Supplemental Remedial Investigation/ Feasibility Study Work Plan

Morrow Dam to Plainwell

Kalamazoo River Study Group
Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site

February 2007

REPORT

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ARCADIS BBL

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Acronyms and Abbreviations

ABSA	Aquatic Biota Sampling Area
Allied OU	Allied Paper, Inc. Operable Unit
amsl	above mean sea level
ARCADIS BBL	ARCADIS G&M of Michigan, LLC.
AOC	Administrative Order on Consent
BBL	Blasland, Bouck & Lee, Inc.
BSP	Biota Sampling Plan
CDM	Camp, Dresser & McKee, Inc.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
cfs	cubic feet per second
CSM	Conceptual Site Model
DQOs	Data Quality Objectives
FSP	Field Sampling Plan
Georgia-Pacific	Georgia-Pacific Corporation
HASP	Health and Safety Plan
KRSG	Kalamazoo River Study Group
MDEQ	Michigan Department of Environmental Quality
mg/kg	milligrams per kilogram
NCP	National Contingency Plan
PAHs	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI	remedial investigation
ROD	Record of Decision
SEM/AVS	Simultaneously Extracted Metals/Acid Volatile Sulphides
SL	Sampling Location
SOPs	standard operating procedures
SOW	Statement of Work
SRI/FS	Supplemental Remedial Investigation and Feasibility Study
TCL/TAL	Target Compound List and Target Analyte List
TCRA	time-critical removal action
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USCS	Unified Soil Classification System
USGS	United States Geological Survey
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1. Introduction

1.1 Background

The Kalamazoo River Study Group (KRSG), comprised of Millennium Holdings, LLC and the Georgia-Pacific Corporation (Georgia-Pacific), has entered an Administrative Order on Consent (AOC) with the United States Environmental Protection Agency (USEPA) that provides for a Supplemental Remedial Investigation and Feasibility Study (SRI/FS) at the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (the Site or Superfund Site). The AOC is authorized by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). The work performed under the AOC is to be consistent with the implementing regulations for CERCLA, known as the National Contingency Plan (NCP).

The Superfund Site is located in Kalamazoo and Allegan Counties and includes, but is not limited to, three miles of Portage Creek and the Kalamazoo River from the City of Kalamazoo to Lake Michigan. This SRI/FS Work Plan focuses primarily on the section of Portage Creek from Alcott Street to the Kalamazoo River and the Kalamazoo River from Morrow Dam to Plainwell Dam, including the area formerly impounded by the Plainwell Dam. Additional work plans will be developed, as identified in the AOC and Statement of Work (SOW), for other sections of the Site. The Kalamazoo River between Battle Creek and Lake Michigan is shown on Figure 1-1.

The AOC also provides for separate development and submittal of a Multi-Area Quality Assurance Project Plan (QAPP), a Multi-Area Field Sampling Plan (FSP), a Generalized Conceptual Site Model (CSM), a Risk Assessment Framework, and a series of Multi-Area FS Documents. The KRSG's previous work included the implementation of a remedial investigation (RI) that was conducted pursuant to an AOC with the Michigan Department of Environmental Quality (MDEQ) and a series of supplemental RI activities. The data from the previous RI and supplemental work will provide the basis for this SRI Work Plan.

1.2 Purpose of Work Plan

This Work Plan describes the supplemental investigations that will be used in conjunction with existing data, subject to the approval of those data by USEPA, to develop a SRI and a FS and ultimately support a record of decision (ROD) following the completion of the removal action and associated monitoring in the former Plainwell Impoundment.

The SRI work includes:

- Site characterization by sampling and analyzing environmental media in Portage Creek from Alcott Street to the Kalamazoo River and in the Kalamazoo River from Morrow Dam to Plainwell Dam, inclusive, to facilitate the development of a FS and a Record of Decision (ROD), for this segment of the River; and

- Monitoring and assessment activities to gauge the effects of the time-critical removal action (TCRA) in the former Plainwell Impoundment.

1.3 Objectives of the Supplemental RI

The objectives of this Work Plan are to:

- **Document current polychlorinated biphenyl (PCB) levels in sediment and assess PCB transport.** The new data will provide an updated characterization of PCB distribution and potential exposures and will be used to evaluate changes in surface sediment PCB concentrations over time.

- **Assess the size and characteristics of potential "hot spot" areas in sediment.** Sampling will be conducted to assess potential hot spots and provide information on the significance of these potential hot spots.

- **Characterize areas in the section of the River running past the urban Kalamazoo area.** Previous sampling has indicated that some of the higher PCB concentrations in the section of the River from Morrow Dam to the upstream end of the former Plainwell Impoundment occur in the section of the River that flows past the urbanized Kalamazoo Area. The new data will provide estimates of PCB exposure concentrations, spatial distributions, and mass inventories in this area.

- **Document current PCB levels in Portage Creek.** Existing sediment PCB data for Portage Creek were collected prior to completion of the Bryant Mill Pond remediation project in 1998 and 1999. The new data will be used to assess potential risks associated with current PCB levels in Portage Creek, and will provide current information on PCB spatial distributions and mass inventories.

- **Characterize PCB concentrations in sediments, river banks, and floodplain soils in the vicinity of the Plainwell No. 2 Dam and Plainwell.** Existing data show that PCB concentrations in this area are relatively higher than PCB concentrations between this area and the urbanized stretch of the river near Kalamazoo. The new data will allow a more detailed assessment of the extent to which PCB in the river banks and floodplain in this area may contribute to potential risks and PCB mass inventories.

