zeta Kappa Chapter.
2000: Best in Practice - Texas 2000 Innovative Technology. Designer, Dual-phased saturated and unsaturated zone treatability demonstration to remediate high explosives. Texas Natural Resource Conservation Commission.
1997: Peer Recognition Award, U.S. Department of Energy.
1996: Greening the Government - Closing the Circle Certificate of Achievement. Department of Energy Washington D.C.
1989: Outstanding Employee Award. SAIC.
1988: Secretary of the Interior Award, Laguna Atascosa Study and contributions to the Selenium and Other Toxic Substance Task Force Secretary of Interior, U.S. Department of the Interior.
1984: Performance Award for Exceptional Work, Velarde Project, U.S. Department of the Interior.

Summary of Experience

Director Environmental Science Program, Full Professor in Life, Earth and Environmental Sciences, researcher. Senior World Bank and United Nations Environmental Program advisor on global environmental issues and post-Soviet Russia, Romania, Azerbaijan and Argentina. Lead technical advisor in demonstration of Caspian Sea coastal oil cleanup technologies. Support to DOT in table-top and full field evaluation of "Oil Protection Act" emergency spill contingency planning and demonstration (Reviewed BP plan in Louisiana estuary and bay). Author of "Oilman's Environmental Quick Reference" a handbook for environmental compliance for the oil industry.

Over 30 years experience in virtually all aspects of environmental planning, restoration, and protection. Managed and prepared large scale, controversial environmental impact statements, directed public-involvement programs, and developed environmental regulation compliance strategies for projects in seven southwestern states and six EPA regions. **Served as the southwestern coordinator on the Secretary of Interior's Task Force on Selenium and Other Toxic Substances evaluating construction and irrigation project effects on surface water and wetland quality and risk assessment of non-point sources and irrigation return flows on human health, aquatic systems and wetlands. Evaluated impacts of irrigation return flows on the environment human health and to the Laguna Atascosa Bay wildlife.**

Senior Program Manager specializing in the area of risk-based closure of complex environmental restoration sites and the evaluation and modeling of environmental risk. **Developed and currently expanding, under contract to Texas Commission on Environmental Quality, "Ecological Protective Cleanup Level (PCL) Model" to integrate and quantify observed and predicted human and ecological effects at construction and contaminated and disturbed sites/habitats for all habitats in Texas. This model has been reviewed and supported by the Texas Ecological Working Group comprised of federal and state agencies as well as private and industrial stakeholders. D**evelopment and Application of the Weight-of-Evidence Ecological Risk Assessment Model

Waste Management and Environmental Restoration Program Manager at the Pantex Nuclear Weapons Plant overseeing a $140 million dollar environmental planning and restoration program with an annual budget of $30 million. Managed multi-disciplinary technical teams and directed large scale environmental projects on highly visible projects such as the Deaf Smith High Level Repository, Yucca Mountain High Level Repository, Nevada Test Site, Savannah River, Oak Ridge, Rocky Flats, White Sands, Los Alamo, and numerous water development projects. Actively involved in implementing the Texas Risk Reduction Program as well as the EPA Region III, risk-based approach to human and ecological risk assessment and site closure. Lead in development of hazardous materials "ecological protective cleanup levels" for TCEQ and member of TCEQ Ecological Working Group. Author of "Oilman's Environmental Quick Reference" an environmental compliance guide for the oil industry.

Litigation Support and Testimony:

Gustave J. Labarre, JR., ET AL. vs. Texas Brine Company, LLC and Georgia Gulf Chemicals & Vinyls, LLC; **Docket No. 30,650; Division "C" 23rd Judicial District Court, State of Louisiana, Parris of Assumption.** Ecological and human health risk assessment (2013)

RARITAN BAYKEEPER, INC., d/b/a NY/NJ Baykeeper, 52 West Front Street) Keyport, NJ 07735) EDISON WETLANDS ASSOCIATION, INC., 206 Tyler Road, Edison, NJ 08820. Plaintiffs v. NL INDUSTRIES, INC. 5430 LBJ Freeway, Suite 1700, Dallas, TX 75240, NL ENVIRONMENTAL MANAGEMENT SERVICES, INC. ,5430 LBJ Freeway, Suite 1700 Dallas, TX 75240, SAYREVILLE ECONOMIC AND REDEVELOPMENT AGENCY,167 Main Street Sayreville, NJ 8872,O'NEILL PROPERTIES GROUP, L.P. Ecological and human environment risk assessment (2012)

*Sterling Sugars, Inc. v BP America Production Company, et al.***;** Case No. 113,095, Div. "E"; 16th JDC, St. Mary Parish, LA; Charenton Oil Field, St. Mary Parish, LA. Ecological and Human Health risk Assessment (2012).

Ecological Rights Foundation v. Pacific Gas and Electric Company. No. 3:10-CV-00121-RS, United States District Court for the Northern District of California. Risk assessment of contaminants from equipment and utility poles storage areas on human environment and to ecological receptors-Ecological and human environment risk assessment (2012)

Geer, et al. v. BP America Production Co., et al. Docket 10-18439, 38th JDC Cameron Parish, Louisiana. Environmental damages associated with oil field development in Big Lake Oil Field, Cameron Parish. For Talbot, Carmouche & Marcello, Baton Rouge, Louisiana. Expert witness – Ecological and Human Health risk Assessment (2011-2012).

State of Louisiana and Cameron Parish School Board v. Aspect Energy, LLC, et al. Docket 10-18673, 38th JDC Cameron Parish, Louisiana. Environmental damages associated with oil field development in Johnson Bayou Oil Field, Cameron Parish. For Talbot, Carmouche & Marcello, Baton Rouge, Louisiana. Expert witness - Ecological and Human Health risk Assessment (2011-2012).

State of Louisiana and the Cameron Parish School Board v. BP America Production Company. Docket 10-18627, 38th JDC, Cameron Parish, Louisiana. Environmental damages associated with oil field development in West Hackberry Oil Field, Cameron Parish, Louisiana. For Talbot, Carmouche & Marcello, Baton Rouge, Louisiana. Expert witness - Ecological and Human Health risk Assessment (2011-2012).

Ruby Mhire et al. v. Total Petrochemicals, USA, Docket No. 10-18239; 38th JDC, Parish of Cameron, Louisiana. (2011-2012) (Expert Report) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)(2012).

The Maryland Company, LLC v. Exxon Mobil Corp., et al. U. S. District Court, Western District of Louisiana, Lafayette Division, #6:10-CV-1781. (2010-2011) (Expert report) (Plaintiff support human health and ecological risk assessment on exploration and production contamination.

Jeffrey Picard, et al. v. Kerr-McGee Chemical Worldwide, LLC, et al., Docket No. 05-C-1871; Div. "A," 27th JDC, St. Landry Parish, Louisiana. Environmental damages associated with oil field development in North Cankton Field, St. Landry Parish. (2010-2011) (Expert Report) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)

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Savoie et al. v. Pioneer Exploration Ltd, et al. Docket No. 10-18078, 38th JDC, Cameron Parish, La. Environmental damages associated with oil field development in Kings Bayou Field, Cameron Parish. For Talbot, Carmouche & Marcello, Baton Rouge, Louisiana. (2010-2011). (Expert witness) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)

Houssiere v. ASCO USA, L.L.C. et al. Docket No. 84068, Div. L, 15th JDC, Acadia Parish. Environmental damages associated with oil field development in Acadia Parish. For Due, Price, Guidry, Piedrahita & Andrews, Baton Rouge, Louisiana. (2010-2011). (Expert witness) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)

C. S. Gaidry, Inc. et al. v. UNOCAL. 32nd Judicial Court, Terrebonne Parish, Louisiana. Environmental damages associated with oil field development in Terrebonne Parish. For Talbot, Carmouche & Marcello, Baton Rouge, Louisiana. (2009-2010). (Expert witness) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)

Daniel Hardee et al. v. Arco et al. 14th Judicial District Court, Calcasieu Parish, Louisiana. Environmental damages associated with oil field development in Vermilion Parish (Hardee tract). (2009-2010) (Expert Report) (Plaintiff support human health and ecological risk assessment on exploration and production contamination)

United States District Court, Northern District of California, **Civil Case No.: C 06-02560 JSW WDB Humboldt Baykeeper,** a program of Ecological Rights Foundation, and Ecological Rights Foundation, a non-profit corporation, Plaintiffs,

v.

Union Pacific Railroad Company, a Delaware corporation, North Coast Railroad Authority, a state agency, and CUE VI, LLC, an Alaska limited liability company, **Defendants.** (Plaintiff support on oil, heavy metal, dioxin and furan contamination of Humbolt Bay, California)

In the 100th Judicial District Court in and for Donley County, Texas, Case No. 5651
JAKE HESS II, James Birchfield and wife, Alice Birchfield,
Joe Glass and Wife, Cynthia Glass, J. Joyce Williams, and
Chad Breddding, Plaintiffs v. **McClean Feedyard, INC. A Texas Corporation, Defendant.**
(Defendant support on cattle feedyard stormwater effects on local drinking water as well as domestic livestock and wildlife)

In the 242nd District Court of Hale County, Texas, Case No B35751-0712
Oneok Westex Transmission, LP, Plaintiffs v. Castor Oil, INC. Defendants (Plaintiff support oil pipeline case and potential to disrupt castor oil production and potential for ricine contamination)
*Hackensack Riverkeeper, Inc. v. Honeywell International Inc.,***D.N.J., Civ. No 06-22 (DMC), consolidated with Civ. No. 05-05955.** (Plaintiff support on potential impacts to Hackensach and estuary wildlife from chromium contamination) (2010 -2013)

Lodwick LLC et al v Chevron, et al; Docket #501879; Div "B"; 1st JDC: Caddo Parish, LA; Belleview Oil Field, Caddo, LA. (Expert report on impacts of legacy oil contamination).

Pennenvironment and Sierra Club v. PPG Industries Inc. and Borough of Ford City, Civil Action Nos. 2:12cv-00342, 2:12-cv-00527; 2:13-cv-01396. (Expert report and ecological risk of glass production wastes)

Sterling Sugars Inc. v. Amerada Hess Corporation, et al. Docket # 100091; Div. "D". (Expert report human health and ecological risk assessment)

Professional Experience

West Texas A&M University, Canyon, Texas
(1997-Present)
Associate Dean Environmental Safety, health and Compliance, Environmental Science Program Director, Researcher, Associate Professor in Life, Earth and Environmental Sciences and technical consultant to the World Bank and United Nations on environmental pollution, remediation, risk and global environmental sustainability. Lead in development of hazardous materials "ecological protective cleanup levels" for TCEQ. Regional expert on pond, lagoon and landfill lining technology and materials applications.

Providing technical support to the U.S. Department of Energy, Pantex Plant in implementation of risk-based remediation and closure of hazardous waste sites. Engaged in environmental projects in Azerbaijan, Russian, Romania, Texas, Kansas, and Colorado working closely with regional and international scientists. **The World Banks technical advisor and lead on one of the world's largest mercury cleanups, construction of the Republics first hazardous waste landfill, demonstration of Caspian Sea oil remediation technologies and the redrafting of their environmental regulations to international standards in post-soviet Azerbaijan.**

Lead Technical advisor to the World Bank to assist Argentina Ministry of Industry in design for the environment and innovative environmental compliance strategies for the tanning, meat processing, dairy and electroplating industries to protect Matanza Basin water quality and inflow in to the LaPlata River to protect human health and marine systems.

Battelle Memorial Institute, Amarillo, Texas
(1996-1997)
Served as Senior Program Manager and Battelle representative on the Chemical Manufactures Association Committee on endocrine disruptors and persistent toxic bioaccumulators. Provided technical support to large corporate clients such as Allied Signal and Honeywell in the area of risked-based site cleanup and closure and well as strategic environmental planning. Member, Battelle Pacific Northwest Laboratory working committee on the expansion of the Battelle developed Multimedia Environmental Pollutant Assessment System (MEPAS) to integrate ecological assessment endpoints into the model resulting in a fully integrated human health and ecological risk assessment modeling tool. Participated on a joint Texas A&M/Battelle team working in Azerbaijan working with Republic scientists on industrial pollution. Current studies are focused on the impacts of industrial pollution on the Caspian Sea Sturgeon.

Battelle Memorial Institute, Amarillo, Texas
(1993-1996)
Department Manager, Environmental Restoration at the U.S. Department of Energy, Pantex Plant. Managed a program budget of $144 million and an annual budget of over $30 million and a direct staff of over 40 technical personnel. Managed all aspects of the Environmental Restoration Program, including technology development, innovative site characterization methodologies, and in situ remediation alternatives. Published an environmental compliance guide for oil industry entitled, "The Oilman's Environmental Quick Reference". Led an initiative to implement the "Streamlined Approach for Environmental Restoration (SAFER)" to the Pantex Environmental Restoration Program. This initiative resulted in a program cost reduction of 44% and accelerated the program by 4 years.

Designed and managed the installation of an innovative dual-phased saturated and unsaturated zone treatability demonstration to remediate high explosives in a perched aquifer. The effort was nominated as a "Texas 2000 Innovative Technology" by the local Texas Natural Resource Conservation Commission office and awarded "Best in Practice" by an independent review panel.

Science Applications International Corporation, San Antonio, Texas
(1992 - 1993)
Deputy Operations Manager and led technical project management and environmental business development with office revenues in excess of $30 million. Program manager of a $6.9 million-per-year environmental support contract to the TVA. Under this contract, managed a staff of up to sixty technical experts and up to twenty concurrent RCRA remediation task orders including a $3 million field effort in Alaska to the U.S. Air Force to remediate the "White Alice" early warning sites and King Salmon Base (Jet fuel contamination of Bristol Bay). Provided both management and technical support to Kelly Air Force Base environmental restoration program including 2 U.S.EPA innovative technology demonstrations.

Science Applications International Corporation, Golden, Colorado
(1990 - 1992)
Environmental Services Manager, Assistant V.P. responsible for innovative technology and program development, project management, and client interface. Staffed and managed an office of 160 personnel. Provided quality assurance support to EG&G Rocky Flats in support of environmental programs at the site. Project Manager for the Rocky Flats Site Wide Quality Assurance Project Plan for CERCLA RI/FS and RCRA FI/CMS Activities. This high profile project was completed and approved by both the Federal and State agencies within 8 months. This effort was in response to the Federal Bureau of Investigation raids and findings at the facility. Los Alamos National Laboratory subsequently adopted the plan. Represented the DOE at regulator meetings and negotiations with federal and state regulators and interest groups and their counsel.

Managed the development of the work plan and sampling procedures for a deep stratigraphic test well in support of a RCRA and Safe Drinking Water Act disposal permit renewal and pending $1 billion class action law suit. The plan was completed in 60 days and was approved without revision or comment by federal and state agencies. Subsequently, the no-migration petition and permits were also approved. Prepared and conducted training programs dealing with NEPA/CEQ, ESA, hazardous waste site worker (OSHA 40 hr), RCRA, SARA, Title III, CERCLA, and environmental regulatory compliance. Managed Environmental Compliance and Assessment System (ECAS) team and protocol development, commended by DOD and used as the model program. Managed a team of three ECAS managers that conducted environmental assessments at over 1200 Department of Defense facilities. Developed a systems approach to CERCLA environmental evaluations and development of data quality objectives. Prepared a technical review of Canadian EIS requirements as they compare to U.S. NEPA and California EIA requirements.

Science Applications International Corporation, Las Vegas, Nevada
(1988 - 1990)
Senior environmental scientist assigned to the Yucca Mountain Project (planned underground high-level nuclear waste repository). Developed Yucca Mountain hazardous materials management and handling program (the first of its kind), which addressed federal, state, and DOE Order requirements. Developed environmental regulatory compliance strategies, programs, schedules, and program tracking systems. Served as a technical reviewer for the DOE in the area of environmental compliance, completed an integration study of state and federal environmental studies, environmental compliance regulations, DOE Orders, and requirements of the Nuclear Waste Policy Act, National Environmental Policy Act, Clean Water Act, Safe Drinking Water Act Endangered Species Act, as well as the Atomic Energy Act.

Provided technical review and comment on proposed regulations on both high level radioactive and hazardous wastes. Served as the principal investigator on biological resources Utah Electronic Training Capability EIS to address the impacts of a combat training on terrestrial and aquatic resources. Other responsibilities included preparation of environmental protection and implementation plans, preliminary safety analysis reports, and environmental safety and health implementation plans.
Battelle Memorial Institute, Amarillo, Texas
(1987 - 1988)
Regulatory compliance specialist on the proposed Deaf Smith County nuclear-waste repository project. Technical reviewer for DOE in the areas of environmental compliance and technical merit of site characterization study plans. Responsibilities included the integration of state and federal environmental compliance regulations with the requirements of the Nuclear Waste Policy Act. Prepared the surface-water sections of the Deaf Smith County Site Characterization Plan and Requirements Resolution and Strategy Plan, and developed and reviewed aquatic resource studies on the area playa lakes.

U.S. Department of Interior - Bureau of Reclamation, Amarillo, Texas
(1985 - 1987)
Served on the Director's staff as Regional Environmental Specialist accountable for environmental compliance and programs for a five-state area. Accountable for regional hazardous waste and emergency response programs. Developed the "Regional Hazardous Materials Management and Contingency Plan" that was recommended for use Bureau-wide. Coordinated environmental studies and assessments, and prepared environmental assessments and impact statements on large-scale construction projects. Served as a regional coordinator on the Secretary of Interior's Selenium and Other Toxic Substance Task Force, which evaluated the impacts of irrigation return flows to aquatic systems. Served as the Regional Endangered Species Coordinator. Responsible for the review, comment, and interpretation of environmental legislation as it related to Bureau of Reclamation construction and operation activities.

Ducks Unlimited, Amarillo, Texas
(1984 - 1985)
Regional Director for a private conservation organization in Oklahoma and Texas. Directed the activities of two state committees and prepared two state newsletters. Coordinated wildlife projects with both state and federal agencies. Coordinated Matching Aid to Restore States Habitat (MARSH) programs in Texas and Oklahoma. Reviewed wetland projects throughout the United and Canada.

U.S. Department of Interior, Bureau of Reclamation, Amarillo, Texas
(1979 - 1984)
Regional Environmental Specialist and Wildlife Biologist for project planning and development. Responsible for NEPA and executive order compliance and managed the preparation of environmental assessments, impact statements, and endangered species assessments. Managed over 40 environmental assessments, EISs and endangered species studies and reintroduction programs. Developed a "Habitat Evaluation Procedures" training program and presented the program to Bureau of Reclamation and U.S. F.W.S offices throughout the southwestern U.S.

Petrolite Corporation, Great Bend, Kansas
(1977 - 1979)
Field Scientist/engineer responsible for development and field-testing of chemical treatments for fresh- and salt-water problems in oil production and industrial applications. Designed treatment performance tests and analyzed corrosion, scaling, bacterial, and fungal contamination and thermal pollution. Conducted field studies on the effects and abatement of microbial corrosion on oil and gas facilities and piping. Evaluated performance of oil demulsifiers, dispersants and oil production treating chemicals.

Commercial Software Developed

2010: Vegetation Establishment Guidance for Decisions: Assistance Tool (VEGDAT). Software decision support tool developed for the Texas Department of Transportation to assist in disturbed roadside vegetation establishment. WTAMU conducted specific research on vegetation re-establishment techniques at three locations in the Texas Panhandle and provides recommendations for improved practices.

2008: Ecological Protective Cleanup Level Generator. The software was developed under a contract with the Texas Commission on Environmental Quality through the Texas Engineering Experimental Station. I led the development of the model and collaborated with Drs. Russell Anderson and Musa Jafar in the Business College as well as the Texas Ecological Risk Working Group. The database will be housed on the WTAMU system for interactive use.

2000: Development and Application of an Integrated Model for Ecological Risk Assessment employing the Spatial Habitat Equivalency Method. I led this project in collaboration with Battelle Memorial Institute and the U.S. Department of Interior Ecological Working Group at Texas A&M University to integrate a contaminant fate and transport model (MEPAS) and a spatial habitat equivalency model to generate current and projected (based on time steps) contaminant concentration dependent effects of ecological indicator species and habitats. This concept and approach was patented.

Selected Peer Reviewed Publications

Heim, Bradley, Brian Yates and William J. Rogers, Protective Concentration Level Calculator: Providing a Web-Based Knowledge Management Tool to the Community of Ecological Risk Assessment Professionals, Proceedings of the International Association for Development of the Information Society, International Symposium, Madrid Spain, February 28,2014. Accepted for publication.

Ghosh, N., Finger, K., Usnick, S., & Rogers, W. J. (2010). Microscopic Examination on Cytological Changes in Allium cepa and Shift in Phytoplanktonic Population at Different Doses of Atrazine. *Scanning Microscopy 2010, 7729 (W-1)*, 1-14.

Anderson, R., Jafar, M., & Rogers, J. (2010). Superfund Site Analysis Using Web 2.0 Technologies. *Journal of Information Systems Applied Research, 3 (6)*, 1-11.

