integral consulting inc.

ECOLOGICAL RISK ASSESSMENT STEPS 3 THROUGH 5 KOPPERS POND KENTUCKY AVENUE WELLFIELD SUPERFUND SITE OPERABLE UNIT 4 HORSEHEADS, NEW YORK

Prepared for
Koppers Pond RI/FS Group

Prepared by
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August 10, 2010

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ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Earth & Environmental, Inc.
AUF	area use factor
AWQC	ambient water quality criteria
BERA	baseline ecological risk assessment
BHC	benzene hexachloride
BTAG	biological technical assistance group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPEC	constituent of potential ecological concern
CSM	conceptual site model
Cummings/Riter	Cummings/Riter Consultants, Inc.
DQO	data quality objective
EcoSSL	ecological soil screening level
EPC	exposure point concentrations
EqP	equilibrium partitioning
ERA	ecological risk assessment
ERAGS	ecological risk assessment guidance for superfund
ERED	environmental residue-effects database
ESL	ecological screening level
ESV	ecological screening value
EWB	Elmira Water Board
Hardinge	Hardinge, Inc.
HQ_{screen}	screening hazard quotient
IAA	International Antimony Association
Integral	Integral Consulting Inc.
LOAEL	lowest-observed-adverse-effect level
MDOC	Maine Department of Conservation
NOAA	National Oceanic and Atmospheric Administration

NOAEL	no-observed-adverse-effect level
NOED	no-observable-effect dose
Norfolk Southern	Norfolk Southern Company
NYNHP	New York Natural Heritage Program
NYSDEC	New York State Department of Environmental Conservation
ORNL	Oak Ridge National Laboratory
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PNEC	probable no effects concentration
RAIS	risk assessment information system
RI/FS	remedial investigation/feasibility study
RTE	rare, threatened, or endangered (species)
SLERA	screening-level ecological risk assessment
SMDP	Scientific/Management Decision Point
SUF	seasonal use factor
SVOC	semi-volatile organic compound
TCEQ	Texas Commission on Environmental Quality
TEC	threshold effect concentration
TOC	total organic carbon
TRV	toxicity reference value
UF	use factor
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Corporation

1 INTRODUCTION

The Koppers Pond RI/FS Group (the Group) has retained Cummings/Riter Consultants, Inc. (Cummings/Riter) and Integral Consulting Inc. (Integral) to conduct data-gathering and evaluation activities for the performance of a remedial investigation and feasibility study (RI/FS) for Koppers Pond in Horseheads, New York (the Site).[1] The RI/FS is being performed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA or "Superfund"); the National Oil and Hazardous Substances Pollution Contingency Plan; and, more specifically, the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study, Index No. CERCLA-02-2006-2025 (Settlement Agreement), entered between the Group and the U.S. Environmental Protection Agency (EPA) on September 28, 2006.

On behalf of the Group, Integral has prepared this revised Ecological Risk Assessment (ERA) Steps 3 through 5 Report to meet the requirements of Task VI of the Statement of Work appended to the Settlement Agreement (Section VII.B.2). Comments provided by USEPA and NYSDEC to the February 2010 draft of this document were incorporated, where appropriate. The work described in this report was performed in accordance with the *RI/FS Work Plan*, submitted on December 6, 2007, and approved by EPA on May 2, 2008.

1.1 PURPOSE OF REPORT

Pursuant to the Settlement Agreement, the RI for Koppers Pond is being prepared under Operable Unit 4 (OU4) of the Kentucky Avenue Wellfield Superfund Site. The objective of the RI is to characterize environmental media at the Site sufficiently to allow for the evaluation of the need for remedial action and, if remedial action is deemed necessary, for the development and evaluation of remedial alternatives in the FS. The RI is to provide the necessary physical, chemical, and biological information pertaining to potential impacts to surface water and sediment in Koppers Pond and use these data to evaluate potential human health and ecological risks posed by chemicals of potential concern associated with these media. Because of their key role in both human health and ecological risk evaluations, the RI also includes tissue analysis of fish taken from Koppers Pond.

[1] The Respondents had contracted with AMEC Earth & Environmental, Inc. (AMEC) to perform the required human health and ecological risk assessment studies in support of the Koppers Pond RI/FS, and AMEC personnel conducted the risk assessment tasks over the 2007 through 2009 timeframe. In late 2009 and early 2010, however, several project team members moved from AMEC to other consulting firms, including Integral and Arcadis. In order to maintain technical continuity on the project and reduce delays in the project schedule, the Respondents retained Integral to complete this Ecological Risk Assessment Steps 3 through 5 document, and the Respondents propose to employ Integral to continue the ongoing risk assessment tasks for the Koppers Pond Site. The key project personnel who went to Arcadis will be available as consultants to Integral for this work.

In developing and negotiating the Settlement Agreement and the Statement of Work, EPA and the Group recognized that several pertinent studies of the Kentucky Avenue Wellfield Site have already been completed and that much is known about the Site. As a result, the scope of the RI was tailored to meet the specific circumstances for Koppers Pond. As described in the RI/FS Work Plan, however, conditions in Koppers Pond are dynamic, and certain aspects and characteristics of the pond have changed since the time data were collected as part of prior studies. Data-gathering activities for the Koppers Pond RI are principally aimed at collecting current information regarding surface water, sediment, and fish tissue.

This report presents the results of the Steps 3 through 5 of the ecological risk assessment process under the Ecological Risk Assessment Guidance for Superfund (ERAGS):

- STEP 3 – Problem Formulation
- STEP 4 – Study Design and Data Quality Objectives Process
- STEP 5 – Field Verification of Sampling Design.

This report relies on the results of the sampling and analyses conducted as part of the RI. These RI data are presented and summarized in the *Site Characterization Summary Report* (Cummings/Riter and AMEC 2008), which also provides comparisons of the more-recent results to comparable findings from prior investigations.

1.2 SITE BACKGROUND

The Kentucky Avenue Wellfield Superfund Site is located within the Village of Horseheads and the Town of Horseheads in Chemung County, New York (Figure 1-1). The Kentucky Avenue Well is a municipal water supply well owned by the Elmira Water Board (EWB) that was used as part of the EWB system to furnish potable water to local communities. The Kentucky Avenue Well was closed in 1980 when it was found that the groundwater produced from this well contained trichloroethylene. In 1983, EPA included the Kentucky Avenue Wellfield Site on the National Priorities List for response actions under CERCLA.

Beginning in the mid-1980s, several CERCLA response actions have been completed with respect to the Kentucky Avenue Wellfield Site:

- Operable Unit 1 (OU1) involved initial Site investigations, identification of potentially impacted private wells, and connection of the affected residents to the public water supply system.
- Operable Unit 2 (OU2) included supplemental investigations of the degree and extent of groundwater impacts, the installation of barrier wells and groundwater treatment system to intercept groundwater at the downgradient limits of the former Westinghouse

Electric Corporation (Westinghouse) Horseheads plant site, and restoration of the Kentucky Avenue Well.

- Operable Unit 3 (OU3) comprised the investigation and remediation of identified source areas at the former Westinghouse Horseheads plant site, the investigation of a waterway (i.e., the "Industrial Drainageway") that conveys surface water discharges from the former Westinghouse Horseheads plant site to Koppers Pond, and the remediation of the Industrial Drainageway.

The response actions specified under OU1 and OU3 are completed. Operation, maintenance, and monitoring activities are continuing with respect to the barrier wells and attendant groundwater treatment system installed under OU2. The RI for Koppers Pond is being conducted under OU4.

Koppers Pond is a man-made, V-shaped pond located in the Village of Horseheads, New York (Figure 1-2). At the northern end of its western leg, the pond receives inflow from the Industrial Drainageway, the watershed for which is a largely a commercial and industrial area. The drainageway receives much of its base flow from discharges originating at the former Westinghouse Horseheads plant site (Figure 1-2). The overflow from Koppers Pond discharges to two outlet streams located at the southern end of the pond, which combine downstream to form a single outlet channel.

Koppers Pond is a shallow, flow-through water body with typical water depths of approximately 2-6 ft. Because of the relatively flat topography, the open water area of the pond is highly dependent on the surface water elevation, and open water areas of approximately seven to more than nine acres have been reported in the various studies of this pond. At a pond surface water elevation of approximately 886 ft above mean sea level, the open water area of the pond covers about 8.9 acres. Water levels declined through 2008, presumably due to the removal of beaver dams that had been constructed in the outlets from the pond. Based on observations made during the September 2009 field program the water levels appear to have returned to historical levels.

1.3 REPORT ORGANIZATION

Following this introductory chapter, Section 2 summarizes the *Screening Ecological Risk Assessment* (SLERA) results (ERAGS Steps 1 and 2). Section 3 presents the results of the ERAGS Step 3 assessment, which includes a refined screening of constituents of potential ecological concern (COPECs), problem formulation, and a summary of the Scientific/Management Decision Point (SMDP). Section 4 presents the key elements of the ERAGS Step 4, which presents the proposed supplemental field work to fill data gaps. Section 5 discusses the ERAGS Step 5 components related to verification of the supplemental field sampling program. Section 6 presents the key elements of ERAGS Steps 6 and 7, which includes the preparation of the quantitative baseline ecological risk assessment (BERA). To minimize confusion with the draft BERA prepared by CDM (1999), the quantitative BERA being prepared for this project is identified as the "Supplemental BERA." Additional supporting documentation is provided in the appendices.

2 STEPS 1 AND 2 – SUMMARY OF SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

This section provides information concerning the regional and site-specific ecological conditions that are relevant to the ERA. Because this report has been prepared as a stand-alone document, some of the introductory information related to the site ecological setting, as well as the analytical results discussed in detail in the SLERA (AMEC 2009a), are provided here for completeness.

2.1 REGIONAL ECOLOGICAL SUMMARY

The site-specific ecological features were summarized in the *Preliminary Conceptual Site Model* (Koppers Pond RI/FS Group 2007) and are presented below with updates based on observations made during the 2008 field investigation.

2.1.1 Regional Climate

Chemung County, New York is characterized by a temperate climate with mild summer and long, cold winters. The annual average temperature is 47 degrees Fahrenheit (°F). August is the warmest month with average high temperatures above 80°F, but summers are moderate and average just 4 or 5 days per year with a maximum temperature of 90°F or above. Winter temperatures from December through February average below 30°F.

The average annual precipitation in Chemung County is approximately 33.5 in., including the water equivalent of the annual average of 45 in. of snowfall. Precipitation is relatively uniformly distributed throughout the year. As presented in the Operable Unit 3 RI report (Philip Environmental Services Corporation 1996), various studies have shown annual average runoff in the range of 7 to 10 in. per year.

2.1.2 Surface Water Hydrology

Historically, the Industrial Drainageway received much of its base flow from discharges originating from permitted outfalls at the former Westinghouse plant site (Figure 1-2). Such discharges included treated process wastewaters, non-contact cooling water, and storm water runoff. Total flows from these sources averaged between 1,000 and 2,000 gallons per minute (gpm) or 2.2 to 4.4 cubic feet per second (cfs). Other sources of flow to the Industrial Drainageway include local surface water runoff. Based on RI reviews of available storm sewer information and field reconnaissance, the contributory watershed area draining to the Industrial Drainageway at the point it enters Koppers Pond is estimated to be 1,350 acres, 59 of which comprise the former Westinghouse plant site. At assumed basin-wide runoff rates of 7 to 10 in.

per year, surface water runoff to the pond, excluding runoff from the former Westinghouse plant site, would be about 470 to 670 gpm (1.0 to 1.5 cfs) as an annual average.

Although some process water discharges continue from ongoing manufacturing operations conducted by the Cutler-Hammer Division of Eaton Corporation, current discharges to the Industrial Drainageway from the former Westinghouse plant site are primarily storm water runoff from building roofs and the treated effluent from the barrier well treatment facility installed under OU2 (1,200 to 1,400 gpm).

Koppers Pond and its outlet channels are classified as Class C fresh surface waters by the New York State Department of Environmental Conservation (NYSDEC)[2]. Class C waters are suitable for fish propagation and survival, and for primary and secondary contact recreation, such as swimming and boating (NYSDEC 1998).

2.1.3 Local Land Use

The pond is surrounded by an area of vacant and active industrial property (Figure 1-2). Immediately to the north and northeast is the Old Horseheads Landfill and to the south is the Kentucky Avenue Well site. Manufacturing facilities operated by Hardinge, Inc. (Hardinge) and the Fairway Spring Co. are located to the southeast and east, respectively. Norfolk Southern Corporation (Norfolk Southern) railroad tracks are located to the west. The property on which the pond is located is partially owned by Hardinge, the Village of Horseheads, and EWB (Figure 1-2). The Industrial Drainageway is bounded by Norfolk Southern railroad tracks to the west and industrial and commercial properties on the east. These industrial and commercial properties include the Chemung County Department of Public Works maintenance facility and the Old Horseheads Landfill.

2.1.4 Rare, Threatened, or Endangered Species

The New York Natural Heritage Program (NYNHP), under authority of NYSDEC, provides information on the locations and identities of rare species to enable fully informed decision-making while protecting these sensitive resources. Appendix A of the SLERA (AMEC 2009a) prepared for Koppers Pond compiled the correspondence with NYNHP and NYSDEC concerning whether there were reported observations of rare, threatened, or endangered (RTE) species at or near the Koppers Pond Site. In December 2008, the RTE summary was updated by NYNHP to include the potential presence of slender pondweed (*Stuckenia filiformis alpinus*) at or near Koppers Pond. This inclusion was based on a historical record from 1943 that this species was reported "in cold brook, Chemung Street, Horseheads." Section 4.1.1 discusses the survey program and results to assess whether this aquatic plant was present in Koppers Pond.

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[2] The Koppers Pond surface water classification is from *Environmental Conservation Law, § 17-0301, Chapter X, Subchapter B, Part 810: Newtown Creek Drainage Basin* [http://www.dec.ny.gov/regs/4576.html]

The U.S. Fish and Wildlife Service (USFWS) list only the bald eagle as a rare, threatened, or endangered species in Chemung County. On August 8, 2007, the bald eagle (*Haliaeetus leucocephalus*) was delisted as an endangered species but still receives protection under the Bald and Golden Eagle Protection Act of 1940 (last amended in 1978).

2.2 SITE-SPECIFIC ECOLOGICAL FEATURES

The site-specific ecological features were summarized in the *Preliminary Conceptual Site Model* (Koppers Pond RI/FS Group 2007). This information is presented below with updates based on observations made during the 2008 field investigation.

2.2.1 Industrial Drainageway

The Industrial Drainageway begins at a point approximately 2,300 ft to the north-northwest of Koppers Pond at the outlet of a 72-in. diameter underground pipe (the "Chemung Street Outfall"). This underground pipe, which is approximately 1,600 ft in length, conveys discharges from the former Westinghouse Horseheads plant site and upstream areas. A 48-in. diameter underground pipe runs in parallel with the 72-in. line for its last 860± ft and receives overflows from the larger pipe. The 48-in. overflow pipe, which only discharges in major storm events, also outlets at the Chemung Street Outfall. From the Chemung Street Outfall, the Industrial Drainageway flows to the south-southeast, discharging into Koppers Pond.

The 1953 U.S. Geological Survey (USGS) map shows the Industrial Drainageway as an open waterway extending to the approximate northern boundary of the former Westinghouse plant site. The underground piping was installed in the 1960s. Throughout most of its current 2,300-ft length, the drainageway is approximately 7- 10 ft wide and varies in depth from about 0.5-2 ft. At its southern end, the Industrial Drainageway widens out to approximately 100 ft as it enters Koppers Pond. In this area, the Industrial Drainageway flows slowly through emergent vegetation (e.g., cattails) and is approximately 0.5 ft deep. The area surrounding the southern portion of the Industrial Drainageway and the northwest corner of Koppers Pond has little topographic relief, and changes in flows and pond water levels due to rainfall conditions can significantly alter the size and shape of these water bodies. Flow data for the Industrial Drainageway are not available from the USGS.

In 2001 and 2002, as part of OU3 of the Kentucky Avenue Wellfield Site, impacted sediments were removed from the Industrial Drainageway and disposed of in permitted off-site facilities. The removed sediments were replaced with clean imported soils as needed to reshape the channel.

2.2.2 Koppers Pond Open Water Habitat

The open water area of Koppers Pond is comprised of a shallow (2-6 ft deep) warm water lake, with characteristics consistent with a eutrophic waterbody (Reschke 1990). The bottom substrate is silty (mucky) and soft over much of the pond. As described in the *Site Characterization Summary Report* (Cummings/Riter and AMEC 2008), the thickness of the silty sediments, based on information collected during historical and the 2008 sediment sampling events, ranges from 0 to 38 in. In the western portion of the pond, observed sediment thicknesses uniformly decreased from the maximum of 38 in. near the outlet of the Industrial Drainageway down to about 12 in. near the mouth of the west outlet channel. In the eastern portion of the pond, observed sediment thicknesses along the perimeter of the pond range from 9 to 26 in., but little to no sediment was observed to be present in much of the eastern portion of the pond further from the shoreline. The hard surface underlying the sediments is predominantly a stiff clay. The preliminary hydrology assessment concluded that the underlying clay minimizes the interaction of the pond with local shallow groundwater.

Anthropogenic debris, such as shopping carts, tires, automobiles, and metal drums, was observed in the past in and around the pond, and some debris was seen during the RI field sampling activities in May and June 2008. Two utility poles are located within the open water of the pond and are reportedly in use.

2.2.3 Outlet Channels

The two outlet streams that flow from the southern end of Koppers Pond merge about 500 ft downstream. After merging, the single outlet channel flows past the Hardinge plant site and converges into Halderman Hollow Creek. From that point, the creek flows south and southeast through mixed industrial, commercial, and residential areas, discharging into Newtown Creek approximately three miles south of Koppers Pond. Newtown Creek is a primary tributary to the Chemung River. Flow data for the pond outlets are not available from the USGS.

2.2.4 Terrestrial Vegetation

The northern and western edges of the pond are vegetated primarily with deciduous trees, and the southern and eastern edges are mostly vegetated with grasses and herbaceous plants. The banks of the Industrial Drainageway are vegetated by occasional cottonwood trees and scrub vegetation. Dominant tree species in the deciduous woods to the north and west of the pond include cottonwood, willow, sugar maple, and quaking aspen. Shrub species in the deciduous forest include honeysuckle and sumac, and teasel, thistle, and mullein are found in the herbaceous layer.

The open-field cover type on the south and east sides of the pond includes the EWB property around the Kentucky Avenue Well and maintained lawn areas that extend to the Hardinge plant facility. This cover type consists of grasses and forbs in the herbaceous layer, with scattered honeysuckle and brambles in the shrub layer. A scrub-shrub upland community dominated by honeysuckle, brambles, and sumac lies between the two outlet channels.

Two areas (one along the south side and the other at the tip of the western arm) of the open water area are composed of emergent marsh. These are shallow water areas and are largely vegetated with wetland species. The northern area was mapped as an emergent palustrine wetland in the wetland delineation survey conducted as part of the remedial design for the Industrial Drainageway remediation (Hails 2001).

2.2.5 Wildlife

Wildlife species reported to inhabit the pond include muskrat, beaver, turtle, green frog, and various fish species (e.g., white sucker, common carp, largemouth bass, black crappie, pumpkinseed). Unidentified minnow-sized fish have been observed in the outlet streams, but not during the 2008 field investigation. Terrestrial species that utilize the pond area are believed to include eastern cottontail, woodchuck, raccoon, white-tailed deer, and a variety of birds, including herons. Field observations made during prior ecological investigations of the Koppers Pond area reported that amphibians and aquatic insects were scarce or missing from habitats in and around Koppers Pond. During the 2008 field investigation, however, both tadpoles and insects (e.g., water striders) were observed. Activity by emergent insects (e.g., adult mayflies, mosquitoes) was likely reduced by the rainfall that occurred during the 2008 fish collections. An evaluation of the benthic community was not performed as part of the 2008 field investigation.

2.3 2008 FIELD INVESTIGATION SUMMARY

Figure 2-1 shows the locations for the sediment and surface water samples collected from Koppers Pond and its outlet channels as part of the May 2008 field investigation. Appendix A presents the analytical results for the individual sample locations by media and chemical class. These results were summarized in the *Site Characterization Study* and *SLERA* Reports[3]. There has been no further sampling for chemical analyses of Koppers Pond or its outlet channels since 2008.

2.4 SUMMARY OF SLERA SCREENING CONCLUSIONS

The principal conclusions from the SLERA (ERAGS Steps 1 and 2) included the following:

[3] More detailed evaluations of these analytical results will be provided in the Remedial Investigation and BERA Reports.

1. A conceptual site model (CSM) was developed based on the *Preliminary Conceptual Site Model* (Koppers Pond RI/FS Group 2007) that showed the potential for direct contact exposure pathways and indirect pathways via consumption of prey that may potentially bioaccumulate chemical residues from environmental media (predominantly sediments).

2. The principal receptor groups include aquatic receptors and semi-aquatic receptors that may prey on aquatic organisms from Koppers Pond. Some of these pathways and receptors are not likely to be relevant to the outlet channels due to local ecological conditions.

3. Chemicals potentially related to historical discharges and other sources were detected in the environmental media (e.g., surface water, sediments, and fish) of Koppers Pond and its outlet channels. The maximum observed concentrations of several of these chemicals exceed conservative screening levels, and several of the organic chemicals were retained as SLERA COPECs. According to EPA (2000a), these substances are also identified as potential bioaccumulative chemicals. The SLERA COPECs are shown in Table 2-1 and are summarized below by medium.

   a. Surface Water SLERA COPECs

      Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals were analyzed in the unfiltered surface water samples, and metals were also analyzed in the filtered water samples. None of the detected chemicals in surface water was retained as SLERA COPECs, except for benzo(a)anthracene, a polycyclic aromatic hydrocarbon (PAH).

   b. Sediment SLERA COPECs

      VOCs, SVOCs, pesticides, PCBs and metals were analyzed in the sediment samples. Samples collected from the 0- to 6-in. interval were used for the screening because these are most relevant for estimating potential exposures of ecological receptors. The maximum concentrations of the VOCs were below their corresponding ecological screening values (ESVs), except for acetone. As a result, acetone was retained as a SLERA COPEC and will be evaluated further in the refined screening performed in Section 3.

      The maximum detected concentrations of the pesticides were below their corresponding ESVs, except for two pesticides [gamma-BHC (benzene hexachloride; Lindane) and gamma-Chlordane]. These two pesticides were retained as SLERA COPECs and will be evaluated further in the refined screening performed in Section 3.

Of the 27 SVOCs detected in the sediment samples, a total of 15 SVOCs had screening hazard quotient (HQ_{screen}) values greater than one and were retained as preliminary sediment COPECs. These included nine individual PAHs, total PAHs, and one phenolic compound (4-methylphenol).

Twenty-four inorganics were reported in the sediment samples. The HQ_{screen} values were greater than one for 15 inorganics that had ESVs, and these were retained as preliminary COPECs for the sediments. These will be will be evaluated further in the refined COPEC screening performed in Section 3.

c. Fish SLERA COPECs

Pesticides, PCBs, and metals were analyzed in the forage fish samples. Of the detected chemicals, the maximum PCB, aluminum, and iron concentrations exceeded their corresponding ESV values and were retained as SLERA fish COPECs.

ERAGS Step 3 (Section 3 of this report) includes a refined screening of the COPECs based on alternate (and relevant) benchmarks, Site-specific information, and additional weight-of-evidence criteria, such as the ecological condition of the pond and outlet channels.

3 ERAGS STEP 3 – PROBLEM FORMULATION

ERAGS Step 3 (Problem Formulation) is the first step in conducting a quantitative ERA following the initial screening steps (USEPA 1997). As described by EPA (1998), it is a process "for generating and evaluating preliminary hypotheses about why ecological effects have occurred, or may occur, from human activities." The components of problem formulation that will be emphasized in the Supplemental BERA are the following:

- Developing preliminary COPECs based on the evaluation of Site-specific data, including comparisons to nearby reference area(s);
- Assessing the spatial distribution of the preliminary COPECs;
- Developing a refined CSM that reflects the potential fate and transport pathways and exposure routes for ecological receptors;
- Identifying assessment and measurement endpoints to frame the evaluation;
- Developing a recommended procedure to identify suitable reference site(s); and
- Selecting receptors to be evaluated.

3.1 SUPPLEMENTAL SCREENING OF COPECS

The initial selection of COPECs that was performed in the SLERA used conservative benchmarks (USEPA 1997, 2001). A supplemental screening of the SLERA surface water, sediment, and forage fish COPECs was performed to identify chemicals that will be assessed further in the Supplemental BERA.

The refined screening approach includes the following components:

- Compare the frequency of detection to a value of 5 percent (if more than 20 samples were collected), and assess the pattern and spatial distribution of the preliminary COPECs. The spatial distribution of the results is used to determine how representative the preliminary COPECs may be for Site conditions or whether it represents a localized area of elevated concentrations only.
- Assess the availability of additional alternative sediment and surface water benchmarks, and compare the average and maximum observed sediment concentrations to these values.
- For metals in sediments, compare the maximum results to the Site-specific background (e.g., reference area) or regional conditions.