- **Assess the potential significance of hazardous substances other than PCB in terms of human health and ecological risk.** Sediment samples will be collected and analyzed for a large array of hazardous substances (Target Compound List and Target Analyte List [TCL/TAL]).

- **Assess the pertinent effects of the TCRA in the former Plainwell Impoundment.** The removal action will change conditions both within the former Plainwell Impoundment and in downstream reaches. The activities planned as part of this SRI will document the changes pertinent to understanding both the nature and extent of PCB distribution following the project and the overall effectiveness of the removal action. An assessment of residual risks in the former Plainwell Impoundment will be conducted as part of this SRI.

  Specifically, the key goals of the assessment of the removal action are to:

  - Assess changes in PCB and sediment transport caused by the project;
  - Assess erosion of remaining sediments after completion of the project;
  - Assess sediment PCB concentrations in the former Plainwell Impoundment following erosion of the majority of the mid-channel sediments not removed as part of the TCRA; and
  - Assess residual risks associated with PCB exposure to sediments and floodplain soil in the former Plainwell Impoundment.

2. Study Area Background

Task 1.3.1 of the SOW requires a description of the study area location, so this section provides a general description of the features of the Kalamazoo River from Morrow Dam to Plainwell Dam. To aid in the description of the study area addressed in this SRI Work Plan, the Kalamazoo River and Portage Creek have been divided into reaches, or sections, based on differences in physical characteristics and locations of geographic landmarks (such as dams).

River slope and surface area vary considerably among the reaches, as evident in the following table. In general, high-gradient, free-flowing sections, such as from Morrow Dam to Main Street, Plainwell, account for much of the river length in this study area (80%), but relatively little of the overall surface area (30%).

River Reach	Length (miles)	Slope (ft/mile)	Average Water Depth (ft)	Average River Width[1] (ft)	Area (acres)
Morrow Dam to Portage Creek Confluence	4.8	2.1	3.0	196	112
Portage Creek Confluence to Mosel Avenue	1.6	1.8	5.0	159	54
Mosel Avenue to Plainwell No. 2 Dam	12	3.0	3.3	200	246
Plainwell No. 2 Dam to Mill Race Confluence	1.6	4.8	3.4	97	34
Former Plainwell Impoundment	1.9	4.6	3.7	197	44
Portage Creek – Alcott Street to Kalamazoo River Confluence	2.0	1.9	2.3	32	8.2

Note:
[1] Average widths represent the actual water widths for the respective transects, excluding islands or sandbars.

Each of these reaches is briefly described below.

Morrow Dam to Portage Creek Confluence. Between Morrow Dam and the confluence with Portage Creek, the Kalamazoo River is approximately 4.8 miles long, with an average channel width of approximately 200 feet and average water depth of approximately 3 feet (MDEQ, 2002). The river bottom is predominantly gravel, sand, and detritus. The river in this segment covers approximately 112 acres and flows through Comstock Township and Kalamazoo Township. Davis Creek and Comstock Creek are tributaries in this section. The average flow at the U.S. Geologic Survey (USGS) gage at River Street in Comstock for the period April 1931 to January 2007 was 785 cubic feet per second (cfs).

Portage Creek Confluence to Mosel Avenue. The Kalamazoo River between the confluence with Portage Creek and Mosel Avenue near Parchment is approximately 1.6 miles long and covers approximately 54 acres, with an average width of approximately 159 feet and an average depth of approximately 5.0 feet. It has a predominantly sand and gravel bottom, with localized areas of fine-grained sediment. This reach is predominantly urban, with several historical and existing industrial facilities along the banks.

Mosel Avenue to Plainwell No. 2 Dam. From Mosel Avenue to the Plainwell No. 2 Dam, the Kalamazoo River is largely rural, with wooded banks and relatively little access. This reach of the river is approximately 11.7 miles long, with an average water depth of 3.3 feet, and average channel width of 159 feet, and a surface area of 246 acres. The river becomes steeper in this reach, with an average slope of 3 feet per mile, limiting the sediment bed to predominantly coarse material, including areas of gravel and cobble bottom. Silver Creek and Spring Creek are the main tributaries in this reach.

The Crown Vantage Landfill, which was capped in 2003, is on the eastern bank of the Kalamazoo River near the town of Parchment. A shallow flowage exits adjacent to the landfill that may convey river flow during high flow periods, but a review of aerial photos indicated that this flowage is predominantly a backwater area off the main river channel. This flowage separates a small area of dry ground from the landfill where paper-making residuals were observed during visual reconnaissance.

The Plainwell No. 2 Dam is located on the Kalamazoo River in the city of Plainwell, Allegan County. The powerhouse flume still carries flow; however, it is no longer used to operate hydropower equipment (United States Army Corps of Engineers [USACE], 1979). Currently, the dam is classified as having a low hazard potential, and its primary purpose is to maintain the power canal.

Plainwell No. 2 Dam to Mill Race Confluence. The Kalamazoo River from the Plainwell No. 2 Dam and Main Street in Plainwell is approximately 1.6 miles long and covers approximately 34 acres, with an average width of approximately 97 feet and an average depth of approximately 3.4 feet (MDEQ, 2002). It has a predominantly sand and gravel bottom. The river in this reach flows through the City of Plainwell, including the former Plainwell Paper mill race.

