Supplemental Investigation Work Plan

Surface Water and Streambed Sediment

Koppers Industries, Inc. Superior, Wisconsin

Beazer East, Inc.
Pittsburgh, Pennsylvania

May 1998

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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"I, Robert K. Goldman, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

Signature

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1. Introduction

1.1 Overview

This *Supplemental Investigation Work Plan, Surface Water and Streambed Sediment* has been prepared on behalf of Beazer East, Inc. (Beazer) for the Koppers Industries, Inc. (KII) wood treating facility located in Superior, Wisconsin. A former owner of this facility, Beazer has identified a need for additional investigation activities to support characterization of surface water and streambed sediment associated with its permitted stormwater Outfall 001. These additional investigation activities will target the collection of field data required to resolve outstanding issues regarding sediment-related constituent fate and transport, and to develop remedial action objectives and potential response actions, if deemed necessary and appropriate. This work plan has been designed to be consistent with the general approach and rationale for conducting an investigation under NR 716 (Wisconsin Administrative Code) and the United States Environmental Protection Agency's (USEPA's) *Ecological Risk Assessment Guidance for Superfund* (USEPA, 1997). While the proposed scope, rationale, and procedures for the proposed investigation activities are described in the following sections, the scope of work includes the following five primary tasks:

- Mapping and survey control;
- Characterization of the fluviomorphology of the Outfall 001 drainageway and Crawford Creek;
- Chemical and geotechnical characterization of the Outfall 001 drainage ditch and Crawford Creek sediments;
- Physicochemical characterization of the Outfall 001 drainage ditch and Crawford Creek surface water; and
- Ecological investigation of the Outfall 001 drainage ditch and Crawford Creek.

The investigation will focus on the surface water drainageway leading from Outfall 001, which includes the Outfall 001 drainage ditch and a portion of Crawford Creek, as shown on Figures 1 and 2. The investigation area was established based on previous investigation results that indicate impacted sediment or potentially impacted sediment may exist within the Outfall 001 drainage ditch and a portion of Crawford Creek. The investigation findings are documented in reports entitled *Phase II RCRA Facility Investigation - Report of Findings, Koppers Industries, Inc., Superior, Wisconsin*, dated June 1991 (Keystone Environmental Resources, Inc., 1991; referred to hereafter as the *Phase II RFI Report*), and *Preliminary Characterization Report, Surface Water and Streambed Sediment Koppers Industries, Inc., Superior, Wisconsin Facility WID 006-179-493*, dated March 1997 (Fluor Daniel, 1997a; referred to hereafter as the *Preliminary Characterization Report*). Study results presented in these two reports indicate no significant impact downstream of the proposed investigation area.

Investigation findings for the permitted stormwater Outfall 004 are also presented in the *Phase II RFI Report.* A review of previous investigation results for Outfall 004 indicates non-detectable or very low levels (i.e., slightly above detection) of potential constituents of concern (PCOCs) in surface water and sediment at Outfall 004. The low levels of PCOCs, the limited sediment transport potential of the Outfall 004 drainage ditch (i.e., intermittent flow from a small area), the limited physical capacity for the ditch to support aquatic life, and the lack of facility operations in the Outfall 004 drainage area combine to indicate that additional assessment of Outfall 004 is not warranted. The previous investigation data are discussed further in Section 2.7 of this work plan.

1.2 Objectives

In the *Preliminary Characterization Report*, PCOCs were reported in soil/sediment samples obtained from the Outfall 001 drainage ditch and a portion of Crawford Creek downstream of Outfall 001. Beazer has determined that the extent of PCOCs and their ultimate fate and transport within these areas require further evaluation. Therefore, a supplemental investigation of surface water and sediment in the drainageway, and a portion of Crawford Creek below Outfall 001 is proposed. The supplemental investigation will be performed to meet the following objectives:

- Characterize the extent of PCOCs in the Outfall 001 ditch and Crawford Creek downstream of the ditch confluence;

- Characterize sediment transport in the Outfall 001 ditch and Crawford Creek to help further understand the fate and transport of PCOCs;

- Evaluate the potential for exposure and the significance of exposure to the PCOCs by ecological receptors; and

- Obtain information to develop remedial action objectives and evaluate potential response actions, if deemed necessary and appropriate.

To effectively achieve these objectives, the supplemental investigation activities will follow the approach described in Sections 2 through 4 of this work plan.

1.3 Work Plan Format

This work plan contains the following sections:

- Section 1 - Introduction
- Section 2 - Background Information
- Section 3 - Supplemental Characterization
- Section 4 - Ecological Assessment (EA)
- Section 5 - Project Organization and Schedule
- Section 6 - References

Supporting information throughout this work plan is incorporated from the *Preliminary Characterization Report*, the *Phase II RFI Report*, and the recently submitted *Phase III RCRA Facility Investigation Report, Soil and Groundwater, Koppers Industries, Inc., Superior Wisconsin Facility, WID 006-179-493*, dated June 1997 (Fluor Daniel, 1997b; referred to hereafter as the *Phase III RFI Report*).

2. Background Information

2.1 Location and Setting

The KII Superior, Wisconsin wood treating facility is located in a rural, sparsely-populated setting in Douglas County, northwest Wisconsin, approximately five miles southeast of the town of Superior. The facility property is approximately 112 acres in size and is zoned for industrial use. As shown on Figure 1, the eastern property boundary parallels County Road A, and the northern property boundary parallels Hammond Avenue. A series of railroad tracks lie immediately to the north, south, and west of the facility. While no wetlands have been identified on the facility property, National Wetland Inventory maps indicate that the property is surrounded by wetlands, with the exception of an area zoned for agricultural use located to the south and southeast of the property. The area to the north, west, and northeast of the property is zoned as a Resource Conservation District. Several parcels of land to the west and north of the facility are owned by Douglas County. No county parks, state parks, or fish hatcheries are located within a one-mile radius of the facility. Critical habitats, natural or scientific areas, and endangered or threatened species within one mile of the facility include sweet coltsfoot and wood turtle (threatened species) and the Nemadji River Floodplain Natural Area. While neither of these species nor the Natural Area occurs within the facility property, their presence or absence in the proposed investigation area will be confirmed during the upcoming supplemental investigation activities.

2.2 Facility History

Constructed by the National Lumber and Creosoting Company, the facility has been in operation since 1928. The property changed hands through a series of property transactions between 1938 and 1988. Currently, the facility is owned by KII; however, Beazer retains certain environmental responsibilities at the facility. The facility produces pressure-treated railroad ties, bridge timbers, switch ties, and crossing panels. The primary preservative used at the facility has been creosote with a Number 6 fuel oil carrier. From 1955 to 1979, pentachlorophenol (PCP) with a petroleum oil carrier also was used. The area surrounding the facility has remained relatively unchanged for the past 60 years and is predominantly undeveloped.

2.3 Climate

Superior, Wisconsin is characterized by a modified continental climate due to the proximity of Lake Superior, located approximately three miles to the northeast of the facility. Monthly temperatures range from an average low of 1.6 degrees Fahrenheit (°F) in January to an average high of 78 °F in July, with an average annual temperature of 39.7 °F. Average annual precipitation is 28.73 inches per year (water equivalent), with an average yearly snowfall of 52 inches per year. The majority of the snowfall occurs in December, January, and March. August, the wettest month of the year, receives an average of 4.23 inches of rainfall, while February receives the least amount of precipitation with an average 8.8 inches of snowfall (0.78 inches water equivalent).

2.4 Topography/Hydrology

Surface water hydrology is controlled by topography and the channelization of surface water through ditches. The facility is not situated within the 100-year floodplain of any surface water body, and is located within a broad upland plain characterized by relatively uniform topography. The majority of the surface water runoff at the facility drains to the north-northwest and is discharged via the Wisconsin Pollutant Discharge Elimination System (WPDES) Outfall 001 at an unnamed ditch. The drainage area of the unnamed ditch is estimated to be less than one square mile. Surface water runoff pathways from the facility are depicted in the *Preliminary Characterization Report*. Drainage Outfall 001 was first permitted in 1974; its discharge is variable and dependent on precipitation events, with the flow received by the unnamed ditch primarily resulting from snowmelt and stormwater runoff at intermittent intervals. The unnamed ditch discharges into Crawford Creek approximately 0.5 mile west of the facility.

Crawford Creek is a meandering stream that flows at intermittent intervals north to the Nemadji River. The creek is 6.2 miles in total length and drains an area of approximately 8.45 square miles. Crawford Creek discharges to the Nemadji River approximately 1 mile downstream of its confluence with the unnamed ditch. The Nemadji River discharges to Lake Superior approximately 3 miles downstream (to the northeast) of its confluence with Crawford Creek. The drainage area of the Nemadji River above the U.S. Geological Survey (USGS) gauge near South Superior, Wisconsin (near the confluence with Crawford Creek) is approximately 420 square miles. Other bodies of water in the vicinity that may affect fate and transport of constituents in sediment include an area known as "Crawford Creek Pond" (located within the creek just downstream from the facility), and wetlands within the floodplain of Crawford Creek. There is no known commercial, recreational, or potable use of Crawford Creek.

2.5 Geology/Hydrogeology

The investigation area is located in the Lake Superior Lowland physiographic province. Geological information collected from past investigations indicates that the area is underlain by highly impermeable clay. These clay deposits directly impact the topography and geomorphology of the area and the potential for migration of PCOCs. As previously discussed, the majority of the facility property is surrounded by wetlands. These upland marshes are present due to the relatively low permeability of the extensive clays deposited by the glacial lake that once covered the region. Surface runoff is created by the low infiltration capacity of the clays underlying the area. Most areas previously investigated at the facility exhibit a thick, plastic, red-brown clay deposit as the uppermost stratigraphic unit. The groundwater table at the facility is shallow and located within the clay, which indicates that the clay acts as an aquitard. Previous investigation findings indicate that some areas exhibit a thin fill (approximately 1 to 2 feet, up to 4 feet) overlying the clay that consists of silt-to-sand and gravel-sized materials. Other areas show a surficial topsoil layer up to one foot in thickness. Borings at the facility have been drilled to depths of 70 feet below ground surface, but have not completely penetrated the clay unit. Clay deposits contain discontinuous lenses of silt, and fine to coarse sand to fine gravel, at depths from 20 to 60 feet. These are characteristic of meltwater stream deposits and may represent esker deposits buried during grounding of the ice mass. Hairline vertical fractures, veins, seams, or pockets filled with a green-gray, fine-grained material are found in the upper portion of the red-brown clay. Regional geologic information indicates that bedrock is present at depths between 170 and 210 feet below ground surface.

2.6 Sediment Transport Processes

Much of the Outfall 001 drainage ditch was cut into a pre-existing low-lying drainage area, and the channel has partially naturalized over the years, at least to the extent that it has many properties of alluvial channels. The ditch is approximately 3 to 5 feet wide between streambanks. Depth of sediment in pools is reportedly slightly less than one foot. Crawford Creek is about 14 to 18 feet wide between streambanks, generally increasing in width with distance downstream. Typical sediment thickness in pools is reportedly 1.5 to 2 feet.

Previously conducted reviews of field summaries and photographs collected during the June 1996 investigation indicate that the principal sediment sources in the watershed of the unnamed ditch and Crawford Creek are red-to-brown, organic-rich clay, with lesser amounts of silt, sand, and gravel. This material is consistent with descriptions of the "red clay" lacustrine deposits within the Lake Superior Lowlands. These deposits are likely to be significant sediment sources when eroding from the stream banks. Lesser amounts of sandier sediment are contributed by the various pitted tills, moraines, paleo-lake terrace deposits, and small areas of glacially scoured bedrock in the upper watershed of Crawford Creek. Based on regional syntheses, rates of erosion in these areas are reportedly more than an order of magnitude lower than those for the red clays. Preliminary field investigation observations indicate limited channel changes (e.g., meander cutoffs, human channelization) because of the intermittent nature and high sediment load of Crawford Creek. Channel obstructions include the railroad grade and culvert, beaver dams, and downed trees, which influence the transport and deposition of sediment.

Previous sediment analyses collected by sieving and by hydrometer reflect the clayey and silty nature of the local red-clay soils, derived from glacial-lake sediments. Grain-size analysis results, obtained during the June 1996 investigation, are presented in the *Preliminary Characterization Report*. The sandier sediments with a moderate clay content are interpreted to be relatively mobile bed sediments, mostly originating in the upper and middle portions of the Crawford Creek watershed and in transit to the Nemadji River. The bed sediments with high clay content appear to be of more local origin, and in some cases may be intact Douglas Till, which forms the bed of the ditch and the creek. The clay-containing bed sediments are more cohesive and less mobile, and are substantially less likely to be transported downstream.