Estrada, G., Thompson, A., Ghosh, N., & Rogers, W. J. (in press, 2009). Effects of Atrazine on Freshwater Phytoplanktonic Growth, Population Density, and Community Structure. *Texas Journal of Microscopy.*

Anderson, R., Jafar, M., & Rogers, J. (2009). Superfund Site Analysis Using Web 2.0 Technologies. Proceedings of the Conference on Information Systems Applied Research.

Rogers, William J,, Gary Barbee, Vipul Saxena, Larry Champaign. Development of web-based toxicity reference values and protective cleanup levels for contaminants of concern and habitat-based indicator receptors. SETAC North America 31st Annual Meeting and Proceedings. Portland, Oregon, November 2010.

Jennifer Collins, William J. Rogers and Nabarun Ghosh. (2007). Microscopic Evaluation of Roundup Influence On A Freshwater Planktonic Community. Texas Journal of Microscopy, 38:2: 23 (2007).

Seong-gi Moon, Brent Auverman and William J. Rogers. Open-Path Transmissometry to determine Atmospheric Extinction of Feedyard Dust, Transactions of the ASAE (2006)

Parker, D.B., J.S. Posey, D.L. Williams, N.A. Cole, **W.J. Rogers**, D.W. Auverman. Biogas production using high solids beef cattle manure in geomembrane lined cells. Transactions of the ASAE (2006)

Swartz C. D., K.C. Donnelly, Arif Islamzadey, Gilbert T. Rowe|, **William J. Rogers**, Grigoriy M. Palatnikov, Rafik Kasimov, Thomas J. McDonald, Jeffery K. Wickliffe and John W. Bickham. 2003. Chemical contaminants and their effects in fish and wildlife from the industrial zone of Sumgayit, Republic of Azerbaijan. Ecotoxicology 12:511-523.

Bickham J. W., C. W. Matson, A. Islamzadey, G. T. Rowe, K. C. Donnelly, C. D. Swartz, **W. J. Rogers**, R. L. Autenrieth, T. J. McDonald, D. Politov, J. K. Wickliffe, G. Palatnikov, A. A. Mekhtiev, and Rafik Kasimov. 2003. Editorial: The unknown environmental tragedy in Sumgayit, Azerbaijan. Ecotoxicology 12:507-510.

Parker, D.B., J.S. Posey, D.L. Williams, N.A. Cole, **W.J. Rogers** and B.W. Auverman. 2001. Psychrophilic biogas production using high solids aged beef cattle manure. Transactions of the ASAE.

Theodorakis, C. W., C. D. Swartz, W. J. Rogers, J. W. Bickham, K. C. Donnelly, and S. M. Adams. 2000. Relationship between genotoxicity, mutagenicity, and fish community structure in a contaminated stream. Journal of Aquatic Ecosystem Stress and Recovery, 7:131-143.

Bickham, J. W., G. T. Rowe, G. Palatnikkov, A. Mekhtiev, M. Mekhtiev, R. Yu. Kasimov, D. W. Hauschultz, J. K. Wickliffe, and W. J. Rogers. 1998. Acute and genotoxic effects of Baku Harbor sediment on Russian sturgeon, *Accipenser guildensteidti*. Bulletin: Environmental Contamination and Toxicology. 61:512-518.

Rogers, W. J., and J. W. Bickham. 1998. Spatial weight-of-evidence ecological risk assessment driven resource allocation. Proceedings of the American Nuclear Society, Topical Meeting on Risk-based Performance Assessment and Decision Making, Richland/Pasco, WA, 180-186. (Risk committee reviewed and invited Paper)

Bickham, J. W., W. J. Rogers, and C. W. Theodorakis. 1998. Transgenerational genetic effects of environmental contamination: Implications for risk assessment. Proceedings: American Nuclear Society, Topical Meeting on Risk-based Performance Assessment and Decision Making, Richland/Pasco. WA. 187-194. (Risk committee reviewed and invited Paper)

Wells, F., Jackson, G., and Rogers, W. J. 1987. Field screening and assessment of irrigation drainage in the Lower Rio Grande Valley and Laguna Atascosa National Wildlife Refuge. Texas: U.S. Geological Survey Water Resources Investigations Report. (Reviewed the National Academy of Science special committee to the Secretary of Interior).

Books and Book Chapters

Rogers, William. 1994. The Oilman's environmental quick reference. Armstrong Oil Directories and Publishing. Amarillo, Texas. 341 p.

Rogers, William J. and Kevin Jeans, Chemical measurement. Encyclopedia of Water Science. Edited by B.A. Stewart and Terry A. Howell. Marcel Dekker Publishing, Inc. 2003. p. 62-66.

Rogers, William J. pH analysis. Encyclopedia of Water Science, Edited by B.A. Stewart and Terry A. Howell, Marcel Dekker Publishing, Inc. 2003. p. 663-665.

Copyrights

William J. Rogers. Development and application of an integrated model for ecological risk assessment-employing the spatial habitat equivalency method. Copyright TX5-158-309, 2000.

William J. Rogers. Ecological Protective Cleanup Level (PCL) User Interactive Generator. In process.

Meeting and Technical Abstracts and Papers Presented

Rogers, W. J., Saxena, V., & Barbee, G. (2010). *Development of web-based toxicity reference values and protective cleanup levels for contaminants of concern and habitat-based indictor species.* Society of Environmental Toxicology and Chemistry (SETAC), Portland, Oregon.

Yates, B. & Rogers, W. J. (2010). *The effects of atrazine and glyphosate on an aquatic microbial community of the Texas Panhandle.* Society of Environmental Toxicology and Chemistry (SETAC), Stockton, New Jersey.

Yates, B. & Rogers, W. J. (2010, April). *The effects of atrazine and glyphosate on an aquatic microbial community of the Texas Panhandle.* Texas Society for Microscopy, Frisco, Texas.

Paper Presentations - Non-Refereed

Yates, B. & Rogers, W. J. (2010, October). *The effects of atrazine and glyphosate on an aquatic microbial community of the Texas Panhandle.* West Texas A&M 8th Annual Pathways Research Symposium, Canyon, Texas.

2009 Meritorious Paper Award, Conference for Information Systems Applied Research (CONISAR) Superfund Site analysis Using Web 2.0 Technologies. (Note: On September 15, 2009 Dr. Musa Jafar and I received and letter of commendation from the TCEQ on our work. The letter outlines the significance of this work to the TCEQ and to the environmental industry as a whole.0

Monroe, M. R., **W. J. Rogers** and D.B. Parker. 2004. Evaluation of stream sampling methodologies for fecal coliform bacteria. ASAE Biological and Environmental Sciences Annual meeting. Ottawa, Canada. Paper No. 04-4071 (Paper and Poster)

Hartley, Richard S. Ph.D., P.E., **William J. Rogers, Ph.D**., Dennis E. Huddleston, Jeffrey R. Flowers, Martin R. Amos, and Michael O'Connell. 2004. Strategy and model for accelerated closure and long-term environmental stewardship. Proceedings Department of Energy Waste Management 2004 Conference. Tucson, AZ.

Buchanan, J.D. D.B. Parker, M.B. Rhoades, J. Koziel and **W. J. Rogers**. 2003. Assessment of moisture control and additives for odor reduction form open-lot feedyard surfaces. ASAE Paper No. 03-4140.

Rogers William J., Sloan Wendall, Danny Bowman. 2002. The influence of agricultural landuse on organchlorine pesticide persistence in soils and potential transport. Proceedings: Texas Academy of Science, 105th Annual Meeting, February 28-March 2, 2002. (Paper and presentation)

Parker, D.B., J. S. Posey, D. L. Williams, N. A. Cole, **W. J. Rogers**, B.W. Auvermann. 2002. Psychrophilic biogas production using high solids aged beef cattle manure. Transactions of the ASAE, July, 2002) Paper and Poster.

Parker, D.B., D.L. Williams, N.A. Cole, B.W. Auverman and **W.J. Rogers**. 2002. Dry nonheated anaerobic biogas fermentation using aged beef cattle manure. ASAE Paper No. 02-4142. Presented at the 2002 ASAE International Meeting, Chicago, Illinois, July 28-31, (Poster presentation)

Parker, D.B., J.E. Calhoon, **W.J. Rogers**, M.B. Rhoades, M.C. McCullough and C. Robinson. 2001. Infiltration characteristics of cracked clay soils in bottoms of feedyard playa catchments. ASAE Paper No. 01-2281. Proceedings 2001 ASAE International Meeting, Sacramento, California. (Paper and Poster presentation).

Auverman, Brent W. and **W. Jim Rogers**. 2000. Documented human health effects of airborne emissions from intensive livestock operations. Proceedings: Workshop, Industry Services Alberta Pork and Intensive Livestock Working Group. Lacombe, AB December 18, 2000.

Rogers, William J., 2000. Risk assessment-defining the field. Paper presented to the Agricultural Medicine and Rural Health Workshop, Texas Tech University Health Sciences Center, Amarillo, TX. December, 15, 2000.

Rogers, William J., J.W. Bickham and T.M. Bolwahnn, 2000. Spatial weight-of-evidence integrated risk assessment. Society of Environmental Toxicology and Chemistry SETAC 19th Annual Meeting. Presentation and Abstract.

Bickham, John W., Christopher W. Theodorakis and **William J. Rogers.** Integration of genotoxicity, population genetics and ecological risk assessment: Kangaroo rats exposed to radionuclide contamination at a nuclear weapon test facility. The EMAP Symposium on Western Ecological Systems: Status, Issues and New Approaches. San Francisco, CA., April 6-8, 1999.

Rogers, William J. Risk assessment and natural resource damage assessment integration using spatial weight-of-evidence model: An approach to integrating natural resource damage assessment and risk assessment. 1999 South-Central SETAC Regional Meeting, Society of Environmental toxicology and Chemistry, Houston, Texas. April 12-13, 1999. (Invited paper)

Rogers, William J. Spatial weight-of-evidence integrated risk assessment as applied to natural resources. Texas Chapter of the Wildlife Society, Annual meeting, Amarillo, Texas, 1999.

Theodorakis, C.W., C. Swartz,**W.J. Rogers** and J.W. Bickham. 1998. Relationship between genotoxicity, mutagenicity, and community structure in a contaminated stream. Proceedings Society of Environmental Toxicology and Chemistry SETAC 19th Annual Meeting.

Heim, Bradley, Brian Yates and William J. Rogers, Protective Concentration Level Calculator: Providing a Web-Based Knowledge Management Tool to the Community of Ecological Risk Assessment Professionals, l Association for Development of the Information Society, International Symposium, Madrid Spain, February 28,2014. Platform Presentation

Ecological Risk Assessment and Development of Protective CleanUp Levels (PCLs) Invited presentation by EPA Region 2-before EPA Regions 2 and 5, NOAA, New Jersey DEQ, Pennsylvania DEQ, FWS-Presentation and Technical Working Session Chair.

Yates BS, WH Mimbs, GC Barbee, L Champagne and WJ Rogers (2013) *Development and Application of a Web-Based Interactive Database for Generating Ecological Species-Specific Protective Concentration Levels*, 34th Annual Meeting of the North America Society of Environmental Toxicology and Chemistry, Nov. 17–21, Nashville TN (poster)

Mimbs WH, WJ Rogers and GC Barbee (2013) *Genotoxicity of Cotton Herbicide Mixtures in Southern High Plains Playa Lakes,* 34th Annual Meeting of the North America Society of Environmental Toxicology and Chemistry, Nov. 17–21, Nashville TN (poster)

Brownlow JW, GC Barbee and WJ Rogers (2013) *Potential Influence of Clay Slickensides on Subsurface Contaminant Transport*, 125th Annual Meeting of the Geological Society of America, Oct 27-30, Denver CO (platform)

Brownlow JW, GC Barbee and WJ Rogers (2014) *Potential Influence of Clay Slickensides on Subsurface Contaminant Migration*, 51st Annual Soil Survey and Land Resource Workshop, Feb 6-7, College Station TX (platform)

Professional Meetings, Workshops and Seminars Conducted

William. J. Rogers, Appala Paila, Venkata Sambara, Vipul Saxena. Development of Ecological Protective Cleanup Levels for Soil and Water. Presented to the Texas Commission on Environmental quality and the TCEQ Ecological Risk Assessment Working Group (Sept. 2005)

William. J. Rogers, Appala Paila, Venkata Sambara, Vipul Saxena. Development of Ecological Protective Cleanup Levels for Soil and Water. Presented to the United States Air Force Center for Environmental Excellence (Invited Presentation) (December 2005)

Ecological Risk Assessment Workshop. Baku, Azerbaijan in 2005 sponsored by the Azerbaijan Ministry of Environment and BP Oil Company.

Ecological Risk Assessment: Methods and Current Trends. Seminar presented to the Azerbaijan National Academy of Science, Baku Oil Academy and Baku Research Institute funded by Amoco Oil Company. Baku, Azerbaijan. 1999.

Professional Meetings, Workshops and Seminars Attended

Development of User-Interactive Default and Site Specific Ecological Regulator Benchmark Generator. Society of Environmental Toxicology and Chemistry, 18th Annual International Conference, Warsaw, Poland, Full abstract and presentation accepted for May, 2008 platform presentation.

Texas Commission on Environmental Quality Trade Fair, Demonstration of an Ecological Protective Cleanup Generator, May 11/ 2008 Austin Texas

Presentation, "Development of a Hazardous Waste Management System and Remediation of Mercury Contamination in Sumgayit, Azerbaijan, Presented to the Air and Waste Management Society, July 2003.

Ecological Risk Assessment Methods and Current Trends, seminar presented to World Bank and United Nations in Washington D.C. January 1999.

Panel member on "World Bank, United Nations and Agency for International Development working Committee on International Environmental Restoration. January 1999.

Workshop sponsor, "Environmentally Sustainable Privatization of Former Soviet Union Industries" Sumgayit, Azerbaijan, July, 1999.

Mediator, "Department of Transportation Oil Protection Act Oil Spill Emergency Response Workshop and Area Drill", New Orleans, La., July 1999.

Weapons Complex Waste Management & Cleanup-*Engineering the Transition to a Budget-Constrained, Risk-Based, Land-Use Directed, Performance-contract Managed Program.* Seventh Annual Decisionmaker's Forum, *Weapons Complex Monitor, September 26-29, 1995.* Participant.

Technical Reports:

2010: Roadside Vegetation Establishment Quick Reference Guide, Texas Department of Transportation

2010: Synthesis and Study of the roadside Vegetation Establishment Process: Project summary Report. TxDot 0-5731-S

2010: Oneok Westex Transmission, Expert Testimony on site contamination and ricine risk, Evaluated waste water pond liner system and permitting requirements for reactivation of once permitted system. Conducted geophysical testing and soil sampling and evaluation .

2010: Humbolt Bay Baykeepers, Dioxin, PCB, Heavy Metals Risk Assessment Humboldt Bay, California, Review of historic data and evaluation of 303d Clean Water Act compliance for Humboldt Bay and ecological risk assessment for both marine and freshwater aquatic and terrestrial habitats .

2010: Humbolt Baykeepers, Ecological Risk Assessment for Humbolt Bay Estuary, Expert testimony on ecological effects of dioxins/furans, heavy metals and hydrocarbons on ecological resources. Designed and conducted field investigation and prepared ecological risk assessment.

2010: Hackensack Baykeepers, Hackensack Chromium cleanup Project, Technical evaluation of chromium cleanup standards and proposed cleanup on the Hackensack River/Estuary Litigation Support. Technical report and ecological risk assessment completed in 2008.

2009: HumboltBay Baykeepers, Review of historic data and evaluation of 303d Clean Water Act compliance for Humboldt Bay and ecological risk assessment for both marine and freshwater aquatic and terrestrial habitats.

2008: Hackensack Baykeepers, Technical evaluation of chromium cleanup standards and proposed cleanup on the Hackensack River/Estuary Litigation Support. Technical report and ecological risk assessment completed in 2008.

2008: Cemex Agregate International Mexico, Development of environmental strategy for development of cement plant in Seligman Arizona. Development of Habitat Conservation Plant and Endangered Species Consultation for black-footed ferret re-introduction.

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Appendix 1: ECOLOGICAL RISK ASSESSMENT

1.0 Introduction

This ecological risk assessment (ERA) evaluates the risks to ecological receptors and habitats on the Vermilion Parish School Board (VPSB) site from past oil and gas exploration and production activities conducted on the property. While the Louisiana Risk Evaluation/Corrective Action Program (RECAP) addresses in detail screening options and management options that are "protective of human health and the environment" those screening tables and management options "do not address ecological risks". RECAP requires that a RECAP Form 18 Ecological Checklist be completed to determine if "the AOI may pose a risk to ecological receptors. If the Form 18 indicates a potential risk to ecological receptors the RECAP requires that an ecological risk assessment be conducted as outlined in Section 7.0 of RECAP. The VPSB site was visited on October 16-17 and the Form 18 was initiated at that time and updated on March 12, 2014 and completed on that date. The required questions on the Form 18 were completed and based on those required responses it was determined that further ecological evaluation was required. The RECAP Form 18 is included in this report as Attachment 1-1.

RECAP requires that the ERA process follow the approach outlined in current EPA guidelines (*Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments,* EPA, 1997). In the screening phase of the ERA, RECAP requires that the EPA guidance*Ecological Soil Screening Level Guidance* (EPA, 2005) be used. These documents as well as guidance referenced in these required documents have been used in this ERA. "Ecological risk assessment (ERA) is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors" (RECAP, October 20, 2003).

2.0 Ecosystem at Risk

The VPSB site lies approximately 17 miles southof Kaplan, Louisiana in VermilionParish.It is located within the White Lake drainage basin, which in turn is located between the coastal Chenier Plain and the elevated Pleistocene prairie terrace area further north. The Chenier Plain is a series of beach ridges that appear to be east-west oriented linear bands and project above the surrounding marsh. These ridges are composed primarily of sand with a variety of shell fragments, clay and silt. The subject property is located within a freshwater marsh that is isolated from the Gulf by Pecan Island, and shielded from saltwater influence by a large expanse of marsh to the south. It is bisected by the east-west oriented Schooner Bayou Canal, which was formerly part of the 1920s Gulf Intracoastal Waterway (GIWW).

The site is relatively flat and comprised mainly of freshwater emergent marsh, with open water (riverine) habitat in the canals and lacustrine (lake) habitat located to the west in White Lake. The property is located in the Coastal Marsh Ecoregion in the deltaic plain of south Louisiana (USEPA 2010). The USFWS Wetland Inventory (2014) classified the area as a mix of freshwater emergent wetland, riverine, and lake habitat. The oilfield canals are characterized as Riverine Lower Perennial Unconsolidated Bottom (which is) Permanent Flooded,and has been Excavated (R2UBHx). The interior portions of the property are characterized as Palustrine Emergent, Subclass 1 (PEM1; Persistent subclass), a nontidal wetland dominated by trees, shrubs, or emergent species where salinity due to ocean derived salts is below 0.5 ppt. There are also small pockets characterized as Palustrine Scrub/Shrub Broad-leaved Deciduous, Seasonally Flooded (PSS1C) and Palustrine Forested Broad-leaved Deciduous, Temporary Flooded (PFO1A). The site provides habitat which currently supports terrestrial and aquatic animals, plants, and native and migratory birds (Rogers 2014 site visit on October 16-17, 2010).

The ERA is a tiered process that typically begins with an "Ecological Risk Assessment Checklist" or "Level I assessment" to determine if ecological habitats and receptors exist at the site and whether or not ERA is warranted at the site. If further ERA is warranted the following steps are usually followed in the assessment (Figure 1). The tiered process can, in some cases, be completed by conducting an often simple "Screening Level" ecological risk assessment using conservative screening benchmarks. Figure 2 illustrates the 8-step process and the decision points at each step of the process.

Steps 1 & 2 are considered to be part of the Screening Level (Level II) Ecological Risk Assessment

1. Screening-level problem formulation and toxicity evaluation

- **Problem formulation** - information is gathered about the site
- **Site visit** - investigators visit the site
- **Ecological effects evaluation** - review of scientific literature to determine at what levels the chemicals present will have adverse effects

2. Screening-level exposure estimate and risk calculation *

- **Estimating exposures** - calculating how much plants and animals are exposed to chemicals at the site;
- **Risk calculation** - calculation of Hazard Quotients--the comparison of the levels of chemical contamination at the site to levels that are known to cause harm

Steps 3 to 7 are considered to be part of the Baseline Ecological Risk Assessment (Level III)

3. Problem formulation *

- **Refining Contaminants of Potential Ecological Concern (COPECs)** - deciding whether or not chemicals found at the site should be considered further in determining potential ecological risk
- **Contaminant fate and transport** - what happens to the chemicals, biologically, chemically, physically and how they move among plants and animals
- **Mechanisms of toxicity** - what are the harmful effects on plants and animals
- **Ecosystems potentially at risk -** habitats and plants and animals present; sensitivity by plants and animals to chemicals; water bodies present
- **Exposure pathways** - how the chemicals pass through the food web from the source of contamination

- **Assessment endpoints** - the characteristic(s) of a plant or animal that can be measured in terms of harmful effects
- **Conceptual site model** - collection of exposure pathways
- **Risk questions** - using various lines of evidence, answer the question "does chemical X cause harmful effects in plant or animal Y?"