Former Plainwell Impoundment. From Main Street, Plainwell, approximately 1.9 miles downstream to the Plainwell Dam, the Kalamazoo River has an average width of approximately 200 feet and an average depth of approximately 3.7 feet (MDEQ, 2002). The reach includes the former Plainwell Impoundment and the

Plainwell Dam, which is a former hydroelectric facility that has been dismantled down to the sill level. The existing sill of the Plainwell Dam has a head of approximately 5 feet (Johnson et al., 1989) and impounds water covering an area of about 44 acres. The contributing drainage area to this reach is approximately 1,299 square miles (Hayes, 1996). The floodplain is covered with historically-deposited sediments and is covered in vegetation. This reach is located in Gun Plain and Otsego townships. According to the MDNR, stages higher than 707.0 feet above mean sea level (amsl) will result in flowing water passing over portions of the embankment adjacent to the spillway and the former powerhouse. Spillway capacity at 707 feet amsl is about 5,700 cfs, which approximates the 10-year flood stage (Hayes, 1996).

Portage Creek. Portage Creek from Alcott Street to its confluence with the Kalamazoo River is approximately 2.0 miles long, with an average width of approximately 32 feet and an average depth of approximately 2.3 feet (MDEQ, 2002). It covers approximately 8.2 acres. Significant portions of Portage Creek are channelized to reduce flooding potential. The average flow at the USGS gage at Lovers Lane in Kalamazoo for the period October 1964 to January 2007 was 40 cfs.

3. Previous Site Investigations

3.1 Summary of Existing Data

Since the finalization of an AOC issued by the MDNR in 1991 (Final Order No. DFO-ERD-91-001), the KRSG has conducted a series of investigations across the Superfund Site, resulting in a PCB database for sediment, floodplain soil, exposed sediment in the former impoundments, surface water, and fish. In addition, analytical data for the TCL/TAL constituents have been generated through analysis of select sediment, soil, surface water, and fish samples. In accordance with Task 1.3.1 of the SOW, which requires a review of existing data, the principal previous data collection efforts are summarized throughout the rest of Section 3.1. The use of existing study area data is subject to review by USEPA to ensure data usability. The Generalized CSM Report will present and explain this information in greater detail.

3.1.1 Morrow Dam to Main Street, Plainwell, Sediment Data

Between Morrow Dam and Main Street, Plainwell, there were four sediment sampling events conducted in relation to the original RI/FS process. These include the 1993 Source Investigation, 1993/1994 RI sediment probing and sampling, 2000 Supplemental Investigation sediment sampling, and 2000 Focused Sampling. The number of PCB samples generated during each of these investigations is summarized below:

Year/Investigation	Number of PCB Sampling Locations	Number of PCB Samples Analyzed
1993 Source Investigation	15	43
1993/1994 RI Sediment Probing and Sampling	314	1,133
2000 Supplemental Investigation Sampling	108	308
2000 Focused Sampling	24	106
Total	**461**	**1,590**

1993 RI Source Investigation

The facilities evaluated and number of samples collected during the 1993 Source Investigation are summarized below:

Facility	Number of Cores	Number of Samples
Benteler Industries, Inc.	2	6
Consumers Power	2	8
Auto-Ion	3	6
Speareflex Corporation	2	7
Hercules Corporation	2	4
North American Aluminum Corporation	2	8
United Technologies	2	4

For each facility listed, sediment cores were collected at or near the known outfalls. Sample locations are shown on Figure 3-1. All samples were analyzed for PCB, resulting in some elevated PCB detections (up to 39 milligrams per kilogram [mg/kg]).

1993/1994 RI Sediment Probing and Sampling

During the original RI, sediment probing and sampling investigations were carried out in 1993/1994, 1997, 1999, and 2000 (Blasland, Bouck & Lee, Inc. [BBL], now known as ARCADIS G&M of Michigan, LLC [ARCADIS BBL], 2000a). A total of 55 transects were established between Morrow Dam and Main Street, Plainwell. Along these transects, 393 locations were probed, and at 340 locations a sediment core was collected (at 53 locations there was no sediment to collect or the sediment was too coarse to recover). In 1997, 32 fine-grained sediment cores and 60 coarse-grained sediment cores were collected and analyzed for PCB, and in 1999 and 2000, 28 more fine-grained sediment cores and 194 more coarse-grained sediment cores were collected and analyzed for PCB. In all, 1,133 samples from 314 locations were analyzed for PCB. All sediment sampling locations are shown on Figure 3-1. Data collected from this investigation indicated the following:

- 80% of the sediment was classified as coarse-grained material.
- Average sediment thickness was 2.5 feet.
- PCB concentrations:

PCB (mg/kg)	Percent of Samples
not detected	46%
< 0.01	69%
< 1.0	93%
< 10	99%

2000 Supplemental Investigation and Focused Sampling

In 2000, 108 cores were collected and 308 samples were analyzed for PCB as part of the Supplemental Investigation (BBL, 2000b). Locations of the 2000 Supplemental Investigation sampling are shown on Figure 3-2. In 2000, an additional focused sediment sampling effort was performed at the request of MDEQ. Those sample locations are also shown on Figure 3-2. As part of that sampling effort, sediment cores were collected at 24 locations specified by MDEQ, producing 106 sediment samples that were analyzed for PCB. The PCB distribution is summarized in the following table:

PCB (mg/kg)	Percent of Samples
ND	31%
< 0.10	42%
< 1.0	81%
< 10	94%

Other Constituent Data

TCL/TAL constituent data were collected during the 1993/1994 RI. Five samples from two sediment cores were collected from between Morrow Dam and Main Street, Plainwell and analyzed for pesticides, semivolatile compounds, volatile compounds, and metals. Three pesticides were detected in more than one sample. Semivolatile compounds, volatile compounds, and metals were detected more frequently than pesticides, but concentrations were generally low. The ranges of TCL/TAL concentrations are shown in Table 3-1.