- Eliminate as COPECs for further evaluation those essential nutrients (e.g., calcium, iron, magnesium, sodium, and potassium) present at low concentrations or concentrations slightly elevated above background.

Tables 3-1a, 3-1b and 3-1c summarize the surface water, sediment and fish (respectively) SLERA ESVs and the alternate ESVs. Table 3-1d summarizes the maximum detected media concentration that was used for the refined screening, and their associated sample locations. Table 3-2 compares the preliminary SLERA COPECs to the COPECs that remain after the refined screening discussed below.

3.1.1 Refined Surface Water COPEC Screening

The COPEC screening that was performed in the SLERA identified one SVOC (benzo(a)anthracene) and one inorganic (magnesium) for further evaluation as part of ERAGS Step 3. The results of this refined screening are discussed below.

Surface Water SVOCs

None of the SVOCs detected in the surface water samples exceeded their corresponding SLERA ESV values, except for one PAH [i.e., benzo(a)anthracene]. This PAH was detected in only 1 of the 10 surface water samples (SW08-15). Since less than 20 samples were collected, the comparison to the 5% detection frequency was not performed. The observed result was less than the refined ESV. Furthermore, review of Figure 2-1 shows that this sample was located within the shallow east outlet channel near a crossing that appears to be constructed from old decking material (Figure 2-2). The sample location is also proximal to a dirt access road, so that this sample may reflect runoff from vehicles. Therefore, this PAH result is not likely Site-related, and it was not retained as a COPEC in the refined screening.

Surface Water Inorganics

None of the maximum filtered surface water results exceeded their corresponding ESVs except for magnesium, which exceeded its conservative ESV (3,230 micrograms per liter [μg/L]). The latter was obtained from the Texas Commission on Environmental Quality (TCEQ) (2006)[4], and is quite low compared to the lowest chronic value (82,000 μg/L) reported for daphnids (Suter and Tsao 1996), which are considered to be sensitive receptors. The observed results (range of 13,400 to 14,400 μg/L) are lower than an alternate ESV (Suter and Tsao 1996), and because magnesium is considered an essential nutrient, it does not require further evaluation in the ERA.

In summary, of the two surface water COPECs that were retained as part of the SLERA screening, none was retained for further evaluation in the ERA.

[4] New York State does not have a magnesium standard or guidance values for ecological receptors.

3.1.2 Refined Sediment COPEC Screening

The COPEC screening that was performed for the sediments in the SLERA identified 1 VOC, 11 SVOCs (10 individual SVOCs, plus total PAHs), 2 pesticides, PCBs, and 15 inorganics. Sediment total organic carbon (TOC) is often related to the levels of residual organic chemicals in environmental samples. Appendix Table A-2c summarizes the frequency of detection, average, and range of the TOC concentrations in the Koppers Pond, Outlet Channels, and Mudflat samples. The average TOC concentration was lowest in the mudflat samples (4.1%); the Koppers Pond and Outlet Channel average TOC concentrations were 6.2% and 8.2% (respectively). The TOC results were incorporated, where appropriate in the refined screening discussed below.

Sediment VOCs

None of the VOCs detected in the sediment samples exceeded their corresponding SLERA ESV values, except for acetone. The maximum sediment acetone concentration (79 microgram per kilogram [µg/kg]) exceeded the SLERA ESV (9.9 µg/kg). The latter was the EPA Region 5 ecological screening level (ESL) (USEPA 2003) which was appropriate for sediments containing one percent total organic carbon (TOC) (equivalent to 10,000 milligrams per kilogram [mg/kg]), because that is the default TOC content of the equilibrium partitioning (EqP) approach (Jones et al. 1997) used to derive this ESV. The sample with the maximum acetone concentration (SD08-15; an outlet channel sediment sample) contained a substantially higher TOC content (220,000 mg/kg, equivalent to 22%), which is also outside of the upper limit (10%) of the EqP method. Therefore, as an alternate ESV the EPA Region 6 sediment screening benchmark (60,030 µg/kg) was used. The EPA Region 6 ESV for acetone was also based on an TOC content of 1%, but uses a modification to the EqP method (Fuchsman, 2003) that accounts for the total VOC concentration (i.e., that portion associated with the pore water and the solid phase). The maximum acetone concentration was well below this value. Therefore, acetone was not retained for further evaluation based on the refined screening.

Sediment SVOCs

A total of 11 SVOCs were retained as preliminary COPECs from the SLERA. These included 9 individual PAHs, total PAHs, and one phenolic compound (4-methylphenol).

- *4-Methylphenol*: An alternate ESV of 670 µg/kg has been used by the State of Washington for 4-methylphenol, but this value is generally applied to marine sediments. Therefore, a refined ESV for 4-methylphenol was not available. 4-Methylphenol was detected in 8 of the 20 sediments, and exceeded the ESV in 5 of the sediment samples. These included none of the Koppers Pond sediments, all four outlet channel sediments, and one of the two mudflat samples. The highest average concentrations were observed in the outlet channel sediments (438 µg/kg), followed by the mud flat samples (53 µg/kg; single detected result), and Koppers Pond sediment (19 µg/kg; maximum detected result)[5]. Although the spatial distribution does not suggest this chemical is Site-related (4-methylphenol is a common biodegradation product), it was nonetheless retained for further evaluation in the ERA.

- *PAHs*: A detailed re-screening of the detected PAHs (and calculated total PAHs) was not performed due the lack of suitable alternate ESVs for this class of chemicals. Therefore, the PAHs were retained for further evaluation in the ERA.

Sediment Pesticides

Two of the pesticides (*gamma*-BHC and *gamma*-chlordane) in the sediment samples exceeded their corresponding ESV values, and were retained as SLERA COPECs. These pesticides were each detected in only 1 of the 20 sediment samples, as shown below.

Parameter	Maximum Concentration (µg/kg)	Sample ID	Location
gamma-BHC	15	SD08-13	Koppers Pond
gamma-Chlordane	1.5	SD08-14	Outlet Channel

The SLERA ESV for gamma-BHC was the EPA Region V ESL [2.37 µg/kg; the same value was also reported in TCEQ (2006) and MacDonald et al. (2000)]. A suitable alternative ESV was not identified for this pesticide. Although the single positive result was greater than the ESV, the detected result is not representative of Site-wide conditions. Therefore, gamma-BHC was not retained for the main risk characterization in the ERA, but will be evaluated as part of the Supplemental BERA uncertainty assessment. The latter will examine the contribution of this pesticide to the potential risks from Koppers Pond only because it was not detected in the outlet channel sediments.

The SLERA ESV for gamma-Chlordane is the NYSDEC sediment criteria adjusted for the sample-specific TOC (0.006 micrograms per gram organic carbon [µg/gOC] based on bioaccumulation). Based on the TOC content of this sample (SD08-13; 17,900 mg/kg) this yielded a TOC-adjusted screening value of 0.107 µg/kg. NYSDEC also has an alternate TOC based on chronic toxicity of 0.03 µg/gOC, which corresponds to a TOC-adjusted screening value of 0.54 µg/kg. In contrast, the EPA Region V ESL is higher (3.24 µg/kg), which is the same value reported in TCEQ (2006) and MacDonald et al. (2000). Therefore, gamma-Chlordane is not retained for the main risk characterization in the Supplemental BERA based on that comparison with the alternate ESV.

[5] The average concentrations for 4-methylphenol are not calculated for the mudflat or outlet sediment samples because these samples exhibited elevated detection limits which resulted in calculated averages that were greater than the observed maximum positive results.

Sediment PCBs

No further refinement to the SLERA screening was performed for the sediment PCBs. PCBs were retained for further evaluation in the Supplemental BERA.

Sediment Inorganics

Fifteen inorganics were identified as SLERA COPECs and were evaluated further using refined ESVs and spatial analysis.

- *Aluminum:* A refined ESV of 25,500 mg/kg was used for aluminum. This is the threshold effects level reported by NOAA (Buchman, 2008). Aluminum was detected in all of sediment samples, and none of the sediment results exceeded the refined aluminum ESV. The highest average concentrations were observed in the outlet channel sediments (12,425 mg/kg), followed by the Koppers Pond sediments (11,486 mg/kg), and mudflat samples (10,125 mg/kg) sediment. Based on this analysis, aluminum was not retained for further evaluation in the Supplemental BERA.
- *Antimony*: A refined ESV of 11.2 mg/kg was used for antimony. This is the probable no effects concentration (PNEC) reported by the European Chemicals Bureau of the European Union (International Antimony Association [IAA] 2008). Antimony was detected in all of the sediment samples, but none of the reported concentrations exceeded the refined ESV. Based on this analysis, antimony was not retained for further evaluation in the Supplemental BERA.
- *Arsenic*: A refined ESV of 9.79 mg/kg was used for arsenic. This is the value reported as the EPA Region V ESL (USEPA 2003) and EPA Region VI sediment benchmark (TCEQ 2006), and is within the range (1- 22 mg/kg) reported as background in the Hudson River watershed sediment database (Rice 1999). Arsenic was detected in all of the sediment samples, but none of the observed results was greater than the refined ESV. The average concentration was highest in the outlet channel sediments (4.4 mg/kg), followed by the mudflat samples (3.45 mg/kg), and Koppers Pond sediments (2.9 mg/kg). Based on this analysis, arsenic was not retained for further evaluation in the Supplemental BERA.
- *Barium*: A refined ESV of 0.7 mg/kg was used for barium. This is the background concentration reported by NOAA (Buchman, 2008). Barium was detected in all of the sediment samples, and all of the results exceeded the refined ESV. Higher average concentrations were observed in Koppers Pond sediment (445 mg/kg) compared to the outlet channel sediments (238 mg/kg) and mudflat sediments (208 mg/kg). Based on this analysis, barium was retained for further evaluation in the Supplemental BERA.
- *Cadmium*: A refined ESV of 0.99 mg/kg was used for cadmium, which is the value reported as the EPA Region V ESL (USEPA 2003), EPA Region VI sediment benchmark

(TCEQ 2006) and the consensus threshold effect concentration (TEC) sediment benchmark (MacDonald et al. 2000). This value is similar to the average concentration (0.93 mg/kg) and is within the range of concentrations (0.2- 6.9 mg/kg) reported as background in the Hudson River watershed sediment database (Rice 1999). All 20 of the sediment results exceeded the refined ESV. Higher average concentrations were observed in the Koppers Pond sediments (245 mg/kg) compared to the outlet channel sediments (42 mg/kg) and mudflat samples (1.7 mg/kg) sediment. Based on this analysis, cadmium was retained for further evaluation in the Supplemental BERA.

- Chromium: A refined ESV of 43.4 mg/kg was used for chromium. This value is the EPA Region V ESL (USEPA 2003), EPA Region VI sediment benchmark (TCEQ 2006), and the consensus TEC sediment benchmark (MacDonald et al. 2000). It is intermediate between the mean (72.2 mg/kg) reported as background in the Hudson River watershed sediment database (Rice 1999) and the mean (35.2 mg/kg) reported for the Elmira quadrant in the USGS National Geochemical Database (USGS 2006). Chromium was detected in all of sediment samples, and 16 of the 20 sediment results exceeded the refined chromium ESV. These included 13 of the 14 Koppers Pond sediment samples, 3 of the 4 outlet channel sediment samples, and none of the mudflat samples. Higher average concentrations were observed in the Koppers Pond sediments (238 mg/kg) compared to the outlet channel sediments (86 mg/kg) and mudflat samples (19 mg/kg) sediment. Based on this analysis, chromium was retained for further evaluation in the Supplemental BERA.
- Copper: A refined ESV of 31.6 mg/kg was used for copper. This is the threshold effects level reported by NOAA (Buchman, 2008). Copper was detected in all of the sediment samples, and 18 of the 20 sediment results exceeded the refined copper ESV. These included 13 of the 14 Koppers Pond sediment samples, 3 of the 4 outlet channel sediment samples, and all of the mudflat samples. Higher average concentrations were observed in the Koppers Pond sediments (341 mg/kg) compared to the outlet channel sediments (99 mg/kg) and mudflat samples (29 mg/kg) sediment. Based on this analysis, copper was retained for further evaluation in the Supplemental BERA.
- Cyanide: A refined ESV of 0.1 mg/kg was used for cyanide. This value is the recommended concentration from EPA Region III Biological Technical Assistance Group (BTAG; USEPA 2006). Cyanide was detected in 6 of the 20 sediment samples, all of which were from Koppers Pond, and there was no apparent relationship between the detected results and sample locations. Where detected, the observed results exceeded the refined ESV. The average cyanide concentration in the Koppers Pond sediments was 0.68 mg/kg. Based on this analysis, cyanide was retained for further evaluation in the Supplemental BERA.
- Iron: A refined ESV of 20,000 mg/kg was used for iron. Iron was detected in all of the sediment samples, and none of the 20 sediment results exceeded the refined iron ESV. Higher average concentrations were observed in outlet channel sediments (24,600

mg/kg) compared to the mudflat sediments (17,650 mg/kg) and Koppers Pond (14,886 mg/kg) sediment. The distribution of iron results suggests contributions from sources other than historical releases from the Industrial Drainageway. However, iron was retained for further evaluation in the Supplemental BERA.

- Lead: A refined ESV of 35.8 mg/kg was used for lead. This is the EPA Region VI sediment benchmark (TCEQ 2006) and the consensus TEC sediment benchmark (MacDonald et al. 2000). Lead was detected in all of the sediment samples, and 19 of the 20 sediment results exceeded the refined lead ESV. These included all of the 14 Koppers Pond sediment samples, 3 of the 4 outlet channel sediments, and both mudflat samples. Higher average concentrations were observed in Koppers Pond sediment (614 mg/kg) compared to the outlet channels (171 mg/kg) and mudflat (64 mg/kg) sediment. Based on this analysis, lead was retained for further evaluation in the Supplemental BERA.
- Mercury: A refined ESV of 0.18 mg/kg was used for mercury, which is the EPA Region VI sediment benchmark (TCEQ 2006) and the consensus TEC sediment benchmark (MacDonald et al. 2000). Mercury was detected in all of the sediment samples, and 15 of the 20 sediment results exceeded the refined mercury ESV. These included 13 of the 14 Koppers Pond sediment samples, 1 of the 4 outlet channel sediments, and 1 of the 2 mudflat samples. Higher average concentrations were observed in Koppers Pond sediment (0.51 mg/kg) compared to the outlet channels (0.14 mg/kg) and mudflat (0.20 mg/kg) sediment. Based on this analysis, mercury was retained for further evaluation in the Supplemental BERA.
- Nickel: A refined ESV of 34 mg/kg was used for nickel. This value is the average concentration of the 46 background sediment samples (range: 9-72 mg/kg) reported by the USGS (Rice 1999) for the Hudson River watershed sediment database. Nickel was detected in all of the sediment samples, and 16 of the 20 sediment results exceeded the refined nickel ESV. These included 13 of the 14 Koppers Pond sediment samples, 3 of the 4 outlet channel sediments, and none of the mudflat samples. Higher average concentrations were observed in Koppers Pond sediment (102 mg/kg) compared to the outlet channels (44 mg/kg) and mudflat (19 mg/kg) sediment. Based on this analysis, nickel was retained for further evaluation in the Supplemental BERA.
- Selenium: A refined ESV of 2 mg/kg was used for selenium. This is the EPA Region III BTAG Sediment Screening Values (USEPA 2006). Selenium was detected in all of the sediment samples, but was greater than the refined ESV in only one of the 14 Koppers Pond sediments, none of the outlet channel sediments, and none of the mudflat sediments exceeded the refined ESV. Based on this analysis, selenium was retained for further evaluation in the Supplemental BERA.
- Silver: An alternate ESV was not available for silver. Silver was detected in all of the sediment samples, and 16 of the 20 sediment results exceeded the silver ESV (1 mg/kg). These included 13 of the 14 Koppers Pond sediments, 3 of the 4 outlet channel

sediments, and neither of the 2 mudflat samples. Higher average concentrations were observed in Koppers Pond sediment (18.7 mg/kg) compared to the outlet channels (6.3 mg/kg) and mudflat (0.53 mg/kg) sediment. Based on this analysis, silver was retained for further evaluation in the Supplemental BERA.

- <u>Zinc</u>: An alternate ESV was not available for zinc. Zinc was detected in all of the sediment samples, and 18 of the 20 sediment results exceeded the zinc ESV (120 mg/kg). These included all 14 of the Koppers Pond sediments, all 4 outlet channel sediments, and neither of the 2 mudflat samples. Higher average concentrations were observed in Koppers Pond sediment (4,019 mg/kg) compared to the outlet channels (809 mg/kg) and mudflat (98 mg/kg) sediment. Based on this analysis, zinc was retained for further evaluation in the Supplemental BERA.

In summary, of the 15 inorganics identified as SLERA COPECs, 12 were retained for further evaluation. The three remaining metals (aluminum, antimony, and arsenic) were excluded based on comparison to alternate ESVs or spatial evaluation of the results.

3.1.3 Refined Forage Fish COPEC Screening

The COPEC screening that was performed in the SLERA identified total PCBs and two metals (aluminum and iron) as preliminary COPECs in forage fish. No further evaluation of the total PCB results was performed as part of this refined screening, and PCBs will be retained for further evaluation in the Supplemental BERA. However, the aluminum and iron forage fish results were re-evaluated to determine whether they warrant evaluation in the Supplemental BERA. The principal data source for the refined fish ESVs was the U.S. Army Corps of Engineers (USACE) Environmental Residue-Effects Database (ERED) tissue burden database[6].

<u>Forage Fish Aluminum Results</u>

The aluminum ESV that was used for SLERA screening of the forage fish results was 10.3 mg/kg. The ERED no-observed-effect dose (NOED) values ranged from 1.15 to 12.5 mg/kg. In comparison, the observed aluminum forage fish whole body results ranged from 3.2 to 12.8 mg/kg, which overlapped the range of NOED values. The mean observed forage fish concentration (7.6 mg/kg) was less than the ESV used in the SLERA. The mean and observed forage fish results were also below the alternate aluminum ESV of 33 mg/kg derived by Dyer et al. (2000) that represents the literature-based fifth percentile of effects residues that focused on community and population effects (e.g., mortality, growth, reproduction). The observed aluminum results do not likely represent a condition in excess of the NOED and aluminum was not retained as part of the refined screening.

[6] The ERED database values were confirmed on 21 September 2009.

Forage Fish Iron Results

The iron ESV that was used for SLERA screening of the forage fish results (22 mg/kg) was the geometric mean of the NOED results reported in the USACE ERED tissue burden database. The ERED values ranged from 9 to 54 mg/kg. In comparison, the observed iron forage fish whole body results ranged from 9.8 to 29.1 mg/kg, which is well within the range of NOED values. In addition, the mean observed forage fish concentration (18.5 mg/kg) was less than the ESV used in the SLERA. The observed iron results do not likely represent a condition in excess of the NOED, and iron was not retained as part of the refined screening.

In summary, of the total PCBs and two metals (aluminum and iron) that were retained as preliminary SLERA COPECs, only the total PCBs were retained as part of the refined COPEC screening for the Supplemental BERA.

3.1.4 Refined COPEC Screening Summary

In summary, several of the chemicals that were identified as preliminary COPECs based on the conservative SLERA screening were not included as COPECs based on the refined screening:

- *Surface Water*: Of the two surface water COPECs identified in the SLERA, neither was retained for further evaluation in the Supplemental BERA.
- *Sediments*: Of the 30 chemicals retained as sediment COPECs from the SLERA screening, all 11 of the SVOCs, neither of the two pesticides, PCBs, and 12 of the 15 inorganics were retained for further evaluation in the Supplemental BERA.
- *Forage Fish*: Of the three forage fish COPECs identified in the SLERA, only the total PCBs were retained for further evaluation in the Supplemental BERA.

These COPECs will be carried through into the quantitative ERA (ERAGS Steps 6 and 7).

3.2 DEVELOPING A REFINED CONCEPTUAL SITE MODEL

The CSM is meant to be an evolving model for potential transport mechanisms and exposure routes. The CSM from the SLERA (AMEC 2009a) was modified and is shown in Figure 3-1. The modifications that were made include 1) segregating the water and sediment direct exposure pathways, and 2) showing the potential pathway of re-dissolved COPEC from the sediment to water, with subsequent uptake by forage organisms. This figure reflects the current understanding of conditions at the Site, which include the following key items noted in this figure:

- Based on observations made during the 2008 field sampling effort, there were no apparent leachate seeps near the Old Horseheads Landfill, and this exposure pathway is considered to be incomplete.
- Surface water is likely a *de minimis* direct pathway based on measured chemical concentrations of chemicals in this medium. However, it will still be evaluated as an exposure medium in the Supplemental BERA.
- The sediment direct-exposure pathways for aquatic receptors (e.g., benthic invertebrates) include ingestion and direct contact. For the higher trophic level receptors (e.g., Great Blue Heron), the direct-exposure pathway is from incidental sediment ingestion.
- The indirect food chain exposure pathways for both aquatic receptors and higher trophic level receptors are based on consumption of forage/prey that bioaccumulate the COPECs from sediments or surface water.
- COPECs may be re-introduced to the water column from the sediments by re-dissolution or bioturbation. Although ingestion of and direct contact with the surface water by both aquatic and higher trophic level receptors can occur (although as noted above this is likely a *de minimis* pathway compared to the other exposure routes), the re-dissolved COPECs may also be bioaccumulated by aquatic organisms which, in turn, can serve as forage/prey for higher trophic level organisms[7].

3.3 IDENTIFYING ASSESSMENT AND MEASUREMENT ENDPOINTS TO FRAME THE EVALUATION

The primary objective of developing appropriate assessment and measurement endpoints is to frame the risk evaluation to be performed as part of the quantitative ERA and to relate potential risk management decisions into the risk evaluation process.

> *Assessment Endpoints* are statements of the characteristics or attributes of the environment that are to be protected. The Supplemental BERA will evaluate five assessment endpoints (and their associated measurement endpoints), for both Koppers Pond and the two outlet streams
>
> *Measurement Endpoints* are a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint. They can include measures of effect and/or measures of exposure.

[7] The measured COPEC concentrations in the forage/prey reflect the contribution of both direct contact and uptake of COPECs re-introduced to the water column from the sediments.

Aquatic species, such as fish and amphibians, and semi-aquatic avian and mammalian species that may utilize the pond and outlet streams as foraging areas have the potential to contact chemical residuals in the media. Such potential exposures may occur through direct contact to the environmental media or from the consumption of biota that may have been exposed to sediment or surface water containing these chemicals. Prey/forage items COPEC concentrations will be based on empirical data (e.g., site-specific fish, and proposed crayfish and plant tissue collections) collected for this project. The assessment endpoints and measurement endpoints have been summarized below.

Assessment Endpoint No. 1: : Evaluate the potential for adverse effects on benthic macroinvertebrates that can serve as a potential prey base for higher trophic level species resulting from exposure to chemicals in sediment and surface water.

The measurement endpoints used to determine whether or not there is an adverse impact to the local amphibian and reptile populations include the following:

- Measurement Endpoint 1-1: Compare observed sediment and surface water concentrations to suitable benchmarks (e.g., sediment quality guidelines [SQG], ambient water quality criteria [AWQC]) to determine potential for adverse effects to benthic populations

- Measurement Endpoint 1-2: Evaluate historical field observations of the benthic macroinvertebrate communities at the Site.

- Measurement Endpoint 1-3: Perform an analysis of potential COPC bioavailability to benthic macroinvertebrates (i.e., evaluation of AVS/SEM results)

- Measurement Endpoint 1-4: Evaluate the results from the historical short-term and proposed longer-term sediment toxicity testing, including the determination of whether there are any correlations between COPEC concentrations and the toxicity metric (e.g., percent survival).

Assessment Endpoint No. 2: Evaluate the potential for adverse effects (survival, growth, or reproduction) to local amphibian and reptile populations resulting from exposures to COPECs in sediment, surface water, and/or prey.

The measurement endpoints used to determine whether or not there is an adverse impact to the local amphibian and reptile populations include the following:

- Measurement Endpoint No. 2-1: Compare observed sediment and surface water concentrations to suitable benchmarks (e.g., surface water quality criteria) to determine potential for adverse effects to amphibians or reptiles.

- Measurement Endpoint No. 2-2: Compare predicted average daily doses of chemicals to amphibians and reptiles to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on the community or local population.

Assessment Endpoint No. 3: Evaluate the potential for adverse effects (survival, growth, or reproduction) to fish species resulting from exposure to COPECs in surface water and sediments.

- Measurement Endpoint No. 3-1: Compare filtered constituent concentrations in surface water to Federal ambient water quality criteria (AWQC), NY State Water Quality Standards and Guidance Values, or other relevant criteria.
- Measurement Endpoint No. 3-2: Compare the distribution of filtered constituent concentrations in surface waters with the range of no significant effect concentrations for growth and reproduction for water column fish.
- Measurement Endpoint No. 3-3: Compare the tissue levels COPECs in fish to benchmarks and determine the probability of potential reductions in fecundity or increased mortality that may impact this population.

Assessment Endpoint No. 4: Evaluate the potential for adverse effects (survival, growth, or reproduction) to local upper trophic level herbivorous avian populations resulting from exposures to COPECs in sediments, surface water, and/or forage.