4. Study design and data quality objectives process *

- **Work plan and sampling plan** - a written description of how the investigation will proceed at the site
- **Measurement endpoints** - what is measured (i.e., reproduction, mortality, growth, etc.) in relationship to the assessment endpoints
- **Study design** - what type of testing will be done to evaluate the potential ecological risk at the site
- **Data quality objectives and statistical considerations -** a series of planning steps to insure the quality, type, and quantity of data will be adequate and defendable

5. Field sampling plan verification *

- Determining if the site conditions still allow the investigation to proceed as described in Step 4 or if new conditions require modifications of the work plan.

6. Site investigation and data analysis *

- **Site investigation** - the work as described in the work plan is carried out
- **Data analysis** - the information gathered is analyzed according to the work plan and statistical design

7. Risk characterization

- **Risk estimation and characterization** - combining the results of the studies performed to produce an estimate of the ecological risk and describe that risk in terms of extent, future potential for risk, how long might contamination remain, and what are the prospects of natural recovery if no action is taken

8. Risk management *

- Decisions are made concerning what future actions, if any, are to be undertaken.

* These steps are followed by a Scientific Management Decision Point (SMDP), during which it is decided upon appropriate future courses of action, if any.

Figure 1. Schematic Diagram of the Superfund Eight-Step Ecological Risk Assessment (ERA) Process

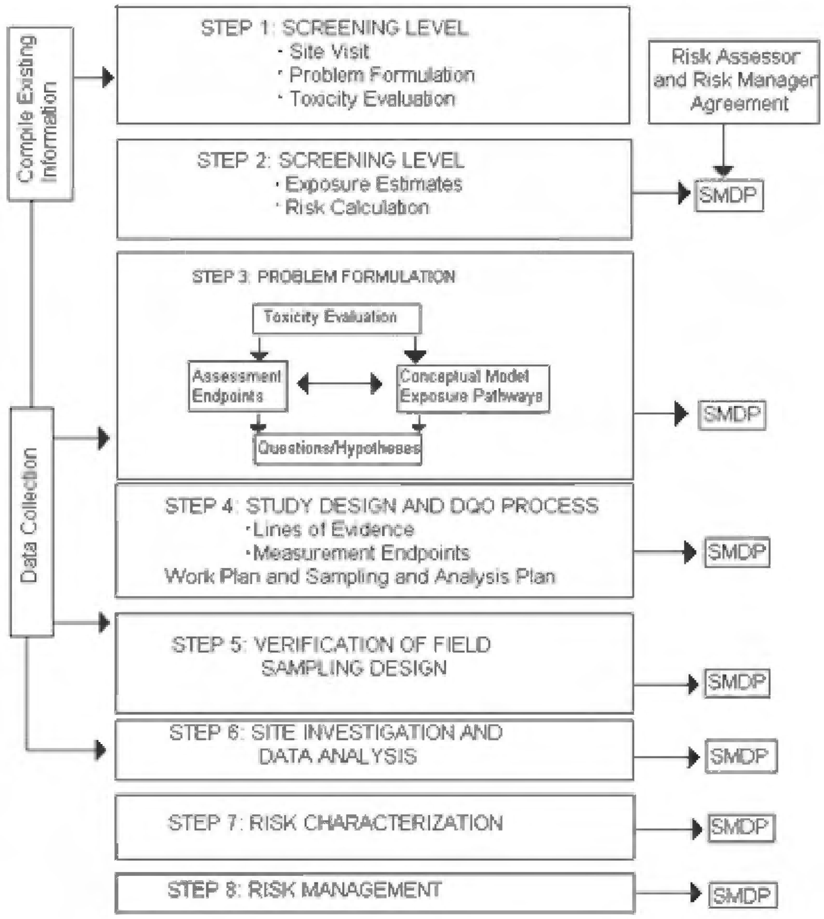

Figure 2: Illustration of the ERA 8 steps and Decision Points

The seventh step of the ERA is the risk characterization step and determination if risk management is needed. If ecological risks exist at the site that require remediation or management the eighth and final Risk Management step is initiated. In this step, the ecological risks, remedial and/or management option costs-to-benefits as well as the potential ecological impacts of the remedial options themselves are weighed and the management options are selected by the risk manager and stakeholders. This VPSBERA has been conducted following the above guidance through steps 1-8.

3.0 METHODOLOGY FOR ECOLOGICAL RISK EVALUATION

The VPSB site ecological risk assessment (ERA) presents a qualitative and quantitative appraisal of the actual or potential impacts on plants and animals, other than humans and domesticated animals. As in the case of human health risk assessment, ecological risk occurs if (i) the chemicals of concern are inherently toxic to plants and or animals, and (ii) such chemicals come in contact with the plants and or animal species for a sufficiently long period of time and at sufficient intensity to cause adverse effects. In the absence of any one of these two factors, namely toxicity and exposure, no ecological risk will occur. The toxicity of a chemical depends on the chemical and the species of interest whereas the exposure primarily depends on site specific factors. The magnitude of risk will depend on the magnitude of toxicity and the magnitude of exposure.

Per the ecological risk assessment protocols developed by USEPA (Figure 1) and illustrated in Figure 2 as adopted by many states in the US, and included by reference in the RECAP process, the VPSB site ecological risk assessment 8-step process can be broken into three primary tiers or levels:

Level 1 Evaluation: This qualitative evaluation consists of completing the RECAP Form 18 questionnaires designed to determine whether any further ecological evaluation is required. Typically, no further evaluation is required if site conditions are such that no habitat/ecological receptors exist on or adjacent to the site or that ecological receptors exist but are not likely to come in contact with chemicals of concern.

Level 2 Evaluation: This evaluation compares the representative site concentrations with the relevant ecological screening levels obtained from literature. If the site specific representative concentrations of the chemicals exceed the relevant ecological screening levels, a site specific ecological evaluation for the selected chemicals may be performed. Alternatively, the site may be "cleaned" to those ecological screening levels. This ERA evaluation is very similar to the RECAP Human Health Screening Option outlined in RECAP Section 3.0.

Level 3 Evaluation: This is a detailed site-specific ecological evaluation that will account for the nature and extent of chemicals, their ecotoxicity, and the complete exposure pathways. The ERA differs from the HRA in that the ERA evaluated the potential toxicological impacts to populations of ecological receptors rather than to individual receptors evaluated in the HRA. The exception to this practice is the evaluation of regulated species such as threatened and endangered species under national and international protection or those species that have unique social and/or cultural significance. The ERA process includes identification of the potentially exposed habitats and indicators species that utilize those habitats. Due to the number of potential species that can be found within a habitat, the ERA process includes a process to select indicators species that are representative of the potentially impacted habitat and the potential toxicity of the contaminant. In the Level 3 ERA the risk assessor evaluates the toxicity of the contaminant, the physical and biological fate and transport including potential for bioconcentration, bioaccumulation and biomagnification in the food chain. The selection of indicator species typically relies on a "guilding" process as identified in EPA Risk Assessment Guidance (EPA,1989, 1997). In the guilding process the risk assessor evaluates the contaminant/trophic level/food chain and web relationship as well as the physical aspects of the habitat to select the appropriate species to act as indicators of the contaminant toxicity. Endpoints in the ERA are typically based on potential for mortality, impact of reproduction or growth within the indicator species population.

4.0 LEVEL 2 ECOLOGICAL EVALUATION

The Level 2 ERA evaluation requires the selection of protective ecological screening levels (ESLs) from literature sources and comparison of the ESLs to the maximum concentrations of the potential contaminants of ecological concern (PCOECs) found at the site. These ESLs have to be relevant for the PCOECs and receptors, or receptor groups, of concern. Screening levels of benchmarks are defined as:

> Levels of contaminants in particular substances (soil, sediment, water) that are known to cause harmful effects in plants or animals. By comparing known, maximum concentrations of contaminants at a site to screening numbers, the possibility of ecological risk can be estimated.

The methodology and sources used to identify screening benchmarks for the VPSB site ERA is described in Section 5. The development of screening levels is described in USEPA (2005) *Ecological Soil Screening Level Guidance, Draft* as well as in other references sited in this ERA. In this step the potential exposure routes are evaluated to first determine if there is potential for exposure to ecological receptors.

5.0 DEVELOPMENT OF SCREENING LEVELS

As stated above, the screening values are based on no-adverse effect levels (NOAELs) using the following assumptions. These assumptions as follows:

- Area-use factor - 100 percent (factor related to home range and population density);
- Bioavailability - 100 percent;
- Life stage - most sensitive life stage;
- Body weight and food ingestion rate - (minimum body weight to maximum ingestion rate); and
- Dietary composition - 100 percent of diet consists of the most contaminated dietary component.

Each of the conservative assumptions used in the development of the screening levels is discussed below:

Area-use factor: For the screening level exposure estimate for terrestrial animals, assume that the home range of one or more animals is entirely within the contaminated area, and thus the animals are exposed 100 percent of the time. This is a conservative assumption and, as an assumption, is only applicable to the screening-level phase of the risk assessment. Species- and site-specific home range information would be needed later, in ERA Step 6 (Figure 1), to estimate more accurately the percentage of time an animal would use a contaminated area. Also evaluate the possibility that some species might actually focus their activities in contaminated areas of the site. For example, if contamination has reduced emergent vegetation in a pond, the pond might be more heavily used for feeding by waterfowl than uncontaminated ponds with little open water.

Bioavailability: For the screening-level exposure estimate, in the absence of site-specific information, assume that the bioavailability of contaminants at the site is 100 percent. For example, at the screening-level, lead would be assumed to be 100 percent bioavailable to mammals. Because few species have been tested for bioavailability, and because ERA Steps 3 through 6 provide an opportunity for this issue to be addressed specifically, the most conservative assumption is appropriate for this step.

Life stage: For the screening-level assessment, assume that the most sensitive life stages are present. If an early life stage is the most sensitive, the population should be assumed to include or to be in that life stage. For vertebrate populations, it is likely that most of the population is not in the most sensitive life stage most of the time. However, for many invertebrate species, the entire population can be at an early stage of development during certain seasons.

Body weight and food ingestion rates: Estimates of body weight and food ingestion rates of the receptor animals also should be made conservatively to maximize the dose (intake of contaminants) on a body-weight basis and to avoid understating risk, although uncertainties in these factors are far less than the uncertainties associated with the environmental contaminant concentrations. U.S. EPA's *Wildlife Exposure Factors Handbook* (U.S. EPA, 1993) is a good source or reference to sources of this information.

Bioaccumulation: Bioaccumulation values obtained from a literature search can be used to estimate contaminant accumulation and food-chain transfer at a Superfund site at the screening stage. Because many environmental factors influence the degree of bioaccumulation, sometimes by several orders of magnitude, the most conservative (i.e., highest) bioaccumulation factor (BAF) reported in the literature should be used in the absence of site-specific information.

Dietary composition: For species that feed on more than one type of food, the screening-level assumption should be that the diet is composed entirely of whichever type of food is most contaminated. For example, if some foods (e.g., insects) are likely to be more contaminated than other foods (e.g., seeds and fruits) typical in the diet of a receptor species, assume that the receptor species feeds exclusively on the more contaminated type of food. Again, EPA's *Wildlife Exposure Factors Handbook* (U.S. EPA, 1993) is a good source or reference to sources of this information.

To determine soil-based screening levels, a receptor-based approach was chosen to evaluate the risk of each PCOEC to different organisms (birds, mammals, plants, invertebrates, microorganisms, benthic invertebrates and other aquatic organisms). Louisiana is located in EPA Region VI who in turn defers to EPA Region V for ecological risk guidance. For each group of receptors, either the a) EPA Region 5 Ecological Screening levels or b) EPA's Eco-Soil Screening Levels were used, and values from Oak Ridge National Laboratories (1997a) were chosen in the absence of either of the former two values as described below:

Soil Screening Levels

- **EPA Region V RCRA Ecological Screening Levels** (Region V ESLs)**:** Region V ESLs is the initial tool used to evaluate and control adverse risks to the environment used by USEPA Region V, as well as other EPA regions and US state environmental protection agencies. They represent a protective benchmark for several different contaminants to organisms that may come in contact with the soil, either directly or indirectly. Region V ESLs were used to evaluate risks for small mammals. Most of the Region V mammal-based ESLs were derived based on exposure to a masked shrew (*Sorexcinerus*) or a meadow vole (*Microtuspennsylvanicus*). These calculations were made using information on the environmental exposures of the organism (i.e. soil and food ingestion rates, metabolism, etc.) combined with toxicological data.

- **Ecological Soil Screening Levels (Eco-SSLs):** Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. Eco-SSLs were developed for plants, birds, mammals, and invertebrates. Derived by a multi-stakeholder team including government agencies, industry and universities, Eco-SSLs are used to identify contaminants of potential concern in soils requiring further evaluation in a baseline ecological risk assessment (see EPA [2005] for details). If contaminants of concern are present in soil at concentrations above the derived Eco-SSL, the environment may be adversely affected, and the soil contaminants may require further evaluation in the baseline ecological risk assessment.
- **ORNL Screening benchmarks for terrestrial plants**: Oak Ridge National Laboratory (ORNL; 1997a) developed toxicological benchmarks for various contaminants to determine which of them are worthy of further consideration as “contaminants of potential concern”. Drawing from a large dataset of toxicological effects on plants from greenhouse, laboratory, or field settings, ORNL derived phytotoxicity benchmarks which would be protective of germination and growth of terrestrial plants. Chemicals that are found in the soil at concentrations exceeding both the phytotoxicity benchmark and the background concentration for the soil type should be considered contaminants of potential concern.
- **ORNL Screening benchmarks for earthworms and soil microorganisms**: Using a methodology similar to that of ORNL screening benchmarks for plants, ORNL(1997b) provides protective benchmarks for soil- and litter-dwelling invertebrates, including earthworms, other micro- and macroinvertebrates, or heterotrophic bacteria and fungi. To derive these values, Lowest Observable Effect Levels (LOELs) from toxicity studies were rank-ordered, and the tenth percentile concentration was chosen as the toxicity benchmark. Chemicals that are found in soil at concentrations exceeding both the benchmarks and background concentrations for that soil type should be considered contaminants of potential concern.

Note: Whenmore than one benchmark was available for a PCOEC, the lower ESL was chosen as a protective measure.

Freshwater Screening Levels

Surface water and shallow (<28’ below ground surface) groundwater was evaluated due to its potential to discharge to a surface water body and come into contact with aquatic organisms.

When possible, two benchmarks were selected to indicate the potential for both acute (i.e., short-term) and chronic (long-term) toxicity. Two sources were used for the evaluation of fresh water:

- **EPA Nationally Recommended Water Quality Criteria (NRWQC):** These are EPA-recommended water quality criteria for the protection of aquatic life in surface water, published pursuant to Section 304(a) of the Clean Water Act. These values are expressed as criteria maximum concentrations (CMCs; acute) and criteria continuous concentrations (CCCs; chronic).
- **Tier II Secondary Acute Values (SAVs) and Secondary Chronic Values (SCVs):** In the absence of EPA NRWQC, Tier II values were derived from Suter and Tsao (1996). Values were derived using the method outlined in the EPA (1993) *Proposed Water Quality Guidance for the Great Lakes System.* Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the National Ambient Water Quality Criteria. Secondary acute/chronic values are concentrations estimated with 80% confidence not to exceed the unknown NAWQC for those chemicals with no NAWQC.

Sediment Screening Levels

Sediments in the top 0-4’ were evaluated for their potential to be carried into freshwater streams and bayous via precipitation and surface runoff, as well as their potential to support benthic life during wetter parts of the year (e.g., spring). Screening levels from Buchman (2008) were used. Two benchmarks were selected to indicate a more conservative (protective) threshold of risk as well as a less conservative (less protective) threshold of risk. Exceedance of only the conservative benchmark would indicate that adverse effects would be possible, whereas exceedance of both the conservative and less conservative benchmarks would indicate a greater probability of adverse effects.

- **Threshold Effects Level (TEL) and Probable Effects Level (PEL)** –TELs and PELs were derived based on a database of synoptic chemical concentrations and sediment toxicity bioassays or benthic community metrics (Macdonald et al. 1996). These benchmarks are calculated as a geometric mean using the full suite of information from the database. TELs were designed to be the threshold between samples which were a) rarely and b) occasionally associated with adverse effects on aquatic life. PELs were designed to be the threshold between samples which were a) occasionally and b) frequently associated with adverse effects on aquatic life. Therefore, concentrations exceeding the PEL are likely to be associated with adverse effects. The Canadian Council of Ministers of the Environment (CCME 1999) has incorporated this approach into their derivation of sediment quality guidelines.TELs were used as the more conservative/protective benchmark to evaluate possible sediment contamination at the VPSB site, while PELs were used as the less conservative/protective benchmark.

Note: when freshwater PELs were not available, the AET was used in its place. Similar to the PEL, the AET represents a less protective benchmark for sediments (Buchman 2008).

6.0 DETERMINATION OF CONTAMINANTS OF ECOLOGICAL CONCERN

ICON (2010) presents an analysis of the data for soil, sediments, surface water and groundwater samples collected from the VPSB site. These chemicals were compared to the appropriate ecological screening levels (ESLs) to identify the chemicals of ecological concern.

The VPSB site is home to a variety of terrestrial wildlife such as birds (including waterfowl, probing shorebirds and other migratory species), deer, and raccoons, as well as semi-aquatic species such as alligators, bullfrogs, turtles and aquatic species such as crawfish, shrimp, crabs and mosquitofish. In order to evaluate the risk of potential contamination to aquatic and terrestrial organisms, samples were compared to both soil and sediment ESLs. This approach is considered appropriate since upland soils can be carried into surface water during rainfall events, and subaqueous sediments can dry out during prolonged droughts and potentially support terrestrial life.

Attachment 1-2shows the chemicals detected in the soil (Table 1-2a), sediment (Table 1-2b), groundwater (Table 1-2c) and surface water (Table1-2d)analyses and the comparison of those chemicals to the above screening criteria for the calculation of a hazard quotient (HQ) discussed below in Section 7.0.

7.0 DETERMINATION OF HAZARD QUOTIENTS FOR POTENTIAL CONTAMINANTS OF ECOLOGICAL CONCERN

In the screening level risk assessment the maximum concentration of the PCOECat the site is compared to the screening benchmarks and hazard quotients are calculated to determine if there is a potential for adverse ecological impact. Using EPA guidance the definition of a "Hazard Quotient" is as follows:

Hazard Quotient:
The ratio of an exposure level by a contaminant (e.g., maximum concentration) to a screening value selected for the risk assessment for that substance (e.g. LOAEL or NOAEL). If the exposure level is higher than the toxicity value, then there is the potential for risk to the receptor. (See Ecological Risk Assessment Guidance Step 2 for more details.)

Screening Level Risk Calculation (Hazard Quotient)

Ecological risk can be estimated numerically using the *Hazard Quotient* (HQ) approach. The HQ is a ratio, which can be used to estimate if risk to harmful effects is likely or not due to the contaminant in question. The HQ is calculated using one of the following equations:

Hazard Quotient Equations

1. **HQ = Dose / Screening Benchmark**
2. **HQ = EEC / Screening Benchmark**

- *Dose* = an estimated amount of how much contaminant is taken in by a plant or animal, in terms of the body weight of the plant or animal (e.g., mg contaminant/kg body weight per day);
- *EEC* = estimated (maximum) environmental contaminant concentration at the site; how much contaminant is in the soil, sediment, or water (e.g, mg contaminant/kg soil)
- *Screening benchmark* = generally a **No-Adverse Effects Level**concentration; if the contamination concentration is below this level, the contaminant is not likely to cause adverse effects.

After the calculation...

If...	*Then...*
HQ > 1.0	**Harmful effects are likely due to the contaminant in question (Note: In November, 2011 Region V revised the language to read "Harmful effects cannot be ruled out")**
HQ = 1.0	**Contaminant *alone* is not likely to cause ecological risk**
HQ < 1.0	**Harmful effects are NOT likely**

As stated above these screening values are conservative and the screening endpoint is an environmental concentration that would result in a no-adverse effect level (NOAEL) exposure to the receptor or receptor group. The tables in Attachment1-2 show the Contaminants Of Ecological Concern (COEC) and the hazard quotients based on the selected screening levels for protection of avian, invertebrate, mammal, plant and microbe receptors or benthic/aquatic organisms in the case of groundwater and sediments.