3.1.2 Former Plainwell Impoundment Sediment Data

Data collection has been performed in the former Plainwell Impoundment, and the various investigative efforts have culminated in the development of a TCRA for the former impoundment that is scheduled to begin in the spring of 2007. Recently collected data are presented in the *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (ARCADIS BBL, 2007), used to delineate specific sediment removal areas. A brief summary of major sediment PCB investigations in the former Plainwell Impoundment is provided below. Locations of all sediment samples collected in the former Plainwell Impoundment to date are shown on Figure 3-3.

During the 1993/1994 RI field work, approximately 125 sediment samples were collected from within the channel of the former Plainwell Impoundment. Total PCB concentrations ranged from not detected to 139 mg/kg.

In 2001, USEPA conducted a Phase I sampling program and collected 53 sediment samples whose total PCB concentrations ranged from not detected to 33 mg/kg (Weston, 2002). During the Phase II sampling, USEPA collected an additional 160 sediment samples from around sample location SD004, which is approximately 1,500 feet upstream of the Plainwell Dam. The results of this effort showed total PCB concentrations ranging from not detected to 4.2 mg/kg (Weston, 2002). In 2006, BBL collected 222 sediment samples and the total PCB concentration ranged from not detected to 220 mg/kg.

As a result of BBL's 2006 sediment sampling, three specific mid-channel sediment deposits were identified as containing PCB concentrations greater than 50 mg/kg. In the design of the TCRA, these three sediment deposits were designated as Mid-Channel Removal Areas A, B, and C. These deposits were further delineated to determine their spatial extent and will be removed as part of the TCRA.

The 1993/1994 RI included the analysis of two samples from one location for TCL/TAL constituents. Results of those analyses indicated no detectable pesticides in sediment and very low levels of semivolatile and volatile compounds (i.e., maximum concentration was a benzo(a)anthracene at 1.2 mg/kg; no other concentration was greater than 1.0 mg/kg).

3.1.3 Portage Creek Sediment Data

The former Bryant Mill Pond, a 29-acre area between Cork Street and Alcott Street within the Allied Paper, Inc. Operable Unit (Allied OU) was the subject of a removal action conducted by the USEPA in 1998 and 1999 under an Administrative Agreement between USEPA and Millennium Holdings, LLC. The sediment bed of Portage Creek within this section was removed. Therefore, the area of Portage Creek that is the focus of the SRI is the section downstream of Alcott Street. The only sediment data collected in Portage Creek between Alcott Street and the Kalamazoo River were collected during the 1993/1994 RI. Within Portage Creek, 15 transects containing 49 probing locations were established, from which 42 sediment cores were collected (at seven locations sediment was too coarse to recover). Portage Creek sediment sampling locations are shown on Figure 3-4. In total, 160 samples from the 42 cores were analyzed for PCB. Of the 42 cores collected, sediment in

81% was classified as coarse. The average sediment thickness in the cores was 2.5 feet. The PCB distribution in the sediment samples is summarized below:

PCB (mg/kg)	Percent of Samples
ND	14%
< 0.1	16%
< 1.0	49%
< 10	92%

In addition to PCB analyses, four sediment samples from one location in Portage Creek between Alcott Street and the Kalamazoo River were analyzed for TCL/TAL constituents. TCL/TAL concentrations were generally detected at a higher frequency and at higher concentrations than in Kalamazoo River sediment. Pesticides, semivolatile compounds, volatile compounds, and metals were detected in all the samples. The ranges of TCL/TAL constituent concentrations detected are shown in Table 3-2.

3.1.4 Morrow Dam to Main Street, Plainwell Floodplain Soil Data

Floodplain soil along the Kalamazoo River between Morrow Dam and Main Street, Plainwell has been sampled as part of the 1993/1994 RI and the 2000 focused sampling. Sample numbers for these two investigations are summarized below:

Year/Investigation	Number of Locations	Number of Samples
1993/1994 RI Floodplain Sampling	16	37
2000 Focused Sampling	29	94
Total	**45**	**131**

Sampling occurred along transects between the river and the outer edge of the 100-year floodplain. Between Morrow Dam and Main Street, Plainwell, two floodplain transects were established, one in Verberg Park in Kalamazoo (Transect KF1) and the other south of D Avenue in the Township of Cooper (Transect KF2). Floodplain soil sampling locations are shown on Figure 3-5. In all, 37 samples were collected from 16 locations and analyzed for PCB. Maximum PCB concentrations at KF1 and KF2 were 1.0 mg/kg and 3.0 mg/kg, respectively, and all other PCB concentrations were less than 0.80 mg/kg.

In 2000, as part of the focused sampling efforts designed by MDEQ, 29 soil cores were collected between Morrow Dam and Main Street, Plainwell, which yielded 94 samples that were analyzed for PCB. All sampling locations are presented on Figure 3-5. The general distribution of PCB concentrations is summarized below:

PCB (mg/kg)	Percent of Samples
ND	41%
< 0.10	48%
< 1.0	75%
< 10	96%

Two soil cores from the 1993/1994 floodplain soil investigation (one from each of the two transects) were analyzed for TCL/TAL constituents as well as PCB. Those two cores produced five samples. Of all the TCL/TAL constituents, five exceeded the MDNR Type-B criteria applicable at the time for residential soil contact, and all were polynuclear aromatic hydrocarbons (PAHs) with natural and anthropogenic sources typically associated with fossil fuels. None of the concentrations exceed the direct contact criteria promulgated by MDEQ on December 21, 2002 (MDEQ, 2004) that are currently in effect. Five pesticides were detected at least once and two of the five (4,4'-DDE and 4-4'DDT) were detected in more than one sample. Of the semivolatile compounds analyzed for, 17 were detected. Twelve of the 17 were PAHs, and all concentrations were estimated since the results were less than the reported quantitation limits. No volatile compounds were detected in any of the floodplain soil samples. Metals were commonly detected in soils – the majority was naturally occurring and present at low concentrations.