The measurement endpoints used to determine whether or not there is an adverse impact to the upper trophic level herbivorous avian populations include the following:

- Measurement Endpoint No. 4-1: Compare predicted average daily doses of chemicals for herbivorous avian receptors to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on the individuals within the local population.
- Measurement Endpoint No. 4-2: Perform an assessment to determine whether there is any potential relationship between COPEC residues in sediments and the integrity of local avian populations based on review of the published literature.

Assessment Endpoint No. 5: Evaluate the potential for adverse effects (survival, growth, or reproduction) to local upper trophic level piscivorous avian populations resulting from exposures to COPECs in sediments, surface water, and/or prey.

The measurement endpoints used to determine whether or not there is an adverse impact to the upper trophic level piscivorous avian populations include the following:

- <u>Measurement Endpoint No. 5-1</u>: Compare predicted average daily doses of chemicals for piscivorous avian receptors to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on the individuals within the local population.
- <u>Measurement Endpoint No. 5-2</u>: Perform an assessment to determine whether there is any potential relationship between COPEC residues in sediments and the integrity of local avian populations based on review of the published literature.

Assessment Endpoint No. 6: Evaluate the potential for adverse effects to local herbivorous mammal populations resulting from exposures to COPECs in sediments, surface water, and/or forage.

The measurement endpoints used to determine whether or not there is an adverse impact to the herbivorous mammalian populations include the following:

- <u>Measurement Endpoint No. 6-1</u>: Compare predicted average daily doses of chemicals for herbivorous mammal receptors to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on individuals within the local population.
- <u>Measurement Endpoint No. 6-2</u>: Perform an assessment to determine whether there is any potential relationship between COPEC residues in sediments and the integrity of local mammalian populations based on review of the published literature.

Assessment Endpoint No. 7: Evaluate the potential for adverse effects to local piscivorous mammal populations resulting from exposures to COPECs in sediments, surface water, and/or prey.

The measurement endpoints used to determine whether or not there is an adverse impact to the piscivorous mammalian populations include the following:

- Measurement Endpoint No. 7-1: Compare predicted average daily doses of chemicals for piscivorous mammal receptors to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on individuals within the local population.
- Measurement Endpoint No. 7-2: Perform an assessment to determine whether there is any potential relationship between COPEC residues in sediments and the integrity of local mammalian populations based on review of the published literature.

Assessment Endpoint No. 8: Evaluate the potential for adverse effects (survival, growth, or reproduction) to local upper trophic level omnivorous mammal populations resulting from exposures to COPECs in sediments, surface water, and/or prey.

The measurement endpoints used to determine whether or not there is an adverse impact to the upper trophic level omnivorous mammal populations include the following:

- Measurement Endpoint No. 8-1: Compare predicted average daily doses of chemicals for omnivorous mammal receptors to toxicity reference values for the species. If the average daily dose is greater than the toxicity reference value, this indicates the potential for adverse effects to some portion of the population. The spatial extent of the area with a hazard quotient exceeding 1 is a measure of potential impact on individuals within the local population.
- Measurement Endpoint No. 8-2: Perform an assessment to determine whether there is any potential relationship between COPEC residues in sediments and the integrity of local mammalian populations based on review of the published literature.

The representative receptors for these different Assessment Endpoints are discussed in Section 3.5.3.

3.4 DEVELOPING A RECOMMENDED PROCEDURE TO IDENTIFY SUITABLE REFERENCE POND(S)

The use of a reference area can facilitate the interpretation and evaluation of potential risks in an ERA. Comparison of the Site to a comparable reference area is critical in the evaluation of the health of certain ecological communities that have been selected as measurement endpoints in the assessment. The selection and use of reference areas can also be critically important when ecologically significant chemicals may be present due to area-wide sources that are not attributable to the Site. For such chemicals, information about their concentrations in reference areas that are separate from Site-related releases can help in the determination of whether concentrations measured at the Site are elevated above regional background levels. The SLERA, and prior ERAs, did not include an evaluation of regional background conditions from a suitable reference site.

The candidate reference pond selection methodology was included as part of *Technical Memorandum No. 1: 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (AMEC 2009b). In the fall of 2009, AMEC conducted a field reconnaissance of candidate reference ponds. The results of those investigations were provided to EPA and NYSDEC as a draft report in December 2009 and was finalized in June 2010 as *Technical Memorandum No. 2: Results from the 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (Integral 2010).

3.5 SELECTING REPRESENTATIVE RECEPTORS TO BE EVALUATED FURTHER IN THE ERA

For this Supplemental BERA, semi-aquatic (e.g., amphibians, avian piscivores) and aquatic (e.g., fish) receptors will be evaluated that have a propensity to inhabit the Koppers Pond and the outlet streams. The selection of the appropriate potential receptors that may be exposed to prey items that have contact with sediments and surface water will be based on the following selection criteria specified in USEPA guidance (USEPA 1997):

- The occurrence of potentially complete pathways for exposure of ecological resources to chemicals in environmental media;
- Resident communities or species exposed to the highest concentrations of the evaluated chemicals in environmental media;
- Species or functional groups considered to be essential to, or indicative of, the normal functioning of the affected habitat; and
- The feasibility of completing a quantitative assessment for the identified pathways and receptors.

The two prior ERAs (CDM 1999; CEC 2003) evaluated several different receptors in their assessments. These receptors, as well as those proposed for the current Supplemental BERA, are compiled in Table 3-3 and are discussed in the sections that follow below.

3.5.1 CDM (1999) Receptors

The CDM (1999) draft BERA focused on the following receptor groups and representative species:

- Benthic organisms – Benthic assemblages.
- Piscivorous Bird – The representative species was the great blue heron.
- Piscivorous Mammals – The two representative piscivorous mammals were the mink and the raccoon. The raccoon's diet was assumed to be comprised entirely (100%) of fish.

Benthic organisms were evaluated by enumerating the existing benthic assemblages at Koppers Pond and by the performance of laboratory acute toxicity test of pond sediment using laboratory test organisms (scud, *Hyalella azteca*, and the midge, *Chironomus tentans*). The benthic community assemblage was not compared to assemblages present in one or more local reference ponds with characteristics similar to Koppers Pond.

The 1999 draft BERA modeled uptake and bioaccumulation of metals and PCBs from sediments into fish (instead of using measured fish data) for their evaluation of the potential risk to the three upper trophic organics (great blue heron, mink and raccoon).

3.5.2 CEC (2003) Receptors

The CEC (2003) evaluation was a re-assessment of the draft BERA prepared by CDM (1999) that focused on the following receptors:

- Piscivorous Bird – The representative species was the great blue heron.
- Piscivorous Mammals – The representative piscivorous mammal was the mink.

Empirical data from fish collected in 2003 were used in lieu of the modeled values applied in the draft BERA prepared by CDM (1999) to evaluate the potential ecological risks to the piscivorous receptors.

3.5.3 Recommended Supplemental BERA Receptors

Aquatic and semi-aquatic receptors may potentially be exposed to COPECs in Site media through direct exposure pathways (e.g., incidental ingestion of sediments) and food-chain pathways, as summarized on the CSM. The receptors that may potentially be exposed to COPECs and will be evaluated in the Supplemental BERA are briefly discussed below.

- *Assessment Endpoint No. 1 - Benthic Macroinvertebrates*: The draft BERA (CDM 1999) found no evidence of benthic toxicity in short-term whole sediment toxicity tests using two sensitive test species. However, there is a data gap relative to the potential longer-term sediment toxicity. Therefore, longer-term benthic toxicity tests (from USEPA 2000b) using *Hyalella azteca* and *Chironomus tentans* will be performed on select sediments from Koppers Pond, plus a composite sample from a reference pond.

- *Assessment Endpoint No. 2 - Amphibians and Reptiles*: Amphibians and reptiles[8] were identified as representative species groups in the prior draft BERA (CDM 1999) but were not evaluated quantitatively. These two receptor groups will be evaluated in the Supplemental BERA.

- *Assessment Endpoint No. 3 - Fish*: The measured concentrations of COPECs in forage fish (minnows and/or young-of-year fish) will be used to evaluate potential risks to semi-aquatic upper trophic level receptors.

- *Assessment Endpoint No. 4 - Herbivorous Avian Species*: Ducks have been observed at Koppers Pond during prior field investigations. Therefore, the mallard duck (*Anas platyrhynchos*) will be evaluated as an herbivorous avian species.

- *Assessment Endpoint No. 5 - Piscivorous Avian Species*: The Supplemental BERA will evaluate the potential risks to a great blue heron (*Ardea herodias*) as the representative avian piscivore.

- *Assessment Endpoint No. 6 - Herbivorous Mammalian Species*: The Supplemental BERA will evaluate the potential risks to a semi-aquatic herbivorous mammal. A representative receptor for this group is the muskrat (*Ondatra zibethicus*).

- *Assessment Endpoint No. 7 - Piscivorous Mammalian Species*: The same species evaluated in the prior draft BERA (CDM 1999) – the mink (*Mustela vison*) – will be re-evaluated in the Supplemental BERA. This evaluation will allow comparison of current potential risks to estimates of potential risk reported in the draft BERA. The Supplemental BERA will also include an evaluation of the suitability of Koppers Pond as habitat for mink.

- *Assessment Endpoint No. 8 - Omnivorous Mammalian Species*: In their draft BERA, CDM (1999) evaluated the raccoon (*Procyon lotor*) as a strict piscivore. This species is more appropriately classified as an omnivore, which is how it will be evaluated in the Supplemental BERA.

[8] The representative receptors for the amphibians and turtles are the green frog (*Rana clamitans melanota*) and painted turtle (*Chrysemys picta marginata*). Both species have been observed at Koppers Pond during prior field investigations.

Larger terrestrial herbivores (e.g., deer) or carnivores (e.g., fox), although reported in the area of Koppers Pond (CDM 1999), were not considered for detailed assessment in the Supplemental BERA because their habitats or prey base would not overlap significant portions of the pond, outlet channels, and associated environments.

3.5.4 Exposure Calculations and Preliminary Exposure Assessments for Supplemental BERA Receptors

This section discusses the dose calculation approach and methods used to estimate potential exposures of the receptors of interest to COPECs from ingestion of sediments, forage, prey, or surface water, for the receptors that correspond to Assessment Endpoints No. 4 or higher[9]. These include the following receptors:

- Herbivorous Avian Species: Mallard Duck
- Piscivorous Avian Species: Great Blue Heron
- Herbivorous Mammalian Species: Muskrat
- Piscivorous Mammalian Species: Mink
- Omnivorous Mammalian Species: Raccoon.

The general equation shown below is used to estimate the average daily dose (ADD) for these receptors in the Supplemental BERA.

$$\text{ADD (mg/Kg-day)} = \frac{\left|(\text{Cw} \times \text{IRw}) + (\text{Cs} \times \text{IRs}) + \sum_{i}^{m} (\text{Cd}_i \times \text{Fr}_i \times \text{IRd}_i)\right| \times \text{SUF} \times \text{AUF}}{\text{BW}}$$

Where

ADD = average daily dose (mg/kg-day)

Cw = concentration of COPEC in surface water (milligrams per liter [mg/L])

Cs = concentration of COPEC in soil/sediment (mg/kg)

Cd_i = concentration of COPEC in diet item (*i*) (mg/kg)

Fr_i = fraction of diet comprised of diet item (*i*) (unitless)

[9] A dose calculation approach will not be used for the receptors that will be used for Assessment Endpoint Nos. 1 through 3. For these receptors, a ratio approach will be used to compare the media concentrations to suitable benchmarks.

IRw = ingestion rate of surface water (liters per day [L/day])

IRs = ingestion rate of soil/sediment (kilograms per day [kg/day])

IRd_i = ingestion rate of diet item (*i*) (dry weight) (kg/day)

AUF = area use factor (unitless)

SUF = seasonal use factor (unitless)

BW = body weight (kilograms [kg]).

Measured environmental media COPEC concentrations are used as inputs to the ADD calculation. The assumptions used in the above equation for each receptor are provided in Tables 3-4a through 3-4e. These were all obtained from standard sources (e.g., Beyer et al. 1994; Sample and Suter 1994; USEPA 1993). These exposure assumptions will be re-evaluated for any new information from the literature prior to preparing the Supplemental BERA.

Area Use Factors (AUFs): AUFs will be calculated as the ratio of the receptor's home range and the estimated available habitat available at Koppers Pond and the reference pond. Some of the receptors may utilize the entire pond for forage or shelter (e.g., mallard ducks), while others may only forage on portions of the pond. The pond and outlet channels will be evaluated separately in the Supplemental ERA because they may differ in the utilization by the evaluated receptors.

Seasonal Use Factors (SUFs): SUFs reflect that portion of the year when Koppers Pond, the outlet channels, or the reference pond may be used for foraging or shelter by the evaluated receptors. This parameter can reflect both ecological (e.g., migratory habits of the evaluated receptors) and abiotic components (e.g., loss of access to the pond areas during the winter months when the pond is frozen).

3.5.5 COPEC Concentrations in Prey or Forage Items

For the selected receptors, the key diet or forage items include the following: sediment, surface water, terrestrial plants, aquatic plants, aquatic invertebrates, and fish. Empirical data are already available for three of these media (sediment, surface water, and fish). The supplemental field program includes the collection of samples of three of the remaining media (terrestrial plants, aquatic plants, and aquatic invertebrates) that may be used as forage or prey for the evaluated receptors. The average media concentrations will be used as inputs to the dose calculations.

The forage fish results will be used to evaluate exposures to piscivorous receptors. The forage fish included four composites of bluegills that ranged in size from 63 to 183 mm (2.5 to 7.2"), and two composites (total of five fish) of pumpkinseeds that ranged in size from 68 to 157 mm (2.8 to 6.2")[10]. These are well within the size preference reported for piscivorous birds, such as herons. For example, Short and Cooper (1985) reported that herons preferred fish less than 200 mm in length, while Henning et al (1999) reported that these piscivorous birds prefer fish of lengths of 300 mm or less. Therefore, the existing forage fish data would be appropriate to characterize the potential exposure for piscivorous birds.

Mink, the representative receptor for the piscivorous mammals, have also been reported to prey upon fish of similar size to the forage fish collected from Koppers Pond. For example, Allen (1986) reported that fish of lengths ranging from 70 to 120 mm were the major group of prey fish for mink. Similarly, Heggenes and Borgstrøm (1988) reported that mink prey upon fish less than 150 mm in length. Therefore, the existing forage fish data should be sufficient to characterize the potential exposure for piscivorous mammals.

3.5.6 Derivation of Toxicity Reference Values

The effects evaluation entails reviewing the ecotoxicology of the COPECs and then selecting toxicity reference values (TRVs) for each receptor evaluated in the Supplemental BERA. Both no-observed-adverse-effect level (NOAEL) and lowest-observed-adverse-effect level (LOAEL) based TRVs (i.e., TRV_{NOAEL} and TRV_{LOAEL}) using growth and reproduction endpoints will be evaluated in the Supplemental BERA.

Several sources of information will be evaluated for developing TRVs. These included literature sources (e.g., Schafer et al. 1983), agency data sources, such as the *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (USEPA 1999), EPA Regional BTAGs (USEPA 2002), and the *Ecological Soil Screening Level (EcoSSL)* documents (e.g., USEPA 2005a), related data sources, such as compilations prepared by Oak Ridge National Laboratory (ORNL; Sample et al. 1996), and other sources. For the avian and mammalian TRVs, precedence will be given to NOAEL and LOAEL values generated to support the EcoSSLs because these documents include some of the more contemporary compilations of these values. The EPA EcoSSL documents include a detailed compilation of NOAELs and LOAELs for many of the metals identified as COPECs for this project for both mammalian and avian receptors. When multiple NOAELs or LOAELs were reported for growth and reproductive effects, the geometric mean of these values were used as the TRVs, consistent with the approach used to derive the EcoSSLs.

For fish, tissue-based TRVs have been developed, which have units of mg/kg. The tissue-based TRV_{NOAEL} and TRV_{LOAEL} were developed from data compiled by USACE in their ERED. In

[10] See Table E-1 of the *Site Characterization Study Report* for the individual sample results.

addition, the MS-Access databases from EPA Mid-Continent Ecology Division Laboratory [e.g., *ToxRes database* based on Jarvinen and Ankley (1999) and *PCB Residue Effects (PCBRes) database*] and NYSDEC documents (Newell et al. 1987) will also be evaluated as sources for TRVs. The tissue-based TRVs allow direct comparison to the tissue analytical results.

The basis for the selected TRV values will be discussed in detail in the Supplemental BERA.

4 STEP 4 – STUDY DESIGN AND DATA QUALITY OBJECTIVE PROCESS

One of the main objectives of ERAGS Step 4 Study Design and data quality objectives (DQO) process is the completion of a refined CSM with the development of measurement endpoints (USEPA 1997). The CSM is then used to develop the study design and DQOs.

The study design consists of the development of a Work Plan and Sampling and Analysis Plan.

The ERA portion of the Work Plan describes the following:

- Assessment endpoints;
- Exposure pathways;
- Questions and testable hypotheses;
- Measurement endpoints and their relation to assessment endpoints; and
- Uncertainties and assumptions.

The ERA portion of the Sampling and Analysis Plan describes the following:

- Data needs;
- Scientifically valid and sufficient study design and data analysis procedures;
- Study methodology and protocols, including sampling techniques;
- Data reduction and interpretation techniques, including statistical analyses; and
- Quality assurance procedures and quality control techniques.

ERAGS (USEPA 1997) was originally designed to develop a stand-alone collection of project plans (e.g., work plans) to support the ERA. Because this ERA is being prepared as part of a larger RI/FS, the following RI/FS project plans will be used as references for sample design, sampling methodologies, and analytical methods:

- *Revised Work Plan, Remedial Investigation/Feasibility Study, Koppers Pond, Kentucky Avenue Wellfield Superfund Site, Operable Unit 4, Horseheads, New York (December 2007);*
- *Revised Work Plan, Remedial Investigation/Feasibility Study, Appendix A, Sampling and Analysis Plan / Volume I - Field Sampling Plan (December 2007);* and
- *Revised Work Plan, Remedial Investigation/Feasibility Study, Appendix B, Sampling and Analysis Plan / Volume II - Quality Assurance Project Plan (December 2007).*

Table 4-1 summarizes the information that was presented in the Project Plans and shows the additional information that will be needed to support the Supplemental BERA field work. The latter is discussed in detail in the following sections.

4.1 STUDY DESIGN

Some additional field work has already been performed or will be needed to fill data gaps and assist in the evaluation of potential ecological risks from Koppers Pond and its outlet channels. The field work that was performed following submission of the SLERA (AMEC 2009a) and outlined in *Technical Memorandum No. 1: 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (AMEC 2009b) included the following:

- Conduct a limited field survey to determine whether there is any evidence of slender pondweed (*Stuckenia filiformis alpinus*)[11] in Koppers Pond and its outlet channels.
- Perform a field reconnaissance of candidate reference ponds to determine their accessibility and whether one or more ponds can serve as a suitable representative(s) of regional conditions.

The field programs and results are discussed in Sections 4.1.1 and 4.1.2.

The proposed additional field work to be performed in 2010, include the following activities:

- Collect additional biota samples (crayfish and plants) that may serve as forage for the evaluated receptors in Koppers Pond;
- Collect additional sediment samples from Koppers Pond mud flat areas; and
- Collect surface water, sediment, and biota (forage and game fish, crayfish, and plants) from a Reference Pond.

These are discussed individually in the sections that follow below.

4.1.1 Slender Pondweed Field Survey

Appendix A of the SLERA compiled the correspondences with NYNHP and NYSDEC concerning whether there were any reported observations of RTE species at or near the Koppers Pond Site. In December 2008, the RTE summary was updated by NYNHP to include the potential presence of slender pondweed (*Stuckenia filiformis alpinus*) at or near Koppers Pond.

[11] A common synonym for this species is *Potamogeton filiformis alpinus*, which is how this plant is listed under NYCRR, Chapter II, Part §193.3 [http://www.dec.ny.gov/regs/15522.html]

This inclusion was based on a historical record (from 1943), prior to the original construction of Koppers Pond, that this species was reported "in cold brook, Chemung Street, Horseheads."

In September 2009, AMEC conducted an investigation to determine the presence of slender pondweed in Koppers Pond and the outlet channels.

The field survey methodology was included as part of *Technical Memorandum No. 1: 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (AMEC 2009b). This document was submitted to EPA and NYSDEC in August 2009, approved later that month, and the field program was implemented in September 2009. The results from the slender pondweed survey were then provided to EPA and NYSDEC in a draft report in December 2009 and finalized in June 2010 as *Technical Memorandum No. 2: Results from the 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (Integral 2010). As described in Technical Memorandum No. 2, the visual survey for the slender pondweed in Koppers Pond and its outlet channels showed that this species was not present in either of these areas. Field measurements collected from each of the survey locations and inspection of the substrate indicate that the habitat is not appropriate for this species. Slender pondweed prefers more alkaline waters (Maine Department of Conservation [MDOC] 2004) than is present at either Koppers Pond or its outlet channels.

4.1.2 Field Reconnaissance of Candidate Reference Pond(s)

As discussed earlier, the candidate reference pond selection methodology was included as part of *Technical Memorandum No. 1: 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (AMEC 2009b). The results from the field reconnaissance of the reference ponds were provided in *Technical Memorandum No. 2: Results from the 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond* (Integral 2010).

As described in Technical Memorandum No. 2, 15 distinct candidate ponds were evaluated as part of the 2009 field effort. These were compared using different hydrologic, land use, sediment lithology, and fish community metrics. Based on this evaluation, four potential reference ponds (or reference pond groups) were identified as candidates for further evaluation. These included the following:

- A group of ponds located behind the school west of Koppers Pond;
- The two Lowe Ponds, located in a county park near the county airport; and
- A group of ponds near the "Center at Horseheads" industrial park northeast of Koppers Pond.

One of the principal objectives of this reconnaissance was to determine candidate pond access issues, which include both the perspective of permission to sample, and the ability to collect the samples (e.g., suitable boat launch locations). As described in Technical Memorandum No. 2, the group of ponds located behind the school, and the Lowe Ponds group, are located on public property, while the group of ponds near the "Center at Horseheads" industrial park are privately owned. Based on the evaluated metrics [see Technical Memorandum No. 2; (Integral 2010)] text for discussion) it is recommended that one of the ponds from the group located at the "Center at Horseheads" be used as the reference pond. The surrounding areas of the other two candidate ponds are well maintained lawns, while the area near the "Center at Horseheads" is less so, plus the latter is associated with mudflat/wetland complex that is more similar to that found at Koppers Pond.

According to information provided by NYSDEC, there are two former New York State Superfund sites located near the "Center of Horseheads." Brief descriptions of these sites are summarized below[12]:

- *Corning Glass-Horseheads Industrial Center*: This site has New York site code 808015 and was located at Building A, Horseheads Industrial Center. Spills of PCB-containing transformer oil contaminated a section of the warehouse floor and several areas adjacent to the building. All remedial work was completed in March 1986, and the Site was delisted in December 1987.

- *Aikman Property*: This site has New York site code 808017 and was located at 104 Wygant Road at the corner of Route 14 in Horseheads. Approximately 100 drums were disposed of on the 10 acre property. Only 30 of the drums were full and most contained waste oil. An unknown amount of chlorinated solvents were also reported at this site. The drum removal was completed in the summer of 1988 with additional sampling in the summer of 1990. The site profile from NYSDEC *Environmental Site Remediation Database* states that the investigations conducted to date do not indicate any potential concerns.

Both of these have site class code "C", which is used for sites where NYSDEC has determined that remediation has been satisfactorily completed. However, the NYSDEC *Environmental Site Remediation Database* indicates that the Aikman Property will be undergoing a soil vapor evaluation in 2010, although it was not specified why this field program was required.

An access agreement will be required to provide permission to access any of the ponds near the "Center of Horseheads" since they are privately owned (Integral 2010). If the Group is unable to secure access agreements with any of the private owners of any of these ponds, the ponds located near the school can serve as a backup for sampling. The latter is located on public property and it is anticipated that the process to obtain permission for sampling the school ponds would be less onerous.

[12] This information was obtained from the NYSDEC on-line *Environmental Site Remediation Database*, which can be accessed at the following URL: http://www.dec.ny.gov/cfmx/extapps/derexternal/haz/results.cfm?pageid=3

4.1.3 Collection of Additional Biota Samples

Fish have been the primary biota samples collected to date from Koppers Pond. To support the preparation of the Supplemental BERA (ERAGS Steps 6 and 7) it is proposed to collect Site-specific data on key forage items for the proposed ecological receptors. These forage items include aquatic invertebrates (for the semi-aquatic[13] invertivores/omnivores) and plant material (for the herbivorous receptors). The plant materials will consist predominantly of submerged and emergent macrophytes.

Aquatic Invertebrate Collections

Aquatic invertebrates can be difficult to collect in sufficient volumes to support analytical sample mass requirements. As a surrogate, we are proposing to collect crayfish from Koppers Pond. Crayfish are a commonly used surrogate for aquatic invertebrate species due to their relative ease of collection (through the use of crayfish traps or hand collection, and larger size relative to other aquatic invertebrates). The crayfish collection methodology is presented in Appendix B.