Sediments from the lower reaches of Crawford Creek are relatively uniform, and have been described as a reasonable characterization of the sandier, moderate-clay content sediments preferentially transported by Crawford Creek. As this coarser material is deposited, it dilutes the finer-grained sediments originating in the lower portions of the watershed, including those from the unnamed ditch. Two primary influences reportedly affect the sediment characteristics in this area. First, storage is much greater, with the floodplain widening by a factor of 10 as Crawford Creek approaches the confluence. Similarly, the railway embankment, beaver dams, and other factors help retain sediment in this reach. Second, much of the sediment load of Crawford Creek is deposited in this reach during times when water levels in the Nemadji River are high, creating a temporary backwater, which likely prevails as much as half of the time when high rates of sediment transport are occurring in Crawford Creek.

2.7 Previous Investigations

From 1981 to the present, various investigations have been performed at the facility. Prior to 1987, the activities were related to the Resource Conservation and Recovery Act (RCRA) impoundments. In 1987, the site-wide corrective action program began with the USEPA's RCRA Facility Assessment, followed by RFI activities conducted by Beazer. Numerous soil and groundwater samples were collected at the facility during these investigations. As indicated in the *Phase III RFI Report*, PCOCs were detected in soil and groundwater; however, there is no evidence that the constituents are migrating in groundwater beyond the facility boundary. In 1990, as part of the Phase II RFI, surface water and ditch soil samples were collected from Outfalls 001 and 004; these data were presented in the *Phase II RFI Report*. The investigation of surface water and streambed sediment was subsequently separated from the remainder of the RFI (i.e., facility soil and groundwater investigation) and the two investigations are being conducted under different schedules. In 1996, as part of the preliminary surface water and streambed sediment investigation, surface water, ditch soil, and sediment samples were collected from areas associated with Outfall 001 (i.e., in the unnamed drainage ditch and Crawford Creek) and analyzed for a variety of parameters. While the 1996 data (qualitative information and quantitative analytical results) are presented in the *Preliminary Characterization Report*, a summary of the surface water and streambed results is presented below. Based on this information, polynuclear aromatic hydrocarbons (PAHs) and PCP have been identified as PCOCs. Analytical results for total PAHs and PCP are depicted on Figures 3 and 4 of this work plan. In addition to PAHs and PCP, surface water and sediment samples were analyzed for tetrachlorophenol (TCP) and acid-extractable phenolics. Available data indicate that these constituents were mostly non-detectable or occurred at levels only slightly above detection.

Outfall 004

- During the 1990 Phase II RFI, one surficial sediment sample (0 to 6 inches in depth) was collected from Outfall 004. Total PAHs were observed in the sample at a concentration of 0.083 mg/kg. PCP was not detected. Total acid-extractable phenolics were observed in the sample at a concentration of 0.201 mg/kg.

- Surface water sampling was conducted at Outfall 004 on two occasions, first in September 1990 and again in October 1990. Total PAHs were not detected in the September 1990 sample, but were observed at a concentration of 0.00045 mg/L in October 1990. PCP was not detected in either of the surface water samples. TCP was observed at a concentration of 0.00013 ug/L in September 1990, but was not detected in the October 1990 sample. Total acid-extractable phenolics were not detected in September 1990, but were observed at a concentration of 0.00013 ug/L in October 1990. Each of the observed concentrations was just slightly above the analytical detection limit.

Outfall 001 Drainage Ditch

- One surficial soil sample (0 to 6 inches in depth) at Outfall 001 was collected during the 1990 Phase II RFI. Analytical results showed concentrations of PAHs (0.637 mg/kg) and PCP (0.169 mg/kg) in this sample.

- Two surface water samples were collected from Outfall 001 during September 1990 and October 1990. No PAHs were detected in either sample. PCP was observed at concentrations of 0.00357 mg/L and 0.00393 mg/L in the surface water samples collected in September 1990 and October 1990, respectively.

- As part of the June 1996 preliminary characterization investigation, eight soil/sediment samples, two ditch bank soil samples, and two surface water samples were collected from the Outfall 001 drainage ditch. Sediment samples were collected from four locations within the ditch at 0- to 6-inch and 6-inch to end-of-core intervals. Results of these analyses are presented below.

  - Total PAHs and PCP were detected in sediment samples collected from the Outfall 001 drainage ditch. Detected concentrations of total PAHs ranged from 46.6 mg/kg to 2,013 mg/kg in the 0- to 6-inch segments (arithmetic mean concentration of 612 mg/kg) and 0.391 mg/kg to 668 mg/kg in the 6-inch to end-of-core segments (arithmetic mean concentration of 275 mg/kg). PCP was detected at estimated concentrations ranging from 0.02 mg/kg to 0.53 mg/kg in the 0- to 6-inch segments (arithmetic mean concentration of 0.242 mg/kg). PCP was detected in only one of the 6-inch to end-of-core samples, at an estimated concentration of 0.041 mg/kg.

  - Both PAHs and PCP were identified in the two ditch bank soil samples collected from the unnamed ditch. Total PAHs were detected at concentrations of 133 mg/kg and 90.7 mg/kg. PCP was detected at estimated concentrations of 87 mg/kg and 100 mg/kg.

  - Total PAHs were detected at concentrations of 0.003 mg/L and 0.005 mg/L in the two surface water samples collected from the Outfall 001 drainage ditch. PCP was detected in only one of the two samples at a concentration of 0.0011 mg/L.

- Analyses for TCP and acid extractable phenolics also were conducted for ditch surface water, sediment, and ditch bank soil. These compounds were not detected in most of the samples. When detected, the observed levels were just slightly above detection.

Crawford Creek

- As part of the June 1996 preliminary characterization investigation, 14 sediment samples and five surface water samples were collected from Crawford Creek. Sediment samples were collected from seven locations within the creek at 0- to 6-inch and 6-inch to end-of-core intervals. Results of these analyses are presented below.

  - PAHs were detected in all sediment samples collected from Crawford Creek at concentrations ranging from 2.67 mg/kg to 1,515 mg/kg (arithmetic mean concentration of 252 mg/kg) in the 0- to 6-inch segments, and 0.442 mg/kg to 5,782 mg/kg (arithmetic mean concentration of 1,075 mg/kg) in the 6-inch to end-of-core segments. PCP was detected at four of the seven Crawford Creek sediment sampling locations at estimated concentrations ranging from 0.024 mg/kg to 0.15 mg/kg (arithmetic mean concentration of 0.029 mg/kg) in the 0- to 6-inch segments, and 0.024 mg/kg to 0.22 mg/kg (arithmetic mean concentration of 0.044 mg/kg) in the 6-inch to end-of-core segments. Diesel range organics (DRO) were detected within the Outfall 001 drainage ditch and a portion of Crawford Creek. Non-detectable DRO levels were observed at the two furthest downstream sediment sampling locations in Crawford Creek. Metals analytical results indicated either no detectable levels or levels comparable to background.

  - Total PAHs were detected in three of the five surface water samples at concentrations ranging from 0.000044 mg/L to 0.000263 mg/L, with an arithmetic mean concentration of 0.000088 mg/L. PCP was not detected in any of the Crawford Creek surface water samples.

  - Although the sampling activities indicated the presence of PAHs at low levels within surface water at certain locations within Crawford Creek, PAH levels were not detectable in the surface water sample location nearest the confluence of Crawford Creek with the Nemadji River. Furthermore, the sediment samples collected from the two sampling locations nearest the Nemadji River were shown to have relatively low levels of PAHs and no PCP.

- Physical characteristics of Crawford Creek sediment and surface water were recorded during the June 1996 investigation. Although visual impacts (i.e., staining and sheens) were observed at some sampling locations and probing transects, no visual impacts were evident at probing location ST-13/14 or further downstream.

2.8 Additional Data Needs

Additional data needs have been identified to assess the extent of PCOCs and their ultimate fate and transport within the investigation area, as well as to evaluate receptor exposure potential. These data needs will be satisfied through the supplemental investigation of surface water and sediment and the proposed ecological assessment described in Sections 3 and 4, respectively, of this work plan. Additional data will be generated through mapping, reconnaissance, sediment probing, bathymetric survey, sediment and soil analysis, surface water analysis, surface water flow measurement, habitat evaluation, endangered species/critical habitat evaluation, benthic macroinvertebrate survey, and fish survey. This information will be used collectively, along with the previous investigation results, to further evaluate the chemical, physical, and biological characteristics within the investigation area and determine the need for remedial actions.

The proposed investigation will expand on the available information regarding sediment transport. The high organic carbon content of the sediments (1.8%) in Crawford Creek and the clayey nature of the sediments collectively support the likelihood that the PCOCs will remain sorbed to the sediments. As such, data collection is proposed to further address whether sediment-sorbed or entrained constituents are immobilized and would be subject to isolation over time by further sediment deposition. In addition, analysis of sediment nutrients and electron acceptors, documented in the *Preliminary Characterization Report,* indicates that aerobic and anaerobic biodegradation may potentially result in further natural attenuation of PCOCs in Crawford Creek. To further study natural attenuation, this work plan describes the collection of additional data to assess sediment transport potential, identify sediment removal and depositional areas, identify impacted sediments, and evaluate natural recovery via sediment deposition.

Crawford Creek is a typical minnow creek, with a turbid water supply. Any potential exposure to benthic or aquatic organisms would occur predominantly through the sediment exposure route, as indicated by the relatively insignificant level of PCOCs in surface water. However, constituents bound to sediment organic carbon will generally not be bioavailable. Regardless, the intermittent nature of the creek and high sediment load may not support the presence of a prevalent benthic or aquatic community. Further evaluation of benthic and aquatic communities will be conducted as part of the EA to evaluate potential ecosystem impacts within the investigation area related to PCOCs.

3. Supplemental Characterization

3.1 Overview

The supplemental characterization activities will be conducted using a multi-task approach. As described in the following sections, the first task will consist of mapping and surveying, field reconnaissance, and sediment probing activities, and the second task will consist of surface water measurement and sampling and analysis of sediment, soil, and surface water. The third, and final, task will consist of EA field activities, described in Section 4 of this work plan.

3.2 Investigation Area

As shown on Figures 1 and 2, the investigation will focus on the surface water drainage leading from Outfall 001, which includes the unnamed drainage ditch and a portion of Crawford Creek. The areal extent of the investigation area has been delineated based on previous investigation results which indicate that impacted sediments or potentially impacted sediments may exist within this area. The extent of the investigation area is as follows: the upstream limit within the drainage ditch is Outfall 001; the upstream limit within Crawford Creek is the confluence point with the unnamed ditch; and the downstream limit is the previous investigation location ST-13/14 (shown on Figure 2). Previous study results indicate that this area encompasses the primary depositional zone of potentially impacted sediment. Deposition within this area is apparently facilitated by various obstructions, including two beaver dams that have been observed approximately 90 feet and 120 feet above the downstream limit (i.e., previous investigation location ST-13/14) of the proposed investigation area. The downstream limit was established based on the previous investigation results which indicated no significant impacts further downstream from this location. Specifically, no evidence of staining or sheens was observed at ST-13/14 or further downstream from this location, and analytical results from samples collected downstream from this location indicate no significant impact (i.e., no PAHs in surface water, PAH levels only slightly above detection in sediment, and no PCP in surface water or sediment). The background location within Crawford Creek is below the Hammond Avenue bridge, approximately 500 feet upstream of the investigation area. The background location and the appropriate limits of the investigation area within Crawford Creek will be confirmed during the proposed field reconnaissance and sediment probing activities described below.

3.3 Mapping and Survey Control

The map currently being utilized to identify the investigation area is a 1993 USGS topographic map. Although useful for assessing general features, the USGS map does not provide an appropriate scale or topographic contour intervals for data depiction and interpretation. As such, aerial photographs will be used in conjunction with field survey data to develop a more accurate and detailed topographic map of the investigation area, as well as to assist in evaluating hydrologic features, land cover, land use, and boundaries. The map will be prepared at an appropriate scale (e.g., 20:1) with appropriate contour intervals. Sampling locations (soil, sediment, and biological) will be surveyed in association with sample collection and subsequently mapped.

3.4 Field Reconnaissance, Sediment Probing, and Bathymetric Survey

Field reconnaissance will be conducted at the beginning of the investigation in conjunction with the mapping and survey control to confirm the background location and identify sediment deposition areas, potential access locations/issues, unique features, and overall drainage patterns, including the identification of water marks in the ditches and creeks. Following the reconnaissance activities, sediment probing, visual characterization, and bathymetric surveys will be performed.