Based on the Step 2 ERA the following COECs at the site exceeded the screening levels and harmful effects to the ecological receptors cannot be ruled out:

Arsenic (mammals, plants, benthic invertebrates)
Barium (invertebrates, mammals, plants, microbes, benthic invertebrates, aquatic life^{gw,sw})
True & Total Barium (invertebrates, mammals, plants, benthic invertebrates)
Cadmium (birds, mammals, benthic invertebrates, aquatic life ^{gw})
Chromium (birds, invertebrates, mammals, plants, microbes)
Lead (birds, mammals, plants, benthic invertebrates, aquatic life ^{gw})
Mercury (invertebrates, plants, benthic invertebrates)

Zinc (birds, invertebrates, mammals, plants, microbes)
Strontium (aquatic life ^{gw})

^{gw} Groundwater samples exceeded freshwater screening levels
^{sw} Surface water samples exceeded freshwater screening levels

Due to a lack of screening levels for wading birds and waterfowl, several COECs (e.g., arsenic, barium, true & total barium, cadmium, chromium, lead, mercury, selenium and zinc) were carried through to the Level III ERA for these species. Finally, for some COECs, no screening levels were available for birds (i.e., mercury, barium, true and total barium) or mammals (mercury), so these COECs were carried through to the Level III ERA.

Based on these assumptions, the Scientific Management Decision Point (Step 2) was to progress to a Level III ERA. Based on a review of the COECs it was determined that the potential for bioaccumulation from site sediments and surface water into blue crabs (*Callinectessapidus*) and ingestion by resident wildlife and human populations warranted further evaluation. This evaluation is presented in Step 7: Risk Characterization.

8.0 LEVEL III ECOLOGICAL RISK CHARACTERIZATION

In this step consideration is given to better defining the assumptions used in the Level II assessment to address the specific site conditions and the potential exposure. In the Level III ERA site-specific tissue samples were collected to determine the potential for COECs to bioaccumulate in the food chain and affect upper trophic level wildlife. In addition to tissue sampling, Protective Concentration Level calculations were calculated to determine the contaminant soil/sediment concentrations that would result in exposures that would be protective of the indicator species populations.

8.1 Potential Exposure

In this evaluation the site specific potential exposures are identified. Considering the potential site use for recreation (i.e.; hunting and fishing) in the freshwater swamps, marshes, lake and canals the following exposures were considered:

- Bioconcentration of contaminants at depth from soils and sediments (i.e. <4 feet) in plant roots and accumulation in the roots and transport and bioconcentration in the above ground vegetation and ingestion by invertebrates, herbivorous mammals and birds (i.e. earthworms, mallards, rabbits)
- Deposition of contaminated plant tissues (detritus) in subsurface and surface soils (i.e. assumes rooted depths from surface to 48")
- Bioconcentration of contaminants in aquatic habitats at depth into benthic invertebrates (midges, aquatic worms, shellfish) and fishand ingestion by shorebirds (i.e. spotted sandpiper and snowy egret)
- Ingestion of contaminated soil during feeding and grooming
- Ingestion of contaminated prey by omnivorous and carnivorous predators (robin, woodcock, least shrew and fox)

- Bioconcentration into blue crabs and ingestion by carnivorous and omnivorous predators (e.g. Great blue heron and American mink)

Based on these predicted pathways and exposures and a review of the species expected to be found at the site, the ecological indicator species selected for detailed Level III evaluation of COECswere as follows:

- Least shrew
- American robin
- Red fox
- Spotted sandpiper
- Swamp rabbit
- American woodcock
- Mallard
- Snowy egret
- American mink
- Great blue heron

A review of the COECS and HQs as well as the potential for the selected COECs to provide a reasonable risk estimate resulted in the following COECs for detailed evaluation in Step 7 of the ERA:

- Aluminum*
- Arsenic
- Barium
- True and Total Barium
- Cadmium
- Chromium
- Copper*
- Lead
- Mercury
- Nickel
- Zinc

*COEC not analyzed in sediment but detected in crab tissue analyses.

Hazard quotients (HQs) for these constituentsexceeded one (1) for one or more of the screening receptor groups (avian, invertebrates, mammals, plants, microbes, benthic/aquatic organisms; Attachment 1-2) or were detected in blue crab (*C. sapidus*) tissue warranting further evaluation for wildlife.

8.2 Risk Calculations of Protective Concentration Levels

The PCL calculation addresses the direct exposure to the COECs in the food, water, incidental soil ingestion and potential for bioconcentration of the COECs in the food and potential for biomagnification up the food chain. The PCL is calculated as follows:

$$Dose_{oral} = \frac{\left[\left(IR_{food} \times C_{food} \times EMF_{food}\right) + \left(IR_{water} \times C_{water} \times EMF_{water}\right) + \left(IR_{soil} \times C_{soil} \times EMF_{soil}\right) + \left(IR_{sediment} \times C_{sediment} \times EMF_{sediment}\right)\right]}{BW}$$

where:

$Dose_{oral}$	=	estimated dose from ingestion (mg COC/kg body weight/day)
IR_{food}	=	ingestion rate of food (prey) (kg/day)
C_{food}	=	COC concentration in food (mg/kg)
EMF_{food}	=	exposure modifying factor for food (unitless)
IR_{water}	=	ingestion rate of water (L/day)
C_{water}	=	COC concentration in water (mg/L)
EMF_{water}	=	exposure modifying factor for water (unitless)
IR_{soil}	=	ingestion rate of soil (kg/day)
C_{soil}	=	COC concentration in soil (mg/kg)
EMF_{soil}	=	exposure modifying factor for soil (unitless)
$IR_{sediment}$	=	ingestion rate of sediment (kg/day)
$C_{sediment}$	=	COC concentration in sediment (mg/kg)
$EMF_{sediment}$	=	exposure modifying factor for sediment (unitless)
BW	=	body weight of receptor (kg)

$$TRV = \frac{\left[\left(IR_{food} \times PCL_{soil} \times UF \times EMF_{food}\right) + \left(IR_{water} \times C_{water} \times EMF_{water}\right) + \left(IR_{soil} \times PCL_{soil} \times EMF_{soil}\right) + \left(IR_{sediment} \times C_{sediment} \times EMF_{sediment}\right)\right]}{BW}$$

$$PCL_{soil} = \frac{TRV \times BW - \left[\left(IR_{water} \times C_{water} \times EMF_{water}\right) + \left(IR_{sediment} \times C_{sediment} \times EMF_{sediment}\right)\right]}{\left[\left(IR_{food} \times UF \times EMF_{food}\right) + \left(IR_{soil} \times EMF_{soil}\right)\right]}$$

UF = Uptake Factor (ratio of the concentration of COEC in biota to the environmental media; unitless)

Species data including body weight, food ingestion rates and soil ingestion rates were compiled from various sources including EPA (1993) and other sources as listed in Attachment 1-3a.

To evaluate the potential risk of contaminants on site to survival of indicator organisms, toxicity reference values (TRVs) were derived using the EPA (2005) Eco-SSLs or toxicological benchmarks from Sample et al. (1996) when no TRVs were available in the Eco-SSLs. TRVs were selected using growth and reproduction endpoints since these endpoints are essential to the health of wildlife populations. These TRVs are shown in Attachment 1-3b.

Bioconcentration is the expected concentration of the contaminant from the source media to the first receptor based on calculated values or literature values. Bioconcentration factors are the ratio of the COEC concentration in biota (i.e. plant/earthworm) to the concentration in media (i.e. soil/sediment). BCF values were obtained from EPA-approved literature sources (EPA 2005 &

1999, Bechtel-Jacobs 1998a, Sample et al. 1999, Sample et al. 1998a, Sample et al. 1998b, Baes et al. 1984) as well as other sources (e.g. USACE2014) as shown in Attachment 1-3c.

The bioaccumulation factor (BAF) is the expected concentration in receptors based on that receptors position in the food chain or trophic level and calculated as:

BAF = BCF x FCM

The FCM is equal to the food chain multiplier, and was set equal to 1.0 for all PCL calculations.

It was assumed that surface water is not ingested within the contaminated area and was therefore not an exposure pathway.

The PCL was calculated by taking the ingestion rate of the food, and multiplying by the BAF. The bioaccumulated food ingestion rate was then added to the soil ingestion rate and divided into the final TRV for the PCL.

8.3 Calculation of Adjusted Protective Concentration Levels

In this calculation the PCL is modified to address the effect of the indicators spatial presence over the contaminated area, temporal (seasonal or migratory presence) and the bioavailability of the contaminant. The spatial aspect is determined by taking the home range of each receptor species, as included in Attachment 1-3a, and dividing that indicator species' home range in acres by the areas of contamination within the suitable habitat for that species in hectares as follows:

$$\% \text{ Home range} = \frac{\text{Species home range (acres)}}{\text{Area of contamination (acres)}}$$

Adjustments were made for % home range for the indicators based on the spatial area of contamination of the contaminants which are included in Attachment 1-3a: Species Input Data.

If the area of contamination exceeds the home range that value is not considered and the maximum percentage can only be 100%. For example, if the home range is 100 acres and the area of contamination within suitable habitat is 50 acres then the percent range impacted by the COEC is 50% and the PCL can be divided by .5 doubling the PCL for that species. The area of contamination was estimated to be approximately 1000 acres. The home ranges for all indicator species except for the red fox were smaller than the area of contamination so for these species the percent home range was 100% (Attachment 1-3a).

Many species evaluated in the ERA may be temporal or seasonal/migratory inhabitants and this is addressed by dividing the months a species is expected to be a resident in the contaminated area by the months of the year by as follows;

$$\% \text{ Time (Temporal) of exposure} = \frac{\text{Residence (months)}}{12 \text{ (months)}}$$

The assumption is that the selected indicators will be present throughout the year so the % temporal or seasonal residence is considered to be 100%.

The same process is used for the % bioavailability which addresses the assumption that only a fraction of the COEC maybe biologically available. Bioavailability of the COEC in dietary items was set at 100% due to the fact that the COEC has already been taken up and made available in the plant, earthworm, fish or benthic invertebrate tissue. The % bioavailability in soil was altered for some COECs based on published studies which compared the absorption of soil-bound contaminants to contaminants administered in the diet (Casteel et al. 1997, 1996) and other sources as identified in Attachment 1-3d.

8.4 Adjusted Level III PCL and HQs

The calculations for each PCL can be found in the following attachments:

- Robin (Attachment 1-3e),
- Woodcock (Attachment 1-3f),
- Spotted sandpiper (Attachment 1-3g),
- Mallard (Attachment 1-3h),
- Snowy egret (Attachment 1-3i)
- Shrew (Attachment 1-3j)
- Red fox (Attachment 1-3k)
- Swamp rabbit (Attachment 1-3l)

The final PCL summary tables and resulting HQs are provided in Attachment 1-3m.

8.5 Blue Crab Tissue Study

To evaluate the potential for bioaccumulation of COECs from sediments and surface water into crabs on the site, twenty-two (22) blue crabs (*Callinectessapidus*) were collected and analyzed for COECs. The results of these analyses were incorporated into a food chain model to determine risks to wildlife. A summary of sample collection, management and analysis is provided below.

On October 16, 2010 at approximately 4:00 p.m. crab traps were placed at 9 locations on the Vermilion Parish School Board property as indicated in Figure 1. The traps were baited with fresh fish and were retrieved between 7:00 and 9:00 AM on the morning of October 17th. Upon arrival at each site, the individual traps were recovered and the collector donned a pair of new nitrile gloves before handling the crabs. The crab trap was retrieved by a professional trapper, and the second person, wearing nitrile gloves, recovered the crabs, applied a cerebral puncture to immobilize the crab and then placed the crab into a zip-lock bag with a unique identification number. The numbering system used was a letter to indicate the species followed by the site number and then the number of the individual captured at that site. For example, C-1-1 would indicate a crab at site 1 and the first crab collected at site 1. Each crab was placed in a separate plastic bag and immediately placed in a cooler with ice.

Figure 3: Blue crab sampling locations.

On October 18th the following measurements were taken for each individual crab: sex, wet weight, maximum width of the lateral spine, and total length. Physical anomalies such as broken spines or discolorations were noted in the field notes. The samples were segregated by site and new nitrile gloves were worn to handle the samples from each site. The individual crabs were repackaged in new zip-lock bags and then the crabs from each site were placed in a separate secondary bag. Using this sample segregation approach reduces the potential for cross contamination. The samples were then repacked in a cooler with gel ice packs and about 2 kilograms of dry ice. A chain-of-custody form was completed and inserted inside the cooler. Two chain-of-custody seals were placed on opposite sides of the cooler, taped over with clear tape and then sent via Federal Express to the Test America analytical laboratory located at 30 Community Drive, Suite 11,South Burlington, VT 05403. The samples were received at Test America on October 19, 2010 at approximately 10:00 a.m. with the chain-of-custody seals intact and the contents were below the required minimum 6° C temperature.

Due to the potential for ingestion of the entire crab by resident wildlife, the entire crab was homogenized before extraction and analysis. This approach is conservative in that it would dilute the concentrations of contaminants that would be expected to accumulate inside the crab in the fatty tissues. At the same time, this approach would account for contaminants that are contained within the crab's digestive system (e.g. hepatopancreas and intestines) which would likely be ingested by wildlife during consumption. Compositing the entire shell fish is a USEPA-accepted method if supported by consumption patterns, which is the case for a variety of wildlife species. The tissue samples were analyzed for total metals, mercury and Total Petroleum Hydrocarbons (C8-C40). The extraction, analytical, and sample handling methods Test America used are described in Attachment 1-4.

The analytical results are shown in Attachment 1-5a along with sex, physical measurements of the individual specimens. NOTE: two data anomalies were noted in the field notes. Crab C-3-1 had a broken lateral spine so the width measurement is lower than expected. Sample C-5-1 had black coloring on the all sternites and plastron (underside) and black coloring on the carapace. Also, of the twenty two specimens captured there was only one female, which is expected due to the female migration to nesting grounds in September and October.

8.6 Level III Dose Calculations

To determine the risk of ingestion of blue crabs, as well as incidental soil/sediment ingestion by predatory wildlife, a daily dose of each COEC to receptors was calculated. The dose calculation addresses the direct exposure to the COEC in the food, water, incidental soil/sediment ingestion and potential for bioaccumulation of the COECs in the food (Section 8.2). To evaluate the potential risk to carnivorous birds and mammals, the Great Blue Heron and American Mink were selected as surrogates for those feeding guilds.

Species data including body weight, food ingestion rates and soil ingestion rates were compiled from various sources including EPA (1993) and other sources as listed in Attachment 1-5b.

Toxicity reference values (TRVs) were derived using EPA (2005) and Sample et al. (1996) as described in Section 8.2; these values are provided in Attachment 1-5c.

It was assumed that surface water is not ingested within the contaminated area and was therefore not an exposure pathway. Since the home range of both receptors is smaller than the estimated site size (1000 acres; see EPA [1993] for home range data), and both receptors are assumed to be present year round, the dose calculations were not adjusted for temporal or area use (Attachment 1-5b).

The % bioavailability in soil or sediment was addressed using values from the peer-reviewed scientific literature as stated in Section 8.3, and is provided in Attachment 1-5d.

The dose calculations for each species are provided in Attachment 1-5e (Great Blue Heron) and Attachment 1-5f (American Mink).

8.6 Adjusted Level III HQs Based on PCLs and Dose Estimates – All COECs

Based on the calculated adjusted PCLs and dose estimates the site contaminants exceed protective levels as follows:

COEC	Indicator Species	Final HQ
Aluminum	American Mink	6.8*
Arsenic	Snowy Egret	7.1
	Least Shrew	2.1
Barium	American Robin	17
	American Woodcock	18
	Spotted Sandpiper	221
	Mallard	25
	Snowy Egret	31
	Least Shrew	10
	Swamp Rabbit	3.4
	Great Blue Heron	5.7*
	American Mink	1.6*
True & Total Barium	American Robin	1.2
	Spotted Sandpiper	20
	Mallard	2.5
	Snowy Egret	3
Cadmium	American Woodcock	1.3
	Least Shrew	4.1
Chromium	American Robin	5.6
	American Woodcock	8.0
	Spotted Sandpiper	8.2
	Snowy Egret	4.3
	Least Shrew	14.1
Copper	Great Blue Heron	1.1*
Lead	American Robin	3.2
	American Woodcock	4.6
	Spotted Sandpiper	5.3
	Snowy Egret	3.2
	Least Shrew	2.5
Mercury	American Robin	6.2
	American Woodcock	7.5

	Spotted Sandpiper	9
	Mallard	1.6
	Snowy Egret	11.2
	Least Shrew	174
	Swamp Rabbit	18
Selenium	Spotted Sandpiper	6.1
	Snowy Egret	4.0
	Least Shrew	2.9
Zinc	American Woodcock	1.1
	Spotted Sandpiper	1.6
	Least Shrew	1.6

*HQ based on dose calculated using blue crab tissue data.

It is important to remember that the indicator species were selected to represent a group of species with similar feeding behavior and occupying the same trophic level. As such, HQs in excess of one indicate a potential effect to the represented group rather than just to the indicator species. For example, the barium HQ for the Spotted Sandpiper indicates a concentration over 220 times the calculated protective level based on the TRV for probing shorebirds. Furthermore, the presence of multiple contaminants with HQs exceeding one likely increases the overall risk to these species.

These HQs represent a potential ecological risk as the site if a management option is not implemented.

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Attachment 1-1: RECAP Form 18, Ecological Checklist

RECAP FORM 18
ECOLOGICAL CHECKLIST

Section 1 - Facility Information

1. Name of facility: Vermilion Parish School Board
2. Location of facility: Section 16, T15S R01E 5mi. SW of town of Forked Island

   Parish: Vermilion
3. Mailing address: NA
4. Type of facility and/or operations associated with AOC: Oil & Gas production, recreational hunting and fishing, commercial fishing boating
5. Name of AOC or AOI: VPSB
6. If available, attach a USGS topographic map of the facility and/or aerial or other photographs of the release site and surrounding areas. ATTACHED as ATTACHMENT 1 overview Map

Section 2 - Land Use Information

1. Describe land use at and in the vicinity of the AOC/AOI: Recreational/commercial fishing, recreational hunting, boating, oil production, gas production
2. Describe land use adjacent to the facility: Recreational/commercial fishing, recreational hunting, cattle operations
3. Provide the following information regarding the nearest surface water body which has been impacted or has the potential to be impacted by COC migrating from the AOC/AOC:

a) Name of the surface water body: Schooner Bayou, White Lake

b) Type of surface water body:

[N] freshwater river or stream
[N] freshwater swamp/marsh/wetland
[ ] saltwater or brackish swamp/marsh/wetland
[ ] lake or pond
[N] bayou or estuary
[N] drainage ditch
[ ] other: ____________

c) Designated use of the segment/subsegment of the surface water body (LAC 33:IX): 050703 (A) Primary contact, (B) Secondary contact, (C) Fish and wildlife propagation (E) Agriculture

d) Distance from the AOC/AOI to nearest surface water body: Immediate to drainage canals to Schooner Bayou.

4. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., federal and state parks, national and state monuments, wetlands, etc? [✓] Yes [ ] No

If yes, explain:
Wetlands, DNR - fresh marsh wetland habitat

Section 3 - Release Information

1. Nature of the release: Oil & gas wastes / production wastes - oil - saltwater, heavy metals,
2. Location of the release (within the facility): See attached map
3. Location of the release with respect to the facility property boundaries: within boundaries
4. Constituents known or suspected have been released: Oil, oil constituents, heavy metals
5. Indicate which media are known or suspected to be impacted and if sampling data are available:

[✓]	soil 0 - 3 feet bgs	[✓] yes [ ] no
[✓]	soil 0 - 15 feet bgs	[✓] yes [ ] no
[✓]	soil >15 feet bgs	[✓] yes [ ] no
[✓]	groundwater	[✓] yes [ ] no
[✓]	surface water/sediment	[✓] yes [ ] no

6. Has migration occurred outside the facility property boundaries? [✓] yes [ ] no Into canals and potentially into Schooner Bayou
If yes, describe the designated use of the offsite land impacted:
Recreational / Commercial fishing, recreational hunting, boating / water contact recreation.

Section 4 - Criteria for Further Assessment

If the AOI meets **all** of the criteria presented below, then typically no further ecological evaluation shall be required. If the AOI **does not** meet **all** of the criteria, then a screening level ecological risk shall be conducted. The Submitter should make the initial decision regarding whether or not a screening level ecological risk assessment is warranted based on compliance of the AOI with criteria listed below. After review of the ecological checklist and other available site information, the Department will make a final determination on the need for a screening level ecological risk assessment. If site conditions at the AOI change such that one or more of the criteria are not met, then a screening level ecological risk assessment shall be conducted. Answers shall be based on current site conditions (i.e., shall not consider future remedial actions or institutional or engineering controls).

Indicate if the AOI meets the following criteria:

(1) The area of impacted soil is approximately 5 acres or less in size (based on the AOI identified for the human health assessment) and it is not expected that the COC will migrate such that the soil AOI becomes greater than 5 acres in size. [ ] yes [✓] no

(2) There is no current release or demonstrable long-term threat of release (via runoff or groundwater discharge) of COC from the AOI to a surface water body. [ ] yes [✓] no

(3) Recreational species, commercial species, threatened or endangered species, and/or their habitats are not currently being exposed, or expected to be exposed, to COC present at or migrating from the AOI.

[ ] yes [✓] no

(4) There are no obvious impacts to ecological receptors or their habitats and none are expected in the future.