The target areas for crayfish collections will consist of the following: One composite crayfish sample in the area bounded by the confluence of the Industrial Drainageway to SD08-02.

Plant Material Collections

The plant materials to be collected and target sampling locations consist of the following:

- Single composite sample of floating aquatic plants (duckweed) from Koppers Pond;
- Grass or similar leafy material from shrubs or small trees bordering Koppers Pond (near SD08-07) and the East Outlet Channel (near SD08-15);
- Plant root or rhizomes from emergent vegetation at the perimeter of Koppers Pond (near SD08-01)

Floating Aquatic Plant Material: Common duckweed is present in portions of Koppers Pond although the locations can vary depending upon the prevailing wind direction. Therefore, a specific sampling location has not been determined. It is proposed that if there are multiple areas of accumulated duckweed in Koppers Pond at the time of sampling, then a single composite sample should be prepared that would be representative of these multiple areas.

Grass/Leafy Vegetation: The boundary of Koppers Pond and the outlet channels are fairly well vegetated. Since this material could be used as forage for some of the evaluated receptors

[13] Semi-aquatic receptors are those that spend part of their lives foraging in aquatic environments, such as ducks.

samples of grass or other leafy vegetation will be performed. A combination of new and older leaves should be collected in order to have a conservative estimate of the concentrations of the COPECs in the plant material.

The target areas for the grass/leafy vegetation will be near sediment sampling station SD08-07 in Koppers Pond and near sediment sampling station SD08-15 in the East Outlet Channel. These locations were selected since they were located near the perimeter of the waterbodies (Figure 2-1) and have elevated COPEC concentrations relative to the refined screening values. The table below summarizes the results for three of the COPECs, as an example.

	Concentration (mg/kg)		
COPEC	Refined ESV	SD08-07	SD08-15
Total PCBs	0.060	0.58	0.19
Lead	68.5	664	189
Zinc	120	4,120	534

Plant Roots or Rhizomes: Cattails have been observed near the juncture of the Industrial Drainageway and Koppers Pond, and along the southern perimeter of Koppers Pond between the two outlets. Cattail roots and rhizomes can serve as forage for some of the ecological receptors that will be evaluated in the BERA.

4.1.4 Collection of Additional Sediment Samples from Koppers Pond Mud Flat Areas

As part of the 2008 field study there were two sediment samples collected from the mudflats associated with Koppers Pond (Figure 2-1). These were both collected from the depth interval of 0 to 6" and are briefly described below:

- Sample SD08-30: This sample was located between the west and east outlet channels, near the right-of-way for overhead transmission lines.
- Sample SD08-40: This sample was collected from the western side of the west wing of Koppers Pond. This location may not represent a perennial mudflat since the pond surface water elevation at the time of sampling (May 2008) was lower than had been reported in prior investigations.

Before concluding that additional samples are required due to the limited number of samples collected for this potential exposure media, the observed results were compared to the refined ESVs[14] (Table 4-2). Five of the COPECs – 4-Methylphenol, copper and mercury in sample SD08-40, and cadmium and lead in both samples – were greater than their corresponding refined ESVs. Because the mudflat area is not perennial near SD08-40, it is recommended to collect

[14] Only those chemicals retained as refined COPECs from Section 3.1.2 are shown on this table.

three additional mudflat samples between the outlet channels (i.e., area near SD08-30) to better characterize the potential exposure and risk from this area. These will be collected from the 0 to 6" depth interval. The approximate proposed sampling locations are shown in Figure 4-1. These may be adjusted in the field based on Site conditions, physical obstacles, and related features.

4.1.5 Collection of Sediment for Toxicity Testing

Section 4.2 of the Site Characterization Report summarized the comparisons between the historical (1995 and 1998) and most current (2008) sediment chemical results. Although there were slight differences in the ranges, medians and averages, the results were generally comparable. The short-term toxicity studies of the 14 sediment samples (plus one field duplicate) were performed in 1998 (CDM, 1999). These included one sample from the Industrial Drainageway, nine samples (plus a field duplicate) from Koppers Pond, and four samples from the outlet channels. There was no acute toxicity (reduction in survival) in any of these samples using the midge, and only one sediment sample (SD-13; located at the juncture of the Industrial Drainageway and Koppers Pond) showed a statistically significant reduction in survival in the amphipod (average of 78%; the range was 50 to 100% for the eight individual replicates in this sample). Therefore, due to the similarity in sediment chemical concentrations between the 1998 and 2008 sampling events, it would be anticipated that the sediments currently would also lack short-term toxicity.

Nonetheless, there is a data gap relative to the potential longer-term sediment toxicity. Therefore, it is proposed to perform the following two longer-term toxicity tests (USEPA 2000b) using five sediments from Koppers Pond, plus one composite sample from a reference pond:

- Test Method 100.4: *Hyalella azteca* 42-day (chronic) Test for Measuring the Effects of Sediment-associated Contaminants on Survival, Growth, and Reproduction

- Test Method 100.5: Life-cycle Test for Measuring the Effects of Sediment-associated Contaminants on *Chironomus tentans*

Sediments will be collected from the following five sample locations in Koppers Pond for toxicity testing: SD08-01, SD08-03, SD08-04, SD08-06, and SD08-08. These were selected based upon review of the 1998 sediment toxicity results and their associated chemical data. Appendix D provides supporting information regarding the selection of these five samples. A single composite sample will also be collected from a reference pond to provide information on the potential sediment toxicity of ponds that are reflective of background conditions.

4.1.6 Collection of Sediment and Biota Samples from a Reference Pond

The reference pond sampling program will consist of the collection of the following media:

- One composite sediment sample for sediment toxicity testing. This composite will consist of 5 to 10 grab samples from throughout the reference pond.
- Five forage fish composites and five gamefish samples[15]. The same target species collected from Koppers Pond will be collected from the reference pond, to the extent possible.
- Two crayfish composite samples
- Three plant composite samples.

Since both aquatic and terrestrial plant material may be consumed by the evaluated receptors, the plant composites would consist of the following:

- One composite of vegetated portions of aquatic plants.
- One composite of root material/tubers of semi-aquatic plants.
- One composite sample of a mixture of leafy portions of terrestrial plants. Preference will be towards herbaceous plants that are more likely to serve as forage.

Collection of these media would allow calculation of reference risks for comparison against the risk results from Koppers Pond and to discern the extent of any incremental risk above baseline levels. The samples will be analyzed only for the chemical groups represented by the refined COPECs (Table 3-2). For sediments, this will include SVOCs, Metals, PCBs, and TOC, while for the biota (fish, crayfish, and plant material) this will include PCBs and total lipid. The sediment sample for chemical analysis will be an aliquot of the well mixed composite sediment sample used for toxicity testing.

4.2 DATA QUALITY OBJECTIVES

The DQOs for the supplemental field program are summarized in Table 4-1 by proposed activity. The DQOs presented in the RI/FS Quality Assurance Project Plan (QAPP; Appendix C of the RI/FS Work Plan) are also applicable to the proposed additional mudflat samples from the Koppers Pond outlet channels, and the surface water, sediment, and biota collections planned for the reference pond. The same laboratories that were used for the 2008 field program will be used for this supplemental field work. These are shown below:

- Sediments, Surface Water: TestAmerica Laboratories, Inc. (TestAmerica), Pittsburgh, Pennsylvania; and
- Biota: TestAmerica, Colchester, Vermont.

[15] The gamefish samples will be used to support the human health risk assessment, while the forage fish samples will be used for the ecological risk assessment.

- Benthic Toxicity Testing: Aqua Survey Inc. (Flemington, New Jersey)

The development of formal DQOs for the surveys to identify the potential presence of the slender pondweed and candidate reference ponds were not required, because neither were quantitative evaluations.

4.3 STEP 4 SDMP SUMMARY

At the close of Step 4, the risk assessors and risk managers should agree on the following:

- Selection of Measurement Endpoints – These are summarized and discussed in Section 3.3.
- Selection of Specific Investigation Methodologies – None of the proposed samples require sampling methodologies or protocols that have not already been implemented at Koppers Pond, with the exception of the crayfish sampling. As discussed above, this sampling will be accomplished using baited crayfish traps, or by hand-picking.
- Selection of Data Reduction and Interpretation Methods – Standard statistical summaries and tests, and graphical presentations – such as those presented in the *Site Characterization Study Report* - will be prepared using supplemental data.

Interpretation approaches may vary with the assessment endpoint, although in most cases a hazard quotient approach will be used to compare the exposure conditions (e.g., surface water concentrations), tissue levels, or estimated dose to TRVs or regulatory limits.

5 STEP 5 – FIELD VERIFICATION OF SAMPLING DESIGN

The field verification of the sampling design consists of several activities (USEPA 1997) including:

- Verification of previously collected information;
- Site visit to evaluate feasibility of sampling; and
- Verification of reference sites.

5.1 VERIFICATION OF PREVIOUSLY COLLECTED INFORMATION

This activity includes a determination that previously collected samples have been properly collected and that there are no data gaps that would indicate potential uncertainty in the reported results. These could include issues such as problems with the analytical reporting (e.g., elevated detection limits), errors in sample locations (e.g., survey problems causing errors in geo-referencing), and other similar items. The key field sampling results that will be used for the Supplemental BERA have been performed recently (i.e., since 2008), and no major problems have been reported during the prior sampling events.

5.2 SITE VISIT TO EVALUATE FEASIBILITY OF SAMPLING

A good understanding of the feasibility of collecting additional sediment samples from the Koppers Pond outlet channels was achieved during the 2008 (and prior) sampling events for surface water, sediments, and biota. The purpose of this step is to ensure that the supplemental field survey locations discussed as part of ERAGS Step 4 can actually be collected.

Collection of Plants and Crayfish from Koppers Pond

There are no anticipated issues with collecting plant materials at Koppers Pond to support the ERA. Plant materials will include leafy vegetation, aquatic macrophyte material, and root/tuber material from semi-aquatic plants like cattails (*Typha latifolia*). The results from the September 2009 field work (see Technical Memorandum No. 2; Integral 2010) showed that there was limited macrophyte material within the pond. If this is also observed in 2010, then it will be replaced with another sample of root/tuber material from semi-aquatic plants. It is not known at this time whether crayfish are present at Koppers Pond. There may be a need to identify a surrogate species if the crayfish collections are unsuccessful. In such a case, EPA and NYSDEC will be contacted to confirm suitable replacement species, if any are available.

Collection of Additional Sediment Samples from Koppers Pond Mud Flat Areas

Access issues for the proposed additional sediment samples from Koppers Pond mud flat areas are not anticipated. These sampling locations can be reached on foot, and the locations are situated on property owned by Hardinge, which is a participating party in the Koppers Pond RI/FS Group. The higher water levels observed in the fall of 2009 compared to the 2008 field investigations (when the mudflat areas were more readily apparent) may result in some minor adjustments to the number and locations of the actual field samples to be collected.

Collection of Sediments and Biota from a Reference Pond

The reconnaissance of the candidate reference ponds presented in Technical Memorandum No. 2 included visual inspections for fish, sediment lithology, and other features. There is the possibility that some of the sediment samples may not be collected from the reference pond due to existing conditions at the reference site, such as poor sediment recoveries due to substrate conditions, but this is not known at this time. Sediments that were viewable during the reconnaissance appeared suitable for sampling. A potential outstanding issue for the proposed supplemental reference samples is obtaining permission to collect samples from the reference pond.

There are no anticipated issues with collecting plant materials at the reference pond to support the Supplemental BERA although different species may be represented in these samples compared to Koppers Pond. As with the proposed collection of crayfish at Koppers Pond, it is not known at this time whether crayfish are present in the reference pond. There may be a need to identify a surrogate species if the crayfish collections are unsuccessful. In such a case, EPA and NYSDEC will be consulted to confirm suitable replacement species, if any are available.

It is anticipated that field samples will be collected from the reference pond in late spring of 2010.

5.3 VERIFICATION OF REFERENCE SITES

One of the primary objectives of ERAGS Step 4 for this project is the identification and collection of samples from a reference site. As discussed in Technical Memorandum No. 1 (AMEC 2009a), a selection process for the identification of a suitable reference site was developed and several candidate sites have been identified. The initial reconnaissance of candidate reference sites was performed in September 2009, and the results of this effort are presented in a Technical Memorandum No. 2 (Integral 2010). The latter identified a short-list of candidate reference ponds. Based on this evaluation, the recommended reference pond was one from the group located at "Center at Horseheads." Since these differ in ownership, the actual pond to be sampled will depend on the ability to obtain an access agreement.

5.4 STEP 5 SCIENTIFIC/MANAGEMENT DECISION POINT

The SMDP for the field verification of the sampling design is the approval of any supplemental sampling and analysis related to the completion of the ERA. Any changes to the investigation proposed in Step 4 must be made with agreement from the risk manager and risk assessment team. The risk manager must understand what changes have been made and why, and must ensure that the risk management decisions can be made from the information that the new study design can provide. The risk assessors must be involved to ensure that the assessment endpoints and testable hypotheses are still being addressed. In some cases, changes in the measurement endpoints could be necessary, with corresponding changes to the risk hypotheses and sampling design. Any new measurement endpoints must be evaluated according to their utility for inferring changes in the assessment endpoints and their compatibility with the Site conceptual model (from ERAGS Steps 3 and 4). Loss of the relationship between measurement endpoints and the assessment endpoints, the risk questions or testable hypothesis, and the Site conceptual model will result in a failure to meet study objectives.

5.5 ERAGS STEP 6 AND 7 COMPONENTS

ERAGS Step 6 (Site Investigation and Data Analysis) consists of the following elements (USEPA 1997):

- Summarizing the Site Investigation Results;
- Changing Field Conditions that May Impact Data Interpretation or Assessment;
- Identification of any Unexpected Nature or Extent of Contamination;
- Characterizing Exposures;
- Characterizing Ecological Effects; and
- Scientific/Management Decision Point.

For the Koppers Pond project, any newly collected chemical data will be formatted in a manner similar to that used in the 2008 Site Characterization Study Report. This will principally consist of chemical results of samples collected from the reference pond and any new samples (e.g., biota) collected from Koppers Pond.

ERAGS Step 7 (Risk Characterization) is the final phase of the ERA and is the culmination of the preceding steps of the ERA. It is a more-refined and detailed quantification of potential Site risks, and it includes a more Site-specific evaluation of risks than was performed in Step 2. Risk characterization involves three principal components: 1) risk estimation, 2) risk description, and 3) uncertainty analysis. In Step 7, the risks estimated with projected exposures are characterized, and the strengths, weaknesses, and assumptions employed in the ERA are fully described. As part of risk estimation, the exposure assessment and effects assessment profiles from Step 6 are integrated to predict the likelihood of adverse effects to different assessment endpoints. In the risk description component, all of the exposure and risk estimates are synthesized and interpreted. The weight of evidence supporting the different risk estimates is summarized and sources of uncertainty are addressed. Conclusions are presented to provide the risk managers with the risk information for environmental decision-making.

To facilitate agency review, ERAGS Steps 6 and 7 will be combined into a single report.

6 REFERENCES

Allen, A.W. 1986. *Habitat Suitability Index Models: Mink, Revised.* Available at: http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-061.pdf. US Department of the Interior, U.S. Fish and Wildlife Service. Biological Report 82(10.127). November. 23 p.

AMEC. 2009a. Screening-level ecological risk assessment, Koppers Pond. Prepared for the Koppers Pond RI/FS Group. AMEC Earth and Environmental, Inc. May 29.

AMEC. 2009b. Technical memorandum No. 1: 2009 field sampling program to support the ecological risk assessment of Koppers Pond. Prepared for the Koppers Pond RI/FS Group. AMEC Earth and Environmental, Inc. August 6.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. *J. Wildlife Manage.* 58:375-382.

Buchman, M.F. 2008. NOAA screening quick reference tables. NOAA Hazmat Report 99-1. Available from: http://response.restoration.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf. National Oceanic and Atmospheric Administration, Coastal Protection and Restoration Division, Seattle, Washington. October. 12 pp.

CDM. 1999. Revised draft ecological risk assessment, Kentucky Avenue Wellfield Site, Horseheads, New York. Document No. 7720-038-RA-CSSM. Prepared for the U.S. Environmental Protection Agency, Region 2, New York, New York. CDM Federal Programs Corporation. February.

CEC. 2003. Investigation of fish in Koppers Pond for the Kentucky Avenue Wellfield Superfund Site. CEC Project 230607. Prepared for Viacom Inc., Pittsburgh, Pennsylvania. Civil & Environmental Consultants, Inc. July.

Cummings/Riter and AMEC. 2008. Draft site characterization summary report, Koppers Pond, Kentucky Avenue Wellfield Superfund Site, Operable Unit 4, Horseheads, New York. Cummings/Riter Consultants, Inc. and AMEC Earth and Environmental, Inc. October 17.

DeGraaf, R.M., V.E. Scott, R.H. Hamre, L. Ernst, and S.H. Anderson. 1991. Forest and rangeland birds of the United States: Natural history and habitat use. U.S. Department of Agriculture, Forest Service, Agriculture Handbook 688. Northern Prairie Wildlife Research Center Home Page. Available from: http://www.npwrc.usgs.gov/resource/birds/forest/index.htm.

Dyer, S.D., C.E. White-Hull, and B.K. Shephard. 2000. Assessments of chemical mixtures via toxicity reference values overpredict hazard to fish communities. *Environ. Sci. Technol.* 34(12): 2518-2524.

Fuchsman, P.C. 2003. Modification of the equilibrium partitioning approach for volatile organic compounds in sediment. *Environ Toxicol Chem.* 22(7): 1532-1534.

Hails, D.C. 2001. Wetlands delineation report, Kentucky Avenue Wellfield Site OU3, Horseheads, New York. Prepared for Viacom Inc., Pittsburgh, Pennsylvania. July.

Heggenes, J. and R.Borgstrøm. 1988. Effect of mink, Mustela vison Schreber, predation on cohorts of juvenile Atlantic salmon, Salmo salar L., in three small streams. Journal of Fish Biology. 33(6): 885-894.

Henning, M.H., N.M. Shear Weinberg, N.D. Wilson, and T.J. Iannuzzi. 1999. Distributions of key exposure factors controlling the uptake of xenobiotic chemicals by Great Blue Herons (Ardea herodius) through ingestion of fish. Human and Ecological Risk Assessment. 5(1): 125-144.

IAA. 2008. Summary of currently available scientific data on antimony trioxide. Available from: www.Antimony.be/antimony-compounds/antimony-trioxide/scientific/docs/Overview-science-ATO-status-September2008.pdf. International Antimony Association.

ICMI. 2006. Environmental and health effects of cyanide. Available from: www.cyanidecode.org/cyanide_environmental.php. International Cyanide Management Institute. 3 pp.

Integral Consulting Inc (Integral). 2010. Technical Memorandum No. 2: Results from the 2009 Field Sampling Program to Support the Ecological Risk Assessment of Koppers Pond, Kentucky Avenue Wellfield Superfund Site, Operable Unit 4, Horseheads, New York. Prepared for the Koppers Pond RI/FS Group. Revised. June 10.

Jarvinen, A.W., and G.T. Ankley. 1999. Linkage of effects to tissue residues: Development of a comprehensive database for aquatic organisms exposed to inorganic and organic chemicals. SETAC Press. 358 pp.

Jones, D.S., G.W. Suter II, and R.N. Hull. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota: 1997 revision. ES/ER/TM-95/R4. Available from: www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf. Oak Ridge National Laboratory. November.

Koppers Pond RI/FS Group. 2007. Preliminary conceptual site model, Koppers Pond, Kentucky Avenue Wellfield Site, Operable Unit 4, Horseheads, NY. Koppers Pond RI/FS Group. February 19.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.* 39: 20-31.

MDOC. 2004. *Stuckenia filiformis Pers. ssp alpinus (Blytt) Hayner, Les & Kral, Northern Slender Pondweed.* Natural Areas Program. Available from: www.mainenaturalareas.org/docs/rare_plants/links/factsheets/stuckeniafiliformisalpinus.pdf. Maine Department of Conservation. May 17. 2 pp.

Nagy, KA. 1987. Field metabolic rate and food requirement scaling in mammals and birds. *Ecolog. Monographs.* 57(2): 111-128.

Nagy K.A. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. *Nutr. Abstracts and Reviews Series B: Livestock Feeds and Feeding.* 71(10): 1R-12R.

NYSDEC. 1999. Technical guidance for screening contaminated sediments. Available from: www.dec.ny.gov/docs/wildlife_pdf/seddoc.pdf. New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources. January 25 update.

NYSDEC. 1998[2002]. Ambient water quality standards and guidance values and groundwater effluent limitations. Division of Water Technical and Operational Guidance Series (TOGS 1.1.1). Available from: www.dec.ny.gov/docs/water_pdf/togs111.pdf. New York State Department of Environmental Conservation.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara River biota contamination project: Fish flesh criteria for piscivorous wildlife. Technical Report 87-3. Available from: www.dec.ny.gov/docs/wildlife_pdf/niagarabiotacontamproj.pdf. New York State Department of Environmental Conservation, Division of Fish and Wildlife. July.

Philip Environmental Services Corporation. 1996. Draft remedial investigation report, Kentucky Avenue Wellfield Site Operable Unit 3, Horseheads, New York. Prepared for Westinghouse Electric Corporation, Pittsburgh, Pennsylvania. Philip Environmental Services Corporation. March.

Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program. Available at: www.dec.ny.gov/animals/29389.html. New York State Department of Environmental Conservation. Latham, N.Y. 96 pp. +xi.

Rice, K.C. 1999. Trace-element concentrations in streambed sediment across the conterminous United States. *Environ. Sci. Technol.* 33(15): 2499-2504. [Database available from: http://water.usgs.gov/nawqa/trace/data/est_v33n15_p2499.xls]

Sample, B.E., and G.W. Suter, II. 1994. Estimating exposure of terrestrial wildlife to contaminants. ES/ER/TM-125. Available from: www.esd.ornal.gov/programs/ecorisk/documents/tm125.pdf. Oak Ridge National Laboratory, Oak Ridge TN. September.

Sample, B.E., D.M. Opresko, and G.W. Suter, II. 1996. Toxicological benchmarks for wildlife: 1996 revision. ES/ER/TM-86/R3. Available from: www.esd.ornl.gov/programs/ecorisk/documents/tm86r3.pdf. Oak Ridge National Laboratory, Oak Ridge, TN. June.

Schafer Jr., E.W., W.A. Bowles Jr, and J. Hurlbut. 1983. The acute oral toxicity, repellency, and hazard potential of 998 chemicals to one or more species of wild and domestic birds. *Arch. Environ. Contam. Toxicol.* 12: 355-382.

Short, H. L. and R. J. Cooper. 1985. Habitat Suitability Index Models: Great Blue Heron. Available at: http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-099.pdf. US Department of the Interior, U.S. Fish and Wildlife Service. Biological Report 82(10.99). July.

Suter II, G.W. and C.L. Tsao. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 revision. ES/ER/TM-96/R2. Available from: www.hsrd.ornl.gov/ecorisk/tm96r2.pdf. Oak Ridge National Laboratory, Oak Ridge, TN. June.

TCEQ. 2006. Update to guidance for conducting ecological risk assessments at remediation sites in Texas RG-263 (Revised). Available from: www.tceq.state.tx.us/assets/public/remediation/eco/0106eragupdate.pdf. Texas Commission on Environmental Quality, Remediation Division. January.

USEPA. 1993. Wildlife exposure factors handbook. EPA/600/R-93/187. Available from: http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=489605. U.S. Environmental Protection Agency, Office Research and Development. December.

USEPA. 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. EPA 540-R-97-006. Available from: www.epa.gov/oswer/riskassessment/ecorisk/ecorisk.htm. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June.

USEPA. 1998. Guidelines for ecological risk assessment. 63FR26845. EPA/630/R-95/002F. Available from: http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=36512. U.S. Environmental Protection Agency. May.

USEPA. 1999. Screening level ecological risk assessment protocol for hazardous waste combustion facilities. EPA530-D-99-001A. Available from: www.epa.gov/waste/hazard/tsd/td/combust/ecorisk.htm. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. August.

USEPA. 2000a. Bioaccumulation testing and interpretation for the purpose of sediment quality assessment: Status and needs. EPA 823-R-00-001. Available from: www.epa.gov/waterscience/cs/biotesting/bioaccum.pdf. U.S. Environmental Protection Agency, Office of Water, Office of Solid Waste. February.

USEPA. 2000b. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition. Available from: www.epa.gov/waterscience/cs/library/freshmanual.pdf. EPA 600/R-99/064. U.S. Environmental Protection Agency, Office of Research and Development, and Office of Science and Technology. March.

USEPA. 2001. Eco update: The role of screening-level risk assessments and refining contaminants of concern in baseline ecological risk assessments. Publication 9345.0-14, EPA 540/F-01/014. Available from: www.epa.gov/oswer/riskassessment/ecoup/pdf/slera0601.pdf. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June.

USEPA. 2002. USEPA Region 9 biological technical assistance group (BTAG) recommended toxicity reference values for mammals and birds. Available from: www.dtsc.ca.gov/assessingrisk/upload/eco_btag-mammal-bird-trv-table.pdf. U.S. Environmental Protection Agency. Revision Date November 21, 2002.