The extent of visible impacts (i.e., sheens, discoloration) was documented in the *Preliminary Characterization Report* as occurring in various sampling locations along the Outfall 001 drainage ditch and at downstream sampling locations within Crawford Creek, ending at sampling location SD-13. The PAH constituents that comprise creosote have low solubilities and are highly sorbed to organic matter. Fine-grained silts and clays, because of their large surface-area-to-volume ratio and electrochemical character, sorb to PAHs. Therefore, the transport and deposition of these sediments is significant to understanding the fate and transport of these PCOCs.

Previous investigations have identified visible staining within the limits of the ditch and creek channel. These visually impacted areas did not extend more than a few feet from the edge of water. Although the probing transects to be completed during the supplemental investigation will focus on the main channel, probing will also extend outward a minimum distance of 50 feet from the top of bank (or water edge) in half of the transects, as described below.

Sediment probing will be performed in the Outfall 001 drainage ditch between the outfall and its confluence with Crawford Creek, and in Crawford Creek from its confluence with the ditch to the downstream limit of the investigation area, as shown on Figure 1. Within this area, transects will cross the creek (and ditch) from top-of-bank to top-of-bank, and will be established at intervals of approximately 200 feet (dependent on health and safety considerations and access). As explained above, probing may also be performed in areas between transects where a more detailed bathymetric survey will be developed. The probing interval will be determined in the field such that obvious depositional areas will be more intensely probed to better confirm sediment topography. Generally, sediment and bank soil will be probed at 5-foot intervals, depending on conditions encountered.

The probing activities within the Outfall 001 drainage ditch and Crawford Creek channel will be extended into the floodplain at approximately 400-foot intervals (i.e., every other transect). Floodplain soil transects will extend outward 50 feet from the stream bank, and probing will be performed at intervals of 25 feet or less.

The distance from the edge of water to the top of the bank will be measured at each location. Both endpoints of each transect will be surveyed for geographic reference and to accurately delineate the stream channel within the floodplain. The probing will focus on depositional areas and areas of abrupt changes in sediment character. Probing frequency will be higher and a more detailed bathymetric survey will be developed for localized areas where sediment deposits exist, where creosote-containing sediments are found, and where sediment thickness or other physical characteristics are highly spatially variable.

At every probing location, a metal or wooden rod will be manually pushed into the sediment or soil until refusal. The water-sediment interface in the ditches, if flowing, and in Crawford Creek will be determined through the use of a "light" probing rod, a piece of Lexan® tubing, or equivalent. The depth of penetrated sediment will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed, from the pre-determined length of the entire rod. The depth of water over the sediment will be determined at each transect.

Periodically, where changes in physical conditions or geomorphological variations occur, cores will be obtained using Lexan® tubing and extracted for visual inspection. Cores will be examined for evidence of creosote, such as visible staining or strong odor. In addition, any visually identifiable strata will be measured and described. These observations will help both to estimate the extent to which facility-related PCOCs are potentially present, and to determine subsequent sampling locations. All measurements and physical characteristics will be recorded in field books. The procedures for probing are provided in Appendix A.

3.5 Sediment/Soil Investigation

Previous sampling has indicated the presence of PAHs and PCP in the Outfall 001 drainage ditch and Crawford Creek sediment. Based on a review of existing data and the results of the field reconnaissance data and sediment probing, sampling locations will be selected to better define the vertical and horizontal distribution of PAHs and PCP, and to provide data to evaluate the need for response actions, as necessary and appropriate. Proposed sediment/soil sampling is described below.

<u>Geochronological Sampling</u>

Sediment core samples will be collected from three locations for geochronological characterization:

- Crawford Creek Pond;
- one location upstream of the two beaver dams; and
- one location downstream of the confluence of the Outfall 001 drainage ditch and Crawford Creek.

These proposed locations may be modified depending on the findings of the field reconnaissance and survey.

Geochronological analysis of select sediment cores will be conducted to estimate rates of natural recovery. The historical rate of sediment deposition will be estimated through the use of radio isotope profiles in sediment cores. Cesium 137 (^{137}Cs) is a radioactive isotope that was globally distributed by nuclear testing in the 1950s and 1960s. Its deposition began in approximately 1957 and peaked in 1963 to 1964. Using these dates as time markers, ^{137}Cs profiles in sediment can be used to estimate historical sediment deposition rates. Lead 210 (^{210}Pb) is a naturally occurring radioactive isotope with a half-life of 22.5 years and a relatively constant input to the environment. The concentration of ^{210}Pb, adjusted for decay, can be used to develop chronologies for sediment cores. Beryllium 7 (^{7}Be), another naturally occurring isotope, has a relatively short half-life of 54 days, and thus will be useful in determining the presence and rate of recent deposition, and in confirming that sediment cores were collected undisturbed. These data will be used in conjunction with PCOC data from finely sectioned cores to develop historical chronologies of sediment and PCOC deposition rates and trends in deposition.

Geochronological samples will be analyzed for three radioactive isotopes (^{137}Cs, ^{210}Pb, and ^{7}Be) to provide a means for dating sediment deposition. Each core will be segmented into thin layers. For screening purposes, the two uppermost ½-inch segments and a minimum of five additional ½-inch segments will be analyzed for ^{137}Cs, ^{210}Pb, and ^{7}Be. In addition, the remaining portions of the core will be retained for possible PAH analysis and possible additional isotope analysis, both pending results of the screening. The screening segments taken from each core will be analyzed for ^{137}Cs, ^{210}Pb, and ^{7}Be to assess evidence of a usable isotope dating profile. Should the initial evidence indicate the possibility of a usable profile, the remaining segments will be retained for analysis for ^{137}Cs, ^{210}Pb, and ^{7}Be. Specific depth intervals and segment intensity will be determined by the isotope profiles, the depth of the core, and the quality of the screening data. Depending upon the usability analysis, a determination will be made as to which (if any) additional ½-inch segments will be analyzed for ^{137}Cs, ^{210}Pb, ^{7}Be, or PAHs. Sediment core collection procedures are presented in Appendix A.

<u>Outfall 001 Drainage Ditch Soil and Crawford Creek Sediment Sampling</u>

Cores and transects will be placed at locations generally between the previous sediment sampling locations to provide spatially distributed coverage of the investigation area and to target sediment deposition areas. Specific locations will be selected with consideration of sediment/soil depth, stratification and type, the presence or absence of staining and/or strong odor, and the relative proximity of locations to one another. In addition, at least four cores will be collected from the unnamed ditch, and one background sediment core will be collected from Crawford Creek approximately 100 feet downstream of the Hammond Avenue bridge. The Hammond Avenue bridge crosses Crawford Creek approximately 600 feet upstream of the Outfall 001 drainage ditch confluence with the creek. The approximate creek transect locations, core background location, and ditch core locations are shown on Figure 2. At each transect, three cores will be collected; one core will be collected from the midchannel, and two cores will be collected from inside the banks of the stream channel (i.e., one from each side). Ditch cores will be collected from the midchannel only.

Select sediment/soil samples from the Outfall 001 drainage ditch and Crawford Creek will undergo geotechnical testing to further characterize the material texture and strength, and to characterize potential sediment transport and deposition patterns. The potential for resuspension and erosion of PCOC-containing sediments is dependent on hydrodynamic conditions and the properties of the sediment or substrate (i.e., grain-size, compaction, organic content, water content, etc.). The properties of this sediment and substrate also affect the potential for bioturbation. To evaluate these properties, the following tests will be performed on selected sediment samples representative of the various zones of sediment erosion or deposition:

- Grain size (ASTM Method D2487);

- Moisture content (ASTM Method D2216);
- Atterburg limits (ASTM Method D4318); and
- Specific gravity (ASTM Method D854).

The exact number, locations, and intervals of these samples will be field-selected to provide data that are representative of different material types observed during probing. Each of the geotechnical parameters will be measured for a given core segment sample so the data can be correlated among parameters. The geotechnical information will be used in sediment/soil characterization and transport evaluation.

Approximately 20 sediment locations will be selected for analytical testing along the Outfall 001 drainage ditch and Crawford Creek. Sediment cores (three cores per transect) will be obtained by pushing Lexan® tubes into the sediment until refusal, using methods described in Appendix A. At each location, the cores will be segmented (e.g., 0 to 3 inches, 3 to 6 inches, 6 to 12 inches, and 12 inches to refusal) and analyzed for PAHs (USEPA Method 8310), PCP (Keystone Method 589), and total organic carbon (TOC) (USEPA Method 9060). The number of segments per core will be determined in the field, depending upon sediment characteristics and depth at each location.

<u>**Crawford Creek Floodplain Soil**</u>

Based on current understanding of surface water discharge characteristics, water discharging from Outfall 001 does not breach the banks of the ditch. Therefore, the floodplain soil sampling activities will focus only on the immediate floodplain of Crawford Creek, from its confluence with the unnamed ditch to the downstream limit of the investigation area. When selecting the locations, consideration will be given to soil stratification and type, and the presence or absence of staining and/or odor. In the Crawford Creek floodplain, approximately 10 locations will be selected for analytical testing to assess the soil quality and characteristics. Soil samples will be collected in the floodplain with a Lexan® tube sampler or a hand auger, depending on soil characteristics. At each location, the cores will be segmented and analyzed for PAHs and TOC. The core segments proposed for analysis are the 0- to 6-inch and the 6-to 12-inch intervals.

3.6 Surface Water Sampling and Flow Measurement

Surface water samples will be collected from the Outfall 001 drainage ditch and Crawford Creek to provide data for the EA, sediment transport characterization, and hydraulic evaluation. The proposed surface water sampling locations are shown on Figure 2.

Surface water samples will be collected at four locations: 1) in the Outfall 001 drainage ditch just upstream from its confluence with Crawford Creek; 2) at the background location in Crawford Creek below the Hammond Avenue bridge, approximately 500 feet upstream of the investigation area; 3) in Crawford Creek approximately 400 feet downstream of Crawford Creek Pond; and 4) in Crawford Creek near the downstream limit of the investigation area. Surface water samples will be collected and analyzed for PAHs (USEPA Method 8310), PCP (Keystone 589), and total suspended solids (TSS) (USEPA Method 160.2). To provide an indication of general water quality, field measurements for temperature, dissolved oxygen (DO), pH, specific conductivity, and turbidity will be made at these locations using standard field instrumentation. Procedures for measuring basic water quality parameters in-situ are provided in Appendix B, while surface water sampling procedures are provided in Appendix C.

Flow in Crawford Creek will be measured to characterize the hydrologic variation and to provide a record of flow during the sampling activities. At the commencement of field activities, a staff gage will be installed on Crawford Creek at one of the bridge crossings. Placement of the staff gage will be determined in the field considering backwater effects and ease of flow measurement and gage reading. Elevation of the water surface will be recorded daily during the field investigation to relate general flow conditions to conditions observed during sediment probing and sampling. Several flow measurements will be made over a range of water surface elevations to calibrate the gage and develop a rating curve for flow estimation. These curves will be used to estimate annual sediment loads. Surface water flow estimation procedures are provided in Appendix D.

The transport of sediment in the Outfall 001 drainage ditch and Crawford Creek can influence the fate and transport of sediment-borne PAHs, as well as the rate of burial and isolation of impacted sediments. To characterize sediment transport in the Outfall 001 drainage ditch and Crawford Creek during flood events, efforts will be made to intensively sample surface water for TSS during and following a significant rainfall event. Typically, a large proportion of annual sediment transport occurs in streams during high flow conditions which occur proportionately over a small percent of the time. Event-based surface water sampling will be performed with the intent to sample TSS over a wide range of flows to develop sediment loading curves that relate flow with sediment conditions.

Measurements of surface-water flow will be performed at the four surface water sampling locations shown on Figure 2. Velocity measurements will be made by dividing the creek into 5-foot sections along the width (as appropriate) and obtaining an average flow velocity at each station. Average flows will be determined by measuring the flow velocity at 20 percent and 80 percent of the water depth and averaging the two values for each 5-foot section. The average flow velocity multiplied by the cross-sectional area of the creek increment will provide an estimate of flow in that increment. The sum of the flows in each increment across the creek represent the total creek flow at that location.

At each surface-water flow measurement location, flow measurements will be taken during "low-flow" and "high-flow" conditions. For the purposes of this investigation, a "low-flow" condition is defined as the flow following a three-day period without precipitation. Similarly, a "high-flow" condition is defined as the flow following a minimum rainfall of 0.5 inches in a 48-hour period. Event water column sampling will consist of the measurement of the standard field parameters (i.e., temperature, pH, DO, specific conductivity, and turbidity) and collection of representative discrete samples for TSS analysis.