3.1.5 Former Plainwell Impoundment Floodplain Soil Data

The floodplain soils adjacent to the Kalamazoo River within the former Plainwell Impoundment are comprised of approximately 59 acres of former sediments (about 3.8 feet thick on average). These floodplain soils/sediment are relatively stable and covered with vegetation. Along the banks of the river, however, the exposed former sediments are subject to undercutting and erosion, causing them to slough off into the river. This erosion is an ongoing source of PCB to the river.

During the RI field work, BBL collected 135 floodplain soil samples that had total PCB concentrations ranging from not detected to 85 mg/kg (BBL, 1994; MDEQ, 2002; BBL, 2000a). In 2001, USEPA collected 147 floodplain soil samples (Phase I), which ranged in total PCB concentration from not detected to 84 mg/kg (Weston, 2002). USEPA conducted Phase II soil sampling in three locations referred to as Grid 1 (218 samples

around Sampling Location [SL] 015), Grid 2 (235 samples around SL029), and Grid 6 (159 samples around SL012). Total PCB concentrations in the Phase II samples ranged from not detected to 158 mg/kg in Grid 1, from not detected to 45.3 mg/kg in Grid 2, and from not detected to 65.6 mg/kg in Grid 6 (Weston, 2002). As described in the *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (ARCADIS BBL, 2007), these data provide a basis for the delineation of specific floodplain soil removal areas, each containing soils with PCB concentrations greater than 50 mg/kg and subject to removal during the TCRA. All soil sampling locations within the former Plainwell Impoundment are shown on Figure 3-6.

3.1.6 Portage Creek Floodplain Soil Data

Portage Creek floodplain soil was sampled as part of the 1993/1994 RI activities. In 1993, a floodplain soil transect was established near Upjohn Park, and five randomly placed sample locations were established in a low-lying area near Reed Street. In total, 23 soil samples from 10 locations were analyzed for PCB. As a result of an elevated PCB concentration near Reed Street (32 mg/kg), three supplemental cores were collected in a low-lying former channel in that area in 1995 and 10 additional soil samples were analyzed for PCB. Results of the additional samples included PCB detections up to 57 mg/kg; however, all the PCB concentrations >2 mg/kg were found within a depression that appeared to be a small former channel running approximately parallel to the current channel. All sampling locations are shown on Figure 3-4. No TCL/TAL data were collected from Portage Creek floodplain soil.

3.2 Data Quality Objectives (DQOs)

The SOW requires that Area-specific DQOs be detailed in each Area-Specific Work Plan. To achieve the objectives of the SOW described in Task 1.3, namely to conduct a supplemental remedial investigation that results in "sufficient data, samples, and other information to fully characterize the nature and extent of the contamination at the Area, to support the human health and ecological risk assessments, and to provide sufficient data for the identification and evaluation of remedial alternatives," this Work Plan incorporates principles of the DQO process described in USEPA (2006) guidance. This is a seven-step planning process for developing an environmental data collection effort in such a way as to ensure that the resulting data are of the appropriate type and quality for their intended use.

The seven steps in the DQO process and a brief description of their applicability to the SRI/FS are described in the remainder of Section 3.2. The sampling activities described in this Work Plan were prepared to address

specific data needs identified to complete a SRI/FS, and to satisfy supplemental sampling agreements between KRSG and USEPA.

Step 1: State the Problem

The problem to be addressed is the presence of PCB in Kalamazoo River fish tissue at levels deemed unacceptable for both ecological and human receptors.

While the distribution of PCB in the reach of the river between Morrow Dam and Plainwell has been documented, additional data are needed to fully characterize PCB in the study area and determine the size and characteristics of potential PCB hot spots. These potential hot spots are represented by locations with the highest sediment PCB concentrations detected in this section of the river. Additional characterization of selected potential hot spots will allow an evaluation of the extent to which these areas may disproportionately influence PCB exposure concentrations and uptake by fish compared to other areas.

For all reaches within the study area where new data is collected, the new data will be used to characterize and assess associated potential risks. The new data will also be used to refine PCB exposure concentrations, provide PCB mass estimates, and evaluate changes in surface sediment PCB concentrations over time.

No PCB data for groundwater in the area of the former Plainwell Impoundment are available. PCB data from wells representative of groundwater flowing to the Kalamazoo River that may be impacted by materials that will be left in place following the removal action at the former Plainwell Impoundment are needed to assess potential risks associated with PCB in groundwater, and potential PCB migration in groundwater to the Kalamazoo River.

The TCRA at the former Plainwell Impoundment (ARCADIS BBL, 2007) is designed to address the riverbank PCB source and restore the river to a free-flowing condition. The design of the action does not call for removal of all the sediments in the former Plainwell Impoundment, and those sediments remaining after construction is complete are anticipated to be transported downstream. A portion of those sediments that will erode once free-flowing conditions are restored contain PCB at relatively low levels. Confirmation samples will be taken in remaining sediments to document residual PCB concentrations. Therefore, an understanding of the impacts of the former Plainwell Impoundment removal action on the distribution of PCB both in the Plainwell section and in downstream sections is important to the overall management of the Superfund Site. Additionally, residual

risks in the former Plainwell Impoundment floodplains and in-stream sediments after the removal action is complete will need to be assessed for purposes of the SRI and FS.