USEPA. 2003. Region 5 RCRA corrective action, ecological screening levels. Available from: www.epa.gov/reg5rcra/ca/ESL.pdf. U.S. Environmental Protection Agency. August 22.

USEPA. 2005a. Human health risk assessment protocol (HHRAP) for hazardous aaste combustion facilities, final. EPA520-R-05-006. Available from: www.epa.gov/waste/hazard/tsd/td/combust/risk.htm. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. September.

USEPA. 2005b. Guidance for developing ecological soil screening levels (Eco-SSLs). Attachment 4-3: Eco-SSL standard operating procedure (SOP) #4: Wildlife toxicity reference value literature review, data extraction and coding. OSWER Directive 92857-55. Available from: www.epa.gov/ecotox/ecossl/pdf/ecossl_attachment_4-3.pdf. U.S. Environmental Protection Agency. June.

USEPA. 2006. *EPA* Region III BTAG freshwater sediment screening benchmarks. Available from: www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm. U.S. Environmental Protection Agency. August

USGS. 2006. National geochemical database—reformatted data from the National Uranium Resource Evaluation (NURE) Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) Program. OFR 97-492: Elmira Quadrangle NURE HSSR Study. Available from: http://pubs.usgs.gov/of/1997/ofr-97-0492/quad/q_elmira.htm. U.S. Geological Survey.

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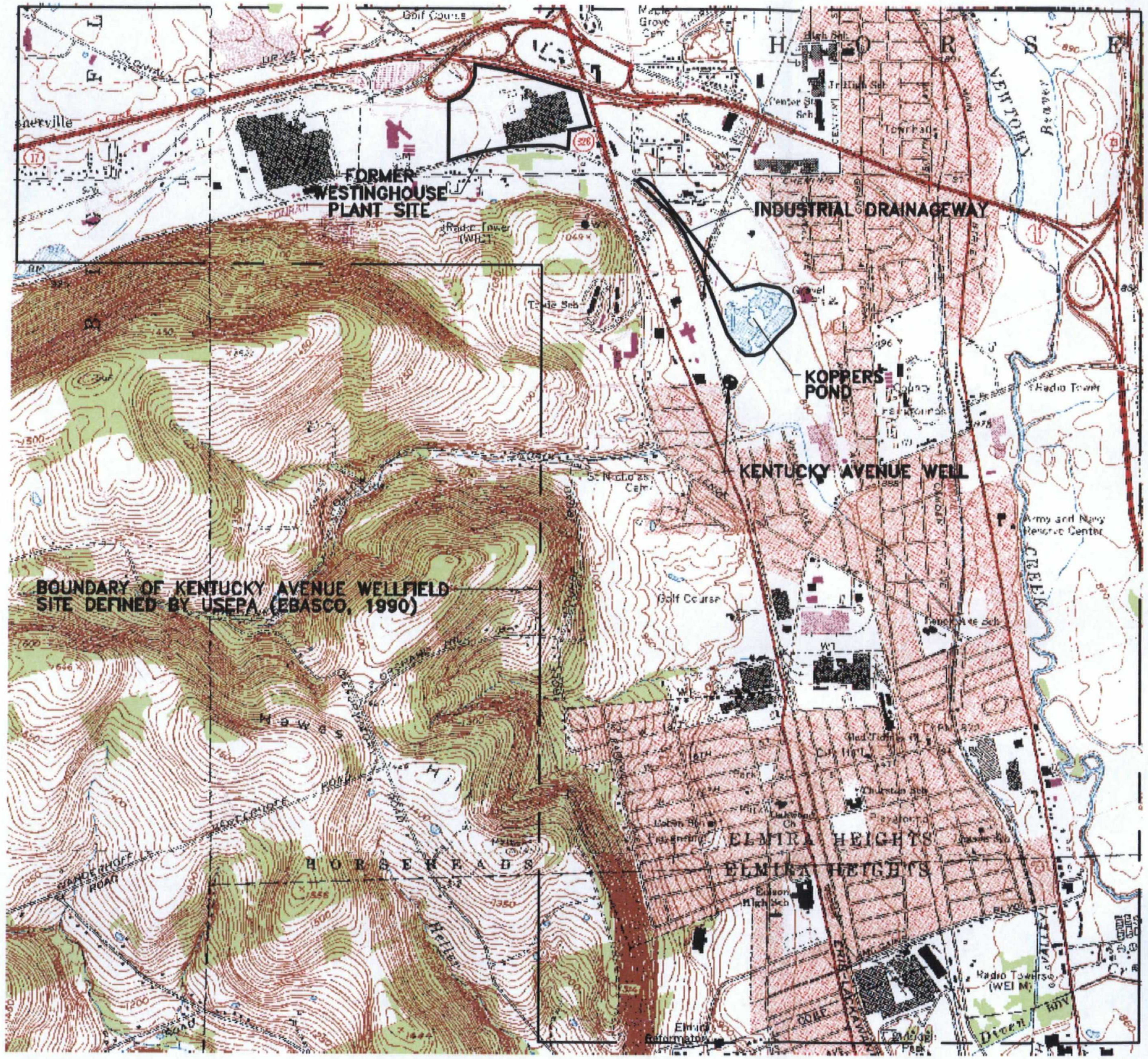

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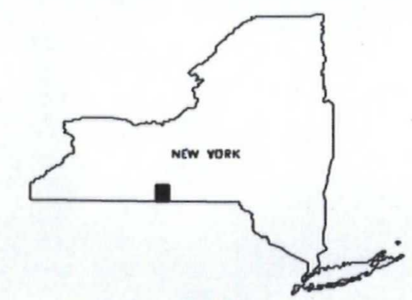

QUADRANGLE LOCATION

REFERENCE:

MODIFIED FROM U.S GEOLOGICAL SURVEY HORSEHEADS, NEW YORK, AND ELIMIRA, NEW YORK-PENNSYLVANIA, QUADRANGLES, PHOTOREVISED 1978.

Figure 1-1
Site Location and Topographic Map
Kentucky Avenue Wellfield OU4 – Koppers Pond, Horseheads, NY

PREPARED FOR

KOPPERS POND RI/FS GROUP

CUMMINGS RITER CONSULTANTS, INC.	DRAWING NUMBER 98245B48
DRAWN BY: T.E. McKee	DATE: 1-31-07
CHECKED BY:	DATE:
APPROVED BY:	DATE:

PLOT SCALE: 1=1

FIGURE 2
SITE PLAN
KENTUCKY AVE. WELLFIELD SITE - OU4
HORSEHEADS, NEW YORK

CUMMINGS RITER CONSULTANTS, INC.

Prepared For:
KOPPERS POND RI/FS GROUP

0 200 400 Feet

hheads-8.mxd

■ Pond Sample Location
⬠ Outlet Channel Sample Location
▲ Mud Flat Sample Location

Prepared For:
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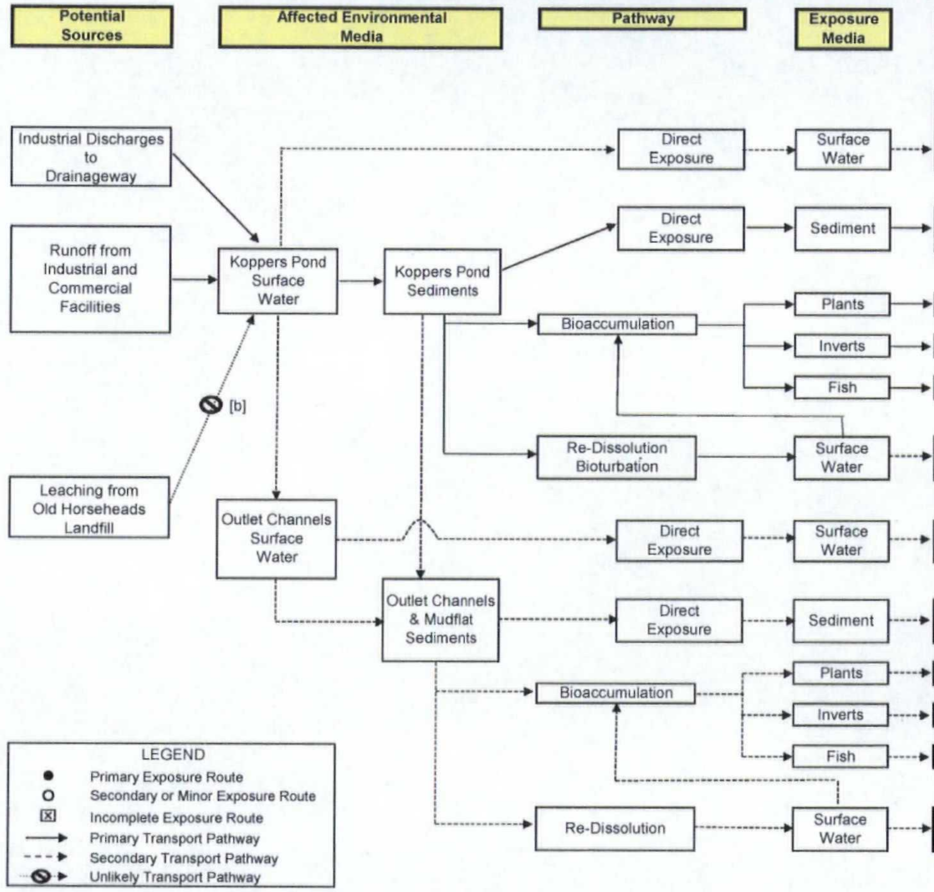
Figure 2-1. Sampling Locations from Koppers Pond and Outlets
Kentucky Avenue Wellfield Site - OU4
Horseheads, New York

Figure 2-2 Photograph of Sample Location SW08-15 Showing Material Used for Crossing Outlet Channel in this Area, Kentucky Avenue Wellfield Site - OU4, Horseheads, New York



Exposure Media	Exposure Route	Aquatic Receptors: Benthic Inverts	Aquatic Receptors: Amphibians and Reptiles	Aquatic Receptors: Fish	Semi-Aquatic Receptors [a]: Aquatic Birds	Semi-Aquatic Receptors [a]: Semi-Aquatic and Terr Birds	Semi-Aquatic Receptors [a]: Mammals
Surface Water	*Ingestion*	○	○	○	●	●	●
	Direct Contact	●	●	●	●	●	●
Sediment	*Ingestion*	●	●	●	●	●	●
	Direct Contact	●	●	○	○	○	○
Plants	*Ingestion*	●	●	●	●	●	●
Inverts	*Ingestion*	☒	●	●	●	●	●
Fish	*Ingestion*	☒	☒	○	●	●	●
Surface Water	*Ingestion*	○	○	○	●	●	●
	Direct Contact	○	●	●	○	○	○
Surface Water	*Ingestion*	●	●	☒	☒	●	●
	Direct Contact	●	●	☒	☒	○	○
Sediment	*Ingestion*	●	●	☒	☒	●	●
	Direct Contact	●	●	☒	☒	○	○
Plants	*Ingestion*	●	●	☒	☒	●	●
Inverts	*Ingestion*	☒	☒	☒	☒	●	●
Fish	*Ingestion*	☒	☒	☒	☒	☒	☒
Surface Water	*Ingestion*	○	○	☒	☒	●	●
	Direct Contact	○	○	☒	☒	○	○

Notes:
[a] Representative species for aquatic birds are mallard ducks (herbivores), semi-aquatic birds are herons (piscivores), mammals include muskrat (herbivores), raccoon (omnivores) and mink (piscivores).
[b] Based on observations made during the 2008 field sampling effort there was no apparent leachate seeps near the Old Horseheads Landfill. Therefore this exposure pathway is considered to be incomplete.
A dashed line indicates that this is likely a *de minimis* transport or exposure pathway under current conditions. Surface water may be minor direct exposure source based on measured chemical concentrations. Potential transport from Koppers Pond to the outlet channels was likely more significant in the past when the Industrial Drainageway was at peak use.
Modified from Figure 2-1 of the SLERA (AMEC, 2009a).

integral consulting inc.

Figure 3-1. Conceptual Site Model for Koppers Pond and Outlet Channels
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

Pond Sample Location

Outlet Channel Sample Location

Mud Flat Sample Location

Proposed Mudflat Sampling Locations (2010)

Prepared For:
KOPPERS POND RI/FS GROUP

CUMMINGS RITER CONSULTANTS, INC.

Figure 4-1. Proposed Mudflat Sampling Locations from Koppers Pond Outlets Kentucky Avenue Wellfield Site - OU4 Horseheads, New York

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Table 2-1. Compilation of Preliminary COPECs from the SLERA Screening, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Chemical Class	Preliminary SLERA (ERAGS Step 2) COPECs		
	Preliminary Sediment COPEC	Preliminary Surface Water COPEC	Preliminary Forage Fish COPEC
VOCs	Acetone	[None]	[None]
SVOCs	4-Methylphenol Acenaphthylene Benzo(a)anthracene Benzo(a)pyrene Benzo(ghi)perylene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Pyrene Total PAHs	Benzo(a)anthracene	NA
Aroclor PCBs	Total PCBs	[None]	Total PCBs
Pesticides	*gamma*-BHC (Lindane) *gamma*-Chlordane	[None]	[None]
Inorganics	Aluminum Antimony Arsenic Barium Cadmium Chromium Copper Cyanide, Total Iron Lead Mercury Nickel Selenium Silver Zinc	Magnesium	Aluminum Iron

Notes:
BHC = benzene hexachloride
COPEC = constituent of potential ecological concern
ERAGS = ecological risk assessment guidance for superfund
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SLERA = screening-level ecological risk assessment
SVOC = semi-volatile organic compound
VOC = volatile organic compound

The preliminary SLERA COPECs were identified based on comparison to conservative screening benchmark
Only those chemicals that were detected in at least one sample are shown in this table.

Table 3-1a. Compilation of SLERA COPEC Surface Water Ecological Screening Values and Refined Ecological Screening Values, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	SLERA Ecological Screening Value		Alternative Benchmarks: NY Class C Water Quality [Type A(C)] Standard	Alternative Benchmarks: NY Class C Water Quality [Type A(C)] Guidance Value	Alternative Benchmarks: ORNL Screening Benchmarks (Suter and Tsao 1996)	Alternative Benchmarks: EPA Region V Surface Water ESLs (USEPA 2003)	Alternative Benchmarks: EPA Region VI Surface Water Screening Benchmark (TCEQ 2006)	Refined Ecological Screening Value	Comment
Semivolatile Organics									
Benzo(a)anthracene	0.03	[a]	NA	0.03	0.65	0.025	34.6	34.6	Detected in only one filtered surface water from an outlet channel sample.
Total PAHs	17		NA	NA	NA	NA	NA	17	ESV for total PAHs from EPA Region IV
Inorganics									
Magnesium	3,230	[b]	NA	NA	82,000	NA	3,230	82,000	ORNL screening benchmark was the lowest chronic value reported for daphnids

Notes:
COPEC = constituent of potential ecological concern
EPA = U.S. Environmental Protection Agency
ESL = ecological screening level
ESV = ecological screening value
NA = not available
ORNL = Oak Ridge National Laboratory
PAH = polycyclic aromatic hydrocarbon
SLERA = screening-level ecological risk assessment

All concentration units are in µg/L.
Only those chemicals retained as SLERA COPECs are shown on this table.
NYSDEC Class C water quality criteria were from TOGS 1.1.1 (NYSDEC 2003), Type A(C)-fish propagation in freshwaters.

Additional surface water screening benchmarks were obtained from ORNL RAIS website (http://rais.ornl.gov/homepage/benchmark.shtml) and were updated following review of original source references: EPA Region IV (USEPA 2001), EPA Region V ESLs (USEPA 2003) and EPA Region VI (TCEQ 2006).
[a] ESL was the NYSDEC Class C surface water guidance value.
[b] ESL was the EPA Region 6 Surface Water Screening Benchmark (TCEQ, 2006)

Table 3-1b. Compilation of SLERA COPEC Sediment Ecological Screening Values and Refined Ecological Screening Values, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

			Alternative Benchmarks											
Parameter	SLERA Ecological Screening Value		NY Sediment Criteria (NYSDEC 1999) Chronic Tox	NY Sediment Criteria (NYSDEC 1999) Bioaccum	EPA Region III BTAG Sediment Screening Values (USEPA 2006)	EPA Region V Sediment ESLs (USEPA 2003)	EPA Region VI Sediment Screening Benchmark (TCEQ 2006)	Consensus TEC Sediment Screening Benchmark (MacDonald et al. 2000)	USGS Sediment Background Range; Mean (Rice 1999)	NURE Sediment Background-Elmira Quadrant Range; Mean (USGS 2006)	NOAA SQuiRT (Buchman 2008)		Refined Ecological Screening Value	Comment
Volatile Organics (µg/kg, unless noted)														
Acetone	9.9	[a]	NA	NA	NA	9.9	60,030	NA	NA	NA	NA		60,030	
Semivolatile Organics (µg/kg, unless noted)														
4-Methylphenol	20.2	[a]	NA	NA	670	20.2	NA	NA	NA	NA	5.1		20.2	NOAA value is the Dutch sediment environmental risk limit for soil or bed sediment.
Acenaphthene	140 µg/g OC 6.71	[a]	140 [a]	NA	6.7	6.71	6.7	NA	NA	NA	6.71		140 [a] 6.71	Alternate ESV (as µg/kg) if TOC>12%
Acenaphthylene	5.9	[a]	NA	NA	5.9	5.87	5.9	NA	NA	NA	57.2	TEC	5.9	NOAA value is the TEC
Benzo(a)anthrac	12 µg/g OC 108	[a]	12 [a]	NA	108	108	108	108	NA	NA	108		12 [a] 108	NYSDEC value has units of µg/g OC. Alternate ESV (as µg/kg) if TOC>12%
Benzo(a)pyrene	150	[a]	NA	NA	150	150	150	150	NA	NA	150		150	
Benzo(ghi)perylene	170	[a]	NA	NA	170	170	NA	NA	NA	NA	NA		170	
Benzo(k)fluoranthene	240	[a]	NA	NA	240	240	NA	NA	NA	NA	240	LEL	240	NOAA value is the LEL
Chrysene	166	[a]	NA	NA	166	166	166	166	NA	NA	166	TEC	166	NOAA value is the TEC
Dibenz(a,h)anthracene	33	[a]	NA	NA	33	33	33	33	NA	NA	33	TEC	33	
Indeno(1,2,3-cd)pyrene	200	[a]	NA	NA	17	200	NA	NA	NA	NA	200	LEL	200	
Pyrene	195	[a]	NA	NA	201	195	195	195	NA	NA	195	TEC	195	
Total PAHs	1,610	[b]	4,022	NA	1,610	NA	4,000	1,610	NA	NA	4,000	LEL	1,610	NYSDEC value has units of µg/kg and is equivalent to the ER-L.
Pesticides/PCBs (µg/kg, unless noted)														
gamma-BHC (Lindane)	2.37	[a]	NA	NA	2.37	2.37	2.37	2.37	NA	NA	2.37	TEC	2.37	
gamma-Chlorda	0.006 µg/g OC 3.24	[a]	0.03 µg/g OC	0.006 µg/g OC	3.24	3.24	3.24	3.24	NA	NA	NA		3.24	
Total PCBs	19.3 µg/g OC 59.8	[a]	19.3 µg/g OC	1.4 µg/g OC	NA	59.8	59.8	59.8	NA	NA	59.8	TEC	19.3 [a] 59.8	Alternate ESV (as µg/kg) if TOC>12%
Inorganics (mg/kg, unless noted)														
Aluminum	14,000	[c]	NA	NA	NA	NA	NA	NA	54,000-89,000; 65,100	14,000 - 91,200; 47,128	25,500	TEL	25,500	NOAA value was for the ARCS program
Antimony	2		2 [b]	NA	2	NA	2	NA	NA	NA	3	UET	11.2	Refined screening value was the EU PNEC for sediment
Arsenic	6		6 [b]	NA	9.8	9.79	9.79	9.79	1.8-22; 7.3	NA	9.79	TEC	9.79	
Barium	0.7		NA	NA	NA	NA	NA	NA	NA	61 - 761; 341	0.7	Bkgd	0.7	
Cadmium	0.6		0.6 [b]	NA	0.99	0.99	0.99	0.99	0.2-6.9; 0.93	NA	0.99	TEC	0.99	
Chromium	26		26 [b]	NA	43.4	43	43.4	43.4	26-160; 72.2	ND - 86; 35.2	43.4	TEC	43.4	
Copper	16		16 [b]	NA	31.6	31.6	31.6	31.6	6-410; 58.2	ND - 501; 15.9	31.6	TEC	31.6	
Cyanide, Total	0.001		NA	NA	0.1	0.001	NA	NA	NA		NA		0.1	
Iron	20,000		20,000 [b]	NA	20,000	NA	20,000	NA	32,000-73,000; 43,300	8,900 - 59,900; 26,666	20,000	LEL	20,000	
Lead	31		31 [b]	NA	35.8	35.8	35.8	35.8	19-450; 68.5	ND - 685; 8.7	35.8	TEC	35.8	
Mercury	0.15		0.15 [b]	NA	0.18	0.174	0.18	0.18	0.01-1.4; 0.22	NA	0.18	TEC	0.18	
Nickel	16		16 [b]	NA	22.7	22.7	22.7	22.7	9-72; 34	ND - 135; 20.0	22.7	TEC	34	
Selenium	0.2		NA	NA	2	NA	NA	NA	0.2-2.4; 0.84	ND - 5; 1.1	0.29	Bkgd	2	
Silver	1		1 [b]	NA	1	NA	1	NA	NA	ND - 10; 1.0	0.5	LEL	1	
Zinc	120		120 [b]	NA	121	121	121	121	110-980; 216.3	22 - 1,631; 73.3	121	TEC	120	

Notes:
bkgd = background
BTAG = biological technical assistance group
COPEC = constituent of potential ecological concern
EPA = U.S. Environmental Protection Agency
ER-L = effects range low
ESL = ecological screening level
ESV = ecological screening value
EU = European Union
LEL = low effect level
NA = not available
NOAA = National Oceanic and Atmospheric Administration
NYSDEC = New York State Department of Environmental Conservation
PCB = polychlorinated biphenyl
PNEC = probable no effects concentration
SLERA = screening-level ecological risk assessment
TEC = threshold effects concentration
UET = upper effects threshold
USGS = U.S. Geological Survey

Only those chemicals retained as SLERA COPECs are shown on this table.
USGS sediment background data (Rice, 1999) is for the Hudson River basin.
[a] ESL was the EPA Region V ESL (USEPA 2003)
[b] ESL was the Consensus TEC Sediment Screening Benchmark (MacDonald et al. 2000)

Table 3-1c. Compilation of SLERA COPEC Fish Ecological Screening Values and Refined Ecological Screening Values, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	SLERA Ecological Screening Value		Alternative Benchmakrs: NYSDEC Niagara River Benchmarks [a]	USACE ERED No Effect Levels [d]: Range	USACE ERED No Effect Levels [d]: Geomean	TOXRES Database (Jarvinen and Ankley 1999)	Dyer et al (2000)	Refined Ecological Screening Value	Comment
Aroclor PCBs									
Aroclor 1254	110	[a]	110	160 - 4,240,000	22,545	NA [c]	800	110	
Aroclor 1260	110	[a]	110	NA [d]	NA [d]	NA [c]	800	110	
Total PCBs	110	[a]	110	160 - 4,240,000	13,860	NA [c]	800	110	Range and geomean based on individual Aroclor results
Inorganics									
Aluminum	10.3	[b]	NA	1.15 - 12.5	3.8	1.15 - 8.53	33.0	8.53 - 12.5	Evaluated against range of ESVs; also compared to Dyer et al. (2000) value.
Iron	22	[b]	NA	9 - 54	22	NA	NA	9 - 54	Evaluated against range of ESVs.

Notes:
COPEC = constituent of potential ecological concern
ERED = environmental residue-effects database
ESV = ecological screening value
NA = not available
NYSDEC = New York State Department of Environmental Conservation
PCB = polychlorinated biphenyl
SLERA = screening-level ecological risk assessment
USACE = U.S. Army Corps of Engineers

PCB results have concentration units of µg/kg, while the inorganics have units of mg/kg.

Only those chemicals retained as SLERA COPECs are shown on this table. A re-evaluation of the PCB results was not peformed, but additional screening values are provided for completeness.

[a] ESV was the NYSDEC Niagara River screening benchmarks from Newell et al (1987).

[b] ESV was the USACE-ERED on-line database.

[c] TOXRES Database did not relate toxic endpoint to tissue levels for PCBs.

[d] No relevant whole body reproduction or growth endpoints were reported in the ERED database for this Aroclor PCB.