3.7 Health and Safety Plan

A Health and Safety Plan (HASP) for the proposed field activities will be developed in a manner consistent with appropriate regulations and guidance, including the Occupational Safety and Health Administration 29 CFR 1910.120 - "Hazardous Waste Operations and Emergency Response, Final Rule," dated March 6, 1990. The HASP will detail the precautions to be taken during the performance of field activities associated with the investigation. The HASP will discuss personnel responsibilities, protective equipment, procedures, protocols, decontamination methods, medical surveillance, local hospitals, and phone numbers of emergency personnel.

3.8 Sample Handling and Analysis

Field sample packing, handling, and shipping procedures are provided in Appendix E. Field cleaning/decontamination procedures are provided in Appendix F. All sampling activities will be conducted in accordance with the *Health and Safety Plan,* and all sample handling and analysis will be in accordance with Appendices A-G of this work plan, the *SAP*, and the *Quality Assurance Plan, Phase III RCRA Facility Investigation (RFI) at the Koppers Industries, Inc. Superior, Wisconsin Facility* (Groundwater Technology, Inc., July 1995; hereafter referred to as the *QAPP*). All data will be validated as prescribed in the QAPP, and the appropriate validation reports will be produced. Following receipt and validation of all data, results of the investigation will be summarized in a report that will include summary of sampling activities and a presentation of all field, analytical and quality assurance/quality control (QA/QC) data, field notes, and sample chain-of-custody forms.

4. Ecological Assessment

4.1 General

This section of the work plan presents the proposed EA activities to be conducted in Crawford Creek. Crawford Creek is intermittent, and is described as a typical minnow creek that presumably has some type of benthic invertebrate community as well. Despite the habitat limitations, available information suggests that the potential exists for exposure of aquatic species to PCOCs in the creek. In addition, the presence of PCOCs in some locations at levels greater than certain conservative screening criteria suggest that further evaluation is appropriate. Because these conservative criteria are based on studies involving exposure of aquatic biota under conditions that are not representative of Crawford Creek, the EA activities described below are designed to provide field data to determine if there is any significant impact on biological resources in the creek.

The proposed EA was developed in general accordance with the USEPA's (1997) *Ecological Risk Assessment Guidance for Superfund* and the WDNR's (1992) *Guidance for Assessing Ecological Impacts and Threats from Contaminated Sediments*. The USEPA guidance is more recent than the WDNR guidance, and generally encompasses the WDNR guidance.

The eight steps of the USEPA guidance are as follows:

1. Screening-Level Problem Formulation and Ecological Effects Evaluation;
2. Screening-Level Preliminary Exposure Estimate and Risk Calculation;
3. Baseline EA Problem Formulation;
4. Study Design and Data Quality Objectives;
5. Field Verification of Sampling Design;
6. Site Investigation and Analysis of Exposure and Effects;
7. Risk Characterization; and
8. Risk Management.

The USEPA (1997) guidance includes the completion of a preliminary screening-level EA [Steps 1 and 2 as listed above]. For purposes of this work plan, the findings presented in the *Preliminary Characterization Report* are assumed to represent a preliminary conservative screening-level assessment as outlined in Steps 1 and 2 above. Based on this assumption, the tasks described in this work plan proceed beyond the screening-level assessment [i.e., they begin with Step 3 of the USEPA (1997) guidance], and describe additional studies that will be conducted to present a more detailed EA.

4.2 Problem Formulation

Problem formulation [i.e., Step 3 of the USEPA (1997) guidance] represents the scoping and design phase of the EA, and establishes the goals, breadth, and focus of the assessment. Specifically, the problem formulation involves the development of a conceptual site model and the selection of assessment and measurement endpoints.

According to USEPA (1997) guidelines, the conceptual site model includes a preliminary description of the degree and extent of chemical constituents, potential migration and exposure pathways, and a description of the biological resources. Much of this information was previously presented in Section 2 of this work plan. For purposes of this EA, the conceptual model involves potential migration of constituents via Outfall 001 drainageways. As noted previously, and as would be expected for the PCOCs, sediments (rather than surface water) are expected to be the primary source media for potential receptor exposure. In terms of potential receptor exposure, the unnamed ditch reportedly does not support a viable aquatic benthic community; therefore, the assessment of potential effects on aquatic biota will focus on Crawford Creek.

A key component of planning and designing an EA is the selection of endpoints (USEPA, 1997; WDNR, 1992). EAs use two types of endpoints: (1) assessment endpoints and (2) measurement endpoints. In general, an assessment endpoint defines both the valued ecological attributes of a site (e.g., species, ecological resources, or habitat types) and associated characteristic(s) to be protected (e.g., reproductive success). The primary assessment endpoint in this case is protecting downstream benthic and aquatic communities from alterations due to PCOCs. A measurement endpoint is a measurable ecological characteristic that is related to the assessment endpoint. This work plan proposes the following measurement endpoints: 1) comparison of benthic macroinvertebrate and fish community measurements (e.g., abundance, diversity) for Crawford Creek upstream and downstream of the ditch confluence; and 2) comparison of the fish physical condition in Crawford Creek upstream and downstream of the ditch confluence.

4.3 Ecological Investigation Activities

The following investigations are proposed to characterize the ecological communities and address the previously described measurement endpoints [i.e., Steps 4 - 6 of the USEPA (1997) guidance]. This work plan presents the general study design for ecological investigation activities (Step 4). Subsequent field surveys (i.e., habitat evaluations and endangered species/critical habitats survey activities) will be used to field-verify the sampling design (Step 5). A benthic macroinvertebrate survey and fish survey subsequently will be conducted to identify ecological effects, if any (Step 6). In this manner, information from the field reconnaissance and habitat evaluation will be used to modify the investigation design as appropriate.

4.3.1 Habitat Evaluations

Habitat evaluations will be conducted for the Outfall 001 drainage ditch and Crawford Creek to determine the different habitat types in the vicinity of the facility and to specify sampling locations for subsequent investigations. Available habitat information will be reviewed prior to the field survey. With the available information in hand, a field biologist will visit the investigation area to verify general locations of different habitat types within the ditch and creek (including the verification of wetlands) and select specific sampling locations.

4.3.2 Endangered Species/Critical Habitat Identification

Prior to the field work for the habitat evaluations, the field biologist will review information from the United States Fish & Wildlife Service and Wisconsin Natural Heritage Inventory Program to become familiar with the habitat requirements and characteristics of threatened/endangered species near the investigation area. Any observations of threatened/endangered species during the habitat evaluation walkover will be documented.

4.3.3 Benthic Macroinvertebrate Survey

A comparison of community structure in the creek at locations upstream and downstream of its confluence with the unnamed ditch will be made to determine whether any adverse impacts on benthic invertebrates may be occurring, and if these impacts may be associated with the PCOCs in Crawford Creek.

Benthic sampling locations will be co-located, to the extent possible, with selected sediment sampling locations and will be located to provide a representative indication of benthic macroinvertebrate composition in the investigation area. At this time, the upstream reference location is proposed to coincide with the background sediment sampling location (i.e., about 100-feet downstream of the Hammond Avenue bridge). Two additional survey locations are recommended in Crawford Creek: one immediately downstream of its confluence with the unnamed ditch [e.g., in the vicinity of previous sediment samples (SD-8, -10, -11)], and one further downstream near the lower end of the investigation area (e.g., in the vicinity of previous sediment sample SD-13). Because of the overriding influence of habitat quality on benthic community structure, it will be necessary to use the field reconnaissance effort to identify specific sampling locations that have very similar habitat. This field-verification of sampling design is Step 5 of the USEPA (1997) guidance.

The benthic survey techniques will generally follow the USEPA (1989) Rapid Bioassessment Protocols. Standard ASTM procedures will also be used as appropriate and may include: ASTM D 4387-84 *Standard Guide for Selecting Grab Sampling Devices for Collecting Benthic Macroinvertebrates*; ASTM D 4342-84 *Standard Practice for Collecting Benthic Macroinvertebrates with Ponar Grab Sampler*; and/or ASTM D 4343-84 *Standard Practice for Collecting Benthic Macroinvertebrates with Ekman Grab Sampler*. Procedures for the benthic macroinvertebrate survey are described in Appendix G.

4.3.4 Fish Survey

A fish survey will be conducted in Crawford Creek to determine if there are any significant differences in fish community composition that might be attributable to PCOCs. To conduct the survey, appropriate reaches of Crawford Creek, approximately 100 feet in length, will be marked off in each sampling area. The reaches to be sampled will be selected based on presence of similar representative habitats, as well as available sediment data. Using either streamside or backpack electrofishing techniques, fish populations will be sampled at each of the three stations. The three proposed sampling locations (one upstream reference location and two downstream locations in Crawford Creek) will coincide with the benthic macroinvertebrate survey locations, subject to field-verification. The techniques for the fish survey will involve isolating discrete sections of stream with block nets, and collecting as many fish as possible within each section using electrofishing equipment. The fish collected from each section will be counted by species, and released back into the stream. As part of the fish survey, observations of their physical condition will be recorded. This information will be used to determine if abnormalities are present in fish from Crawford Creek. If sufficient numbers of fish are collected, appropriate ecological indices will be calculated using the numerical and taxonomic information provided by this activity. More detailed procedures for performing the fish survey are provided in Appendix G.

4.4 Risk Characterization

Risk characterization [Step 7 of the USEPA (1997) guidance] will involve evaluating the results of the fish and macroinvertebrate surveys (i.e., comparing indices to those from the upstream background location) to determine if significant differences exist. These differences, if any, will then be evaluated in conjunction with available chemical data and information on habitat quality to determine if observable differences may have been caused by the presence of PCOCs. Finally, the ecological significance of PCOC-related effects on community structure will be evaluated in terms of the size of the affected area, the value of the potentially impacted community, and the likelihood of impacts outside the investigation area. This information will then be used to determine what risk management actions (Step 8), if any, may be appropriate to mitigate ecological effects.

5. Project Organization and Schedule

5.1 Project Organization

This investigation is being conducted on behalf of Beazer East, Inc. by Blasland, Bouck & Lee, Inc. The concurrent RFI at the KII Superior, Wisconsin facility is being conducted on behalf of Beazer East, Inc. by Fluor Daniel GTI, Inc. Addresses are as follows:

Address and Telephone Numbers:
Beazer East, Inc. One Oxford Center, Suite 3000 Pittsburgh, PA 15219 (412) 208-8800
Blasland, Bouck & Lee, Inc. 6723 Towpath Road Syracuse, NY 13214 (315) 446-9120
Fluor Daniel GTI, Inc. 637 Braddock Avenue East Pittsburgh, PA 15112 (412) 823-5300

5.2 Project Schedule

Provided as Figure 5, the proposed project schedule assumes that agreements to access the investigation area are obtained prior to initiating field activities, and that there are no unforeseen delays associated with gaining access. The proposed timing of the field activities is approximate and will be weather-dependent. It is anticipated that the field activities will be implemented during the summer and/or fall, given the completion date of this work plan. Additionally, it is estimated that the field investigation and laboratory analyses described in this work plan can be implemented within a nine-week time schedule. The work will be conducted in a coordinated effort, starting with the field reconnaissance and sediment probing. Mapping and surveying will be conducted concurrently with the sample collection and EA activities. It is assumed that an investigation report will be prepared after all the proposed field activities are completed.

6. References

Fluor Daniel GTI, Inc. *Preliminary Characterization Report, Surface Water and Streambed Sediment - Koppers Industries, Inc., Superior, Wisconsin Facility*, East Pittsburgh, PA. March 1997.

Fluor Daniel GTI, Inc. *Phase III RCRA Facility Investigation Report, Soil and Ground Water, Koppers Industries, Inc., Superior, Wisconsin Facility*, East Pittsburgh, PA. June 1997.

Keystone Environmental Resources, Inc. *Phase II RCRA Facility Investigation Report of Findings, Koppers Industries, Inc., Superior, Wisconsin*, Monroeville, Pennsylvania. June 1991.

USEPA. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, EPA 540-R-97-OCS. June 1997.