[ ] yes [✓] no

Is further ecological evaluation required at this AOI? [✓] yes [ ] no

This determination is subject to Department concurrence.

Section 5 - Site Summary

The ecological checklist submittal shall include a site summary that presents sufficient information to verify that the AOI meets or does not meet the criteria for further assessment.

Section 6 - Submitter Information

Date: 3/12/2014

Name of person submitting this checklist: William J. Rogers

Affiliation: Omega Environ Solutions, Inc.

Signature: [signature] Date: 3/12/2014

Additional Preparers: N/A

ATTACHMENT II: Overview Map.

Attachment 1-2: Screening Level Ecological Risk Assessment

Table 1-2a: Soil Evaluation

				Arsenic						Barium				
Sample ID	Depth	Date	Sample Type	Conc. (mg/kg dry)	Eco-SSL Avian HQ	Eco-SSL Inverts[a] HQ	Region V Mammal[v] HQ	Eco-SSL Plant[a] HQ	ORNL Microbes[4] HQ	Conc. (mg/kg dry)	Eco-SSL Invert HQ	Eco-SSL Plant[a] HQ	Region V Mammal[v] HQ	ORNL Microbes[4] HQ
Screening Level…					43	60	5.7	18	100	-	330	500	1.04	3000
SS7	0-1.4'	4/26/06	Syringe	22.00	0.51	0.37	**3.86**	**1.22**	0.22	15700.00	**47.58**	**31.40**	**15096.15**	**5.23**
SS7	1.4-2.5'	4/26/06	Syringe	21.50	0.50	0.36	**3.77**	**1.19**	0.22	13500.00	**40.91**	**27.00**	**12980.77**	**4.50**
SS7	2.5-3.5'	4/26/06	Syringe	9.10	0.21	0.15	**1.60**	0.51	0.09	3780.00	**11.45**	**7.56**	**3634.62**	**1.26**
SED2	0-2'	2/25/10	Russian*	8.29	0.19	0.14	**1.45**	0.46	0.08	308.00	0.93	0.62	**296.15**	0.10
SED2	0-2'	2/25/10	Russian*	5.17	0.12	0.09	0.91	0.29	0.05	334.00	**1.01**	0.67	**321.15**	0.11
SED2	2-4'	2/25/10	Russian*	40.30	0.94	0.67	**7.07**	**2.24**	0.40	265.00	0.80	0.53	**254.81**	0.09
SED3	0-2'	2/25/10	Russian*	8.72	0.20	0.15	**1.53**	0.48	0.09	315.00	0.95	0.63	**302.88**	0.11
SED3	0-2'	2/25/10	Russian*	8.82	0.21	0.15	**1.55**	0.49	0.09	335.00	**1.02**	0.67	**322.12**	0.11
SED3	2-4'	2/25/10	Russian*	29.90	0.70	0.50	**5.25**	**1.66**	0.30	246.00	0.75	0.49	**236.54**	0.08
SED4	0-2'	2/25/10	Russian*	5.42	0.13	0.09	0.95	0.30	0.05	662.00	**2.01**	**1.32**	**636.54**	0.22
SED4	0-2'	2/25/10	Russian*	1.58	0.04	0.03	0.28	0.09	0.02	342.00	**1.04**	0.68	**328.85**	0.11
SED5	0-2'	2/25/10	Russian*	4.75	0.11	0.08	0.83	0.26	0.05	216.00	0.65	0.43	**207.69**	0.07
SED5	0-2'	2/25/10	Russian*	6.18	0.14	0.10	**1.08**	0.34	0.06	123.00	0.37	0.25	**118.27**	0.04
SED6	0-2'	2/25/10	Russian*	8.06	0.19	0.13	**1.41**	0.45	0.08	522.00	**1.58**	**1.04**	**501.92**	0.17
SED6	0-2'	2/25/10	Russian*	3.31	0.08	0.06	0.58	0.18	0.03	227.00	0.69	0.45	**218.27**	0.08
SED11	0-2'	2/25/10	Russian*	6.50	0.15	0.11	**1.14**	0.36	0.07	1260.00	**3.82**	**2.52**	**1211.54**	0.42
SED11	0-2'	2/25/10	Russian*	7.68	0.18	0.13	**1.35**	0.43	0.08	2021.00	**6.12**	**4.04**	**1943.27**	0.67
SED11	2-4'	2/25/10	Russian*	6.54	0.15	0.11	**1.15**	0.36	0.07	1130.00	**3.42**	**2.26**	**1086.54**	0.38
SED11	0-0.5'	5/6/10	PVC	4.80	0.11	0.08	0.84	0.27	0.05	713.00	**2.16**	**1.43**	**685.58**	0.24
SED11	0-0.5'	5/6/10	PVC	4.39	0.10	0.07	0.77	0.24	0.04	550.00	**1.67**	**1.10**	**528.85**	0.18
SED12	0-2'	2/25/10	Russian*	3.80	0.09	0.06	0.67	0.21	0.04	933.00	**2.83**	**1.87**	**897.12**	0.31
SED12	0-2'	2/25/10	Russian*	3.43	0.08	0.06	0.60	0.19	0.03	1016.00	**3.08**	**2.03**	**976.92**	0.34
SED12	2-4'	2/25/10	Russian*	5.93	0.14	0.10	**1.04**	0.33	0.06	1500.00	**4.55**	**3.00**	**1442.31**	0.50
SED13	0-2'	2/26/10	Russian*	4.32	0.10	0.07	0.76	0.24	0.04	773.00	**2.34**	**1.55**	**743.27**	0.26
SED13	0-2'	2/26/10	Russian*	4.47	0.10	0.07	0.78	0.25	0.04	632.00	**1.92**	**1.26**	**607.69**	0.21
SED13	2-4'	2/26/10	Russian*	3.47	0.08	0.06	0.61	0.19	0.03	682.00	**2.07**	**1.36**	**655.77**	0.23
SED13	0-0.5'	5/6/10	PVC	3.11	0.07	0.05	0.55	0.17	0.03	586.00	**1.78**	**1.17**	**563.46**	0.20
SED13	0--0.5'	5/5/10	PVC	5.02	0.12	0.08	0.88	0.28	0.05	909.00	**2.75**	**1.82**	**874.04**	0.30
SED14	0-2'	2/26/10	Russian*	3.33	0.08	0.06	0.58	0.19	0.03	1180.00	**3.58**	**2.36**	**1134.62**	0.39
SED14	0-2'	2/26/10	Russian*	3.56	0.08	0.06	0.62	0.20	0.04	1021.00	**3.09**	**2.04**	**981.73**	0.34
SED14	2-4'	2/26/10	Russian*	5.74	0.13	0.10	**1.01**	0.32	0.06	1540.00	**4.67**	**3.08**	**1480.77**	0.51
SED15	0-2'	2/26/10	Russian*	3.09	0.07	0.05	0.54	0.17	0.03	2670.00	**8.09**	**5.34**	**2567.31**	0.89
SED15	0-2'	2/26/10	Russian*	6.01	0.14	0.10	**1.05**	0.33	0.06	1777.00	**5.38**	**3.55**	**1708.65**	0.59
SED15	2-4'	2/26/10	Russian*	4.67	0.11	0.08	0.82	0.26	0.05	2300.00	**6.97**	**4.60**	**2211.54**	0.77
SED15	2-4'	2/26/10	Russian*	3.24	0.08	0.05	0.57	0.18	0.03	1130.00	**3.42**	**2.26**	**1086.54**	0.38
SED15	0-0.5'	5/6/10	PVC	2.76	0.06	0.05	0.48	0.15	0.03	470.00	**1.42**	0.94	**451.92**	0.16
SED15	0-0.5'	5/6/10	PVC	6.75	0.16	0.11	**1.18**	0.38	0.07	943.00	**2.86**	**1.89**	**906.73**	0.31
SED16	0-2'	2/26/10	Russian*	5.09	0.12	0.08	0.89	0.28	0.05	270.00	0.82	0.54	**259.62**	0.09
SED16	0-2'	2/26/10	Russian*	5.24	0.12	0.09	0.92	0.29	0.05	324.00	0.98	0.65	**311.54**	0.11
MPA-AB13	0-3'	5/20/10	PVC	5.41	0.13	0.09	0.95	0.30	0.05	NA	-	-	-	-
SB-1	0-7'	5/5/10	PVC	2.35	0.05	0.04	0.41	0.13	0.02	104.00	0.32	0.21	**100.00**	0.03
SB-2	0-7'	5/7/10	PVC	4.66	0.11	0.08	0.82	0.26	0.05	661.00	**2.00**	**1.32**	**635.58**	0.22
SPMPA-5	0-5'	10/6/10		1.36	0.03	0.02	0.24	0.08	0.01	347.00	**1.05**	0.69	**333.65**	0.12
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-

[a]ORNL (1997a) Screening benchmark for earthworms and soil microorganisms

[p] Eco-SSL for terrestrial plants. [v] EPA Region 5 ESL

[4] ORNL 1997b, ES/ER/TM-85/R3.

All concentrations in mg/kg unless otherwise noted.

*Russian Borer

Note: some samples have been excluded for brevity; tables include samples with maximum PCOEC concentrations.

Table 1-2a: Soil Evaluation (Continued)

Sample ID	Depth	Date	Sample Type	True and Total Barium Conc. (mg/kg dry)	Eco-SSL **Invert** HQ	Eco-SSL **Plant**[a] HQ	Region V **Mammal**[v] HQ	ORNL **Microbes**[4] HQ	Cadmium Conc. (mg/kg dry)	Eco-SSL **Avian** HQ	Eco-SSL **Inverts**[a] HQ	Region V **Mammal**[v] HQ	Eco-SSL **Plant**[a] HQ	ORNL **Microbes** HQ
Screening Level...				-	330	500	1.04	3000	-	0.77	20	0.00222	4	20
SS7	0-1.4'	4/26/06	Syringe	NA	-	-	-	-	NA	-	-	-	-	-
SS7	1.4-2.5'	4/26/06	Syringe	NA	-	-	-	-	NA	-	-	-	-	-
SS7	2.5-3.5'	4/26/06	Syringe	NA	-	-	-	-	NA	-	-	-	-	-
SED2	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.496	-	-	-	-	-
SED2	0-2'	2/25/10	Russian*	NA	-	-	-	-	1.26	**1.64**	0.06	**567.57**	0.32	0.06
SED2	2-4'	2/25/10	Russian*	NA	-	-	-	-	1.35	**1.75**	0.07	**608.11**	0.34	0.07
SED3	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.496	-	-	-	-	-
SED3	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.06	-	-	-	-	-
SED3	2-4'	2/25/10	Russian*	NA	-	-	-	-	1.10	**1.43**	0.06	**495.50**	0.28	0.06
SED4	0-2'	2/25/10	Russian*	NA	-	-	-	-	0.59	0.77	0.03	**267.57**	0.15	0.03
SED4	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.01	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.496	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	NA	-	-	-	-	<0.02	-	-	-	-	-
SED6	0-2'	2/25/10	Russian*	NA	-	-	-	-	1.21	**1.57**	0.06	**545.05**	0.30	0.06
SED6	0-2'	2/25/10	Russian*	NA	-	-	-	-	2.10	**2.73**	0.11	**945.95**	0.53	0.11
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED11	2-4'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	1600.00	**4.85**	**3.20**	**1538.46**	0.53	<0.498	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	NA	-	-	-	-	<0.024	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED12	2-4'	2/25/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED13	2-4'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED13	0-0.5'	5/6/10	PVC	1070.00	**3.24**	**2.14**	**1028.85**	0.36	<0.499	-	-	-	-	-
SED13	0--0.5'	5/5/10	PVC	NA	-	-	-	-	<0.03	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED14	2-4'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	NA	-	-	-	-	1.07	**1.39**	0.05	**481.98**	0.27	0.05
SED15	0-2'	2/26/10	Russian*	NA	-	-	-	-	0.43	0.56	0.02	**193.69**	0.11	0.02
SED15	2-4'	2/26/10	Russian*	NA	-	-	-	-	0.69	0.90	0.03	**311.71**	0.17	0.03
SED15	2-4'	2/26/10	Russian*						0.27	0.35	0.01	**121.62**	0.07	0.01
SED15	0-0.5'	5/6/10	PVC	831.00	**2.52**	**1.66**	**799.04**	0.28	<0.497	-	-	-	-	-
SED15	0-0.5'	5/6/10	PVC	NA	-	-	-	-	<0.034	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	NA	-	-	-	-	-
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	-	-	NA	-	-	-	-	-
SB-1	0-7'	5/5/10	PVC	225.00	0.68	0.45	**216.35**	0.08	<0.499	-	-	-	-	-
SB-2	0-7'	5/7/10	PVC	1090.00	**3.30**	**2.18**	**1048.08**	0.36	<0.498	-	-	-	-	-
SPMPA-5	0-5'	10/6/10		639.00	**1.94**	**1.28**	**614.42**	0.21	<0.497	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	NA	-	-	-	-	-

[a]ORNL (1997a) Screening benchmark for earthworms soil microorganisms

[P] Eco-SSL for terrestrial plants. [V] EPA Region 5 ESL

[4] ORNL 1997b, ES/ER/TM-85/R3.

All concentrations in mg/kg unless otherwise noted.

*Russian Borer

Table 1-2a: Soil Evaluation (Continued)

				Chromium[c]						Lead					
Sample ID	Depth	Date	Sample Type	Conc. (mg/kg dry)	Eco-SSL Avian HQ	Eco-SSL Inverts[a] HQ	Eco-SSL Mammal HQ	Eco-SSL Plant[a] HQ	ORNL Microbes HQ	Conc.	Eco-SSL Avian HQ	Eco-SSL Invert HQ	Region V Mammal[v] HQ	Eco-SSL Plant[a] HQ	ORNL Microbe[4] HQ
Screening Level...				-	26	0.4	34	1	10	-	11	500	0.0537	50	900
SS7	0-1.4'	4/26/06	Syringe	20.00	0.77	**50.00**	0.59	**20.00**	**2.00**	67.50	**6.14**	0.14	**1256.98**	**1.35**	0.08
SS7	1.4-2.5'	4/26/06	Syringe	13.30	0.51	**33.25**	0.39	**13.30**	**1.33**	117.00	**10.64**	0.23	**2178.77**	**2.34**	0.13
SS7	2.5-3.5'	4/26/06	Syringe	8.25	0.32	**20.63**	0.24	**8.25**	0.83	20.00	**1.82**	0.04	**372.44**	0.40	0.02
SED2	0-2'	2/25/10	Russian*	19.20	0.74	**48.00**	0.56	**19.20**	**1.92**	21.00	**1.91**	0.04	**391.06**	0.42	0.02
SED2	0-2'	2/25/10	Russian*	8.74	0.34	**21.85**	0.26	**8.74**	0.87	26.22	**2.38**	0.05	**488.27**	0.52	0.03
SED2	2-4'	2/25/10	Russian*	8.16	0.31	**20.40**	0.24	**8.16**	0.82	10.80	0.98	0.02	**201.12**	0.22	0.01
SED3	0-2'	2/25/10	Russian*	15.20	0.58	**38.00**	0.45	**15.20**	**1.52**	19.90	**1.81**	0.04	**370.58**	0.40	0.02
SED3	0-2'	2/25/10	Russian*	<0.16	-	-	-	-	-	26.74	**2.43**	0.05	**497.95**	0.53	0.03
SED3	2-4'	2/25/10	Russian*	8.87	0.34	**22.18**	0.26	**8.87**	0.89	10.10	0.92	0.02	**188.08**	0.20	0.01
SED4	0-2'	2/25/10	Russian*	16.40	0.63	**41.00**	0.48	**16.40**	**1.64**	22.40	**2.04**	0.04	**417.13**	0.45	0.02
SED4	0-2'	2/25/10	Russian*	5.27	0.20	**13.18**	0.16	**5.27**	0.53	11.90	**1.08**	0.02	**221.60**	0.24	0.01
SED5	0-2'	2/25/10	Russian*	15.30	0.59	**38.25**	0.45	**15.30**	**1.53**	15.40	**1.40**	0.03	**286.78**	0.31	0.02
SED5	0-2'	2/25/10	Russian*	<0.05	-	-	-	-	-	14.86	**1.35**	0.03	**276.72**	0.30	0.02
SED6	0-2'	2/25/10	Russian*	24.10	0.93	**60.25**	0.71	**24.10**	**2.41**	55.20	**5.02**	0.11	**1027.93**	**1.10**	0.06
SED6	0-2'	2/25/10	Russian*	3.57	0.14	**8.93**	0.11	**3.57**	0.36	18.73	**1.70**	0.04	**348.79**	0.37	0.02
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED11	2-4'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	13.60	0.52	**34.00**	0.40	**13.60**	**1.36**	19.30	**1.75**	0.04	**359.40**	0.39	0.02
SED11	0-0.5'	5/6/10	PVC	14.50	0.56	**36.25**	0.43	**14.50**	**1.45**	18.80	**1.71**	0.04	**350.09**	0.38	0.02
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED12	2-4'	2/25/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED13	2-4'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED13	0-0.5'	5/6/10	PVC	15.70	0.60	**39.25**	0.46	**15.70**	**1.57**	18.10	**1.65**	0.04	**337.06**	0.36	0.02
SED13	0--0.5'	5/5/10	PVC	18.50	0.71	**46.25**	0.54	**18.50**	**1.85**	22.00	**2.00**	0.04	**409.68**	0.44	0.02
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED14	2-4'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	501.00	**19.27**	**1252.50**	**14.74**	**501.00**	**50.10**	179.00	**16.27**	0.36	**3333.33**	**3.58**	0.20
SED15	0-2'	2/26/10	Russian*	297.20	**11.43**	**743.00**	**8.74**	**297.20**	**29.72**	130.80	**11.89**	0.26	**2435.75**	**2.62**	0.15
SED15	2-4'	2/26/10	Russian*	209.00	**8.04**	**522.50**	**6.15**	**209.00**	**20.90**	87.30	**7.94**	0.17	**1625.70**	**1.75**	0.10
SED15	2-4'	2/26/10	Russian*	292.00	**11.23**	**730.00**	**8.59**	**292.00**	**29.20**	76.70	**6.97**	0.15	**1428.31**	**1.53**	0.09
SED15	0-0.5'	5/6/10	PVC	12.30	0.47	**30.75**	0.36	**12.30**	**1.23**	16.70	**1.52**	0.03	**310.99**	0.33	0.02
SED15	0-0.5'	5/6/10	PVC	18.00	0.69	**45.00**	0.53	**18.00**	**1.80**	23.70	**2.15**	0.05	**441.34**	0.47	0.03
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	-	NA	-	-	-	-	-
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-
SB-1	0-7'	5/5/10	PVC	11.20	0.43	**28.00**	0.33	**11.20**	**1.12**	13.80	**1.25**	0.03	**256.98**	0.28	0.02
SB-2	0-7'	5/7/10	PVC	11.70	0.45	**29.25**	0.34	**11.70**	**1.17**	16.50	**1.50**	0.03	**307.26**	0.33	0.02
SPMPA-5	0-5'	10/6/10		12.60	0.48	**31.50**	0.37	**12.60**	**1.26**	7.83	0.71	0.02	**145.81**	0.16	0.01
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-

[a]ORNL (1997a) Screening benchmark for soil microorganisms

[P] Eco-SSL for terrestrial plants. [V] EPA Region 5

[4] ORNL 1997b, ES/ER/TM-85/R3.

All concentrations in mg/kg unless otherwise noted.