Step 2: Identify the Goal of the Study

The key goals of this Work Plan are to:

- Generate information sufficient to complete a SRI that fully determines the nature and extent of the release or threatened release of hazardous substances, pollutants, or contaminants at and from the study area, and evaluate potential risks to human and ecological receptors, and to complete a FS based on the conditions of the sections of Portage Creek (between Alcott St. and the Kalamazoo River) and the Kalamazoo River (between Morrow Lake and the Plainwell Dam) under investigation; and
- Understand the effects of the removal action in the former Plainwell Impoundment on the distribution of PCB in both the former impoundment and downstream and the impact on PCB transport.

Step 3: Identify Information Inputs

In addition to the existing data the following new data will be collected to meet the goals of this Work Plan:

- Surface sediment PCB and total organic carbon (TOC) data from throughout the study area.
- Sediment core samples from the urbanized Kalamazoo area.
- Sediment core samples around potential hot spot areas.
- Sediment and/or soil samples as appropriate in the area adjacent to the Crown Vantage Landfill.
- Sediment core samples from Portage Creek.
- Bank and floodplain soil samples from the historically inundated area upstream of the Plainwell No. 2 Dam.
- Sediment core samples and bank soil samples in the vicinity of the Plainwell No. 2 Dam to the former Plainwell Inc. Mill.
- Sediment PCB, TOC, TCL/TAL, and Simultaneously Extracted Metals/Acid Volatile Sulphides (SEM/AVS) data from the study area.
- Surface water sampling upstream and downstream of the Plainwell Impoundment
- Bathymetric data from the former Plainwell Impoundment collected periodically during and after implementation of the removal action.

- Regularly collected surface water flow, PCB, and total suspended solids (TSS) data collected upstream and downstream of the former Plainwell Impoundment during construction activities.
- Sediment PCB data in the former Plainwell Impoundment following completion of the removal action.
- Yearling smallmouth bass tissue PCB data from the Otsego City Impoundment following completion of the removal action in the former Plainwell Impoundment.
- Groundwater PCB data from wells representative of groundwater flowing to the Kalamazoo River that may have been impacted by materials left in place in the former Plainwell Impoundment following completion of the removal action.

Step 4: Define the Boundaries of the Sampling

The general geographic boundaries of the study area are the Kalamazoo River and its floodplain from Morrow Dam in Comstock to Plainwell Dam, and Portage Creek from Alcott Street to the Kalamazoo River.

Temporally, the limits of the study vary according to the specific objectives defined in Step 2.

Step 5: Develop the Analytic Approach

The analytic approach to the completion of the Work Plan goals will incorporate both statistical hypotheses testing and estimation or other analytic approaches. The analytic approach includes, but is not limited to:

- Comparison of new sediment data to historical data to update trend analyses, test previously calculated trends, and determine the statistical significance of trends over time.
- Calculation of updated PCB mass inventories.
- Geostatistical evaluation of PCB data collected around potential hot spots to assess the extent of these areas.
- Statistical comparison of average PCB concentration to assess the statistical significance of changes in concentrations over time and between locations.
- Calculation of annual PCB and solids loads at several locations in the SRI study area for analysis of spatial trends in transport, and to compare with historical PCB and solids load estimates.
- Statistical comparison of surface water PCB and TSS data from upstream and downstream of the former Plainwell Impoundment during construction.

- Comparison of sequential bathymetric surveys conducted after construction in the former Plainwell Impoundment is complete to evaluate the movement of mid-channel sediment that will be left behind.
- Comparison of mean PCB concentrations in yearling bass collected from the Otsego City Impoundment pre- and post-construction.
- Calculation of groundwater PCB mass flux to the Kalamazoo River.

Step 6: Specify Performance or Acceptance Criteria

Based on the potential uses of the data in the decision-making process, performance criteria and acceptance criteria should be equivalent to those associated with data collected as part of the original RI and 2000 Supplemental Investigations. Data quality assurance/quality control (QA/QC) will be managed as described in the FSP and QAPP, which are being developed separately. Performance or acceptance criteria for data applications, such as statistical comparisons or trend analysis, will depend on the data results and variance of the data.

Step 7: Design Optimization

Implementation of the sampling activities will result in data that can be used to meet the objectives of the SRI/FS. Data gaps are identified and rationale for each of the individual investigations is provided in Section 3.3, while specific sampling and analysis activities are described in detail in Section 3.5. The plans for data collection will be continually reviewed and revised as appropriate and as approved by USEPA, in response to changes in the river system and the results of data collected. The iterative and adaptive approach to data collection is provided for in USEPA DQO guidance, and is reflected in the phased study approach in this Work Plan.

3.3 Identification of Data Needs

Task 1.3.2 of the SOW requires an assessment of data gaps. Much of the data needs for the river from Morrow Dam to the Plainwell Dam and in the reach of Portage Creek included in this Work Plan are primarily related to fully characterizing the nature and extent of PCB within this reach, with additional data needed for a screening-level assessment of risks related to hazardous substances other than PCB. Supplemental data needed for the completion of the SRI/FS include PCB levels in sediment, soil, surface water, and fish.