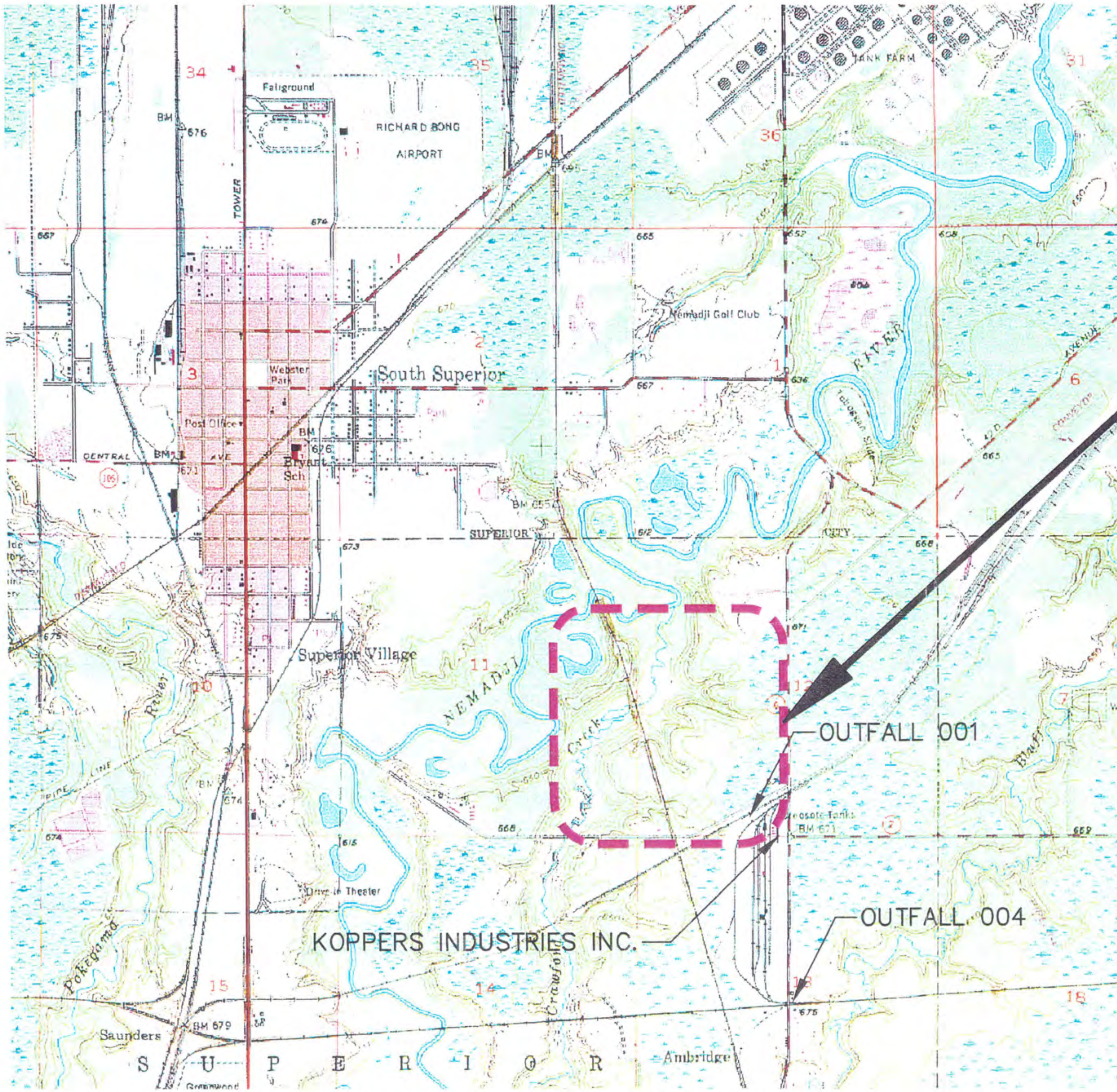
USEPA. *Revision to Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish.* Office of Water. October 1996.

WDNR. *Guidance for Assessing Ecological Impacts and Threats from Contaminated Sediments*, PUBL-WR-321-93. October 1992.

WDNR. *Background Document on Assessing Ecological Impacts and Threats from Contaminated Sediments* PUBL-WR-322-930. October 1992.

Figures

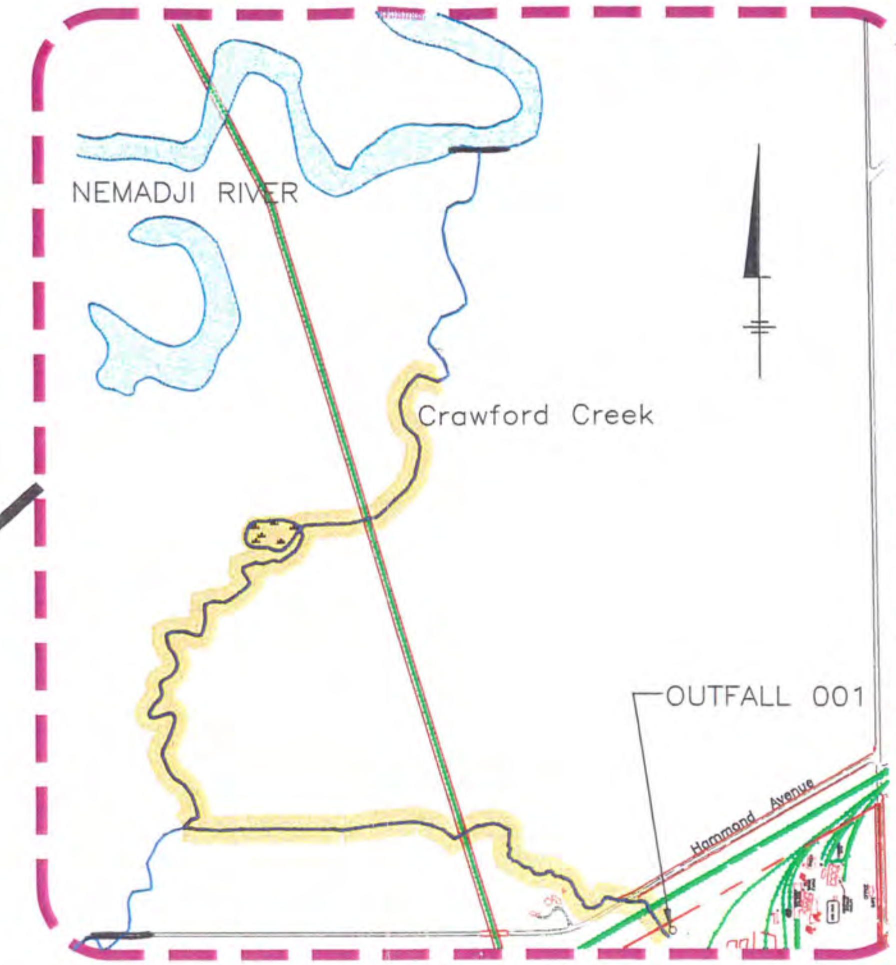
BLASLAND, BOUCK & LEE, INC.
engineers & scientists



BASE MAP SOURCE: USGS 7.5 MIN TOPO QUAD., SUPERIOR, WIS.–MINN., 1954 (PHOTO REVISED 1993)

LOCATION MAP

0 2500' 5000'
APPROXIMATE GRAPHIC SCALE



BASE MAP SOURCE: FLUOR DANIEL GTI, INC. FIGURE 2–1, PRELIMINARY CHARACTERIZATION REPORT – SURFACE WATER AND STREAMBED SEDIMENT, MARCH 1997

LEGEND

PROPOSED SUPPLEMENTAL INVESTIGATION AREA

PROPOSED INVESTIGATION AREA

0 1000' 2000'
APPROXIMATE GRAPHIC SCALE

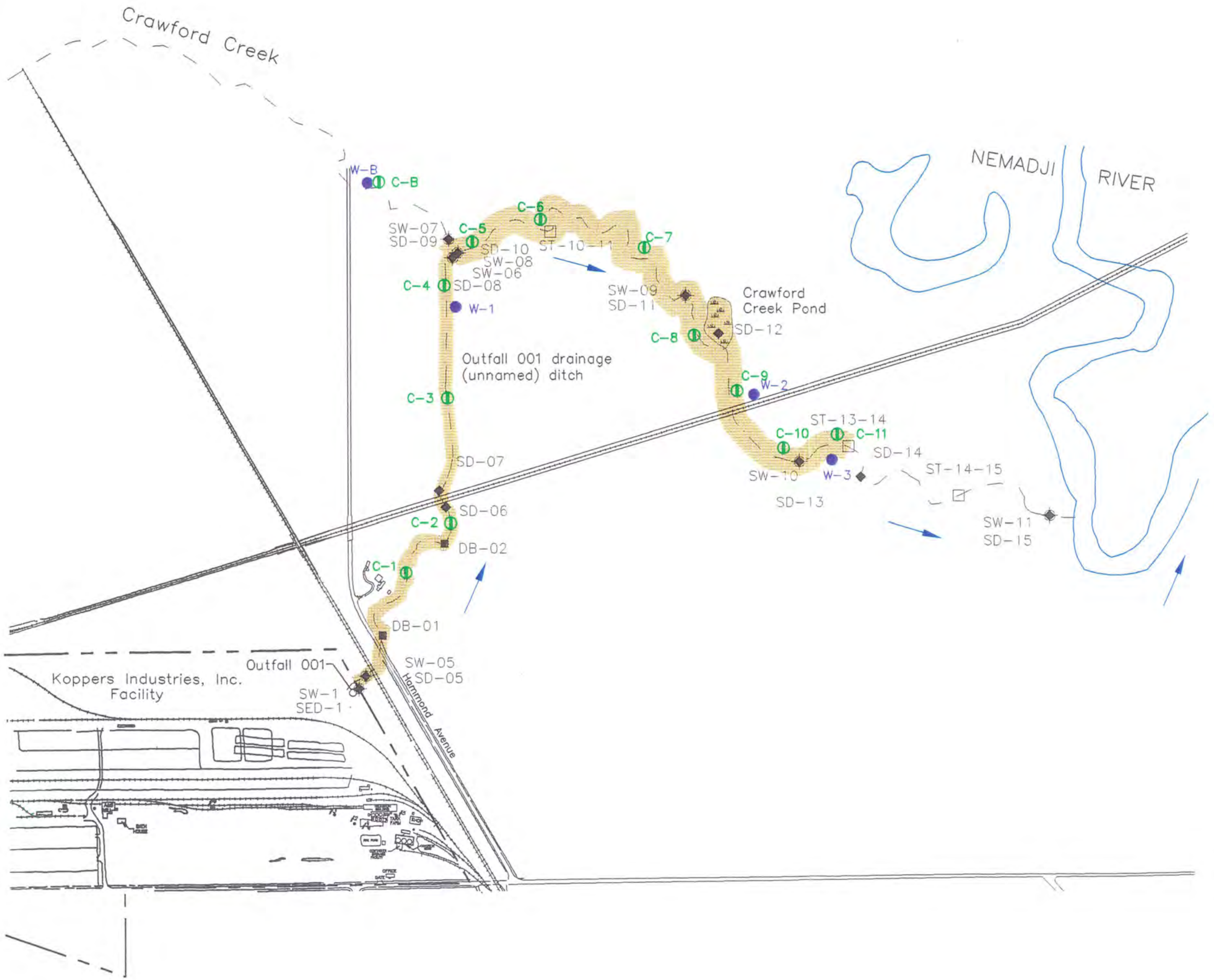
L: ON=*, OFF=REF
P: STD-PCP/BL
4/30/98 SYR-54-GMS
38721001/38721G01.DWG

KOPPERS INDUSTRIES, INC.
SUPERIOR, WISCONSIN FACILITY
SUPPLEMENTAL INVESTIGATION WORK PLAN

INVESTIGATION LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 1



LEGEND

- Intermittent Stream
- Approximate Facility Property Boundary
- SW-05 Previous Surface Water Sample Location
- SD-13 Previous Sediment Sample Location
- DB-01 Previous Ditch Bank Sample Location
- ST-13-14 Stream Description Location
- Proposed Investigation Area
- W-B Proposed Surface Water Sample Location and Surface Water Measurement Location
- C-4 Proposed Core Sample Location
- Drainage Flow Direction

NOTES:
1. Sample locations are based on surveyed coordinates. The remaining portions of the map are approximated from the U.S.G.S topographic map of the area.
2. Base map source: Fluor Daniel GTI, Inc. Figure 2-1, Preliminary Characterization Report-Surface Water and Streambed Sediment, March 1997.
3. Proposed sediment probing locations and biota monitoring locations are not shown. These locations will be selected as described in Sections 3 and 4, respectively, of the work plan.