*Russian Borer

Table 1-2a: Soil Evaluation (Continued)

				Mercury						Selenium					
Sample ID	Depth	Date	Sample Type	Conc. (mg/kg dry)	Eco-SSL Avian HQ	Eco-SSL Mammal HQ	Region V Invert[v] HQ	ORNL Plant[a] HQ	ORNL Microbe[4] HQ	Conc. (mg/kg dry)	Eco-SSL Avian HQ	Eco-SSL Mammal HQ	Eco-SSL Invert HQ	Eco-SSL Plant[a] HQ	ORNL Microbe[4] HQ
Screening Level...				-	no data	no data	0.1	0.3	30	-	1.2	0.63	4.1	0.52	100
SS7	0-1.4'	4/26/06	Syringe	NA	-	-	-	-	-	NA	-	-	-	-	-
SS7	1.4-2.5'	4/26/06	Syringe	NA	-	-	-	-	-	NA	-	-	-	-	-
SS7	2.5-3.5'	4/26/06	Syringe	NA	-	-	-	-	-	NA	-	-	-	-	-
SED2	0-2'	2/25/10	Russian*	<0.1	-	-	-	-	-	<1.98	-	-	-	-	-
SED2	0-2'	2/25/10	Russian*	0.06	-	-	0.60	0.20	0.00	<1.09	-	-	-	-	-
SED2	2-4'	2/25/10	Russian*	<0.1	-	-	-	-	-	<1.99	-	-	-	-	-
SED3	0-2'	2/25/10	Russian*	<0.1	-	-	-	-	-	<1.99	-	-	-	-	-
SED3	0-2'	2/25/10	Russian*	0.14	-	-	**1.40**	0.47	0.00	<1.74	-	-	-	-	-
SED3	2-4'	2/25/10	Russian*	0.11	-	-	**1.08**	0.36	0.00	<1.99	-	-	-	-	-
SED4	0-2'	2/25/10	Russian*	0.22	-	-	**2.20**	0.73	0.01	<1.98	-	-	-	-	-
SED4	0-2'	2/25/10	Russian*	0.04	-	-	0.40	0.13	0.00	<0.42	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	0.62	-	-	**6.23**	**2.08**	0.02	<1.99	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	0.04	-	-	0.40	0.13	0.00	<0.50	-	-	-	-	-
SED6	0-2'	2/25/10	Russian*	14.30	-	-	**143.00**	**47.67**	0.48	<1.98	-	-	-	-	-
SED6	0-2'	2/25/10	Russian*	0.88	-	-	**8.80**	**2.93**	0.03	<0.51	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	0.19	-	-	**1.92**	0.64	0.01	<1.99	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	0.09	-	-	0.90	0.30	0.00	1.11	0.93	**1.76**	0.27	**2.13**	0.01
SED11	2-4'	2/25/10	Russian*	0.14	-	-	**1.42**	0.47	0.00	<1.99	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	<0.1	-	-	-	-	-	<1.99	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	0.10	-	-	0.96	0.32	0.00	<0.731	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	0.13	-	-	**1.28**	0.43	0.00	<1.99	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	0.07	-	-	0.70	0.23	0.00	1.53	**1.28**	**2.43**	0.37	**2.94**	0.02
SED12	2-4'	2/25/10	Russian*	0.21	-	-	**2.07**	0.69	0.01	<1.99	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	0.23	-	-	**2.31**	0.77	0.01	<1.99	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	0.07	-	-	0.70	0.23	0.00	1.65	-	-	-	-	-
SED13	2-4'	2/26/10	Russian*	<0.1	-	-	-	-	-	<1.98	-	-	-	-	-
SED13	0-0.5'	5/6/10	PVC	<0.1	-	-	-	-	-	<2.0	-	-	-	-	-
SED13	0–0.5'	5/5/10	PVC	0.11	-	-	**1.05**	0.35	0.00	<0.909	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	0.10	-	-	**1.03**	0.34	0.00	<1.99	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	0.07	-	-	0.70	0.23	0.00	1.42	**1.18**	**2.25**	0.35	**2.73**	0.01
SED14	2-4'	2/26/10	Russian*	0.12	-	-	**1.24**	0.41	0.00	<1.99	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	1.04	-	-	**10.40**	**3.47**	0.03	<2.0	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	0.61	-	-	**6.10**	**2.03**	0.02	1.02	0.85	**1.62**	0.25	**1.96**	0.01
SED15	2-4'	2/26/10	Russian*	0.42	-	-	**4.15**	**1.38**	0.01	<1.99	-	-	-	-	-
SED15	2-4'	2/26/10	Russian*	0.15	-	-	**1.50**	0.50	0.01	0.66	0.55	**1.05**	0.16	**1.27**	0.01
SED15	0-0.5'	5/6/10	PVC	0.24	-	-	**2.35**	0.78	0.01	<1.99	-	-	-	-	-
SED15	0-0.5'	5/6/10	PVC	0.17	-	-	**1.67**	0.56	0.01	<1.016	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	0.60	-	-	**6.04**	**2.01**	0.02	<1.99	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	0.09	-	-	0.90	0.30	0.00	2.11	**1.76**	**3.35**	0.51	**4.06**	0.02
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	-	-	-	NA	-	-	-	-	-
SB-1	0-7'	5/5/10	PVC	NA	-	-	-	-	-	<2.0	-	-	-	-	-
SB-2	0-7'	5/7/10	PVC	<0.1	-	-	-	-	-	<1.99	-	-	-	-	-
SPMPA-5	0-5'	10/6/10		<0.1	-	-	-	-	-	<1.99	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	0.12	-	-	**1.22**	0.41	0.00	NA	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	0.20	-	-	**2.04**	0.68	0.01	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	0.34	-	-	**3.43**	**1.14**	0.01	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	16.70	-	-	**167.00**	**55.67**	0.56	NA	-	-	-	-	-

[a]ORNL (1997a) Screening benchmark for soil microorganisms

[P] Eco-SSL for terrestrial plants. [V] EPA Region 5

[4] ORNL 1997b, ES/ER/TM-85/R3.

All concentrations in mg/kg unless otherwise noted.

*Russian Borer

Table 1-2a: Soil Evaluation (Continued)

Sample ID	Depth	Date	Sample Type	Zinc					
				Conc. (mg/kg dry)	Eco-SSL **Avian** HQ	Eco-SSL **Mammal** HQ	Region V **Invert**[v] HQ	ORNL **Plant**[a] HQ	ORNL **Microbe**[4] HQ
Screening Level…				-	46	79	6.62	50	100
SS7	0-1.4'	4/26/06	Syringe	111.00	**2.41**	**1.41**	**16.77**	**2.22**	**1.11**
SS7	1.4-2.5'	4/26/06	Syringe	98.10	**2.13**	**1.24**	**14.82**	**1.96**	0.98
SS7	2.5-3.5'	4/26/06	Syringe	63.10	**1.37**	0.80	**9.53**	**1.26**	0.63
SED2	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED2	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED2	2-4'	2/25/10	Russian*	NA	-	-	-	-	-
SED3	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED3	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED3	2-4'	2/25/10	Russian*	NA	-	-	-	-	-
SED4	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED4	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED5	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED6	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED6	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED11	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED11	2-4'	2/25/10	Russian*	NA	-	-	-	-	-
SED11	0-0.5'	5/6/10	PVC	51.40	**1.12**	0.65	**7.76**	**1.03**	0.51
SED11	0-0.5'	5/6/10	PVC	51.80	**1.13**	0.66	**7.82**	**1.04**	0.52
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED12	0-2'	2/25/10	Russian*	NA	-	-	-	-	-
SED12	2-4'	2/25/10	Russian*	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED13	2-4'	2/26/10	Russian*	NA	-	-	-	-	-
SED13	0-0.5'	5/6/10	PVC	61.40	**1.33**	0.78	**9.27**	**1.23**	0.61
SED13	0--0.5'	5/5/10	PVC	65.10	**1.42**	0.82	**9.83**	**1.30**	0.65
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED14	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED14	2-4'	2/26/10	Russian*	NA	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED15	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED15	2-4'	2/26/10	Russian*	NA	-	-	-	-	-
SED15	2-4'	2/26/10	Russian*	NA	-	-	-	-	-
SED15	0-0.5'	5/6/10	PVC	51.30	**1.12**	0.65	**7.75**	**1.03**	0.51
SED15	0-0.5'	5/6/10	PVC	73.20	**1.59**	0.93	**11.06**	**1.46**	0.73
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
SED16	0-2'	2/26/10	Russian*	NA	-	-	-	-	-
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	-	-	-
SB-1	0-7'	5/5/10	PVC	53.40	**1.16**	0.68	**8.07**	**1.07**	0.53
SB-2	0-7'	5/7/10	PVC	55.40	**1.20**	0.70	**8.37**	**1.11**	0.55
SPMPA-5	0-5'	10/6/10		29.20	0.63	0.37	**4.41**	0.58	0.29
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	-	-	-

[a]ORNL (1997a) Screening benchmark for soil microorganisms

[P] Eco-SSL for terrestrial plants. [v] EPA Region 5

[4] ORNL 1997b, ES/ER/TM-85/R3.

All concentrations in mg/kg unless otherwise noted.

*Russian Borer

Table 1-2b: Sediment Evaluation

Boring ID	Depth	Date	Sample Type	Metals (dry-mg/kg)								
				Arsenic			Barium			True Total Barium		
				Conc.	TEL[3]	PEL[3]	Conc.	TEL[6#]	AET[7#]	Conc.	TEL[6#]	AET[7#]
Screening Level...					5.9	17		130.1	48		130.1	48
SS7	0-1.4'	4/26/06	Syringe	22.00	**3.73**	**1.29**	15700.00	**120.68**	**327.08**	NA	-	-
SS7	1.4-2.5'	4/26/06	Syringe	21.50	**3.64**	**1.26**	13500.00	**103.77**	**281.25**	NA	-	-
SS7	2.5-3.5'	4/26/06	Syringe	9.10	**1.54**	0.54	3780.00	**29.05**	**78.75**	NA	-	-
SED2	0-2'	2/25/10	Russian*	8.29	**1.41**	0.49	308.00	**2.37**	**6.42**	NA	-	-
SED2	0-2'	2/25/10	Russian*	5.17	0.88	0.30	334.00	**2.57**	**6.96**	NA	-	-
SED2	2-4'	2/25/10	Russian*	40.30	**6.83**	**2.37**	265.00	**2.04**	**5.52**	NA	-	-
SED3	0-2'	2/25/10	Russian*	8.72	**1.48**	0.51	315.00	**2.42**	**6.56**	NA	-	-
SED3	0-2'	2/25/10	Russian*	8.82	**1.49**	0.52	335.00	**2.57**	**6.98**	NA	-	-
SED3	2-4'	2/25/10	Russian*	29.90	**5.07**	**1.76**	246.00	**1.89**	**5.13**	NA	-	-
SED4	0-2'	2/25/10	Russian*	5.42	0.92	0.32	662.00	**5.09**	**13.79**	NA	-	-
SED4	0-2'	2/25/10	Russian*	1.58	0.27	0.09	342.00	**2.63**	**7.13**	NA	-	-
SED5	0-2'	2/25/10	Russian*	4.75	0.81	0.28	216.00	**1.66**	**4.50**	NA	-	-
SED5	0-2'	2/25/10	Russian*	6.18	**1.05**	0.36	123.00	0.95	**2.56**	NA	-	-
SED6	0-2'	2/25/10	Russian*	8.06	**1.37**	0.47	522.00	**4.01**	**10.88**	NA	-	-
SED6	0-2'	2/25/10	Russian*	3.31	0.56	0.19	227.00	**1.74**	**4.73**	NA	-	-
SED11	0-2'	2/25/10	Russian*	6.50	**1.10**	0.38	1260.00	**9.68**	**26.25**	NA	-	-
SED11	0-2'	2/25/10	Russian*	7.68	**1.30**	0.45	2021.00	**15.53**	**42.10**	NA	-	-
SED11	2-4'	2/25/10	Russian*	6.54	**1.11**	0.38	1130.00	**8.69**	**23.54**	NA	-	-
SED11	0-0.5'	5/6/10	PVC	4.80	0.81	0.28	713.00	**5.48**	**14.85**	1600.00	**12.30**	**33.33**
SED11	0-0.5'	5/6/10	PVC	4.39	0.74	0.26	550.00	**4.23**	**11.46**	NA	-	-
SED12	0-2'	2/25/10	Russian*	3.80	0.64	0.22	933.00	**7.17**	**19.44**	NA	-	-
SED12	0-2'	2/25/10	Russian*	3.43	0.58	0.20	1016.00	**7.81**	**21.17**	NA	-	-
SED12	2-4'	2/25/10	Russian*	5.93	**1.01**	0.35	1500.00	**11.53**	**31.25**	NA	-	-
SED13	0-2'	2/26/10	Russian*	4.32	0.73	0.25	773.00	**5.94**	**16.10**	NA	-	-
SED13	0-2'	2/26/10	Russian*	4.47	0.76	0.26	632.00	**4.86**	**13.17**	NA	-	-
SED13	2-4'	2/26/10	Russian*	3.47	0.59	0.20	682.00	**5.24**	**14.21**	NA	-	-
SED13	0-0.5'	5/6/10	PVC	3.11	0.53	0.18	586.00	**4.50**	**12.21**	1070.00	**8.22**	**22.29**
SED13	0--0.5'	5/5/10	PVC	5.02	0.85	0.30	909.00	**6.99**	**18.94**	NA	-	-
SED14	0-2'	2/26/10	Russian*	3.33	0.56	0.20	1180.00	**9.07**	**24.58**	NA	-	-
SED14	0-2'	2/26/10	Russian*	3.56	0.60	0.21	1021.00	**7.85**	**21.27**	NA	-	-
SED14	2-4'	2/26/10	Russian*	5.74	0.97	0.34	1540.00	**11.84**	**32.08**	NA	-	-
SED15	0-2'	2/26/10	Russian*	3.09	0.52	0.18	2670.00	**20.52**	**55.63**	NA	-	-
SED15	0-2'	2/26/10	Russian*	6.01	**1.02**	0.35	1777.00	**13.66**	**37.02**	NA	-	-
SED15	2-4'	2/26/10	Russian*	4.67	0.79	0.27	2300.00	**17.68**	**47.92**	NA	-	-
SED15	2-4'	2/26/10	Russian*	3.24	0.55	0.19	1130.00	**8.69**	**23.54**			
SED15	0-0.5'	5/6/10	PVC	2.76	0.47	0.16	470.00	**3.61**	**9.79**	831.00	**6.39**	**17.31**
SED15	0-0.5'	5/6/10	PVC	6.75	**1.14**	0.40	943.00	**7.25**	**19.65**	NA	-	-
SED16	0-2'	2/26/10	Russian*	5.09	0.86	0.30	270.00	**2.08**	**5.63**	NA	-	-
SED16	0-2'	2/26/10	Russian*	5.24	0.89	0.31	324.00	**2.49**	**6.75**	NA	-	-
MPA-AB13	0-3'	5/20/10	PVC	5.41	0.92	0.32	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-

[#] Marine benchmark used due to lack of freshwater benchmarks

[3] Arch ET&C 200, 39(1)20- TEL and PEL are also known as Canadian ISQGs and PELs

[6] Ecotox. 1996, 5(4):253-

[7] Chapter 173-204 WAC, 1991/95 as a supplemented by WA Dept of Ecology staff with unpublished data

*Russian borer

Note: some samples have been excluded for brevity; tables include samples with maximum PCOEC concentrations.

Table 1-2b: Sediment Evaluation (Continued)

Boring ID	Depth	Date	Sample Type	Metals (dry-mg/kg) Cadmium Conc.	Cadmium TEL[3]	Cadmium PEL[3]	Chromium Conc.	Chromium TEL[3]	Chromium PEL[3]	Lead Conc.	Lead TEL[3]	Lead PEL[3]
Screening Level…					0.596	3.53		37.3	90		35	91.3
SS7	0-1.4'	4/26/06	Syringe	NA	-	-	20.00	0.54	0.22	67.50	**1.93**	0.74
SS7	1.4-2.5'	4/26/06	Syringe	NA	-	-	13.30	0.36	0.15	117.00	**3.34**	**1.28**
SS7	2.5-3.5'	4/26/06	Syringe	NA	-	-	8.25	0.22	0.09	20.00	0.57	0.22
SED2	0-2'	2/25/10	Russian*	<0.496	-	-	19.20	0.51	0.21	21.00	0.60	0.23
SED2	0-2'	2/25/10	Russian*	1.26	**2.11**	0.36	8.74	0.23	0.10	26.22	0.75	0.29
SED2	2-4'	2/25/10	Russian*	1.35	**2.27**	0.38	8.16	0.22	0.09	10.80	0.31	0.12
SED3	0-2'	2/25/10	Russian*	<0.496	-	-	15.20	0.41	0.17	19.90	0.57	0.22
SED3	0-2'	2/25/10	Russian*	<0.06	-	-	<0.16	-	-	26.74	0.76	0.29
SED3	2-4'	2/25/10	Russian*	1.10	**1.85**	0.31	8.87	0.24	0.10	10.10	0.29	0.11
SED4	0-2'	2/25/10	Russian*	0.59	1.00	0.17	16.40	0.44	0.18	22.40	0.64	0.25
SED4	0-2'	2/25/10	Russian*	<0.01	-	-	5.27	0.14	0.06	11.90	0.34	0.13
SED5	0-2'	2/25/10	Russian*	<0.496	-	-	15.30	0.41	0.17	15.40	0.44	0.17
SED5	0-2'	2/25/10	Russian*	<0.02	-	-	<0.05	-	-	14.86	0.42	0.16
SED6	0-2'	2/25/10	Russian*	1.21	**2.03**	0.34	24.10	0.65	0.27	55.20	**1.58**	0.60
SED6	0-2'	2/25/10	Russian*	2.10	**3.52**	0.59	3.57	0.10	0.04	18.73	0.54	0.21
SED11	0-2'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED11	0-2'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED11	2-4'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED11	0-0.5'	5/6/10	PVC	<0.498	-	-	13.60	0.36	0.15	19.30	0.55	0.21
SED11	0-0.5'	5/6/10	PVC	<0.024	-	-	14.50	0.39	0.16	18.80	0.54	0.21
SED12	0-2'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED12	0-2'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED12	2-4'	2/25/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED13	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED13	2-4'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED13	0-0.5'	5/6/10	PVC	<0.499	-	-	15.70	0.42	0.17	18.10	0.52	0.20
SED13	0--0.5'	5/5/10	PVC	<0.03	-	-	18.50	0.50	0.21	22.00	0.63	0.24
SED14	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED14	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED14	2-4'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED15	0-2'	2/26/10	Russian*	1.07	**1.80**	0.30	501.00	**13.43**	**5.57**	179.00	**5.11**	**1.96**
SED15	0-2'	2/26/10	Russian*	0.43	0.72	0.12	297.20	**7.97**	**3.30**	130.80	**3.74**	**1.43**
SED15	2-4'	2/26/10	Russian*	0.69	**1.16**	0.20	209.00	**5.60**	**2.32**	87.30	**2.49**	0.96
SED15	2-4'	2/26/10	Russian*	0.27	0.45	0.08	292.00	**7.83**	**3.24**	76.70	**2.19**	0.84
SED15	0-0.5'	5/6/10	PVC	<0.497	-	-	12.30	0.33	0.14	16.70	0.48	0.18
SED15	0-0.5'	5/6/10	PVC	<0.034	-	-	18.00	0.48	0.20	23.70	0.68	0.26
SED16	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
SED16	0-2'	2/26/10	Russian*	NA	-	-	NA	-	-	NA	-	-
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	NA	-	-	NA	-	-	NA	-	-

[#]Marine benchmark used due to lack of freshwater benchma

[3] Arch ET&C 200, 39(1)20- TEL and PEL are also known as (

[6] Ecotox. 1996, 5(4):253-

[7] Chapter 173-204 WAC, 1991/95 as a supplemented by WA

*Russian borer

Table 1-2b: Sediment Evaluation (Continued)