3.3.1 Sediment Data

Sediment data will be collected as part of this Work Plan to fully characterize the study area, update trend analyses, and facilitate an assessment of risk for PCB and if appropriate, other hazardous substances. Identified sediment data needs include:

- Characterization of PCB concentrations in surface sediment in the Kalamazoo River between the Georgia-Pacific Kalamazoo Mill and the Crown Vantage Landfill and from the vicinity of the Plainwell No. 2 Dam and the former Plainwell Inc. Mill area.
- PCB concentrations from the entire sediment core at multiple sampling locations targeted around potential hot spot locations.
- PCB concentrations from the entire sediment core at locations along additional transects and focused coring locations in the Kalamazoo River between the Georgia-Pacific Kalamazoo Mill and the Crown Vantage Landfill.
- PCB concentrations from the entire sediment core at locations along Portage Creek from Alcott Street to the Kalamazoo River.
- PCB concentrations from the entire sediment core at locations along additional transects in the Kalamazoo River from the vicinity of Plainwell No. 2 Dam to the former Plainwell Inc. Mill area.
- PCB concentrations from sediment cores in the vicinity of the Crown Vantage Landfill, subject to an USEPA-approved determination of whether sediment core sampling is appropriate based on field reconnaissance.
- TCL/TAL constituents and SEM/AVS data (SEM/AVS analyses are performed to assess general bioavailability of metals) in sediment from select locations throughout the study area.

Data will be of comparable quality to support statistical comparison of PCB concentrations over time, among reaches, and between the fine and coarse sediment texture strata. Sediment samples will be representative of data variability within the reach, which is meaningful for the assessment of ecological exposure.

Finally, almost all of the sediment data collected as part of this Work Plan can be used to support future development, if needed, of either a quantitative or qualitative sediment and constituent transport model. A contemporary sediment PCB dataset that updates previous data collection efforts can serve to update and enhance the existing contaminant fate and transport model and confirm the model's predictive capacity. Data

could also potentially be used, if needed, to guide the recalibration of model-predicted recovery trajectories to improve the long-term predictive capacity of the model.

3.3.2 River Bank and Floodplain Soil Data

River bank and floodplain soil samples will be collected as part of the Work Plan to characterize the area historically inundated by the Plainwell No. 2 Dam, and along the banks of the river and mill race from this dam to the area of the former Plainwell Inc. Mill. Specific data targeted for collection include:

- PCB concentrations from river bank and floodplain soil samples in the area historically inundated by Plainwell No. 2 Dam.
- PCB concentrations from bank soil samples at locations along additional transects in the Kalamazoo River from the vicinity of Plainwell No. 2 Dam to the former Plainwell Inc. Mill area.
- PCB concentrations from bank and/or floodplain soil samples in the vicinity of the Crown Vantage Landfill, subject to a determination of whether soil sampling is appropriate based on field reconnaissance.

3.3.3 Surface Water Data

Surface water data will be collected to specifically evaluate the effects of the removal action in the former Plainwell Impoundment on downstream transport of PCB and solids remaining in the channel after implementation. Specific surface water data needs include focused surface water data from upstream and downstream of the former Plainwell Impoundment during the course of implementation of the removal action.

3.3.4 Sampling to Assess the Effects of the Former Plainwell Impoundment Removal Action

The impacts of the removal action to be performed in the former Plainwell Impoundment will be monitored as part of this Work Plan. Two potential responses of the impoundment to the proposed removal action that need to be quantified are:

- The rate of erosion of the mid-channel sediment prism that will be left behind; and
- The impact of construction activities on downstream solids and PCB transport.

To evaluate the effects of the removal action, bathymetric data will be collected periodically from the former Plainwell Impoundment during and after the project, and PCB and TSS in the surface water will be monitored upstream and downstream of the construction activities during the project. The sequential bathymetric surveys will be compared to assess changes in the volume and shape of the prism over time, and in response to significant high-flow events. For the surface water, routinely collected PCB and TSS data are needed throughout the duration of the project to allow for a mass-balance analysis of PCB and TSS loads to detect effects of the construction activities.

In addition to monitoring within the former Plainwell Impoundment, assessment of potential impacts on PCB exposure concentrations in the Otsego City Impoundment is also needed. The effects will be quantified by monitoring yearling smallmouth bass tissue PCB concentrations in the Otsego City Impoundment following completion of the removal action. The yearling smallmouth bass PCB data will be compared to an identical dataset collected in November 2006 by KRSG.

3.4 Supplemental Sampling Tasks

As required by Task 1.3 of the SOW, this section presents a detailed work plan for the study area – the Kalamazoo River from Morrow Dam to Plainwell Dam, and Portage Creek from Alcott Street to the Kalamazoo River. This SRI Work Plan includes sampling of sediment, bank and floodplain soil, surface water, and fish.

3.4.1 Sediment Sampling

The sediment sampling will be a phased sampling effort. The initial phases – which vary depending on geographic location – are fully developed in this Work Plan, while the elements of subsequent phases will be finalized in an adaptive style depending on results of the earlier phases and Agency approval. Major components of the sediment investigation include:

- Sediment transect probing and core sampling;
- Surface sediment sampling at locations sampled in 2000; and
- Step-out sampling in radial or grid-like patterns around specific samples of interest.