0 600' 1200'
APPROXIMATE GRAPHIC SCALE

KOPPERS INDUSTRIES, INC.
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SUPPLEMENTAL INVESTIGATION WORK PLAN

SAMPLE LOCATIONS

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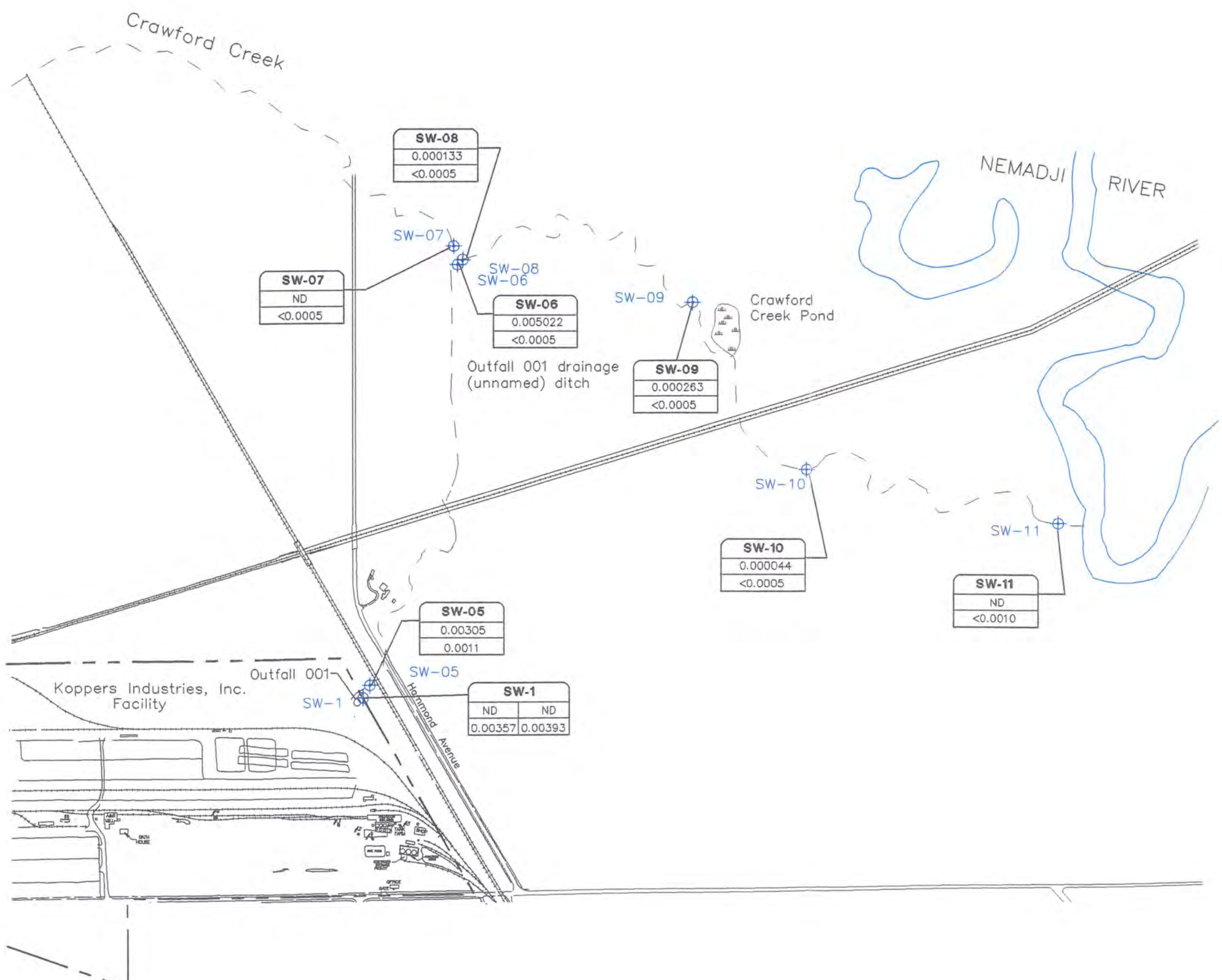
FIGURE 2

X: (XREF)
L: OFF=AOC,CONTOUR-GS,DCA INFO,F3*,F4*,NODE,POST_OFF,REF,WELLS,SSL,SDSL,DBSL,GRID
P: Superior
5/4/98 SYR-54-RCB, PGL
38721001/38721SM1.DWG



LEGEND

Intermittent Stream

Approximate Facility Property Boundary

SW-05 Surface Water Sample Location

SW-05	1996 Surface Water Sample Location
0.00305	Total PAH Concentration (mg/L)
0.0011	Pentachlorophenol Concentration (mg/L)

SW-1		1990 Surface Water Sample Location
ND	ND	Total PAH Concentration (mg/L)
0.00357	0.00393	Pentachlorophenol Concentration (mg/L)

NOTES:

1. Sample locations are based on surveyed coordinates. The remaining portions of the map are approximated from the U.S.G.S topographic map of the area.
2. Base map source: Fluor Daniel GTI, Inc. Figure 2-1, Preliminary Characterization Report-Surface Water and Streambed Sediment, March 1997.
3. 1990 Data Source: Keystone Environmental Resources, Inc. Phase II RCRA Facility Investigation - Report of Findings, June 1991.
4. ND = Not Detected.
   No individual PAH compounds were detected; detection limits for the individual PAHs ranged from 0.00002 mg/L to 0.002 mg/L.

0 600' 1200'

APPROXIMATE GRAPHIC SCALE

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SUPPLEMENTAL INVESTIGATION WORK PLAN

PREVIOUS SURFACE WATER SAMPLE RESULTS

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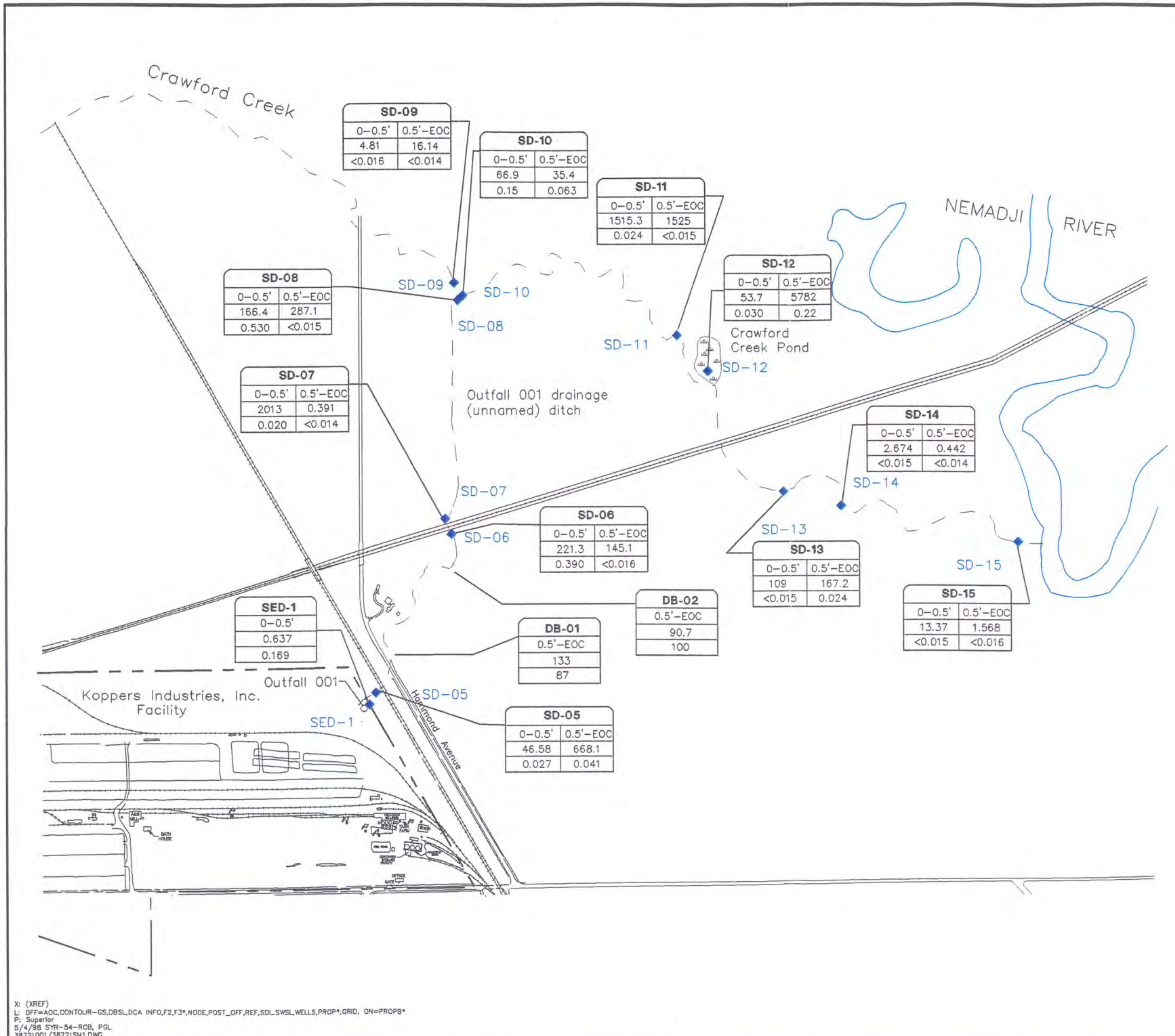
FIGURE 3

X: (XREF)
L: OFF=AOC,CONTOUR-GS,DBSL,DCA INFO,F2,F4*,NODE,POST_OFF,REF,SDL.SSL,WELLS,PROP* ON=PROPB*
P: Superior
5/4/98 SYR-54-RCB, PGL
38721001/38721SM1.DWG



LEGEND

Intermittent Stream

Approximate Facility Property Boundary

SD-13 Sediment Sample Location

DB-01 Ditch Bank Sample Location

SD-14	
0-0.5'	0.5'-EOC
2.674	0.442
<0.015	<0.014

1996 Sediment Sample Location
Sample Depth
Total PAH Concentration (mg/Kg)
Pentachlorophenol Concentration (mg/Kg)

SED-1
0-0.5'
0.637
0.169

1990 Sediment Sample Location
Sample Depth
Total PAH Concentration (mg/Kg)
Pentachlorophenol Concentration (mg/Kg)

NOTES:
1. Sample locations are based on surveyed coordinates. The remaining portions of the map are approximated from the U.S.G.S topographic map of the area.
2. Base map source: Fluor Daniel GTI, Inc. Figure 2-1, Preliminary Characterization Report-Surface Water and Streambed Sediment, March 1997.
3. 1990 Data Source: Keystone Environmental Resources, Inc. Phase II RCRA Facility Investigation - Report of Findings, June 1991.
4. EOC = End of core

0 600' 1200'
APPROXIMATE GRAPHIC SCALE

KOPPERS INDUSTRIES, INC.
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SUPPLEMENTAL INVESTIGATION WORK PLAN

PREVIOUS SEDIMENT AND DITCH BANK SOIL SAMPLE RESULTS

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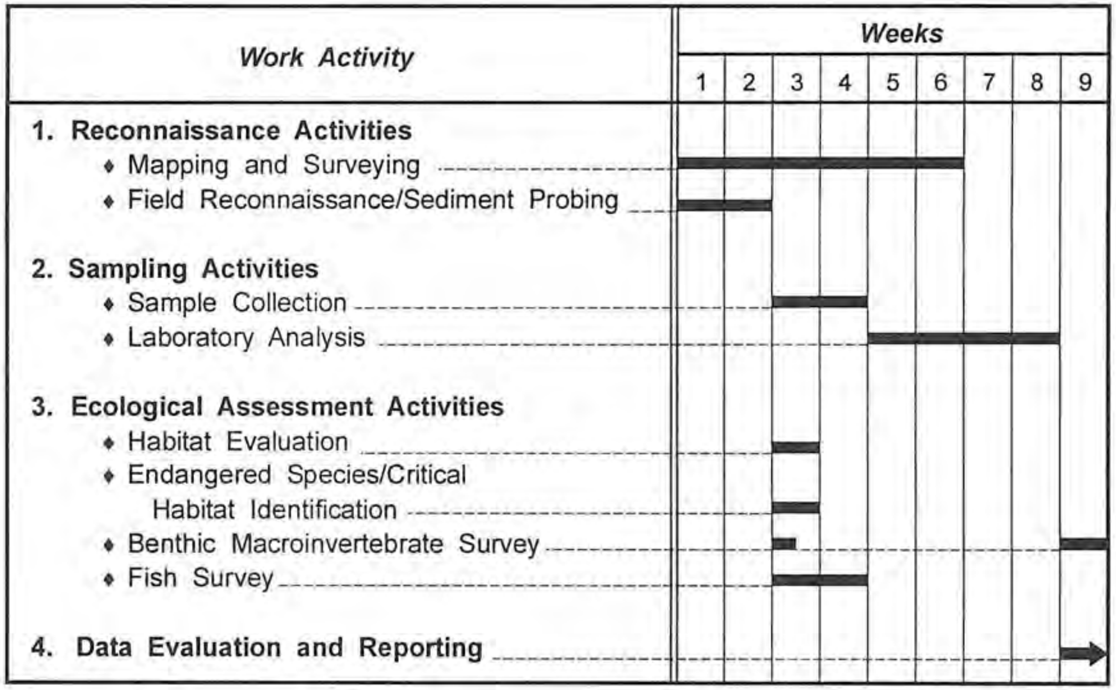
FIGURE 4

X: (XREF)
L: OFF=ADC,CONTOUR-GS,DBSL,DCA INFO,F2,F3*,NODE,POST_OFF,REF,SDL,SWSL,WELLS,PROP*,GRID, ON=PROPB*
P: Superior
5/4/98 SYR-54-RCB, PGL
38721001/38721SM1.DWG



NOTES:

1. The proposed schedule assumes that timing/weather conditions are appropriate for conducting field activities.

KOPPERS INDUSTRIES, INC.
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SUPPLEMENTAL INVESTIGATION WORK PLAN - SURFACE WATER AND STREAMBED SEDIMENT

PROPOSED PROJECT SCHEDULE

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FIGURE **5**

4/98 SYR-D54-LBR, DJH
38721002/38721j03.cdr

Appendices

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engineers & scientists

Appendix A - Sediment Sampling Procedures

Sediment Sampling Procedures (full core, sediment dating cores, underlying material)

I. Introduction

The general procedures to be utilized in obtaining samples from the Outfall 001 drainage ditch and Crawford Creek is outlined below. This includes full core and sediment dating cores. Lexan® tubing will be the primary method used to collect sediment cores. The core will be inserted with a straight, vertical entry into the sediments to secure a representative cross-section sample.