Boring ID	Depth	Date	Sample Type	Metals (dry-mg/kg)								
				Mercury			Selenium			Zinc		
				Conc.	TEL[3]	PEL[3]	Conc.	TEL[3]	AET[7#]	Conc.	TEL[3]	PEL[3]
Screening Level...				-	0.174	0.486		-	1		123	315
SS7	0-1.4'	4/26/06	Syringe	NA	-	-	NA	-	-	111.00	0.90	0.35
SS7	1.4-2.5'	4/26/06	Syringe	NA	-	-	NA	-	-	98.10	0.80	0.31
SS7	2.5-3.5'	4/26/06	Syringe	NA	-	-	NA	-	-	63.10	0.51	0.20
SED2	0-2'	2/25/10	Russian*	<0.1	-	-	<1.98	-	-	NA	-	-
SED2	0-2'	2/25/10	Russian*	0.06	0.34	0.12	<1.09	-	-	NA	-	-
SED2	2-4'	2/25/10	Russian*	<0.1	-	-	<1.99	-	-	NA	-	-
SED3	0-2'	2/25/10	Russian*	<0.1	-	-	<1.99	-	-	NA	-	-
SED3	0-2'	2/25/10	Russian*	0.14	0.80	0.29	<1.74	-	-	NA	-	-
SED3	2-4'	2/25/10	Russian*	0.11	0.62	0.22	<1.99	-	-	NA	-	-
SED4	0-2'	2/25/10	Russian*	0.22	**1.26**	0.45	<1.98	-	-	NA	-	-
SED4	0-2'	2/25/10	Russian*	0.04	0.23	0.08	<0.42	-	-	NA	-	-
SED5	0-2'	2/25/10	Russian*	0.62	**3.58**	**1.28**	<1.99	-	-	NA	-	-
SED5	0-2'	2/25/10	Russian*	0.04	0.23	0.08	<0.50	-	-	NA	-	-
SED6	0-2'	2/25/10	Russian*	14.30	**82.18**	**29.42**	<1.98	-	-	NA	-	-
SED6	0-2'	2/25/10	Russian*	0.88	**5.06**	**1.81**	<0.51	-	-	NA	-	-
SED11	0-2'	2/25/10	Russian*	0.19	**1.10**	0.40	<1.99	-	-	NA	-	-
SED11	0-2'	2/25/10	Russian*	0.09	0.52	0.19	1.11	-	**1.11**	NA	-	-
SED11	2-4'	2/25/10	Russian*	0.14	0.82	0.29	<1.99	-	-	NA	-	-
SED11	0-0.5'	5/6/10	PVC	<0.1	-	-	<1.99	-	-	51.40	0.42	0.16
SED11	0-0.5'	5/6/10	PVC	0.10	0.55	0.20	<0.731	-	-	51.80	0.42	0.16
SED12	0-2'	2/25/10	Russian*	0.13	0.74	0.26	<1.99	-	-	NA	-	-
SED12	0-2'	2/25/10	Russian*	0.07	0.40	0.14	1.53	-	-	NA	-	-
SED12	2-4'	2/25/10	Russian*	0.21	**1.19**	0.43	<1.99	-	-	NA	-	-
SED13	0-2'	2/26/10	Russian*	0.23	**1.33**	0.48	<1.99	-	-	NA	-	-
SED13	0-2'	2/26/10	Russian*	0.07	0.40	0.14	1.65	-	**1.65**	NA	-	-
SED13	2-4'	2/26/10	Russian*	<0.1	-	-	<1.98	-	-	NA	-	-
SED13	0-0.5'	5/6/10	PVC	<0.1	-	-	<2.0	-	-	61.40	0.50	0.19
SED13	0--0.5'	5/5/10	PVC	0.11	0.60	0.22	<0.909	-	-	65.10	0.53	0.21
SED14	0-2'	2/26/10	Russian*	0.10	0.59	0.21	<1.99	-	-	NA	-	-
SED14	0-2'	2/26/10	Russian*	0.07	0.40	0.14	1.42	-	**1.42**	NA	-	-
SED14	2-4'	2/26/10	Russian*	0.12	0.71	0.26	<1.99	-	-	NA	-	-
SED15	0-2'	2/26/10	Russian*	1.04	**5.98**	**2.14**	<2.0	-	-	NA	-	-
SED15	0-2'	2/26/10	Russian*	0.61	**3.51**	**1.26**	1.02	-	**1.02**	NA	-	-
SED15	2-4'	2/26/10	Russian*	0.42	**2.39**	0.85	<1.99	-	-	NA	-	-
SED15	2-4'	2/26/10	Russian*	0.15	0.86	0.31	0.66	-	0.66	NA	-	-
SED15	0-0.5'	5/6/10	PVC	0.24	**1.35**	0.48	<1.99	-	-	51.30	0.42	0.16
SED15	0-0.5'	5/6/10	PVC	0.17	0.96	0.34	<1.016	-	-	73.20	0.60	0.23
SED16	0-2'	2/26/10	Russian*	0.60	**3.47**	**1.24**	<1.99	-	-	NA	-	-
SED16	0-2'	2/26/10	Russian*	0.09	0.52	0.19	2.11	-	**2.11**	NA	-	-
MPA-AB13	0-3'	5/20/10	PVC	NA	-	-	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	0.12	0.70	0.25	NA	-	-	NA	-	-
HGMPA 7	0-0.5'	10/6/10	PVC	0.20	**1.17**	0.42	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	0.34	**1.97**	0.71	NA	-	-	NA	-	-
HGMPA 7	0.5-2'	10/6/10	PVC	16.70	**95.98**	**34.36**	NA	-	-	NA	-	-

[#] Marine benchmark used due to lack of freshwater benchma

[3] Arch ET&C 200, 39(1)20- TEL and PEL are also known as (

[6] Ecotox 1996, 5(4):253-

[7] Chapter 173-204 WAC, 1991/95 as a supplemented by WA

*Russian borer

Table 1-2c: Groundwater Evaluation

Boring ID	Screened Interval (ft. bgs)	Date	Metals (mg/L)														
			Arsenic	Arsenic Acute HQ	Arsenic Chronic HQ	Barium	Barium Acute HQ	Barium Chronic HQ	Cadmium	Cadmium Acute HQ	Cadmium Chronic HQ	Lead	Lead Acute HQ	Lead Chronic HQ	Strontium	Strontium Acute HQ (T)	Strontium Chronic HQ (T)
Nationally Recommended Water Quality Criterion (mg/L)				0.34	0.15		0.110	0.004		0.002	0.00025		0.065	0.0025		15	1.5
AB2	11-21'	10-Nov-06	0.015	0.0	0.1	0.670	**6.1**	**167.5**	0.001	0.5	**4.0**	0.010	0.2	**4.0**	1.060	0.1	0.7
AB3	10-20'	10-Nov-06	<0.01	-	-	1.520	**13.8**	**380.0**	0.001	0.5	**4.0**	0.011	0.2	**4.4**	1.680	0.1	**1.1**
AB5	12-22'	13-Nov-06	<0.01	-	-	1.120	**10.2**	**280.0**	0.002	1.0	**8.0**	0.006	0.1	**2.4**	11.900	0.8	**7.9**
AB6	8-18'	10-Nov-06	0.012	0.0	0.1	2.130	**19.4**	**532.5**	<0.001	-	-	<0.005	-	-	5.680	0.4	**3.8**
AB6DUP	8-18'	11-Nov-06	0.011	0.0	0.1	2.140	**19.5**	**535.0**	0.001	0.5	**4.0**	<0.005	-	-	5.390	0.4	**3.6**
AB7	10-20'	13-Nov-06	0.025	0.1	0.2	2.360	**21.5**	**590.0**	0.002	1.0	**8.0**	<0.005	-	-	2.430	0.2	**1.6**
AB15	8-18'	13-Nov-06	0.017	0.1	0.1	3.690	**33.5**	**922.5**	0.002	1.0	**8.0**	<0.005	-	-	11.400	0.8	**7.6**
AB19	8-18'	10-Nov-06	<0.01	-	-	1.060	**9.6**	**265.0**	0.001	0.5	**4.0**	<0.005	-	-	1.470	0.1	1.0

T - Tier II Secondary Acute or Chronic Value (Suter and Tsao 1996)

d - Expressed in terms of the dissolved metal in the water column

e - Expressed as a function of hardness - assumes 100 mg/L (EPA 2014)

† - values for Chromium VI used due to its potential to occur in a surface water body under oxidizing conditions

Table 1-2d: Surface Water Evaluation

Boring ID	Date	Metals (mg/L)														
		Barium	Barium Acute HQ (T)	Barium Chronic HQ (T)	Lead	Lead Acute HQ	Lead Chronic HQ	Selenium	Selenium Acute HQ	Selenium Chronic HQ	Strontium	Strontium Acute HQ (T)	Strontium Chronic HQ (T)	Zinc	Zinc Acute HQ (d,e)	Zinc Chronic HQ (d,e)
Nationally Recommended Water Quality Criterion (mg/L)			**0.11**	**0.004**		**0.07**	**0.003**		**-**	**0.005**		**15**	**1.5**		**0.12**	**0.12**
SW05	5/5/10	0.265	**2.4**	**66.3**	<0.01	-	-	0.037	-	**7.4**	0.602	0.0	0.4	0.012	0.1	0.1
SW03	5/5/10	0.262	**2.4**	**65.5**	<0.01	-	-	0.039	-	**7.8**	0.558	0.0	0.4	0.015	0.1	0.1
SW02	5/5/10	0.285	**2.6**	**71.3**	<0.01	-	-	0.034	-	**6.8**	0.637	0.0	0.4	0.013	0.1	0.1
SW04	5/5/10	0.245	**2.2**	**61.3**	<0.01	-	-	0.033	-	**6.6**	0.614	0.0	0.4	0.012	0.1	0.1
SW01	5/6/10	0.284	**2.6**	**71.0**	<0.01	-	-	0.035	-	**7.0**	0.554	0.0	0.4	0.017	0.1	0.1
SW06	5/6/10	0.346	**3.1**	**86.5**	<0.01	-	-	0.048	-	**9.6**	0.729	0.0	0.5	0.016	0.1	0.1
SW07	5/6/10	0.413	**3.8**	**103.3**	<0.01	-	-	0.032	-	**6.4**	0.778	0.1	0.5	<0.01	-	-
SW10	5/6/10	0.345	**3.1**	**86.3**	<0.01	-	-	0.039	-	**7.8**	0.721	0.0	0.5	0.020	0.2	0.2
SW09	5/6/10	0.378	**3.4**	**94.5**	<0.01	-	-	0.036	-	**7.2**	0.829	0.1	0.6	<0.01	-	-
SW20	5/7/10	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-

T - Tier II Secondary Acute or Chronic Value (Suter and Tsao 1996)

d - Expressed in terms of the dissolved metal in the water column

e - Expressed as a function of hardness - assumes 100 mg/L (EPA 2014)

† - values for Chromium VI used due to its potential to occur in a surface water body under oxidizing conditions

PCOECs which were not detected or for which no screening criteria are available, are not shown.

Attachment 1-3: Level III Protective Concentration Levels and HQs

Attachment 1-3a: Species Uptake Factors

Parameter	Description	American Robin	Spotted Sandpiper	American Woodcock	Mallard	Least shrew	Red Fox	Swamp Rabbit	Snowy Egret	units	Source
BW	body weight of receptor	0.0773	0.0425	0.169	1.134	0.0055	4.53	1.882	0.371	kg	Clench and Leberman (1978), Maxson & Oring (1980), EPA (1993), Nelson and Martin (1953), Burt and Grossenheider (1998), Storm et al. (1976), Bond et al. (2006), Dunning (1993)
Food IR	Food Ingest. Rate	0.0102	0.00933	0.0201	0.0551	0.00108	0.171	0.0978	0.0428	kg/day	Nagy (2001)
Soil IR	Soil Ingest. Rate	0.000530	0.00168	0.00209	0.00182	8.32E-05	0.004788	0.00616	0.00312	kg/day	Beyer et al. (1994, 2003)
Fd (plants)	Fraction of diet made up of plants	0.41	0	0	0.5	0	0.07	1	0	-	Wheelwright (1986), Maxson and Oring (1980), Whitaker (2006), Hockman & Chapman (1983), Zollner et al. (1999), EPA (1993), Stribling and Doerr (1985), Strong et al. (1997)
Fd (inverts)	Fraction diet made up of soil invertebrates	0.59	0	1	0.5	1	0.03	0	0	-	
Fd (mammals)	Fraction of diet made up of small mammals	0	0	0	0	0	0.9	0	0	-	
Fd (benthic inverts)	Fraction of diet made up of benthic invertebrates	0	1	0	0	0	0	0	0	-	
Fd (fish)	Fraction of diet made up of fish	0	0	0	0	0	0	0	1		
Exposure Modifying Factors (EMF)s											
Home range	Home range of receptor	1.04	8	11	405	0.49	3030	3.6	0.6	acres	Pitts (1984), Hays (1972), McCay (2001), Jones & Theberge (1982), Sargeant (1972), Ables (1969), Toll et al. (1960), Gregg (1984), EPA (1993), Gilmer et al. (1975), Moralez-Silva (2010)*
Home range factor	Fraction of home range that is contaminated	1.0	1.0	1.0	1.00	1.0	0.330	1.0	1.0	-	Calculated based on an estimated site size of 1000 acres
Time (temporal) factor	Fraction of time spent in contaminated area	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	

*Little blue heron used as a surrogate for home range due to similar feeding habits and lack of data for egret

BW: Body Weight. IR: Ingestion Rate. EMF: Exposure Modifying Factor. Note: Assume water contamination to be negligible

Attachment1-3b: Toxicity Reference Values

Contaminant	TRV (mg/kg-day)			
	Avian (Robin, Woodcock, Mallard, Egret & Sandpiper)		Mammal (Shrew, Fox, Rabbit)	
	Value	Source	Value	Source
Arsenic	2.24	EPA (2005)	1.04	EPA (2005)
Barium	20.8	Sample et al. (1996)*	51.8	EPA (2005)
True & Total Barium	20.8	Sample et al. (1996)*	51.8	EPA (2005)
Cadmium	1.47	EPA (2005)	0.77	EPA (2005)
Chromium	2.66	EPA (2005)	2.4	EPA (2005)
Lead	1.63	EPA (2005)	4.7	EPA (2005)
Mercury	0.45	Sample et al. (1996)	0.032	Sample et al. (1996) [1]
Selenium	0.29	EPA (2005)	0.143	EPA (2005)
Zinc	66.1	EPA (2005)	75.4	EPA (2005)

Chromium is assumed to be in the trivalent form

*Based on a subchronic NOAEL of 208.26 mg/kg-d (Johnson et al. 1960). The TRV was multiplied by an uncertainty factor of 0.1 to extrapolate from subchronic to chronic effects as per Sample et al. (1996).

[1] NOAEL for methyl mercury due to its potential presence in anoxic sediments.

Attachment 1-3c: Bioconcentration factors(BCFs)

COEC	Soil-to-Plant BCF	Source	Soil-to-Earth-worm BCF	Source	Soil-to-Mammal BCF	Source	Sediment-to-Benthic Invertebrate BCF	Source	Sediment-to-Fish BCF	Source
Arsenic	0.0375	Median value from Table 6 (Bechtel-Jacobs 1998a)	0.224	Median value from Table 11 (Sample et al. 1998a)	0.0025	Median value from Table 7 (Sample et al. 1998b)	0.127	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	3.4	Meador et al. (2004) Table 2
Barium	0.156	Median value from Table D-1 (Bechtel-Jacobs 1998a)	0.0910	Median Value from Table C.1 (Sample et al. 1998a)	0.0566	Median value from Table 7 (Sample et al. 1998b)	1.154	No data - value is the average of the other metals as per EPA (1999)	0.28	Hamilton et al. (2002)
True & Total Barium	0.156	Median value from Table D-1 (Bechtel-Jacobs 1998a)	0.0910	Median Value from Table C.1 (Sample et al. 1998a)	0.0566	Median value from Table 7 (Sample et al. 1998b)	1.154	No data - value is the average of the other metals as per EPA (1999)	0.28	Hamilton et al. (2002)
Cadmium	0.586	Median value from Table 6 (Bechtel-Jacobs 1998a)	7.708	Median value from Table 11 (Sample et al. 1998a)	0.3333	Median value from Table 7 (Sample et al. 1998b)	0.614	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	0.42	Chen and Chen (1999) Table 2
Chromium	0.041	Median value from Table D-1 (Bechtel-Jacobs 1998a)	0.3060	Median value from Table 11 (Sample et al. 1998a)	0.0846	Median value from Table 7 (Sample et al. 1998b)	0.108	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	0.161	Hamilton et al. (2002)
Lead	0.0389	Median value from Table 6 (Bechtel-Jacobs 1998a)	0.2660	Median value from Table 11 (Sample et al. 1998a)	0.1054	Median value from Table 7 (Sample et al. 1998b)	0.066	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	0.187	Meador et al. (2005)
Mercury	0.6520	Median value from Table 6 (Bechtel-Jacobs 1998a)	1.6930	Median value from Table 11 (Sample et al. 1998a)	0.0543	Median value from Table 7 (Sample et al. 1998b)	1.081	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	2.62	Median value from Meador et al. (2005)
Selenium	0.6720	Median value from Table 6 (Bechtel-Jacobs 1998a)	0.9850	Median value from Table 11 (Sample et al. 1998a)	0.1619	Median value from Table 7 (Sample et al. 1998b)	3.75	Hamilton et al. (2002)	4.81	Hamilton et al. (2002)
Zinc	0.366	Median value from Table 6 (Bechtel-Jacobs 1998a)	3.201	Median value from Table 11 (Sample et al. 1998a)	0.7717	Median value from Table 7 (Sample et al. 1998b)	2.33	Median non-depurated value[#] from Bechtel Jacobs (1998b) Table 2	0.138	Chen and Chen (1999) Table 2

[#]Non-depurated value used because wildlife typically consume prey whole.

Attachment 1-3d: Bioavailability estimates

Contaminant	Soil Bioavailability Factor	Note
Arsenic	0.6	1
Barium	1	2
Barium (True and Total)	0.1	
Cadmium	0.036	3
Chromium	0.5	4
Lead	0.86	5
Mercury	0.1	6
Selenium	0.4	7
Zinc	0.44	8

(1) Based on EPA (2010) upper-bound relative bioavailability estimate

(2) Barium is estimated to be 1 (100%). True and total barium is estimated to be 0.1 (10%) based on the low solubility of barium forms and estimated barium concentrations in most wildlife digestive systems (Menzie et al. 2008).

(3) Estimated to be 3.6% based on the percentage of cadmium in solution (Prokop et al. 2003).

(4) Estimated to be 50% based on differences in chromium administered orally vs. in soil (Witmer et al. 1991).

(5) Estimated to be 86% which is the upper-bound relative bioavailability value found by Casteel et al. (1997).

(6) Estimated to be 10% which is the upper-bound value for the percent of mercury recovered from Mobile Bay sediments (Gambrell et al. 1980).

(7) Estimated to be 40% based on the fraction of selenite and organic selenium relative to the overall selenium concentration (Amweg et al. 2003).

(8) Estimated at 44% based on the upper-bound value for the potentially available, nonresidual fraction (Ma and Rao 1997).

Attachment 1-3e: Robin PCL Calculation

Body weight (kg)	0.0773
Soil ingestion rate (kg/day)	0.000530
Food ingestion rate (kg/day)	0.0102
Fraction of diet based on plants	0.41
Fraction of diet based on invertebrates	0.59
Home range factor	1
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil Bioavailability Factor	Bioconcentration Factor		PCL (mg/kg)
			Plant	Earthworm	
Barium	20.8	1	0.156	0.091	929.16
True & Total Barium	20.8	0.1	0.156	0.091	1283.12
Cadmium	1.47	0.036	0.586	7.708	2.33
Chromium	2.66	0.5	0.041	0.306	90.26
Lead	1.63	0.86	0.0389	0.266	56.77
Mercury	0.45	0.1	0.652	1.693	2.68
Selenium	0.29	0.4	0.672	0.985	2.50
Zinc	66.1	0.44	0.366	3.201	242.99

Note: arsenic not evaluated for this species because maximum site concentrations did not exceed screening criteria for terrestrial birds.

Attachment 1-3f: American Woodcock PCL Calculation

Body weight (kg)	0.169
Soil ingestion rate (kg/day)	0.00209
Food ingestion rate (kg/day)	0.0201
Fraction of diet based on plants	0
Fraction of diet based on invertebrates	1
Home range factor	1
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil Bioavailability Factor	Bioconcentration Factor	PCL (mg/kg)
			Earthworm	
Barium	20.8	1	0.091	896.85
True & Total Barium	20.8	0.1	0.091	1724.71
Cadmium	1.47	0.036	7.708	1.60
Chromium	2.66	0.5	0.306	62.47
Lead	1.63	0.86	0.266	38.56
Mercury	0.45	0.1	1.693	2.22
Selenium	0.29	0.4	0.985	2.38
Zinc	66.1	0.44	3.201	171.18

Note: arsenic not evaluated for this species because maximum site concentrations did not exceed screening criteria for terrestrial birds.