Table 3-1d. Compilation of Maximum Observed Chemical Concentrations by Media used in the Refined Screening
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

Media	Chemical	Maximum Detected Result	Units	Corresponding Sample	Location Code	Comment
Surface Water	**Semivolatile Organics**					
	Benzo(a)anthracene	0.051	µg/L	SW08-15	OC	
	Total PAHs	1.92	µg/L	SW08-15	OC	
	Inorganics					
	Magnesium	14,200	µg/L	SW08-14	OC	Unfiltered sample result
Sediment	**Volatile Organics**					
	Acetone	79	µg/kg	SD08-15	OC	
	Semivolatile Organics					
	4-Methylphenol	1,600	µg/kg	SD08-16	OC	
	Acenaphthene	230	µg/kg	SD08-3	KP	
				SD08-15	OC	
	Acenaphthylene	310	µg/kg	SD08-3	KP	
	Benzo(a)anthracene	2,200	µg/kg	SD08-15	OC	
	Benzo(a)pyrene	1,400	µg/kg	SD08-3	KP	
	Benzo(ghi)perylene	1,200	µg/kg	SD08-1	KP	
				SD08-3	KP	
	Benzo(k)fluoranthene	920	µg/kg	SD08-3	KP	
	Chrysene	3,400	µg/kg	SD08-15	OC	
	Dibenz(a,h)anthracene	370	µg/kg	SD08-1	KP	
	Indeno(1,2,3-cd)pyrene	1,100	µg/kg	SD08-3	KP	
	Pyrene	4,600	µg/kg	SD08-15	OC	
	Total PAHs	28,040	µg/kg	SD08-15	OC	
	Pesticides/PCBs					
	gamma-BHC (Lindane)	15	µg/kg	SD08-13	KP	
	gamma-Chlordane	1.5	µg/kg	SD08-14	OC	
	Total PCBs	2,700	µg/kg	SD08-13	KP	
	Inorganics					
	Aluminum	17,000	mg/kg	SD08-6	KP	
	Antimony	6	mg/kg	SD08-15	OC	
	Arsenic	7.2	mg/kg	SD08-14	OC	
	Barium	596	mg/kg	SD08-3	KP	

Table 3-1d. Compilation of Maximum Observed Chemical Concentrations by Media used in the Refined Screening
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

Media	Chemical	Maximum Detected Result	Units	Corresponding Sample	Location Code	Comment
	Cadmium	739	mg/kg	SD08-1	KP	
	Chromium	462	mg/kg	SD08-1	KP	
	Copper	820	mg/kg	SD08-1	KP	
Sediment	Cyanide, Total	2.1	mg/kg	SD08-2	KP	
(cont)	Iron	37,400	mg/kg	SD08-14	OC	
	Lead	1,620	mg/kg	SD08-2	KP	
	Mercury	1.4	mg/kg	SD08-2	KP	
	Nickel	180	mg/kg	SD08-1	KP	
	Selenium	2.5	mg/kg	SD08-1	KP	
	Silver	52.5	mg/kg	SD08-2	KP	
	Zinc	12,500	mg/kg	SD08-1	KP	
Fish	**Aroclor PCBs**					
	Total PCBs	2,060	µg/kg	CC08-01	KP	Carp
	Inorganics					
	Aluminum	12.8	mg/kg	FF08-06	KP	Pumpkinseed
	Iron	29.1	mg/kg	FF08-05	KP	Pumpkinseed

Notes:

Only those chemicals retained as SLERA COPECs are shown on this table.

Location Codes: KP = Koppers Pond; OC = Outlet Channels. None of the maximum positive results were observed in the mudflat samples.

Table 3-2. Compilation of Preliminary COPECs based on the SLERA Screening and ERAGS Step 3 Refined Screen COPECs, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

	Preliminary SLERA (ERAGS Step 2) COPECs			ERAGS Step 3 COPECs - Refined Screening		
Chemical Class	Preliminary Sediment COPEC	Preliminary Surface Water COPEC	Preliminary Forage Fish COPEC	Sediment COPEC	Surface Water COPEC	Forage Fish COPEC
VOCs	Acetone	[None]	[None]	[None]	[None]	[None]
SVOCs	4-Methylphenol	Benzo(a)anthracene	NA	4-Methylphenol	[None]	NA
	Acenaphthylene			Acenaphthylene		
	Benzo(a)anthracene			Benzo(a)anthracene		
	Benzo(a)pyrene			Benzo(a)pyrene		
	Benzo(ghi)perylene			Benzo(ghi)perylene		
	Benzo(k)fluoranthene			Benzo(k)fluoranthene		
	Chrysene			Chrysene		
	Dibenz(a,h)anthracene			Dibenz(a,h)anthracene		
	Indeno(1,2,3-cd)pyrene			Indeno(1,2,3-cd)pyrene		
	Pyrene			Pyrene		
	Total PAHs			Total PAHs		
Aroclor PCBs	Total PCBs	[None]	Total PCBs	Total PCBs	[None]	Total PCBs
Pesticides	*gamma*-BHC (Lindane)	[None]	[None]	[None]	[None]	[None]
	gamma-Chlordane					
Inorganics	Aluminum	Magnesium	Aluminum	Barium	[None]	[None]
	Antimony		Iron	Cadmium		
	Arsenic			Chromium		
	Barium			Copper		
	Cadmium			Cyanide, Total		
	Chromium			Iron		
	Copper			Lead		
	Cyanide, Total			Mercury		
	Iron			Nickel		
	Lead			Selenium		
	Mercury			Silver		
	Nickel			Zinc		
	Selenium					
	Silver					
	Zinc					

Table 3-3. Compilation of Receptors from Prior Assessments and Proposed Supplemental BERA Receptors, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Receptor Group	CDM (1999)	CEC (2003)	ERAGS Step 3 Receptors (2010)
Benthic Organisms	Benthic toxicity Benthic assemblages	NE	Benthic toxicity [1]
Amphibians and Reptiles	[2]	NE	Green frog Painted turtle
Herbivorous Avian Species	NE	NE	Mallard duck
Piscivorous Avian Species	Great blue heron	Great blue heron	Great blue heron
Semi-Aquatic Mammalian Species	Mink Raccoon [3]	Mink	Mink Muskrat Raccoon [4]
Fish	NE	NE	Forage Fish

Notes: BERA = baseline ecological risk assessment
ERAGS = ecological risk assessment guidance for superfund
NE = not evaluated

CEC (2003) was not a comprehensive ERA since it focused exclusively on upper trophic level piscivores.
Alternate species may be considered as part of the ERA uncertainty assessment.
[1] Results from the benthic evaluation from CDM (1999) will be also be incorporated into the current ERA.
[2] In CDM (1999), amphibians and reptiles were mentioned as potential receptors but were not quantitatively evaluated.
[3] In CDM (1999), raccoons were evaluated as 100% piscivores.
[4] For the current ERA, the raccoon will be evaluated as an omnivore which can also prey on fish.

Table 3-4a. Preliminary Exposure Assumptions for the Herbivorous Avian Species - Mallard Duck
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	Descriptor or Value	Equation	Reference or Comment
Receptor Group	Herbivorous Bird		
Receptor Name	Mallard		
Latin Name	*Anas platyrhynchos*		
Class	Aves		
Order	Anseriiformes		
Family	Anatidae		
Food Ingestion Rate (FIR)	17.78 g/d (dry weight)	$FIR = 0.301*(BW)^{0.751}$ FIR = [0.301*(1134^0.751] * 0.3	Calculated using equation for non-Passerine birds from Nagy (1987) based on body weight in grams and FIR as fresh weight. Latter is converted to dry weight by multiplying by 0.3.
Diet - Breeding females, avg. of 3 mos.	Plant (25%), Invertebrate (75%)		3-Month average diet of breeding females (USEPA 1993)
Sediment Ingestion Rate	0.36 g/d	SIR = 0.02*FIR SIR = 0.02*17.78	Incidental ingestion based on 2% ratio to dry weight ingestion rate (Beyer et al. 1994 as cited by USEPA 1993)
Surface Water Ingestion Rate (SWIR)	0.064 L/day	$SWIR = 0.059 * (BW)^{0.67}$ SWIR = 0.059 * (1.134)^0.67	Calculated using allometric equation provided in EPA (1993) for "all birds" using body weight (in kg).
Body Weight	1.134 kg		Average of males and females, EPA (1993)
Prefered Habitat	Mallards inhabit natural bottomland wetlands and rivers; water depths of 20 to 40 cm are optimum for foraging. They nest is dense grassy vegetation and other areas that provide concealment from predators (e.g., seeded cover, cool-season introduced legumes and grasses), and idle grassland with tall, dense, rank cover in the area.		EPA (1993)
Home Range (Avg: F,M - spring)	580 hectares (1432 acres)		EPA (1993)
Area Use Factor			
Koppers Pond	0.006	AUF = 8.9/1432	Based on 8.9 acres for pond
Outlet Channels	0	AUF = 0/1432	Insufficient standing water in this area
Reference Pond	TBD		Calculated when reference is identified
Seasonal Use Factor	0.75		Migrant in NY. Assumed present from March through November.

Notes: Avg = average
F = female
M = male
TBD = to be determined

Table 3-4b. Exposure Assumptions for the Piscivorous Avian Species - Great Blue Heron
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	Descriptor or Value	Equation	Reference or Comment
Receptor Group	Piscivorous Bird		
Receptor Name	Great Blue Heron		
Latin Name	*Ardea herodias*		
Class	Aves		
Order	Ciconiiformes		
Family	Ardeidae		
Food Ingestion Rate (FIR)	0.123 kg/d (dry weight)	$FIR = [10^{(0.966 * LOG(BW) - 0.64)}] * 0.3$ FIR = [10^(0.966* LOG(2336) - 0.64)] * 0.3	Calculated using equation from EPA (1993) reported for wading birds by Kushlan (1978) and the average body weight. The Kushlan equation was based on fresh weight, and this was converted to a dry weight basis by multiplying by 0.3. This was converted to kg/day by dividing by 1000.
Diet	Fish (99%), Invertebrates (1%)		EPA (1993)
Sediment Ingestion Rate	5.8E-03 kg/d	SIR = 0.02*FIR SIR = 0.02*0.123	Incidental ingestion based on 2% ratio to dry weight ingestion rate (Beyer et al. 1994)
Surface Water Ingestion Rate (SWIR)	0.105 L/day	SWIR = (0.045 g/g-d)*(2336 g)*(0.001 L/g)	Calculated by converting SWIR reported in EPA (1993) from a g/g-day to L/day basis using body weight and water density converstion factor of 0.001 L/g.
Body Weight	2.336 kg		EPA (1993). Average of three values reported for adults.
Prefered Habitat	Fresh- or Saltwater habitats including ponds, lakes, streams, rivers, marshes, wet meadows, tidal flats, sandbars, and shallow bays, especially where shallow water or marsh vegetation is present		DeGraaf et al. 1991
Home Range	4.5 hectares (11.1 acres)		EPA (1993)
Area Use Factor			
Koppers Pond	0.802	AUF = 8.9/11.1	Based on 8.9 acres for pond.
Outlet Channels	0	AUF = 0/11.1	Insufficient standing water in this area to support prey fish.
Reference Pond	TBD		Calculated when reference is identified

Notes: TBD = to be determined

Table 3-4c. Exposure Assumptions for the Herbivorous Mammalian Species - Muskrat
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	Descriptor or Value	Equation	Reference or Comment
Receptor Group	Omnivorous Mammal		
Receptor Name	Muskrat		
Latin Name	*Ondatra zibethicus*		
Class	Mammalia		
Order	Rodentia		
Family	Cricetidae		
Food Ingestion Rate (FIR)	0.102 kg/day (dry weight)	$FIR = 0.614*BW^{0.705}$ FIR = [614*(1415)^0.705]/1000	Calculated from allometric equations provided in Table 2 of Nagy (2001) for mesic rodents. Equation based on body weight in grams, and is on a dry weight basis.
Diet	Aquatic Vegetation (95%); Invertebrates (5%)		EPA (1993). Invertebrates (mollusks and crayfish) and fish make up remainder of diet.
Sediment Ingestion Rate	9.2 g/d (dry weight)	SIR = 0.094*FIR SIR = 0.094*102	Incidental ingestion based on 9.4% ratio to dry weight ingestion rate, as presented for racoon and opposum (Beyer et al. 1994). Converted to g/d from FIR (kg/day).
Surface Water Ingestion Rate (SWIR)	1.38 L/day	SWIR = (0.975 g/g-d)*(1415 g)*(0.001 L/g)	Calculated by converting average SWIR reported in EPA (1993) from a g/g-day to L/day basis using body weight and water density converstion factor of 0.001 L/g.
Body Weight	1.415 kg		Average of male and female body weights (USEPA 1993)
Prefered Habitat	Saltwater and brackish marshes and freshwater creeks, streams, lakes, marshes, and ponds. Muskrats generally excavate dens in the banks of waterways or construct lodges in ponds when plant material is available.		EPA (1993)
Home Range (Summer)	0.17 hectares (0.42 acres)		EPA (1993)
Area Use Factor			
Koppers Pond	1.0	AUF = 8.9/0.42 (see comment)	Based on 8.9 acres for pond. Since calculated value was greater than one, was set to one.
Outlet Channels	0		Insufficient standing water in this area
Reference Pond	TBD		Calculated when reference is identified
Seasonal Use Factor	1		Assumed year-round resident.

Notes: TBD = to be determined

Table 3-4d. Exposure Assumptions for the Piscivorous Mammal - Mink
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	Descriptor or Value	Equation	Reference or Comment
Receptor Group	Piscivorous Mammal		
Receptor Name	Mink		
Latin Name	*Mustela vison*		
Class	Mammalia		
Order	Carnivora		
Family	Mustelidae		
Food Ingestion Rate (FIR)	69.83 g/d (dry weight)	$FIR = 0.0687*BW^{0.822}$ FIR = 0.0687*(5.597)^0.822	Calculated using equation from Nagy (1987) and EPA (1993).
Diet	Fish (78.5%), Aquatic Plants (11.5%), and Aquatic Invertebrates (10%)		EPA (1993). A small proportion of the mink diet (5.5%) includes small mammals but these were added to the fish porportions for conservatism.
Sediment Ingestion Rate	0.0014 kg/d	SIR = 0.094*FIR SIR = 0.094*0.29	Incidental ingestion based on 2% ratio to dry weight ingestion rate (Beyer et al. 1994)
Surface Water Ingestion Rate (SWIR)	0.081 L/day	SWIR = SWIR = (0.0825*5600)/1000	Calculated using allometric equation (USEPA 1993)
Body Weight	1.02 kg		EPA (1993)
Prefered Habitat	Riparian and forested wetlands with standing water		
Home Range	239 - 380 ha (590 - 940 acres)		EPA (1993)
Area Use Factor			
Koppers Pond	0.012	AUF = 8.9/765	Based on 8.9 acres for pond, and average of home range (765 acres).
Outlet Channels	0	AUF = 0/765	Insufficient standing water in this area
Reference Pond	TBD		Calculated when reference is identified
Seasonal Use Factor	1		Assumed year-round resident.

Notes: TBD = to be determined

Table 3-4e. Exposure Assumptions for the Omnivorous Mammal - Raccoon
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Parameter	Descriptor or Value	Equation	Reference or Comment
Receptor Group	Omnivorous Mammal		
Receptor Name	Raccoon		
Latin Name	*Procyon lotor*		
Class	Mammalia		
Order	Carnivora		
Family	Procyonidae		
Food Ingestion Rate (FIR)	0.29 kg/day	$FIR = 0.0687*BW^{0.822}$ FIR = 0.0687*(5.597)^0.822	Calculated using equation from Nagy (1987) and EPA (1993).
Diet	50% invertebrates 50% plants/seeds/fruit		EPA (1993)
Soil Ingestion Rate (SIR)	0.027 kg/d	SIR = 0.094*FIR SIR = 0.094*0.29	Incidental ingestion based on 9.4% ratio to dry weight ingestion rate (Beyer et al. 1994)
Surface Water Ingestion Rate (SWIR)	0.462 L/day	SWIR = (0.0825 g/g-d)*(5600 g)*(0.001 L/g)	Calculated by converting average SWIR reported in EPA (1993) from a g/g-day to L/day basis using body weight and water density converstion factor of 0.001 L/g.
Body Weight	5.6 kg		Average value for adults from EPA (1993)
Prefered Habitat	Common near aquatic habitats, farmlands and residential areas		EPA (1993)
Home Range	156 hectares (385 acres)		Average value for Michigan riparian areas from EPA (1993)
Area Use Factor			
Koppers Pond	0.023	AUF = 8.9/385	Based on 8.9 acres for pond.
Outlet Channels	0	AUF = 0/385	Insufficient standing water in this area
Reference Pond	TBD		Calculated when reference pond is identified
Seasonal Use Factor	1.00		Assumed year-round resident.

Notes: TBD = to be determined

Table 4-1. Data Quality Objectives for Field Investigations to Support the Ecological Risk Assessment, Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY.

Activity	Location	Collection Period	Analytical Parameters	DQOs
Collection of sediment	Koppers Pond Outlet Channels	May 2008	VOCs SVOCs PCBs TAL Metals TOC	RI/FS Work Plan, App C
Collection of surface water	Koppers Pond Outlet Channels	May 2008	VOCs SVOCs PCBs TAL Metals DOC General Parameters (e.g., alkalinity)	RI/FS Work Plan, App C
Collection of forage fish and game fish	Koppers Pond Outlet Channels	May 2008	SVOCs PCBs TAL Metals Lipids	RI/FS Work Plan, App C
A limited field survey for slender pondweed	Koppers Pond Outlet Channels	Sept 2009	NA	None required
Reference pond selection and initial reconnaisance	Reference Pond	Sept 2009	NA	None required
Supplemental biota samples (plants, crayfish)	Koppers Pond	Sept 2010 (est)	SVOCs PCBs TAL Metals Lipids	Same DQOs as RI/FS Work Plan, App C
Supplemental soil/sediment	Mudflat Areas [1]	Sept 2010 (est)	SVOCs PCBs TAL Metals TOC	Same DQOs as RI/FS Work Plan, App C
Sediment sampling for longer-term toxicity testing	Koppers Pond	Sept 2010 (est)	Toxicity Testing (Methods 100.4 and 100.5 from EPA 2000b)	See Appendix D for DQO summary
Collection of sediment from the reference pond for toxicity testing and chemical analyses	Reference Pond	Sept 2010 (est)	Toxicity Testing (Methods 100.4 and 100.5 from EPA 2000b) SVOCs PCBs TAL Metals TOC (sediments only)	See Appendix D for DQO summary of toxicity tests. Chemical analyses have the same DQOs as RI/FS Work Plan, App C
Collection of biota (game and forage fish, cray fish, and plants) from the reference pond	Reference Pond	Sept 2010 (est)	PCBs Lipids (biota only)	Same DQOs as RI/FS Work Plan, App C

Notes:
DOC = dissolved organic carbon
DQO = data quality objective
NA = not applicable
PCB = polychlorinated biphenyl
RI/FS = remedial investigation/feasibility study
SVOC = semi-volatile organic compound
TAL = target analyte list
TOC = total organic carbon
VOC = volatile organic compound

This summary includes all of the field work that was performed to support the ERA.

Three candidate reference ponds were identified during the Sept 2009 field reconnaissance. Based on the evaluated metrics (see text for discussion) it is recommended that one of the ponds from the "Center at Horseheads" be used as the reference pond.

[1] Primary mudflat areas are located between the outlet channels and a small area on the western side of the west wing of Koppers Pond.

Table 4-2. Comparison of Individual Mudflat Sediment Sample Results to the Refined ESVs
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

Parameter	Concentration Units	Refined ESV	SD08-30	SD08-40	Mean	Comment
Semivolatile Organics						
4-Methylphenol	µg/kg	20.2	330 U	**53 J**	**53**	Max used
Acenaphthylene	µg/kg	5.9	88	65 U	60.25	
Benzo(a)anthracene	µg/kg	1,050	89	84	86.5	
Benzo(a)pyrene	µg/kg	150	110	100	105	
Benzo(ghi)perylene	µg/kg	170	69	61 J	65	
Benzo(k)fluoranthene	µg/kg	240	60 J	21 J	40.5	
Chrysene	µg/kg	166	150	110	130	
Dibenz(a,h)anthracene	µg/kg	33	66 U	65 U	0	Not detected
Indeno(1,2,3-cd)pyrene	µg/kg	200	77	61 J	69	
Pyrene	µg/kg	195	160	98	129	
Total PAHs	µg/kg	1,610	1,484	1,079	1,282	
PCBs						
Total PCBs	µg/kg	59.8	16 U	43	25.5	
Inorganics						
Antimony	mg/kg	11.2	0.95 J	0.96	0.955	
Barium	mg/kg	0.7	229	187	208	
Cadmium	mg/kg	0.99	**1.3**	**2**	**1.65**	
Chromium	mg/kg	43.4	21.4 J	17.5 J	19.45	
Copper	mg/kg	31.6	21.2	**36.2 J**	28.7	
Cyanide, Total	mg/kg	0.1	0.48 UJ	0.38 UJ	0	Not detected
Iron	mg/kg	20,000	17,500	17,800	17,650	
Lead	mg/kg	35.8	**49.3 J**	**79.3 J**	**64.3**	
Mercury	mg/kg	0.18	0.072	**0.33 J**	**0.201**	
Nickel	mg/kg	34	21.4	16.3	18.85	
Selenium	mg/kg	2	0.79	0.74	0.765	
Silver	mg/kg	1	0.53	0.34	0.435	
Zinc	mg/kg	120	94.5 J	101 J	97.75	

Notes:
ESV = ecological screening value
J = estimated value
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated binphenyl
U = not detected
UJ = not detected at estimated value shown

Only those chemicals that were retained as refined COPECs are shown on this table.

Mean calculated by setting non-detects to one-half the reported detection limit. If this value exceeded the maximum observed value, then the latter was used for comparison to the refined ESV.

SD08-30 was located between the west and east outlet channels.

SD08-40 was located on western side of the west wing of Koppers Pond.

Values in bold and light blue highlight exceed the refined ESV.

APPENDIX A
CHEMICAL DATA SUMMARIES

Preface

This appendix contains the chemical data summaries for samples collected in May 2008 from Koppers Pond and the Outlet Channels. These tables are similar to tables provided in the SLERA, but for the current report the sediment samples collected from the Pond, outlet channels, and mudflats have been segregated.

List of Appendix Tables

Table A-3a. Summary of Pesticide and PCB Analytical Results for Forage Fish Collected from Koppers Pond in May 2008, Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

Table A-3b. Summary of Inorganic Analytical Results for Forage Fish Collected from Koppers Pond in May 2008, Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

Table A-1a. Summary of VOC and SVOC Analytical Results for Surface Water Samples from Koppers Pond and Outlet Channels
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Volatile Organics								
Chloroform	1/6	MNR	0.083 - 0.083	1 - 1	1/4	MNR	0.069 - 0.069	1 - 1
Tetrachloroethene	0/6	ND	-	1 - 1	1/4	MNR	0.22 - 0.22	1 - 1
Toluene	1/6	MNR	0.28 - 0.28	1 - 1	1/4	MNR	0.21 - 0.21	1 - 1
1,1,1-Trichloroethane	1/6	MNR	0.36 - 0.36	1 - 1	1/4	MNR	0.29 - 0.29	1 - 1
Semivolatile Organics								
Acenaphthene	0/6	ND	-	0.19 - 0.19	1/4	0.11	0.16 - 0.16	0.19 - 0.19
Benzaldehyde	1/6	0.407	0.057 - 0.057	0.94 - 0.97	1/4	0.39	0.13 - 0.13	0.95 - 0.95
Benzo(a)anthracene	0/6	ND	-	0.19 - 0.19	1/4	0.084	0.051 - 0.051	0.19 - 0.19
Benzo(b)fluoranthene	1/6	0.121	0.25 - 0.25	0.19 - 0.19	1/4	0.139	0.27 - 0.27	0.19 - 0.19
Chrysene	1/6	0.088	0.05 - 0.05	0.19 - 0.19	1/4	0.0865	0.061 - 0.061	0.19 - 0.19
Dibenzofuran	5/6	0.221	0.17 - 0.17	0.95 - 0.95	4/4	0.165	0.16 - 0.17	-
Di-n-butyl phthalate	6/6	0.373	0.32 - 0.43	-	3/4	0.51	0.37 - 0.61	0.95 - 0.95
Fluoranthene	3/6	0.281	0.44 - 0.51	0.19 - 0.19	3/4	0.37	0.43 - 0.51	0.19 - 0.19
Fluorene	0/6	ND	-	0.19 - 0.19	1/4	0.19	0.47 - 0.47	0.19 - 0.19
Phenanthrene	5/6	0.186	0.17 - 0.26	0.19 - 0.19	4/4	0.195	0.17 - 0.23	-
Phenol	1/6	0.096	0.1 - 0.1	0.19 - 0.19	0/4	ND	-	0.19 - 0.19
Pyrene	1/6	0.090	0.067 - 0.067	0.19 - 0.19	1/4	0.0885	0.069 - 0.069	0.19 - 0.19
Total PAHs	6/6	0.60	0.17 - 1.24	---	4/4	0.96	0.37 - 1.92	---
Corresponding Samples	SW08-02, SW08-04, SW08-05, SW08-08, SW08-10, and SW08-13				SW08-14, SW08-15, SW08-16, and SW08-17			

Notes:
MNR = mean not reported because the calculated value exceeds the maximum positive result
ND = not detected
PAH = polycyclic aromatic hydrocarbon
SVOC = semi-volatile organic compound
VOC = volatile organic compound
--- = not required

Concentration units are μg/L.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.
See Tables 5 and 6 of the Site Characterization Study Report for the individual surface water results for VOCs and SVOCs, respectively.
Total PAHs calculated as sum of detected PAH results.