II. Materials

The following materials will be available, as required, during sediment sampling activities:

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required in Appendix F);
- Boat;
- Aluminum or stainless steel tray;
- Duct tape;
- Lexan® tubing with end caps;
- Stainless steel core driver;
- Stainless steel spatula;
- Brass push rod;
- Calibrated rod for sediment depth measurement;
- Hacksaw;
- 6-Foot rule or survey rod;
- Vacuum pump;
- Transport container with ice;
- Appropriate sample containers and forms;
- Field notebook; and
- Camera.

"171

III. Procedures for Lexan® Tube Sampling

1. Identify the proposed sample locations in the field notebook along with other appropriate information collected during sediment sampling activities.

2. Don personal protective equipment (as required by the Health and Safety Plan).

3. At each sample location, lower a section of Lexan® tube until it just reaches the top of sediment. Measure the depth of water (Sections of Lexan® tube may need to be spliced together in deep water locations).

4. Push the Lexan® tube into the sediment by hand until refusal. Measure the depth of sediment.

5. Drive the tube several more inches, using a stainless steel core driver, and measure the distance. This procedure is performed to obtain a "plug" at the bottom of the core and prevent the loose sediment from escaping.

6. Place a vacuum pump on the top end of the Lexan® tube and create a vacuum to prevent the sediments/plug from escaping.

7. Slowly pull the tube from the sediment, twisting it slightly (if necessary) as it is removed.

8. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

9. Keeping the tube upright, wipe the bottom end dry and seal the cap with duct tape. Measure the length of sediment recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat coring procedure adjacent to the first location attempted.

10. While still keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately one inch above the sediment.

11. Re-cap the cut end of the tube, seal the cap with duct tape, and mark this end as "TOP."

12. Wipe the tube dry.

13. Place a completed sample label on the tube.

14. Record the following information on both the tube and on the cap: 1) sample number; 2) sampling date; and 3) sampling time.

15. Photograph the core.

16. Place the core sample upright in a container with ice.

17. Repeat the above procedures until all core samples are collected (for the sampling event or the sampling day).

18. Sediment cores will be extruded from the Lexan® tubing onto an aluminum or stainless steel tray. Cores will be sectioned into the required depth-proportioned increments based on the ratio of the measured sediment depth to the recovered sediment depth to account for sample compression or expansion during collection. Each increment will be homogenized prior to placement in sample containers and individually packaged. Containers with samples for analysis of volatiles will be filled first prior to homogenization (if required). Describe and record sample descriptions.

19. Core sections may be frozen to facilitate sectioning when sediment is extremely loose.

20. The handsaw or spatulas used to section the core should be cleaned (as described in Appendix F) between each cut.

21. Label all sample containers and record all appropriate information in the field notebook.

22. Handle, pack, and ship the samples in accordance with the procedures in Appendix E.

Underlying Material Sampling Procedures

I. Introduction

The general procedures to be utilized in obtaining underlying material samples beneath sediment are outlined below. Underlying material samples beneath sediment may be collected using procedures described above for the sediments. As an alternative, the following sampling procedures are presented.

II. Materials

The following materials will be available, as required, during underlying material sampling:

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required by Appendix F);
- Boat and motor;
- Rope;
- Surveyor's rod and 6-foot rule;
- Aluminum or stainless steel tray;
- Duct tape;
- Lexan® tubing with end caps, standard split-spoon, and/or stainless steel bucket auger;
- Brass push rod;
- Hacksaw;
- Stainless steel spatula;
- Calibrated rod for sediment depth measurement;
- 4-Inch PVC pipe with capped bottom end;
- Vacuum pump;
- Transport container with ice;
- Appropriate sample containers and forms; and
- Field notebook.

III. Procedures for Underlying Material Sampling

A. 1. Identify the proposed sample location in the field notebook along with other appropriate information collected during underlying material/sediment sampling activities.

2. Don personal protective equipment (as required by the Health and Safety Plan.)

3. At each sample location, lower the closed piston sampler through the sediment until the underlying material is distinguished. Measure and record the depth to top of underlying material layer.

4. Hold the piston in place and drive the outer Lexan® into the underlying material to a depth to ensure sufficient soil recovery or until refusal. Measure the depth of soil penetrated.

5. Keep the piston in place and withdraw the piston sampler evenly. This is important in order to prevent a void in the tube below the underlying material sample, which may allow sediment to enter while passing through the sediment layer.

6. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

7. Keeping the tube upright, wipe the bottom end dry and seal the cap with duct tape. Measure the length of material recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat coring procedure adjacent to the first location attempted.

8. While still keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately one inch above the material.

9. Re-cap the cut end of the tube, seal the cap with duct tape, and mark this end as "TOP."

10. Wipe the tube dry.

11. Place a completed sample label on the tube.

12. Record the following information on both the tube and on the cap

    a. Sample number;
    b. Sampling date; and
    c. Sampling time.

13. Place the core sample upright in a container with ice.

14. Repeat the above procedures until all core samples are collected (for the sampling event or the sampling day).

15. Underlying material will be extruded from the Lexan® tubing onto an aluminum or stainless steel tray. Cores will be sectioned into the required depth-proportioned increments, based on the ratio of the measured material depth to the recovered material depth to account for sample compression or expansion during collection. Each increment will be homogenized prior to placement in sample containers and packaged. Describe and record sample descriptions.

16. The hacksaw or spatulas used to section the core should be cleaned (as described in Appendix F) between each cut.

17. Label all sample containers and record all appropriate information in the field notebook.

18. Handle, pack, and ship the samples in accordance with the procedures in Appendix F.

B. As an alternative sampling method, steps 3 through 14 can be substituted with the following procedures:

1. At each sample location, lower the 4-inch PVC pipe with capped bottom end through the sediment until the underlying material layer is distinguished. This is performed to prevent the overlying sediment from

contaminating the material to be sampled. Measure and record the depth to the top of the underlying material.

2. Place a stainless steel bucket auger or split-spoon sampler through the PVC pipe, breaking the cap. Maintain the PVC pipe in position at all times.

3. The bucket auger is then manually advanced to collect the underlying material sample.

4. Retrieve the bucket auger through the PVC pipe, while keeping the PVC pipe in position.

5. Open the bucket auger and remove the liner containing the sample.

6. Extrude the material from the core liner onto an aluminum or stainless steel tray.

7. After sample collection, follow steps 15 through 18, as described in the preceding Section III. A.

Appendix B - Procedures for Measuring Basic Water Quality Parameters In-Situ

I. Introduction

Water quality parameters (e.g., turbidity, specific conductivity, pH, and temperature) of natural waters are usually measured in the field. The temperature, pH, specific conductivity, dissolved oxygen, and turbidity of surface water will be measured in-situ with a combination water quality meter (Horiba U-10 or equivalent). Conductivity is the ability of a solution to pass an electric current. This current is carried by inorganic dissolved solids. The measurement of conductivity is useful to relate the chemical purity of the water and the amount of dissolved solids in a solution. The measurement of turbidity is useful in that it expresses the relative amount of suspended particles in the water column.

II. Materials

The following materials, as required, shall be available during field measurement of water quality:

- Personal protective equipment;
- Cleaning equipment;
- Combination water quality meter;
- Standard solutions for calibration;
- Distilled/deionized water;
- Extra batteries for the meter; and
- Appropriate forms and field notebook.

III. Measurement of Temperature, pH, Conductivity, and Turbidity

Calibration Procedures

The meter will be calibrated following the manufacturer's instructions. Calibration information will be recorded in the field notebook.

Operation Procedures

The meter will be operated following the manufacturer's instructions. Two readings will be made and the average will be recorded in the field notebook.

Maintenance Procedures

The meter will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field notebook. A replacement meter and probes will be available on-site or ready for overnight shipment, as necessary.

Appendix C - Surface Water Sampling Procedures

I. Introduction

The general procedures to be utilized in obtaining water column samples are outlined below.

II. Materials

The following materials will be available, as required, during water column sampling:

- Health and safety equipment;
- Cleaning equipment;
- Boat and motor;
- Rope;
- Appropriate water sampler (Wildco Kemmerer stainless steel bottle sampler or equivalent);
- Flagging;
- Large glass mixing container;
- Teflon stirring rod;
- Combination water quality meter (Horiba U-10, or equivalent);
- Appropriate transport containers and packing, labeling, and shipping materials (coolers) with ice;
- Appropriate sample containers and forms; and
- Field notebook.

III. Water Column Sampling Procedures

Water column samples will be collected utilizing a stainless steel Kemmerer water sampler or equivalent. Water column samples will be collected from flowing water; grab samples will not be collected from standing water. Surface water samples at each location will be collected from depths of 0.2 and 0.8 times the total water depth and will be combined for analysis (if possible).

1. Identify sampling locations in field notebook along with other appropriate information.

2. Don health and safety equipment (as required by the Health and Safety Plan).

3. Clean the sampling equipment (as described in Appendix F).

4. Measure the total depth of the water column with an electronic depth sounder.

5. Lower the water sampler to 0.8 times the total water depth and release trigger.

6. Raise the water sampler from the water column with minimal disturbance.

7. Remove the cover from the appropriate sample container(s) and slightly tilt the mouth of the container below the sampling device. Fill the appropriate premarked sample containers with equal portions directly from the Kemmerer for each sample collected.

8. Additional casts at 0.2 times the total depth will be required to obtain the depth integrated sample;

9. Repeat steps 5-9 at all remaining stations;

10. After sampling containers have been filled, take in-situ meter readings for pH, temperature, conductivity, and turbidity at the mid width station at 0.2 and 0.8 times the total water depth, and record results in the field notebook.

11. Field duplicates will be prepared by filling two sets of containers with water collected at the same time and depth.

12. Secure all sample jar caps tightly.

13. Label all sample containers.

14. Place filled sample containers on ice in a cooler.

15. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures of samples as set forth in Appendix E.

16. Record required information on the appropriate forms and/or field notebook.

Appendix D - Surface Water Flow Estimation Procedures

I. Introduction

This procedure describes a method for estimating surface water flow rate using a hand-held electromagnetic current meter (Marsh-McBirney, Inc. Model 2000 Portable Water Flowmeter or equivalent) in conjunction with direct measurements of width and water depth.

II. Materials

The following materials will be available, as required, during fiver flow measurement activities.

- Health and safety equipment;
- Boat and motor;
- Rope;
- Surveyor's rod and/or calibrated weighted rope;
- Duct tape;
- 200-foot measuring tape;
- Electromagnetic velocity meter; and
- Field notebook.

III. Procedures

The following procedures will be used to determine the velocity profile at river cross sections:

1. Don health and safety equipment.

2. Extend rope across the stream and measure the total width.

3. Divide the total width into equally spaced measurement locations. For locations less than 30 feet in width, the spacing should be 5 feet. If locations greater than 30 feet are encountered, the spacing will be increased, as appropriate.

4. The meter will be calibrated following the manufacturer's instructions.

5. Lower the surveyor's rod and measure and record the water depth to the nearest 0.1 foot at each measurement location.

6. Attach the velocity meter probe to the surveyor's rod, measure and record the velocity in feet per second at depths equaling 0.2 and 0.8 times the total river depth at each measurement.