Attachment 1-3g: Spotted Sandpiper PCL Calculation

Body weight (kg)	0.0425
Soil ingestion rate (kg/day)	0.0016794
Food ingestion rate (kg/day)	0.00933
Fraction of diet based on plants	0
Fraction of diet based on benthic invertebrates	1
Home range factor	1.00
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil/Sediment Bioavailability Factor	Bioconcentration Factor	PCL (mg/kg)
			Soil/sediment to benthic invertebrate	
Arsenic	2.24	0.6	0.127	43.42
Barium	20.8	1	1.153714286	71.04
True & Total Barium	20.8	0.1	1.153714286	80.86
Cadmium	1.47	0.036	0.614	10.79
Chromium	2.66	0.5	0.108	61.20
Lead	1.63	0.86	0.066	33.63
Mercury	0.45	0.1	1.081	1.87
Selenium	0.29	0.4	3.75	0.35
Zinc	66.1	0.44	2.33	124.98

Attachment 1-3h: Mallard PCL Calculation

Body weight (kg)	1.134
Soil ingestion rate (kg/day)	0.00182
Food ingestion rate (kg/day)	0.0551
Fraction of diet based on plants	0.5
Fraction of diet based on benthic invertebrates	0.5
Home range factor	1.00
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil/Sediment Bioavailability Factor	Bioconcentration Factor		PCL (mg/kg)
			Soil/sediment to plant	Soil/sediment to benthic invertebrate	
Arsenic	2.24	0.6	0.0375	0.127	451.75
Barium	20.8	1	0.156	1.153714286	622.34
True & Total Barium	20.8	0.1	0.156	1.153714286	650.42
Cadmium	1.47	0.036	0.586	0.614	50.32
Chromium	2.66	0.5	0.041	0.108	601.59
Lead	1.63	0.86	0.0389	0.066	415.03
Mercury	0.45	0.1	0.652	1.081	10.648
Selenium	0.29	0.4	0.672	3.75	2.683
Zinc	66.1	0.44	0.366	2.33	998.44

Attachment 1-3i: Snowy Egret PCL Calculation

Body weight (kg)	0.371
Soil ingestion rate (kg/day)	0.00312
Food ingestion rate (kg/day)	0.0428
Fraction of diet based on fish	1
Fraction of diet based on benthic invertebrates	0
Home range factor	1.00
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil/Sediment Bioavailability Factor	Bioconcentration Factor	PCL (mg/kg)
			Sediment to fish	
Arsenic	2.24	0.6	3.400	5.64
Barium	20.8	1	0.280	510.76
True & Total Barium	20.8	0.1	0.280	627.56
Cadmium	1.47	0.036	0.420	30.15
Chromium	2.66	0.5	0.161	116.75
Lead	1.63	0.86	0.187	56.57
Mercury	0.45	0.1	2.620	1.48
Selenium	0.29	0.4	4.810	0.52
Zinc	66.1	0.44	0.138	3368.03

Attachment 1-3j: Shrew PCL Calculation

Body weight (kg)	0.0055
Soil ingestion rate (kg/day)	0.00008316
Food ingestion rate (kg/day)	0.00108
Fraction of diet based on plants	0
Fraction of diet based on invertebrates	1
Home range factor	1
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil Bioavailability Factor	Bioconcentration Factor	PCL (mg/kg)
			Earthworm	
Arsenic	1.04	0.6	0.224	19.60
Barium	51.8	1	0.091	1570
True & Total Barium	51.8	0.1	0.091	2673
Cadmium	0.77	0.036	7.708	0.509
Chromium	2.4	0.5	0.306	35.48
Lead	4.7	0.86	0.266	72.05
Mercury	0.032	0.1	1.693	0.0958
Selenium	0.143	0.4	0.985	0.7169
Zinc	75.4	0.44	3.201	118.70

Attachment1-3k: Fox PCL Calculation

Body weight (kg)	4.53
Soil ingestion rate (kg/day)	0.004788
Food ingestion rate (kg/day)	0.171
Fraction of bioconcentration pathway based on plants	0.07
Fraction of bioconcentration pathway based on invertebrates	0.03
Fraction of diet based on small mammals	0.9
Home range factor	0.330
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil Bioavailability Factor	Bioconcentration Factor			PCL (mg/kg)
			Plant	Invertebrate	Mammal	
Arsenic	1.04	0.6	0.0375	0.224	0.0025	2939.92
Barium	51.8	1	0.156	0.091	0.0566	44906.62
True & Total Barium	51.8	0.1	0.156	0.091	0.0566	61699.13
Cadmium	0.77	0.036	0.586	7.708	0.3333	107.82
Chromium	2.4	0.5	0.041	0.306	0.0846	1885.16
Lead	4.7	0.86	0.0389	0.266	0.1054	2910.00
Mercury	0.032	0.1	0.652	1.693	0.0543	17.34
Selenium	0.143	0.4	0.672	0.985	0.1619	49.16
Zinc	75.4	0.44	0.366	3.201	0.7717	7305.06

Attachment 1-3l: Swamp Rabbit PCL Calculation

Body weight (kg)	1.882
Soil ingestion rate (kg/day)	0.0061614
Food ingestion rate (kg/day)	0.0978
Fraction of diet based on plants	1
Fraction of diet based on invertebrates	0
Home range factor	1
Time (temporal) factor	1

COEC	Toxicity Reference Value (mg/kg-day)	Soil Bioavailability Factor	Bioconcentration Factor	PCL (mg/kg)
			Plant	
Arsenic	1.04	0.6	0.0375	266
Barium	51.8	1	0.156	4552
True & Total Barium	51.8	0.1	0.156	6142
Cadmium	0.77	0.036	0.586	25.2
Chromium	2.4	0.5	0.041	637
Lead	4.7	0.86	0.0389	972
Mercury	0.032	0.1	0.652	0.94
Selenium	0.143	0.4	0.672	3.95
Zinc	75.4	0.44	0.366	3685

Attachment 1-3m: Final PCLs and Hazard Quotients

		Protective Concentration Level (mg/kg dw)								Hazard Quotient							
COEC	Max Conc. (mg/kg)	Am. Robin	Am. Wood-cock	Spotted Sand-piper	Mallard	Snowy Egret	Least Shrew	Red Fox	Swamp Rabbit	Am. Robin	Am. Wood-cock	Spotted Sand-piper	Mallard	Snowy Egret	Least Shrew	Red Fox	Swamp Rabbit
Arsenic	40.3	95	66	43	452	6	20	2940	266	0.4	0.6	0.9	0.1	**7.1**	**2.1**	0.0	0.2
Barium	15700	929	897	71	622	511	1570	44907	4552	**16.9**	**18**	**221.0**	**25.2**	**30.7**	**10.0**	0.3	**3.4**
True & Total Barium	1600	1283	1725	81	650	628	2673	61699	6142	**1.2**	0.9	**20**	**2.5**	**3**	0.6	0	0.3
Cadmium	2.1	2.33	1.60	10.8	50	30	0.509	108	25	0.9	**1.3**	0.2	0.0	0.1	**4.1**	0.0	0.1
Chromium	501	90	62	61	602	117	35	1885	637	**5.6**	**8.0**	**8.2**	0.8	**4.3**	**14.1**	0.3	0.8
Lead	179	57	39	34	415	57	72	2910	972	**3.2**	**4.6**	**5.3**	0.4	**3.2**	**2.5**	0.1	0.2
Mercury	16.7	2.68	2.22	1.87	10.65	1.48	0.10	17.34	0.94	**6.2**	**7.5**	**9.0**	**1.6**	**11.2**	**174.3**	1.0	**17.9**
Selenium	2.1	2.50	2.38	0.35	2.68	0.52	0.72	49.16	3.95	0.8	0.9	**6.1**	0.8	**4.0**	**2.9**	0.0	0.5
Zinc	194	243	171	125	998	3368	119	7305	3685	0.8	**1.1**	**1.6**	0.2	0.1	**1.6**	0.0	0.1

Hazard quotients (HQs) above '1' are shown in bold and red, and indicate a potential risk to that receptor-COEC pair.

Attachment 1-4: Crab Tissue Sample Handling, Extraction and Analysis Methods

Homogenization
Tissue samples are homogenized using a titanium blade homogenizer. Biota samples are homogenized using stainless steel knives and/or a food processor. The homogenized sample(s) are transferred to labeled glass jars and stored in a freezer maintained at a temperature of -15ºC (±5ºC) in preparation for extraction.

The laboratory's standard procedure is to perform whole body homogenization of the tissue sample. Any customer specifications for dissection or homogenization of certain parts of the tissue sample, compositing multiple samples or other must be negotiated with the laboratory during project initiation and specific instructions for sample processing must be prepared and provided to the extraction laboratory by the laboratory PM. In the absence of instruction, the laboratory will homogenize the entire sample.

The homogenization procedure is a laboratory developed procedure based on the procedures described in the Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

Extraction
A portion of homogenized sample is mixed with anhydrous sodium sulfate then macerated for 3 minutes in an appropriate extraction solvent using the Tissumizer. The solvent layer decanted poured through sodium sulfated and collected in a collection vessel. The extraction is repeated two more times with fresh portions of extraction solvent. After extraction, the combined extracts are concentrated to an appropriate final volume using K-D Technique. Percent lipids are determined following procedures given in laboratory SOP BR-EX-016 Percent Lipid Determination and extract cleanup is performed when necessary.

The extraction procedure is a laboratory developed procedure based on the procedures described in the Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

Quantitation of Semi-Volatile Petroleum Products by GC/FID
Summary of Method
A measured volume or weight of sample is extracted using an appropriate matrix-specific extraction technique. The subsequent extract is analyzed by injecting a 2 µL aliquot into a GC equipped with a Flame Ionization Detector (FID).

Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

New Jersey Department of Environmental Protection, Office of Quality Assurance, Analytical Method: *Quantitation of Semi-Volatile Petroleum Products in Water, Soil, Sediment, and Sludge. Document # OQA-QAM-025-02/08, Revision 7, 2/25/08.*

SW-846 Method 8015Bm Non-Halogenated Volatile Organics using GC/FID, Revision 2, December 1996, USEPA SW-846 Methods for Evaluating Solid Waste, Update III.

Metals by ICP-OES
Summary of Method
Prior to analysis samples are digested using an appropriate preparation method following laboratory SOPs BR-ME-009 (SW-846 3010), BR-ME-010 (SW-846 3005) or BR-ME-011 (SW-846 3050).

The digested samples are introduced to the ICP-AES, which measures characteristic emission spectra by optical spectrometry. An aliquot of sample is nebulized and the resulting aerosol is transported to a plasma torch. Element-specific emission spectra are produced by radio-frequency inductively coupled plasma. The spectra are dispersed by a spectrometric grating and the intensities of the emission lines are monitored by photosensitive devices. Background correction is performed with the background measured adjacent to analyte lines on samples during analysis. The sample is analyzed by multiple integrations (2) and the average integration is converted to a concentration from a calibration curve.

This procedure is based on the following reference method:
SW-846 Method 6010B, Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 2, December 1996.

Acid Digestion of Solids
Summary of Method
A representative 1-2 gram (wet weight) soil, sediment or tissue sample is digested with repeated additions of nitric acid and hydrogen peroxide. Air samples collected on filters or wipes are digested as whole volume samples or a portion of the filter or wipe is subsampled as per the instructions from the customer.

For ICP-OES analysis, hydrochloric acid (HCl) is added to the initial digestate and the digestate is refluxed, filtered or allowed to settle for 24 hours then diluted to a final volume of 100 mL.

This procedure is based on the following reference methods:
SW-846 Method 3050B, Acid Digestion of Sediments, Sludge, and Soils, Revision 2 December 1996.

Mercury by CVAA
Summary of Method
A portion of solid sample is acid digested for 2 minutes at a temperature of 95°C then digested with potassium permanganate and potassium persulfate for 30 minutes at a temperature of 95°C. Hydroxylamine hydrochloride is added to each digestate in order to reduce excess permanganate. The digestate is placed on a closed-system mercury autoanalyzer and stannous chloride is added to each sample. The elemental mercury released is measured spectrophotometrically at a wavelength of 253.7 nm. The concentration is calculated from the response of the sample absorbance applied against the calibration curve. This procedure is based on the following reference method: SW-846 Method 7471A, Revision 1, September 1994.

Attachment 1-5: Crab Tissue Data and Level III Dose Calculations

Attachment 1-5a: Tissue Analysis Results

Sample #	M/F	Wet Wt (g)	Length (mm)	Width (mm)	Al	As	Ba	Cd	Cu	Hg	Pb	Ni	TPH
C-1-1	M	154.22	63.4	141.42	55.2	0.81 (U)	290	0.18 (J)	9	0.032	0.81 (U)	2.1 (J)	61 (U)
C-1-2	M	138.84	63.16	146.16	39.8	0.47 (J)	203	0.044 (J)	11.4	0.052	0.58 (U)	0.32 (J)	33 (J)
C-2-1	M	148	66.5	144.64	50.8	0.69 (J)	250	0.45 (U)	8.5	0.079	0.89 (U)	0.19 (J)	58 (U)
C-2-2	M	242	74.94	159.5	79.6	0.94	234	0.38 (U)	9.9	0.15	0.75 (U)	0.63 (J)	31 (J)
C-2-3	M	171.79	64.14	150.24	42.2	0.61 (J)	256	0.15 (J)	13.3	0.182	0.86 (U)	0.49 (J)	41 (J)
C-3-1*	M	138.6	65.68	128.16*	43.7	0.37 (J)	167	0.38 (U)	5.6	0.038	0.76 (U)	0.46 (J)	32 (J)
C-3-2	M	207	72.6	174.16	49.3	0.74	356	0.17 (J)	12.9	0.032	0.72 (U)	0.46 (J)	33 (J)
C-3-3	M	125.33	62.2	144.76	44.3	0.84 (J)	254	0.089 (J)	9.6	0.039	1.0 (U)	0.32 (J)	37 (J)
C-3-4	M	123.91	65.78	143.24	54	0.41 (J)	220	0.5 (U)	10.9	0.048	0.99 (U)	0.19 (J)	60 (U)
C-4-1	M	210	71.84	155.5	42.8	0.64 (J)	198	0.4 (U)	6	0.045	0.79 (U)	0.53 (J)	38 (J)
C-4-2	F	127	57.74	137.36	40.8	0.61 (J)	220	0.32 (U)	15.3	0.052	0.63 (U)	0.33 (J)	42 (J)
C-5-1[a]	M	278	80.74	178.9	45.2	0.58 (J)	219	0.15 (J)	17.7	0.038	0.72 (U)	0.46 (J)	370[a]
C-6-1	M	126.62	62.54	141.44	58	0.36 (J)	452	0.38 (U)	5.1	0.042	0.77 (U)	0.34 (J)	59 (U)
C-6-2	M	312	83.62	186.62	50	0.92	241	0.55	12.6	0.059	0.83 (U)	0.42 (J)	58 (U)
C-6-3	M	177.92	67.94	141.84	65	0.99	154	0.085 (J)	5.6	0.034	0.9 (U)	0.6 (J)	40 (J)
C-6-4	M	132.5	59.42	135.88	54.7	0.92 (J)	312	0.060 (J)	9.9	0.081	0.96 (U)	0.12 (J)	40 (J)
C-6-5	M	127.74	63.46	136	58.6	0.74 (J)	342	0.1 (J)	9	0.058	0.89 (U)	0.32 (J)	58 (U)
C-6-6	M	128.38	60.3	138.72	50.5	0.85	348	0.28 (J)	9.6	0.051	0.79 (U)	0.36 (J)	36 (J)
C-8-1	M	327	86.94	194.82	79.9	0.87 (J)	280	0.24 (J)	18.6	0.03	0.88 (U)	1.3 (J)	57 (U)
C-8-2	M	278	78.24	175.88	47.8	0.64 (J)	214	0.35 (J)	12.1	0.05	0.85 (U)	1.1 (J)	55 (U)
C-9-1	M	200	68.62	161.1	47.1	0.57 (J)	229	0.17 (J)	11	0.047	0.94 (U)	0.75 (J)	58 (U)
C-9-2	M	202	70.16	169.8	38	0.43 (J)	165	0.087 (J)	6.3	0.049	0.81 (U)	0.94 (J)	35 (J)

* Claw was broken off on this specimen.
[a] Specimen plastron black and stained.
All analyte concentrations are reported as mg/kg wet weight.
J: The reported value was less than the practical quantitation limit (PQL) but greater than or equal to the method detection limit (MDL).
U: If the reading was less than the MDL, U-flagged values were not considered in this evaluation.

Attachment 1-5b: Species Uptake Factors (Dose Calculation)

Parameter	Description	Great Blue Heron	American Mink	units	Source
BW	body weight of receptor	2.229	1	kg	EPA (1993)
Food IR	Food Ingest. Rate (wet weight)	0.230	0.164	kg[ww]/kg-d	Nagy (2001) equations for carnivorous birds/mammals
Soil IR	Soil Ingest. Rate	0.00092	0.00066	kg[dw]/kg-d	Beyer et al. (1994, 2003); assume 2% soil in diet
Fd (crabs)	Fraction of diet made up of crabs	1	1	-	Conservative estimate (EPA 1993)
Exposure Modifying Factors (EMF)s					
Home range	Home range of receptor	11	2.2	acres	EPA (1993), Sample and Suter (1994); value for GBH is average feeding territory (EPA 1993) due to lack of home range data
Home range factor	Fraction of home range that is contaminated	1.0	1.0	-	Calculated based on an estimated site size of 1000 acres
Time (temporal) factor	Fraction of time spent in contaminated area	1.0	1.0	-	Present year-round

*Little blue heron used as a surrogate for home range due to similar feeding habits and lack of data for egret

BW: Body Weight. IR: Ingestion Rate. EMF: Exposure Modifying Factor. Note: Assume water contamination to be negligible

Attachment 1-5c: Toxicity Reference Values (Dose Calculation)

Contaminant	TRV (mg/kg-day)			
	Avian (Great Blue Heron)		Mammal (Mink)	
	Value	Source	Value	Source
Aluminum	109.7	Sample et al. (1996)	1.93	Sample et al. (1996)
Arsenic	2.24	EPA (2005)	1.04	EPA (2005)
Barium	20.8	Sample et al. (1996)*	51.8	EPA (2005)
Cadmium	1.47	EPA (2005)	0.77	EPA (2005)
Copper	4.05	EPA (2005)	5.6	EPA (2005)
Lead	1.63	EPA (2005)	4.7	EPA (2005)
Mercury	0.45	Sample et al. (1996)	0.032	Sample et al. (1996) [1]
Nickel	6.71	EPA (2005)	1.7	EPA (2005)

Chromium is assumed to be in the trivalent form

*Based on a subchronic NOAEL of 208.26 mg/kg-d (Johnson et al. 1960). The TRV was multiplied by an uncertainty factor of 0.1 to extrapolate from subchronic to chronic effects as per Sample et al. (1996).

[1] NOAEL for methyl mercury due to its potential presence in anoxic sediments.

Attachment 1-5d: Soil Bioavailability Factors (Dose Calculation)

Contaminant	Soil Bioavailability Factor	Note
Aluminum	nd	*
Arsenic	0.6	1
Barium	1	2
Cadmium	0.036	3
Copper	nd	*
Lead	0.86	5
Mercury	0.1	6
Nickel	nd	*

nd: No data. *The direct soil ingestion pathway was not evaluated due to the lack of COEC concentrations in soil; therefore, a soil bioavailability factor was not necessary.

(1) Based on EPA (2010) upper-bound relative bioavailability estimate

(2) Barium is estimated to be 1 (100%). True and total barium is estimated to be 0.1 (10%) based on the low solubility of barium forms and estimated barium concentrations in most wildlife digestive systems (Menzie et al. 2008).

(3) Estimated to be 3.6% based on the percentage of cadmium in solution (Prokop et al. 2003).

(4) Estimated to be 50% based on differences in chromium administered orally vs. in soil (Witmer et al. 1991).

(5) Estimated to be 86% which is the upper-bound relative bioavailability value found by Casteel et al. (1997).

(6) Estimated to be 10% which is the upper-bound value for the percent of mercury recovered from Mobile Bay sediments (Gambrell et al. 1980).

(7) Estimated to be 40% based on the fraction of selenite and organic selenium relative to the overall selenium concentration (Amweg et al. 2003).

(8) Estimated at 44% based on the upper-bound value for the potentially available, nonresidual fraction (Ma and Rao 1997).

Attachment 1-5e: Great Blue Heron Dose Calculation

BW	2.229	kg
FIR_{ww}	0.23015	kg_{ww}/kgBW-d
SIR_{dw}	0.00092	kg_{dw}/kgBW-d

TRV: Toxicity Reference Value

COPEC	CF_{ww} mg/kg	CS_{dw} mg/kg	BF -	Dose mg/kg-d	TRV mg/kg-d	HQ
Aluminum	79.9		*	18	109.7	0.2
Arsenic	0.99	40.3	0.6	0.2501	2.24	0.1
Barium	452	15700	1	118.4709	20.8	5.7
Cadmium	0.55	2.1	0.036	0.1267	1.47	0.1
Copper	18.6		*	4.2808	4.05	1.1
Lead	0.5	179	0.86	0.2567	1.63	0.2
Mercury	0.182	16.7	0.1	0.0434	0.45	0.1
Nickel	2.1		*	0.4833	6.71	0.1

Grey: not-detected, estimated at 1/2 the MDL.

Yellow: no data.

Notes:

BW: Body Weight — BF: Bioavailability Factor

FIR: Food Ingestion Rate — CF: Conc. in food (max value)

SIR: Soil Ingestion Rate — CS: Conc. in soil/sediment (max value)

HQ: Hazard Quotient — TRV: Tox. Reference Value

*The direct soil ingestion pathway was not evaluated due to the lack of COEC concentrations in soil; therefore, a soil bioavailability factor was not necessary.

Attachment 1-5f: American Mink Dose Calculation

BW	1	kg
FIR_{ww}	0.164	kg_{ww}/kgBW-d
SIR_{dw}	0.00066	kg_{dw}/kgBW-d

TRV: Toxicity Reference Value

	CF_{ww}	CS_{dw}	BF	Dose	TRV	HQ
COPEC	mg/kg	mg/kg	-	mg/kg-d	mg/kg-d	-
Aluminum*	79.9		*	13.10	1.93	**6.8**
Arsenic	0.99	40.3	0.6	0.18	1.04	0.2
Barium	452	15700	1	84.43	51.8	**1.6**
Cadmium	0.55	2.1	0.036	0.09	0.77	0.12
Copper	18.6		*	3.05	5.6	0.54
Lead	0.5	179	0.86	0.18	4.7	0.04
Mercury	0.182	16.7	0.1	0.03	0.032	0.97
Nickel	2.1		*	0.34	1.7	0.20

Grey: not-detected, estimated at 1/2 the MDL.

Yellow: no data.

<u>Notes:</u>

BW: Body Weight — BF: Bioavailability Factor

FIR: Food Ingestion Rate — CF: Conc. in food (max. value)

SIR: Soil Ingestion Rate — CS: Conc. in soil/sediment (max value)

HQ: Hazard Quotient — TRV: Tox. Reference Value

*The direct soil ingestion pathway was not evaluated due to the lack of COEC concentrations in soil; therefore, a soil bioavailability factor was not necessary.