Table A-1b. Summary of Inorganic Analytical Results for Unfiltered Surface Water Samples from Koppers Pond and Outlet Channels
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Aluminum	6/6	300	178 - 446	---	4/4	255	126 - 417	---
Antimony	6/6	0.48	0.23 - 0.72	---	4/4	0.38	0.27 - 0.49	---
Arsenic	4/6	0.33	0.17 - 0.33	1 - 1	2/4	0.5	0.21 - 0.79	1 - 1
Barium	6/6	116	104 - 123	---	4/4	124	118 - 129	---
Cadmium	6/6	2.99	0.59 - 7.1	---	3/4	1.02	0.52 - 2.1	1 - 1
Calcium	6/6	62,967	54,600 - 68,600	---	4/4	67,050	63,500 - 70,500	---
Chromium	6/6	6.6	4.9 - 9.3	---	4/4	5.4	3.8 - 6.7	---
Cobalt	6/6	0.315	0.25 - 0.38	---	4/4	0.325	0.24 - 0.41	---
Copper	6/6	5.9	3 - 9.9	---	4/4	4.5	2 - 6.6	---
Iron	6/6	398	260 - 550	---	4/4	402	267 - 559	---
Lead	6/6	14.1	9.1 - 25.7	---	4/4	11.6	6.2 - 16.9	---
Magnesium	6/6	12,817	10,700 - 13,700	---	4/4	13,700	13,000 - 14,200	---
Manganese	6/6	8.95	8.3 - 10	---	4/4	17.7	11.7 - 28.5	---
Nickel	6/6	2.32	1.9 - 2.8	---	4/4	2.23	1.5 - 2.8	---
Potassium	6/6	1,031	893 - 1,110	---	4/4	1,198	1,060 - 1,400	---
Selenium	2/6	MNR	0.28 - 0.44	5 - 5	1/4	MNR	0.34 - 0.34	5 - 5
Silver	5/6	0.37	0.087 - 0.72	1 - 1	1/4	MNR	0.22 - 0.22	1 - 1
Sodium	6/6	86,200	68,300 - 93,900	---	4/4	92,900	87,900 - 95,600	---
Vanadium	6/6	0.77	0.43 - 1.2	---	3/4	0.61	0.5 - 0.75	1 - 1
Zinc	6/6	56.3	13.8 - 119	---	4/4	28.7	13.6 - 49.2	---
Corresponding Samples	SW08-02, SW08-04, SW08-05, SW08-08, SW08-10, and SW08-13				SW08-14, SW08-15, SW08-16, and SW08-17			

Notes: MNR = mean not reported because the calculated value exceeds the maximum positive result
--- = values not presented because they were not relevant to the summary

Concentration units are µg/L.
See Table 8 of the Site Characterization Study Report for the individual surface water results for inorganics.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

Table A-1c. Summary of Inorganic Analytical Results for Filtered Surface Water Samples from Koppers Pond and Outlet Channels
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Aluminum	6/6	21.5	19.3 - 24.1	---	4/4	17.8	16.5 - 19.1	---
Antimony	6/6	0.7	0.36 - 0.99	---	4/4	0.59	0.41 - 0.75	---
Arsenic	0/6	ND	0.28 - 0.29	1 - 1	2/4	0.39	0.28 - 0.29	1 - 1
Barium	6/6	120.3	118 - 124	---	4/4	118.3	116 - 120	---
Beryllium	0/6	ND	---	1 - 1	0/4	ND	---	1 - 1
Cadmium	0/6	ND	---	1 - 1	0/4	ND	---	1 - 1
Calcium	6/6	68,883	65,400 - 72,600	---	4/4	67,825	65,400 - 70,500	---
Chromium	6/6	3.0	2.7 - 3.4	---	4/4	3.2	3.1 - 3.4	---
Cobalt	6/6	0.2	0.16 - 0.19	---	4/4	0.20	0.19 - 0.21	---
Copper	6/6	0.9	0.57 - 1.3	---	4/4	0.75	0.66 - 0.87	---
Iron	0/6	ND	---	50 - 50	0/4	ND	---	50 - 54
Lead	6/6	2.4	1.4 - 3.2	---	4/4	1.95	1.7 - 2.1	---
Magnesium	6/6	14,050	13,800 - 14,400	---	4/4	13,950	13,400 - 14,200	---
Manganese	6/6	3.1	1.2 - 5.6	---	4/4	4.75	3.7 - 5.7	---
Mercury	0/6	ND	---	0.2 - 0.2	0/4	ND	---	0.2 - 0.2
Nickel	6/6	1.1	0.84 - 1.3	---	4/4	1.33	1.2 - 1.5	---
Potassium	6/6	1,082	1,050 - 1,120	---	4/4	1,095	1,050 - 1,140	---
Selenium	2/6	1.8	0.21 - 0.38	5 - 5	3/4	0.83	0.26 - 0.31	5 - 5
Silver	0/6	ND	---	1 - 1	0/4	ND	---	1 - 1
Sodium	6/6	98,767	97,300 - 101,000	---	4/4	96,550	93,100 - 100,000	---
Thallium	3/6	0.3	0.027 - 0.085	1 - 1	0/4	ND	---	1 - 1
Vanadium	0/6	ND	---	1 - 1	0/4	ND	---	1 - 1
Zinc	6/6	3.0	2.6 - 3.5	---	4/4	3.85	2.7 - 5.2	---
Corresponding Samples	SW08-02, SW08-04, SW08-05, SW08-08, SW08-10, and SW08-13				SW08-14, SW08-15, SW08-16, and SW08-17			

Notes: MNR = mean not reported because the calculated value exceeds the maximum positive result
ND = not detected
--- = values not presented because they were not relevant to the summary

Concentration units are µg/L.
See Table 8 of the Site Characterization Study Report for the individual surface water results for inorganics.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

Table A-1d. Summary of General Chemistry Analytical Results for Unfiltered Surface Water Samples from Koppers Pond and Outlet Channels
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Ammonia Nitrogen	6/6	0.064	0.036 - 0.13	---	4/4	0.098	0.081 - 0.13	---
Hardness, as $CaCO_3$	6/6	251	238 - 262	---	4/4	247	234 - 254	---
Nitrite	1/6	0.032	0.066 - 0.066	0.05 - 0.05	3/4	0.062	0.067 - 0.087	0.05 - 0.05
Non-Distilled Fluoride	6/6	0.46	0.39 - 0.5	---	4/4	0.48	0.44 - 0.5	---
Total Suspended Solids	6/6	17.2	12 - 29	---	4/4	23.8	12 - 45	---
Corresponding Samples	SW08-02, SW08-04, SW08-05, SW08-08, SW08-10, SW08-13				SW08-14, SW08-15, SW08-16, and SW08-17			

Notes: --- = values not presented because they were not relevant to the summary

Concentration units are mg/L.

See Table 9 of the Site Characterization Study Report for the individual surface water results for general chemical parameters.

Mean values calculated by setting non-detect results to one-half the reported detection limit.

Table A-2a. Summary of VOC and SVOC Analytical Results for Surface Sediments (0-6") from Koppers Pond, Outlet Channels, and Mudflats
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels				Mud Flat			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Volatile Organics												
2-Butanone	1/14	8.3	14 - 14	8.4 - 20	0/4	ND	-	10 - 30	0/2	ND	6.6 - 6.9	10 - 30
Acetone	3/14	36.1	31 - 73	41 - 80	3/4	41	11 - 79	52 - 52	0/2	ND	26 - 28	52 - 52
Methyl acetate	3/14	8.1	5.6 - 8.9	10 - 20	1/4	10.6	23 - 23	10 - 16	0/2	ND	6.6 - 6.9	10 - 16
Toluene	0/14	ND	-	8.4 - 20	1/4	46.6	160 - 160	10 - 30	0/2	ND	6.6 - 6.9	10 - 30
Semivolatile Organics												
2-Methylnaphthalene	2/14	MNR	14 - 24	54 - 270	3/4	26.9	19 - 48	35 - 35	1/2	MNR	24 - 24	66 - 66
4-Methylphenol	3/14	351	15 - 19	270 - 1300	4/4	438	35 - 1600	-	1/2	MNR	53 - 53	330 - 330
Acenaphthene	4/14	90.5	14 - 230	31 - 270	3/4	72.6	19 - 230	35 - 35	0/2	ND	-	65 - 66
Acenaphthylene	5/14	97.5	51 - 310	31 - 270	3/4	65.4	24 - 190	35 - 35	1/2	60.3	88 - 88	65 - 65
Acetophenone	0/14	ND	-	150 - 1300	2/4	125	58 - 66	260 - 490	0/2	ND	-	320 - 330
Anthracene	12/14	211.1	12 - 510	110 - 140	4/4	151	10 - 490	-	1/2	64.8	97 - 97	65 - 65
Benzaldehyde	4/14	MNR	28 - 48	310 - 1300	4/4	87.8	52 - 170	-	0/2	ND	-	320 - 330
Benzo(a)anthracene	14/14	393	37 - 1200	-	4/4	667	46 - 2200	-	2/2	86.5	84 - 89	-
Benzo(a)pyrene	14/14	544	160 - 1400	-	4/4	387	48 - 940	-	2/2	105	100 - 110	-
Benzo(b)fluoranthene	14/14	751	72 - 2000	-	4/4	912	89 - 2600	-	2/2	185	160 - 210	-
Benzo(ghi)perylene	14/14	439	34 - 1200	-	4/4	344	55 - 580	-	2/2	65	61 - 69	-
Benzo(k)fluoranthene	8/14	259	45 - 920	31 - 140	0/4	ND	-	35 - 100	2/2	40.5	21 - 60	-
bis(2-Ethylhexyl) phthalate	11/14	484	20 - 1400	520 - 890	4/4	186	53 - 260	-	0/2	ND	-	320 - 330
Butyl benzyl phthalate	4/14	291	42 - 130	150 - 1300	3/4	69.8	36 - 75	260 - 260	0/2	ND	-	320 - 330
Caprolactam	4/14	MNR	55 - 120	310 - 1300	2/4	145.0	90 - 250	220 - 260	0/2	ND	-	320 - 330
Carbazole	7/14	148	29 - 490	31 - 270	3/4	118	13 - 380	52 - 52	0/2	ND	-	65 - 66
Chrysene	14/14	572	70 - 1600	-	4/4	1,049	66 - 3400	-	2/2	130	110 - 150	-
Dibenz(a,h)anthracene	11/14	129	12 - 370	110 - 180	4/4	57.8	14 - 85	-	0/2	ND	-	65 - 66
Dibenzofuran	2/14	MNR	12 - 17	270 - 1300	3/4	76.5	20 - 180	170 - 170	0/2	ND	-	320 - 330
Di-n-butyl phthalate	0/14	ND	-	150 - 1300	1/4	MNR	68 - 68	170 - 490	0/2	ND	-	320 - 330
Fluoranthene	14/14	1,134	97 - 3200	-	4/4	2,848	140 - 10000	-	2/2	270	250 - 290	-
Fluorene	6/14	146	20 - 670	31 - 270	3/4	96.4	24 - 310	35 - 35	0/2	ND	-	65 - 66
Indeno(1,2,3-cd)pyrene	14/14	368	29 - 1100	-	4/4	297	48 - 580	-	2/2	69	61 - 77	-
Naphthalene	2/14	MNR	18 - 24	54 - 270	2/4	23.4	22 - 28	35 - 52	0/2	ND	-	65 - 66
Phenanthrene	14/14	398	70 - 1200	-	4/4	514	46 - 1600	-	2/2	97	84 - 110	-
Phenol	0/14	ND	-	31 - 270	1/4	MNR	29 - 29	35 - 100	0/2	ND	-	65 - 66
Pyrene	14/14	650	45 - 2000	-	4/4	1,344	67 - 4600	-	2/2	129	98 - 160	-
Total PAHs	14/14	5,984	978 - 16500	---	4/4	8,881	629 - 28040	---	2/2	1,282	1079 - 1484	---
Corresponding Samples	SD08-1(0-6), SD08-2(0-6), SD08-3(0-6), SD08-4(0-6), SD08-5(0-6), SD-DUP1 [SD08-5(0-6)Dup],SD08-6(0-6), SD08-7(0-6),SD08-8(0-6), SD08-9 (0-6), SD08-10 (0-6), SD08-11 (0-6), SD08-12 (0-6), and SD08-13 (0-6)				SD08-14, SD08-15, SD08-16, and SD08-17				SD08-30(0-6) and SD08-40(0-6)			

Notes:
- MNR = mean not reported, because the calculated value exceeds the maximum positive result
- NC = not calculated
- ND = not detected
- PAH = polycyclic aromatic hydrocarbon
- SVOC = semi-volatile organic compound
- VOC = volatile organic compound
- --- = values not presented because they were not relevant to the summary

Concentration units are µg/Kg (ppb).
Duplicate samples treated as independent result for this summary.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.
See Tables 15 and 16 of the Site Characterization Study Report for the individual sediment results for VOCs and SVOCs, respectively.
Total PAHs calculated as sum of detected PAH results.

Table A-2b. Summary of Pesticides and PCB Analytical Results for Surface Sediments (0-6") from Koppers Pond, Outlet Channels, and Mudflats, Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels				Outlet Channels			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Pesticides												
delta-BHC	1/14	MNR	4.9 - 4.9	1.6 - 160	0/4	ND	-	1.8 - 13	0/2	ND	---	17 - 84
gamma-BHC (Lindane)	1/14	MNR	15 - 15	0.93 - 160	0/4	ND	-	0.36 - 13	0/2	ND	---	17 - 84
gamma-Chlordane	0/14	ND	-	0.75 - 160	1/4	MNR	1.5 - 1.5	2.8 - 16	0/2	ND	---	17 - 84
Aroclor PCBs												
Aroclor 1254	14/14	812	20 - 2700	-	4/4	155	20 - 280	-	1/2	25.5	43 - 43	16 - 16
Total PCBs	14/14	812	20 - 2700	-	4/4	155	20 - 280	-	1/2	25.5	43 - 43	16 - 16
Corresponding Samples	SD08-1(0-6), SD08-2(0-6), SD08-3(0-6), SD08-4(0-6), SD08-5(0-6), SD-DUP1 [SD08-5(0-6)Dup],SD08-6(0-6), SD08-7(0-6),SD08-8(0-6), SD08-9 (0-6), SD08-10 (0-6), SD08-11 (0-6), SD08-12 (0-6), and SD08-13 (0-6)				SD08-14, SD08-15, SD08-16, SD08-17				SD08-30(0-6) and SD08-40(0-6)			

Notes:
BHC = benzene hexachloride
MNR = mean not reported, because the calculated value exceeds the maximum positive result
NC = not calculated
ND = not detected
PCB = polychlorinated biphenyl
--- = values not presented because they were not relevant to the summary

Concentration units are µg/Kg (ppb).
See Table 17 of the Site Characterization Study Report for the individual sediment results for pesticides and PCBs.
Duplicate samples treated as independent result for this summary.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

Table A-2c. Summary of Inorganic Analytical Results for Surface Sediments (0-6") from Koppers Pond, Outlet Channels, and Mudflats, Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	Koppers Pond				Outlet Channels				Mud Flats			
Analyte	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Aluminum	14/14	11,486	5910 - 17000	-	4/4	12,425	8100 - 16700	-	2/2	10,125	8550 - 11700	-
Antimony	14/14	2.91	0.28 - 5.2	-	4/4	2.00	0.27 - 6	-	2/2	0.955	0.95 - 0.96	-
Arsenic	14/14	2.90	1.9 - 4.8	-	4/4	4.40	3 - 7.2	-	2/2	3.45	2.6 - 4.3	-
Barium	14/14	445	226 - 596	-	4/4	238	198 - 282	-	2/2	208	187 - 229	-
Beryllium	14/14	0.53	0.26 - 0.88	-	4/4	0.61	0.41 - 0.93	-	2/2	0.55	0.5 - 0.6	-
Cadmium	14/14	244.5	4.4 - 739	-	4/4	41.6	3 - 91.9	-	2/2	1.65	1.3 - 2	-
Calcium	14/14	127,706	6290 - 199000	-	4/4	50,660	7440 - 70100	-	2/2	3,650	3630 - 3670	-
Chromium	14/14	238	21.8 - 462	-	4/4	86.4	24.8 - 149	-	2/2	19.45	17.5 - 21.4	-
Cobalt	14/14	9.49	5.8 - 13.3	-	4/4	10.3	7.6 - 13.1	-	2/2	5.95	5 - 6.9	-
Copper	14/14	341	25.9 - 820	-	4/4	98.9	25.1 - 175	-	2/2	28.7	21.2 - 36.2	-
Cyanide, Total	6/14	0.68	0.17 - 2.1	0.34 - 1.6	0/4	ND	-	1 - 3	0/2	ND	-	0.38 - 0.48
Iron	14/14	14,886	11800 - 19700	-	4/4	24,600	16800 - 37400	-	2/2	17,650	17500 - 17800	-
Lead	14/14	614	36.6 - 1620	-	4/4	171	34.3 - 288	-	2/2	64.3	49.3 - 79.3	-
Magnesium	14/14	4,989	3340 - 5970	-	4/4	5,418	4690 - 6540	-	2/2	2,805	2290 - 3320	-
Manganese	14/14	111	77.8 - 141	-	4/4	279	216 - 415	-	2/2	136	101 - 170	-
Mercury	14/14	0.51	0.096 - 1.4	-	4/4	0.139	0.044 - 0.25	-	2/2	0.201	0.072 - 0.33	-
Nickel	14/14	102	23.8 - 180	-	4/4	44.0	29.9 - 55.5	-	2/2	18.85	16.3 - 21.4	-
Potassium	14/14	889	612 - 1220	-	4/4	1,021	932 - 1150	-	2/2	536	475 - 596	-
Selenium	14/14	1.31	0.32 - 2.5	-	4/4	0.78	0.47 - 1.3	-	2/2	0.765	0.74 - 0.79	-
Silver	14/14	18.65	0.53 - 52.5	-	4/4	6.28	0.42 - 14.5	-	2/2	0.435	0.34 - 0.53	-
Sodium	14/14	548	251 - 733	-	4/4	518	325 - 875	-	2/2	160	158 - 162	-
Thallium	13/14	0.28	0.19 - 0.42	0.18 - 0.18	3/4	0.18	0.15 - 0.22	0.3 - 0.3	2/2	0.14	0.13 - 0.15	-
Vanadium	14/14	18.6	9.8 - 27.5	-	4/4	19.9	15.7 - 24.7	-	2/2	15.2	15.2 - 15.2	-
Zinc	14/14	4,019	129 - 12500	-	4/4	809	123 - 1690	-	2/2	97.8	94.5 - 101	-
Total Organic Carbon	14/14	6.2	2.29 - 13.5	---	4/4	8.2	1.79 - 22.2	---	2/2	4.09	4.06 - 4.11	---
Corresponding Samples	SD08-1(0-6), SD08-2(0-6), SD08-3(0-6), SD08-4(0-6), SD08-5(0-6), SD-DUP1 [SD08-5(0-6)Dup],SD08-6(0-6), SD08-7(0-6),SD08-8(0-6), SD08-9 (0-6), SD08-10 (0-6), SD08-11 (0-6), SD08-12 (0-6), and SD08-13 (0-6)				SD08-14, SD08-15, SD08-16, and SD08-17				SD08-30(0-6) and SD08-40(0-6)			

Notes: ND = not detected
--- = values not presented because they were not relevant to the summary
Concentration units are mg/Kg (ppm), except for Total Organic Carbon (%).
See Tables 18 and 20 of the Site Characterization Study Report for the individual sediment results for inorganics and total organic carbon (respectively).
Duplicate samples treated as independent result for this summary.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

Table A-3a. Summary of Pesticide and PCB Analytical Results for Forage Fish Collected from Koppers Pond in May 2008
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	FF-Bluegill Sunfish				FF-Pumpkinseeds				All Forage Fish			
Chemical	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Pesticides/PCBs												
beta-BHC	1/4	0.35	0.42 - 0.78	0.58 - 0.58	0/2	0.21	0.42 - 0.42	-	1/6	0.30	0.42 - 0.78	0.58 - 0.58
alpha-Chlordane	1/4	1.64	2.5 - 4	2 - 2	0/2	0.9	1.6 - 2	-	1/6	1.39	1.6 - 4	2 - 2
gamma-Chlordane	3/4	10.85	19 - 19	9.9 - 13	1/2	5.65	11 - 11	5.8 - 5.8	4/6	9.12	11 - 19	5.8 - 13
Endosulfan sulfate	1/4	1.30	1.4 - 2.4	2.5 - 2.5	0/2	0.5625	0.55 - 1.7	-	1/6	1.05	0.55 - 2.4	2.5 - 2.5
Endrin aldehyde	1/4	0.93	0.42 - 0.6	3 - 3	1/2	0.955	0.42 - 0.42	1.7 - 1.7	2/6	0.94	0.42 - 0.6	1.7 - 3
Aroclor 1254	3/3	943	---	640 - 1,300	2/2	485	---	400 - 570	5/5	760	---	400 - 1300
Aroclor 1260	3/3	160	---	99 - 240	2/2	83	---	75 - 91	5/5	129	---	75 - 240
Total PCBs	3/3	1103	---	739 - 1,540	2/2	568	---	491 - 645	5/5	889	---	491 - 1,540
Miscellaneous												
Percent Lipid	3/3	1.3	---	1.2 - 1.5	1/1	1.6	---	1.6 - 1.6	4/4	1.4	---	1.2 - 1.6
Corresponding Samples	FF08-01, FF08-02, FF08-03, and FF08-04				FF08-05 and FF08-06				FF08-01, FF08-02, FF08-03, FF08-04, FF08-05, and FF08-06			

Notes:
BHC = benzene hexachloride
FF = forage fish
ND = not detected
PCB = polychlorinated biphenyls
--- = values not presented because they were not relevant to the summary

Concentration units for pesticides/PCBs are µg/kg (ww) and is percent for percent (ww)lipids.
See Table 33 of the Site Characterization Study Report for the individual fish results for pesticides, PCBs, and lipids.
Fish were not present in the Outlet Channels at the time of sampling.
The Aroclor PCB and lipid results were from samples re-analyzed by TA-Burlington. The remaining analyses were performed by TA-Pittsburgh.
Forage fish results include some individual fish and also composites of smaller fish.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

Table A-3b. Summary of Inorganic Analytical Results for Forage Fish Collected from Koppers Pond in May 2008
Kentucky Avenue Wellfield Site, OU 4 - Koppers Pond, Horseheads, New York.

	FF-Bluegill Sunfish				FF-Pumpkinseeds				All Forage Fish			
Chemical	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects	Frequency of Detection	Mean	Range of Detected Concentrations	Range of Non-Detects
Aluminum	4/4	5.23	---	3.2 -8.6	2/2	11.10	---	8.6 -12.6	6/6	7.60	---	3.2 -12.6
Antimony	2/4	0.053	0.1 - 0.1	0.0047 -0.0068	1/2	MNR	0.1 - 0.1	0.021 -0.021	3/6	0.055	0.1 - 0.1	0.0047 -0.021
Arsenic	4/4	0.10	---	0.053 -0.13	2/2	0.083	---	0.073 -0.097	6/6	0.092	---	0.053 -0.13
Barium	4/4	1.49	---	0.85 -2.2	2/2	1.57	---	1.4 -1.7	6/6	1.51	---	0.85 -2.2
Cadmium	4/4	0.07	0.1 - 0.1	0.04 -0.12	2/2	0.08	---	0.055 -0.12	6/6	0.073	---	0.04 -0.12
Calcium	4/4	8,993	---	5300 -12900	2/2	10,000	---	8140 -13700	6/6	9,638	---	5300 -13700
Chromium	4/4	0.35	---	0.26 -0.42	2/2	0.46	---	0.42 -0.51	6/6	0.39	---	0.26 -0.51
Cobalt	4/4	0.034	---	0.022 -0.043	2/2	0.041	---	0.035 -0.052	6/6	0.038	---	0.022 -0.052
Copper	4/4	0.49	---	0.45 -0.61	2/2	0.58	---	0.51 -0.62	6/6	0.52	---	0.45 -0.62
Iron	4/4	13.53	---	9.8 -18.4	2/2	25.07	---	18.4 -29.1	6/6	18.48	---	9.8 -29.1
Lead	4/4	0.32	---	0.23 -0.4	2/2	0.47	---	0.4 -0.53	6/6	0.38	---	0.23 -0.53
Magnesium	4/4	425	---	348 -526	2/2	461	---	435 -501	6/6	439	---	348 -526
Manganese	4/4	1.30	---	0.81 -1.7	2/2	0.92	---	0.78 -1.1	6/6	1.14	---	0.78 -1.7
Nickel	4/4	0.107	---	0.056 -0.13	2/2	0.157	---	0.13 -0.18	6/6	0.128	---	0.056 -0.18
Potassium	4/4	2,358	---	2160 -2610	2/2	2,473	---	2190 -2750	6/6	2,395	---	2160 -2750
Selenium	4/4	0.325	---	0.28 -0.35	2/2	0.25	---	0.18 -0.35	6/6	0.28	---	0.18 -0.35
Silver	1/4	0.039	0.1 - 0.1	0.005 -0.005	2/2	0.007	---	0.0028 -0.013	3/6	0.028	0.1 - 0.1	0.0028 -0.013
Sodium	4/4	880	---	839 -946	2/2	930	---	885 -1010	6/6	904	---	839 -1010
Thallium	2/4	0.027	0.1 - 0.1	0.0034 -0.0044	1/2	0.042	0.1 - 0.1	0.026 -0.026	3/6	0.031	0.1 - 0.1	0.0034 -0.026
Vanadium	3/4	0.071	0.1 - 0.1	0.018 -0.12	2/2	0.077	---	0.031 -0.15	5/6	0.078	0.1 - 0.1	0.018 -0.15
Zinc	4/4	15.55	---	13 -18.6	2/2	18.53	---	17.3 -19.7	6/6	16.53	---	13 -19.7
Mercury	4/4	0.027	---	0.019 -0.046	2/2	0.016	---	0.011 -0.019	6/6	0.023	---	0.011 -0.046
Corresponding Samples	FF08-01, FF08-02, FF08-03, and FF08-04				FF08-05 and FF08-06				FF08-01, FF08-02, FF08-03, FF08-04, FF08-05, and FF08-06			

Notes: FF = forage fish

MNR = mean not reported because the calculated value exceeds the maximum positive result

--- = values not presented because they were not relevant to the summary

All concentration units are in mg/kg (ww)
See Table 34 of the Site Characterization Study Report for the individual fish results for inorganics.
Fish were not present in the Outlet Channels at the time of sampling.
Forage fish results include some individual fish and also composites of smaller fish.
Mean values calculated by setting non-detect results to one-half the reported detection limit.
Only the target analytes with at least one positive detection are summarized in this table.