7. Record all measurements in field notebook.

8. Calculate the river flow rate by multiplying the average velocity reading times the cross-sectional area of the 5-foot (or 10- or 20-foot) increment. The cross-sectional area is determined by multiplying the width for the increment (i.e., 5, 10, or 20 feet) times the average water depth within that increment. The total flow rate is the sum of the velocity times the area for each increment.

$$Q_T = V_1 A_1 + V_2 A_2 + \ldots + V_n A_n$$

where: Q_T = Total flow in cubic feet per second
$V_{1\text{-}a}$ = Average velocity in feet per second
$A_{1\text{-}a}$ = Cross-sectional area of each increment (square feet)

IV. Maintenance Procedures

Routine maintenance of the unit is confined to cleaning the sensor and changing the batteries.

1. Clean the sensor with soap and water. Do not use hydrocarbon solvents.
2. Replace batteries on a regular basis.
3. Store in protective casing when not in use.
4. Keep records of operation, maintenance, calibration, problems, and repairs.
5. After use, the meter will be inspected and the inspection recorded in the field notebook.
6. A replacement meter will be available on-site or ready for overnight shipment, as necessary.
7. Velocity meter will be sent back to manufacturer for service, when needed.
8. Record maintenance information in field notebook.

Appendix E - Field Sample Packing, Handling, and Shipping Procedures

I. Introduction

The procedures below are for field sample packaging, handling and shipping of environmental samples to be collected for the supplemental surface water and sediment investigation area.

II. Handling

1. Fill in sample label with:
   a. Sample type (sediment, soil, etc.);
   b. Project number and site name;
   c. Sample identification code and other sample identification information, if applicable;
   d. Analysis required;
   e. Date;
   f. Time sampled;
   g. Sample type (composite or discrete); and
   h. Preservative added, if applicable.

2. Cover the label with clear packing tape to secure the label onto the container.

3. Check the caps on the sample containers to ensure that they are tightly sealed.

4. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.

5. Place a signed custody seal label over the cap such that the cap cannot be removed without breaking the custody seal.

6. Initiate chain-of-custody by designated sampling personnel responsible for sample custody (after sampling or prior to sample packing). Note: If the designated sampling person relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.

III. Packing

1. Using duct tape, secure the outside and inside of the drain plug at the bottom of the cooler that is used for sample transport.

2. Place each sample container or package in individual polyethylene bags (Ziploc® type) and seal.

3. Place one to two inches of vermiculite at the bottom of the cooler as a cushioning material.

4. Place the sealed sample containers and package upright in the cooler.

5. Repackage ice (if required) in small Ziploc® type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent addition of sufficient cushioning material.

6. Fill the remaining space in the cooler with vermiculite.

7. Place the completed chain-of-custody forms in a large Ziploc® type bag and tape the forms to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with duct tape.

9. Wrap strapping tape around both ends of the cooler at least twice.

10. Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels on the top and on one side, and arrows indicating "This Side Up" on two adjacent sides.

11. Place custody seals over the front right and back left of the cooler lid and cover with clear plastic tape.

IV. Shipping

1. All samples will be hand delivered or delivered by an express carrier (e.g., Federal Express) within 48 hours or less from the date of sample collection.

2. The following chain-of-custody procedures will apply to sample shipping:

    a. Relinquish the sample containers to the laboratory via express carrier. The signed and dated chain-of-custody forms should be included in the cooler. The express carrier will not be required to sign the chain-of-custody forms. The sampler should retain the express carrier receipt or bill of lading.

    b. When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody forms by recording receipt of samples, and then check the sample identification numbers on the containers against the chain-of-custody forms.

Appendix F - Field Cleaning/Decontamination Procedures

I. Introduction

The general procedures to be utilized for field cleaning and decontamination of sampling equipment and sampling devices are outlined below.

II. Materials

- Health and safety equipment (as required in the Health and Safety Plan);
- Distilled water;
- Non-phosphate soap (Alconox® or equivalent);
- Tap water;
- Appropriate cleaning solvent (e.g., hexane);
- Rinse collection plastic containers;
- Knife;
- Brushes;
- Aluminum foil;
- Garbage bags;
- Spray bottles;
- Ziploc®type bags; and
- Plastic sheeting.

III. Cleaning Procedures for Small Equipment and Sampling Devices

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.), will follow the decontamination procedures presented below:
   a. Non-phosphate detergent and distilled water wash;
   b. Distilled water rinse;
   c. Rinse equipment with solvent (hexane);
   d. Distilled water rinse; and
   e. Allow to air dry and wrap in aluminum foil.

3. Cleaning/decontamination will be conducted in plastic containers that will be transported to each sampling location. These containers will also be used to collect all decontamination rinseate.

V. Cleaning Procedures for Large Equipment (if applicable)

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of large sampling equipment will follow the decontamination procedures. Wash all large equipment with a high pressure water wash using a brush as deemed necessary, to remove any particles.

Appendix G - Ecological Survey Procedures

I. Introduction

This protocol set forth the field procedures to be used to complete the benthic macroinvertebrate assessment and resident fish survey in the Crawford Creek investigation area.

II. Benthic Macroinvertebrate Survey

This protocol sets forth the field procedures to be used to complete the benthic macroinvertebrate survey in Crawford Creek. The benthic community assessment will use procedures which closely follow the Rapid Bioassessment Protocol II (RBP II) for benthic macroinvertebrates as described in the draft revisions to *Rapid Bioassessment Protocols for Use in Streams and Rivers* (USEPA, 1996).

The macroinvertebrate survey activities will involve placement of the Hester-Dendy artificial substrate samplers and collection of dredge samples for assessing benthic macroinvertebrate community composition. The artificial substrates will be pulled and sampled after a six-week exposure.

The following procedures apply to the benthic macroinvertebrate sampling activities completed under this task.

III. Materials

The following materials will be available for use, as required, during sampling activities associated with the benthic macroinvertebrate survey.

- Health and Safety equipment (as required by the Health and Safety Plan);
- Maps;
- Boat and anchor;
- Ekman or ponar dredge;
- Centrifugal pump;
- Hester-Dendy multi-plate artificial substrate samplers;
- Compound microscope, glass slides, and cover slips;
- Stainless steel mixing bowl and scoop;
- Cleaning equipment;
- Buoys, anchors, and rigging;
- Buckets;
- Mesh or sieve screen (standard U.S. No. 30);
- Gridded lab pan;
- Magnifying glass;
- Tweezers;
- Sample jars and preservative;
- Taxonomic keys;
- RBP physical characterization/water quality field data sheet;
- Insulated coolers;
- Appropriate packaging materials and forms; and
- Field notebook.

IV. Procedures

General procedures that will be followed to complete the benthic macroinvertebrate survey include the following:

1. Don appropriate health and safety equipment (e.g., personal flotation device).

2. Identify the appropriate Crawford Creek sampling locations to complete dredge sampling and set-up of Hester-Dendy multi-plate artificial substrate samplers for the collection of macroinvertebrate samples.

3. Collect three dredge samples from each location following the appropriate ASTM methodology (ASTM D-4387 and D-4343). Empty dredge contents into a bucket and strain sediments through a sieve net (no. 30) to isolate benthic organisms. Hand transfer organisms from the sieve net to a sample jar, and preserve in the field following standard preservation techniques. Mark each sample with the appropriate sample identification number, and store the samples in a padded container for transport to the processing laboratory.

4. Set one three-unit cluster of square 14-plate Hester-Dendy multi-plate sampling devices (total surface are of 0.116 m^2) following appropriate ASTM methodology (ASTM D-1469). Suspend sampler approximately four feet below the surface using a float and anchor system. Mark the sampling unit with appropriate identification.

5. As dredge samples are collected and Hester-Dendy substrates are being placed in the creek, record the following in the field notebook:

   - date and time of sampling;
   - sampling personnel;
   - sampler type;
   - sample location; and
   - sample identification number.

6. Repeat Steps 2 through 6 until all sample locations have been completed.

7. After a period of six weeks, return and collect samples from the Hester-Dendy substrates. Remove the substrate unit and immediately place in a water-filled bucket. Scrub the substrate with a soft brush to dislodge all organisms and then strain the contents of the bucket through a sieve net (U.S. No. 30) to collect the organisms. Hand transfer organism from the sieve net to a sample jar, and preserve in the field following standard preservation techniques. Mark each sample with the appropriate sample identification number, and store the samples in a padded container for transport to the processing laboratory. As the Hester-Dendy substrate samples are collected, record the following in the field notebook:

   - date and time of sampling;
   - sampling personnel;
   - sampler type and sampling duration;
   - sample location; and
   - sample identification number.

   Repeat at each sample location.

8. In the laboratory, empty each sample into a gridded pan and randomly select a 100 organism subsample.

9. Complete family-level identification of all organisms in each 100 individual sample and sort accordingly. Confirm sorting efficiency by resorting every tenth sample.

10. Complete assessment of benthic community composition and structure using appropriate RBP II multi-metric assessment techniques.

V. Resident Fish Survey

This protocol sets forth the field procedures to be used to complete the resident fish survey in Crawford Creek. The fish survey will focus on evaluations of community structure and relative abundance using standard electrofishing capture procedures and field identification/enumeration techniques.

Electrofishing activities may be completed with either a streamside or backpack electrofishing unit, as appropriate. Collection procedures are detailed below.

<u>**Collection Procedures**</u>

To conduct the survey, appropriate reaches of Crawford Creek, approximately 100 feet in length, will be marked off in each sampling area. The reaches to be sampled will be selected based on presence of similar representative habitats, as well as available sediment data.

Using the electrofishing techniques described subsequently, fish populations will be examined at each station as follows:

1) 4-foot x ¼-inch mesh block nets will be placed at the upstream edge and downstream edge of the sampling reach to prevent fish movement out of the sample area.

2) Direct current electrofishing equipment will be used to stun fish, which will then be netted and removed to a live well. Collections will begin on the downstream edge of each study reach and progress upstream. Two passes will be completed through each reach.

3) All captured fish will be identified to species and counted. Any anomalies present will be noted and recorded.

4) After sampling and identification are completed, all fish will be released back to the reach from which they were originally removed. If a positive identification cannot be made in the field, select individuals of the species in question will be retained and preserved to verify field identification in the laboratory. Laboratory identification will be completed using morphometric and meristic characteristics in conjunction with known distribution patterns. If sufficient numbers of fish are collected, appropriate ecological indices will be calculated using the numerical and taxonomic information provided by this activity.

5) Steps 1 through 4 will be repeated at each sampling location until all locations have been surveyed.

<u>**Electrofishing Procedures**</u>

The following procedures describe general methods to be used for the collection and short-term storage of resident fish using the streamside and backpack electrofishing units.

1. Collection equipment and materials available for the Smith-Root Model 6 streamside electrofisher and Smith-Root Model 12 backpack unit include the following:

   - Fiberglass tote barge for streamside unit;
   - Gasoline powered generator;
   - Battery operated backpack electrofishing unit;
   - Electrodes;

- Control unit to regulate voltage and current to the electrodes;
- Wiring to provide safe transmission of current under operating conditions;
- Switching, including a switch that keeps the circuit open unless actively and continuously closed (i.e., a "dead-man's" switch);
- Fish collecting equipment such as dip nets with handles of non-conductive material;
- Live well;
- Ice and insulated coolers;
- Sample jars and appropriate field preservation materials (10% buffered formalin)
- Safety equipment including life preservers, footwear with non-conductive soles, and non-conducting gloves;
- Field notebook.

2. The field crew will set up and test electrofishing equipment in accordance with the procedures specified in the operating manual for the unit(s) employed at the site.

3. Procedures for operation of the streamside and backpack electrofishing units will include the following assignments:

   a. Field Crew

   - A crew leader will be responsible for:
     - Control of the tote barge (if used); and
     - Operation of the control equipment and generator.

   - Other crew personnel will be responsible for:
     - Control of the dead-man's switch; and
     - Capturing fish with nets.

   b. Operation

   - Select an appropriate power setting employing pulsed DC to stun fish.

   - Apply current to the water by closure of the dead-man's switch while the generator and control equipment are operative.

   - Collect target species of appropriate size fish in dip nets when seen.

   - Retain fish in a live well or on ice in an insulated cooler until sampling is completed, or processing of samples for shipment to the laboratory is undertaken.

4. Safety considerations to be employed during electrofishing operations include:

   a. Use of appropriate aquatic safety equipment (e.g., personal flotation devices) when sampling conditions warrant.

   b. Use of appropriate non-conductive personal safety gear (e.g., footwear, gloves) and sampling equipment (e.g., dip nets with non-conductive handles).

   c. Temporary suspension of sampling activities when any persons, pets, or livestock are observed in the water or on the shore within approximately 10 meters of the electrofishing unit.