APPENDIX B
CRAYFISH COLLECTION METHODOLOGY

B. 1 INTRODUCTION

This appendix outlines the methodology that will be used to collect crayfish from Koppers Pond and the reference pond to support the Supplemental BERA. It is based on the protocol developed by the Wisconsin Department of Natural Resources (WDNR; 2007).

Daniels (2004) summarized the crayfish (and other decapod) species that have been reported in New York State. The relative frequency of collections or observations of the different crayfish species were summarized for six river systems (e.g., Hudson River, Long Island streams). Table C-1 is a compilation of the crayfish that have been reported in New York waters. A key to assist identification of these species is available at the following URL:

http://iz.carnegiemnh.org/crayfish/Keys/index2.htm

Crayfish are more active (and therefore easier to collect) when water temperatures are greater than 12°C (54°F). Based on typical weather conditions in Chemung County, this water temperature roughly corresponds to the period from late May through late summer.

B.2 METHODOLOGY

A combination of methods – electroshocking, baited traps, or hand/net collection – will be used to collect crayfish. Minnow traps are an effective way to collect crayfish, but should be checked on a daily basis. These methods should be used until a sufficient number of crayfish are collected for chemical analysis.

B.2.1 Equipment

The crayfish collection equipment should include the following, at a minimum:

- Backpack electroshock units;
- Modified minnow traps or crayfish traps;
- Buoys to mark minnow traps;
- Rope;
- Bait;
- Sample containers and coolers;
- Dip net;

- Weight scale; and
- Field parameter meter (i.e., conductivity, temperature, dissolved oxygen, oxidation/reduction potential, turbidity, and pH).

B.2.2 Minnow Trap Collection Method

The following approach can be used to collect crayfish using minnow traps.

1. Expand the trap opening to 4 to 5 centimeters (cm) (1.5 to 2 in.) in diameter of the minnow trap (or use a commercial crayfish trap).
2. Put bait (about 1/4 pound) into a standard wire-caged minnow trap. The typical bait is fish, preferably oilier fish. Although commercial bait is produced[1], these are typically available in large volumes only.
3. Label and tag the trap. Floats and markers used to locate the traps must be less than 5 in. in diameter and cannot be orange or fluorescent. Traps must be tagged or marked with a contact name, street address, city, and contact phone number.
4. Set multiple traps at each sample location. Traps should be at least 10 meters (30 feet) apart from each other at water depths of 0.5- 3.0 meters (2- 10 ft). Place the traps in both rocky areas (preferred) and other habitats (as available).
5. Leave the trap overnight and remove it the next day. If the capture success is poor, use the hand/net collection techniques described in the next section.

B.2.3 Dip Nets, Hand Collection, Seine Net

This technique should be used in combination with trapping. When it is not possible to return the following day to pick up crayfish traps, use hand/dip net/seine net alone.

Use a collection technique that suits the conditions. For areas with reduced water clarity, a seine net can be used provided the sediment substrate is stable (i.e., not mucky). Crayfish can also be collected by hand or with a dip net. This method works well in streams with low current and/or good visibility, and also in lakes. At Koppers Pond, this may require disturbing rocks or submerged limbs to locate crayfish.

1 Purina makes several varieties of crayfish (crawfish) bait. See this URL: http://www.purinamills.com/OurProducts.aspx?product=fish

B.2.4 Electrofishing Collection Method

Electrofishing has been reported to be one of the most effective methods to collect crayfish from streams (Price and Welch, 2009; Rabeni et al., 1997), and also may be effective the wade able portions of the lakes. The electrofishing method requires a two person team - one member equipped with a back-pack electrofishing unit, and the other with a small seine or dip net to collect the stunned crayfish. In a flowing system, the netter should be located downstream of the shocker. In a non-flowing system, the netter will follow the shocker as the area is swept with the shocking unit.

The netted crayfish should be placed in a collection bucket during the sampling until further processing.

B.2.5 Water Characteristics at Sampling Locations

Field measurements of the following nine parameters will be collected from each of the sampling locations:

Survey Depth	Oxidation-Reduction Potential
Temperature	Salinity
pH	Total Dissolved Solids
Conductivity	Turbidity
Dissolved Oxygen	

Field water quality will be measured using a Horiba U-50 Series multi-parameter water quality meter, or similar equipment. In addition, the global positioning system coordinates of the sampling locations will be collected.

B.2.6 Sample Storage and Shipment to the Analytical Laboratory

Crayfish should be washed thoroughly making sure they are free of any sediment and stored on wet ice until sufficient sample mass has been collected for chemical analyses. Approximately 100 grams of crayfish should be collected for chemical analyses. Assuming a body weight of 15 grams, this equates to about 6 crayfish per sample location composite. These samples will be analyzed for target compound list (TCL) SVOCs, PCBs, target analyte list (TAL) metals, and percent lipid.

When preparing the samples for shipment to the laboratory, crayfish will be placed in laboratory-provided glass bottles or wrapped in foil and placed in plastic bags. The bottle (if used) will be tightly capped, the sample identification number affixed to the bottle (or placed inside the plastic bag), and the containers will be sealed with custody seals. Samples will be shipped to the laboratory in coolers with ice as soon as possible.

B.3 REFERENCES

Daniels, R. A. 2004. Crayfishes, shrimps and crabs of New York's inland waters. New York State Biodiversity Clearinghouse, New York State Biodiversity Project and New York State Biodiversity Research Institute. Available from: http://www.nybiodiversity.org/

Price, J.E. and S.M. Welch. 2009. Semi-quantitative methods for crayfish sampling: sex, size, and habitat bias. *Journal of Crustacean Biology*. 29(2): 208-216.

Rabeni, C.F., K.J. Collier, S.M. Parkyn and B.J, Hicks. 1997. Evaluating techniques for sampling stream crayfish (Paranephrops planifrons). *New Zealand Journal of Marine and Freshwater Research*. 31: 693-700

WDNR. 2007. Protocol for Wisconsin crayfish sampling - 2007 WAV version. Prepared by the University of Wisconsin-Madison Center for Limnology for Wisconsin Department of Natural Resources. Available from:
http://watermonitoring.uwex.edu/pdf/level3/Protocol2007CrayfishSampling.pdf.

APPENDIX C
AQUATIC AND SEMI-AQUATIC PLANT COLLECTION METHODOLOGY

C.1 INTRODUCTION

This appendix outlines the methodology that will be used to collect aquatic and semi-aquatric plants from Koppers Pond and the reference pond to support the Supplemental BERA. It is based on the protocol developed by USEPA (2007). Although there are several USEPA and New York guidance documents available for surveying aquatic macrophytes (e.g., NYSDEC, 1995, 2006; New York Citizens Statewide Lake Assessment Program, 2009; USEPA , 1998) these were not considered suitable for this sampling effort which focuses on the collection of plant material for chemical analyses.

Based on the survey performed in September 2009, the only submerged aquatic vegetation present in the pond was small pockets of coontail (*Ceratophyllum demersum*). The lesser duckweed (*Lemna minor*), a common floating aquatic plant, was present at the pond and covered much of the water surface (greater than 50 percent) along the southern and southwestern shorelines (i.e., backwater areas). The pond boundaries are well vegetated, and include stands of cattails (*Typha* spp.), mature eastern cottonwood trees (*Populus deltoides*), honeysuckle (*Lonicera* spp.), the invaisve japanese knotweed (*Fallopia japonica*) and other shrubs and trees typical of this portion of New York State.

C.2 METHODOLOGY

Vegetative portions, shoots, tubers and seeds of some aquatic and semi-aquatic plants can be used as forage by the ecological receptors that will be collected to provide empirical data for the COPECs on these media to support the Koppers Pond ERA. The plant materials sampled will consist of the following:

- Floating aquatic plants (duckweed) from Koppers Pond;
- Grass or similar leafy material from shrubs or small trees bordering Koppers Pond (near SD08-07) and the East Outlet Channel (near SD08-15);
- Plant root or rhizomes from emergent vegetation at Koppers Pond (near SD08-01).

The rationale for selecting these sampling locations is provided in the main text.

C.2.1 Equipment

The plant collection equipment should include the following, at a minimum:

- Dip net for collecting duckweed;
- Small pick or hoe to expose roots/tubers;
- Stainless steel trowel;
- Knife for sampling vegetation;
- Sample containers and coolers;
- Weight scale; and
- Field parameter meter (i.e., conductivity, temperature, dissolved oxygen, oxidation/reduction potential, turbidity, and pH).

C.2.2 Floating Aquatic Plant Collection Method

Common duckweed is present in portions of Koppers Pond although the locations can vary depending upon the prevailing wind direction. The floating plant will be collected by sweeping the water surface with a fine mesh dip net to collect sufficient material for chemical analysis. If there are multiple locations in Koppers Pond that the duckweed has accumulated it is recommended that these areas be composited into a single sample.

C.2.3 Leafy Vegetation Collection Method

The boundary of Koppers Pond and the outlet channels are fairly well vegetated. Since this material could be used as forage for some of the evaluated receptors samples of grass or other leafy vegetation will be performed.

The following approach can be used to collect leafy vegetation material.

1. Using a knife, collect portions of grass or other leafy material from the sampled vegetation.

2. Although the herbivores may prefer the newer growth, which is more tender and easier to digest, a combination of new and older leaves should be collected in order to have a conservative estimate of the concentrations of the COPECs in the plant material.

3. Plants that are not typical browse (e.g., poison ivy) should not be included in these samples.

4. Do not remove all of the leaves for an individual plant. If additional material is needed then this can be collected from additional nearby plants.

5. Note the GPS location(s) of the sampled materials.

C.2.4 Root, or Rhizome Collection Method

Cattails have been observed near the juncture of the industrial drainageway and Koppers Pond, and along the perimeter of Koppers Pond between the two outlets. Cattail roots and rhizomes can serve as forage for some of the ecological receptors that will be evaluated in the BERA.

The following approach can be used to collect root/rhizome material.

1. Use a pick or shovel to remove the surface soil/sediment to reveal unexposed root/rhizome material. Note the presence of any iron floc material on the *Typha* root surfaces.

2. Using the pick or a knife, cut away portions of the root and rhizomes. If new shoots are present, these can also be included with the root samples. Do not remove the outer layer of the roots or rhizomes.

3. Do not remove all of the root or rhizome material for an individual plant. If additional material is needed then this can be collected from additional nearby plants. Cover the disturbed area with the soil/sediment that was removed at the first step.

4. Note the GPS location(s) of the sampled root/rhizome materials.

C.2.5 Water Characteristics at Sampling Locations

If standing water is present at any of the sampled locations, field measurements of the following nine parameters will be collected:

Survey Depth	Oxidation-Reduction Potential
Temperature	Salinity
pH	Total Dissolved Solids
Conductivity	Turbidity
Dissolved Oxygen	

Field water quality will be measured using a Horiba U-50 Series multi-parameter water quality meter, or similar equipment. In addition, the global positioning system coordinates of the sampling locations will be collected.

C.2.6 Sample Storage and Shipment to the Analytical Laboratory

Plant material should be washed thoroughly making sure they are free of any soil/sediment and stored on wet ice until sufficient sample mass has been collected for chemical analyses. Approximately 30 to 50 grams of plant material (except for duckweed) should be collected for chemical analyses. A smaller mass of duckweed may be collected due to the abundance of this plant at Koppers Pond. These samples will be analyzed for target compound list (TCL) PAHs, PCBs, target analyte list (TAL) metals, percent lipid, and total organic carbon.

The samples will be coded in the following manner:

VEG10-nn

Where "10" represents the sample year, and "nn" is the sample ascension number.

When preparing the samples for shipment to the laboratory, plant material will be placed in laboratory-provided glass bottles or wrapped in foil and placed in plastic bags. The bottle (if used) will be tightly capped, the sample identification number affixed to the bottle (or placed inside the plastic bag), and the containers will be sealed with custody seals. Samples will be shipped to the laboratory in coolers with ice as soon as possible.

C.3 References

New York Citizens Statewide Lake Assessment Program. 2009. Aquatic Plant Sampling Protocol. Available from: http://www.cslap.net/2009/2009%20CSLAP%20Plant%20Sampling%20Protocol.pdf. 17p.

New York State Department of Environmental Conservation (NYSDEC). 1995. A Primer on Aquatic Plant Management in New York State. Available from: http://www.dec.ny.gov/docs/water_pdf/ch6apr05.pdf. Draft. April. Division of Water. 63p.

New York State Department of Environmental Conservation (NYSDEC). 2002. Draft DER-10, Technical Guidance for Site Investigation and Remediation. Available from: http://www.dec.ny.gov/docs/remediation_hudson_pdf/der10dr.pdf. December.

New York State Department of Environmental Conservation (NYSDEC). 2006. 2006 Aquatic Plant Monitoring Guidelines. Available from: http://www.dec.ny.gov/docs/water_pdf/aquatic06.pdf.

USEPA. 1997. *Superfund Program, Representative Sampling Guidance, Volume 3: Biological.* Environmental Response Team Center, Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-25A, EPA 540/R-97/028. Interim Final. May. Available from http://www.ert.org/products/sf-bio.pdf.

USEPA. 1998. *Lake and Reservoir Bioassessment and Criteria. Technical Guidance Document*. EPA 841-B-98-007. U.S. Environmental Protection Agency, Office of Water. Available from: http://www.epa.gov/owow/monitoring/tech/lakes.html.

Appendix D

Supporting Information for the Selection of Koppers Pond Sediment Samples for Toxicity Testing

D.1 INTRODUCTION

Section 4.2 of the Site Characterization Report summarized the comparisons between the historical (1995 and 1998) and most current (2008) sediment chemical results. Although there were slight differences in the ranges, medians and averages, the results were generally comparable. The short-term toxicity studies of the 14 sediment samples (plus one field duplicate) were performed in 1998 (CDM, 1999). These included one sample from the Industrial Drainageway, nine samples (plus a field duplicate) from Koppers Pond, and four samples from the outlet channels. There was no acute toxicity (reduction in survival) in any of these samples using the midge, and only one sediment sample (SD-13; located at the juncture of the Industrial Drainageway and Koppers Pond) showed a statistically significant reduction in survival in the amphipod (average of 78%; the range was 50 to 100% for the eight individual replicates in this sample). Therefore, due to the similarity in sediment chemical concentrations, it would be anticipated that the sediments currently would also lack short-term toxicity.

Nonetheless, there is a data gap relative to the potential longer term sediment toxicity. Therefore, it is proposed to perform the following two longer-term toxicity tests (USEPA, 2000) using five sediments from Koppers Pond, plus one composite sample from a reference pond:

- Test Method 100.4: *Hyalella azteca* 42-day (chronic) Test for Measuring the Effects of Sediment-associated Contaminants on Survival, Growth, and Reproduction

- Test Method 100.5: Life-cycle Test for Measuring the Effects of Sediment-associated Contaminants on *Chironomus tentans*

The five samples selected for toxicity testing are the following: SD08-01, SD08-03, SD08-04, SD08-06, and SD08-08. These were selected based upon review of the 1998 sediment toxicity results and their associated chemical data, which is discussed below.

D.2 SAMPLE SELECTION METHODOLOGY

A rank scoring technique was used to identify the samples from Koppers Pond. The nine Koppers Pond samples collected during the 1998 field program were used for this assessment, which included examination of both the historical toxicity test results and also the reported chemical results (CDM, 1999). The results for 1998 sample SD-11 and its field duplicate SD-20 were averaged for these calculations. The 1998 toxicity test results and 1998 sediment chemical results are presented in Tables D-1 and D-2, respectively.

The methodology is summarized below:

- The amphipod and midge survival results were sorted and ranked from lowest to highest. The lowest survival received the highest rank. When multiple samples had the same survival percentage, the average rank value was used for the samples.

- The chemical results for total PCBs and eight of the COPEC metals (barium, cadmium, copper, chromium, iron, lead, silver, and zinc) were sorted individually from lowest to highest, with the highest concentration receiving the highest rank value.

  Four of the COPEC metals were excluded for the following reasons: (1) Cyanide and mercury were excluded since these were chemicals had a low detection frequency in these samples; (2) Nickel was excluded since the analytical results were rejected in three of the nine samples; and (3) Selenium was excluded since it was not detected in any of the Koppers Pond samples collected in 1998.

- The ranks were then summed across the two toxicity test results, total PCBs, and eight metals. The cumulative values by sample were then sorted and the top five summed ranks were selected for 2010 sediment toxicity testing.

The rank results are summarized in Table D-3. The 2008 samples that were closest in proximity to the top five ranked 1998 samples are the following: SD08-01, SD08-03, SD08-04, SD08-06, and SD08-08. These five 1998 samples also had the higher reported nickel results compared to the remaining samples. All of the sediments in these samples exceeded their corresponding refined ESVs, except for iron. Four of the five proposed samples also have 2008 AVS/SEM results.

In addition to these five samples from Koppers Pond, a single composite sample (consisting of 5 to 10 individual grab samples) will also be collected from a reference pond to provide information on the potential sediment toxicity of ponds that are reflective of background conditions.

D.4 DATA QUALITY OBJECTIVES

Section 9 of USEPA (2000) outlines the Quality Assurance and Quality Control for the toxicity testing methods. Additional QA/QC related items include the following:

- One of the Koppers Pond sediment samples will be analyzed in duplicate to allow determination of the precision of the toxicity test results.

- A single composite sample will also be collected from a reference pond to provide information on the potential sediment toxicity of ponds that are reflective of background conditions, as well as exposure to "natural" media.

D.5 REFERENCES

CDM. 1999. Revised draft ecological risk assessment, Kentucky Avenue Wellfield Site, Horseheads, New York. Document No. 7720-038-RA-CSSM. Prepared for the U.S. Environmental Protection Agency, Region 2, New York, New York. CDM Federal Programs Corporation. February.

USEPA. 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition. Available from: www.epa.gov/waterscience/cs/library/freshmanual.pdf. EPA 600/R-99/064. U.S. Environmental Protection Agency, Office of Research and Development, and Office of Science and Technology. March.

Table D-1. Summary of Sediment Toxicity Results for Sediments Collected in 1998 from Koppers Pond and their Corresponding 2008 Sampling Locations
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

1998 Sample (CDM, 1999)	Closest 2008 Sample	1998 Sediment Toxicity Results (Survival) Chironomid Set 1	Chironomid Set 2	Amphipod	Comment
--	--	83%	95%	96%	Control sediment. Chironomid tests were performed in two batches.
SD-5	SD08-13	90%	--	99%	
SD-6	SD08-12	89%	--	100%	
SD-7	SD08-10	89%	--	99%	
SD-8	SD08-09	--	90%	91%	
SD-9	SD08-08	--	83%	99%	
SD-10	SD08-06	89%	--	99%	
SD-11/SD-20	SD08-04	--	96%/86%	99%/93%	
SD-12	SD08-03	91%	--	96%	
SD-13	SD08-01	74%	--	78% [a]	

Notes:

The 2008 sample locations are shown on Figure 2-1 in this report. See Figure 2-1 of CDM (1999) for figure showing 1998 sediment sampling locations.

The 2008 samples that were not near any of the 1998 sample locations were SD08-02, SD08-05, SD08-07, SD08-30, and SD08-40.

The 1998 samples SD-11 and SD-20 were field duplicates.

[a] Statistically significant reduction in survival.

Table D-2. Summary of PCB and COPEC Metal Analytical Results from Sediments Collected in 1998 from Koppers Pond and their Corresponding 2008 Sampling Locations
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

		Included in Rank Score									Excluded from Rank Scoring			
1998 Sample (CDM, 1999)	Closest 2008 Sample	Total PCBs (μg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)	Cyanide (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)
SD-5	SD08-13	150 U	565	52.8	142	135	12,500	532	6.9	1,130	0.56	0.29 U	60.5	4.4 U
SD-6	SD08-12	410	510	59.9	164	179	9,630	427	6.7	1,020	0.32 U	0.23 U	21.7 U	3.3 U
SD-7	SD08-10	220	346	82	98	130	9,860	234	4.5	1,300	0.19 U	0.12 U	21.7 U	2.0 U
SD-8	SD08-09	1,500	393	238	164	282	7,850	355	11.4	3,500	1.20	1.20	R	2.9 U
SD-9	SD08-08	1,100	558	304	231	371	11,600	509	15.6	4,470	0.50	0.38	R	2.7 U
SD-10	SD08-06	730	473	135	329	354	14,300	459	9.3	2,120	0.46 U	0.33 U	156	4.9 U
SD-11/SD-20	SD08-04	4,500	522	502	246	541	9,240	734	25.6	6,680	0.26 U	1.0	R	2.7 U
SD-12	SD08-03	1,200	577	508	295	562	10,400	1,270	30.2	7,240	0.28 U	0.20 U	124	3.0 U
SD-13	SD08-01	1,100	684	415	342	544	10,700	2,210	39.6	6,820	0.33 U	0.23 U	155	3.4 U
Refined ESV			0.7	0.99	43.4	31.6	20,000	35.8	0.5	121	NA	0.18	22.7	0.29

Notes:

The chemical results are from Tables 2-2 (PCBs) and 2-3 (metals) from CDM (1999).

Some of the metal COPECS were excluded from the rank scoring for the following reasons: (1) Cyanide and mercury were excluded since these were chemicals had a low detection frequency in these samples; (2) Nickel was excluded since the analytical results were rejected in three of the nine samples; (3) Selenium was excluded since it was not detected in any of the Koppers Pond samples collected in 1998.

Sample SD-20 was the field duplicate of samples SD-11.

NA: Not available.

R: Rejected.

U: Not detected at the value shown.

Table D-3. Summary of Ranks of Amphipod and Midge Survival and Chemical Results from Sediments Collected in 1998 from Koppers Pond
Kentucky Avenue Wellfield OU4 - Koppers Pond, Horseheads, NY

1998 Sample	Closest 2008 Sample	Rank Scores: Amphipod Survival	Midge Survival	Total PCBs	Barium	Cadmium	Copper	Chromium	Iron	Lead	Silver	Zinc	Sum of Ranks	Sum of Ranks (Less Iron)	2008 AVS/SEM Sample?	2010 Sample
SD-13	SD08-01	9	9	5.5	9	7	8	9	6	9	9	8	88.5	82.5	Yes	Yes
SD-12	SD08-03	6	1.5	7	8	9	9	7	5	8	8	9	77.5	72.5	Yes	Yes
SD-11/SD-20	SD08-04	7	1.5	9	5	8	7	6	2	7	7	7	66.5	64.5	Yes	Yes
SD-9	SD08-08	3	8	5.5	6	6	6	5	7	5	6	6	63.5	56.5	No	Yes
SD-10	SD08-06	3	6	4	3	4	5	8	9	4	4	4	54.0	45.0	Yes	Yes
SD-8	SD08-09	8	3.5	8	2	5	4	3	1	2	5	5	46.5	45.5	No	No
SD-5	SD08-13	5	3.5	1	7	1	2	2	8	6	3	2	40.5	32.5	No	No
SD-6	SD08-12	1	6	3	4	2	3	4	3	3	2	1	32	29	No	No
SD-7	SD08-10	3	6	2	1	3	1	1	4	1	1	3	26	22	Yes	No

Notes:

The amphipod and midge survival results were sorted and ranked from lowest to highest. The lowest survival received the highest rank.

The chemical results for total PCBs and eight metals were sorted individually from lowest to highest, with the highest concentration receiving the highest rank value.

Nickel was not included in this assessment since it was rejected in three of the nine samples. However, the five proposed 2010 samples all had greater nickel results compared to the other samples using the 1998 sample results.