Results of the sediment sampling will be used to characterize nature and extent of PCB in the sediment and update PCB trends in the Kalamazoo River. Sediment will be investigated in Portage Creek between Alcott

Street and the Kalamazoo River, in the approximately four-mile long urban reach of the Kalamazoo River between the former Georgia-Pacific Mill Lagoons and the Crown Vantage Landfill, and in the Kalamazoo River and Plainwell Mill race way in the vicinity of and downstream of the Plainwell No. 2 Dam. Limited sampling will occur between the Crown Vantage Landfill and the Plainwell No. 2 Dam to characterize areas around five selected focused core locations from the 2000 Focused Sampling program. No sediment sampling is proposed for the reach between Morrow Dam and the former Georgia-Pacific Mill lagoons. Sediment sampling activities – which are described for each of the individual geographic reaches in the following subsections – will vary by geographic reach of the river in response to varying data needs, previous sampling results, and physical characteristics of the reach. A summary of the sediment sampling in the Kalamazoo River and Portage Creek is presented in Table 3-3, and specific sample locations are identified in Table 3-4.

3.4.1.1 Former Georgia-Pacific Mill Lagoons to Crown Vantage Landfill

Between the former Georgia-Pacific Mill lagoons and the Crown Vantage Landfill, the phased approach to sediment sampling in the Kalamazoo River involves first performing probing along transects to characterize the sediments, then analyzing particular sediment cores. The cores will be selected, sectioned, and then submitted for laboratory analysis based on the results of the probing. A third phase will be implemented to assess hot spots identified in the analysis phase or based on prior data.

Phase 1: Sediment in this reach will be probed and cored along transects established across the river perpendicular to flow (see Figures 3-7 and 3-8). Sediment probing transects will be established approximately halfway between the existing 1993/1994 RI transect locations, for a total of 10 new transects. At each new transect, the river will be probed and a sediment core collected at 8 locations. Locations will include each edge-of-water location and 6 equally-spaced locations between them. All probing locations will be surveyed. At each probed location, the water depth and sediment thickness will be measured and the sediment composition described. The sediment cores will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed, described using the Unified Soil Classification System (USCS), and retained in frozen storage for potential future analysis. The sediment probing and core data will be used to assess the distributions of sediment type and thickness and select cores for laboratory analysis.

In addition to the transect sampling, sediment cores will be collected from the KPT transect locations in this reach that were first established and sampled in 1993/1994, and resampled in 2000 (see Figures 3-7 and 3-8). Surface sediment samples (0- to 2-inch increment) will be collected at these locations to provide an updated characterization of PCB distribution and potential exposures and to evaluate changes in surface sediment PCB concentrations over time. At each of the targeted locations, a core will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed and described using the USCS for comparison with earlier data. The upper 2 inches of sediment will be sectioned from the core and submitted for laboratory analysis of PCB Aroclors, TOC, and particle size distribution. All remaining core material will be retained in frozen storage for potential future use.

Phase 2: Based on the sediment characteristics observed in Phase 1 and previously collected data, approximately 30 cores (an average of 3 cores per transect) will be selected for laboratory analysis. Cores will be selected to evaluate the PCB distribution and mass in the sediment bed, and will be biased toward fine-grained sediment. Approximately 75 percent of the selected cores will be from fine sediments, with the remaining 25 percent from other sediments. Selected cores will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB analysis; and select intervals, including the surface sample of each core, will be analyzed for TOC, and particle size distribution. Based on the results of those PCB analyses, up to 20 more cores will be selected (an average of 2 more cores per transect) for similar sectioning and analyses. Sediment samples from two of the cores (determined as approved by USEPA) will be submitted for laboratory analysis of TCL/TAL constituents, and the surficial interval from those two cores will also be analyzed for SEM/AVS.

In addition, sediment cores will be collected at 20 agency-directed locations within this reach. Core locations will be determined based on Phase 1 results and previous information. At each of the locations identified, a core will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed and described using the USCS. All cores will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

Phase 3: Based on Phase 1 and Phase 2 results as well as previous data, a hot spot assessment will be carried out in this reach. A total of 6 to 8 core locations will be targeted for further, localized sampling to characterize a

specific area or sediment deposit. These locations will be selected based on approval by USEPA. At each of these targeted locations, sediment probing and field survey work will be performed, if necessary, during a focused reconnaissance effort to characterize and map the bathymetry, sediment type, and sediment thickness around the 6 to 8 targeted locations. These maps will be then be used to design a radial, grid-like or other sampling scheme, as appropriate, fit to the delineated deposit. Four to eight cores will be collected from each of the targeted areas in similar manner as in Phase 1. All core collection locations will be surveyed. Cores will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis. If appropriate, select cores will be analyzed for TCL/TAL constituents, and the surficial interval from those cores will also be analyzed for SEM/AVS. Samples to be analyzed will be determined as approved by USEPA.

3.4.1.2 The Plainwell Area – Plainwell No. 2 Dam to the Mill Race Confluence

The sediment investigation in the vicinity of the Plainwell No. 2 Dam to the mill race confluence will follow a phased approach similar to that of the reach between the former Georgia-Pacific Mill lagoons and the Crown Vantage Landfill. The sediment will first be probed along transects and the sediment characterized; then, based on the results of probing, sediment cores will be selected, sectioned, and submitted for laboratory analysis; and finally a more specific assessment of potential hot spots will be conducted, if necessary.

Phase 1: Sediment will be probed and cored along transects established across the river perpendicular to flow. Sediment probing transects will be established between adjacent existing 1993/1994 RI transect locations, for a total of 6 new transects (see Figure 3-10):

- One new transect upstream of Dam No. 2, downstream of KPT-49 (T10);
- Two new transects in the Mill Race (T13, T14);
- Two new transects in the main channel (T11, T12); and,
- One new transect near former Plainwell Mill (T15).

At each transect, the river will be probed and a sediment core collected at 8 locations. Locations will include each edge-of-water location and 6 equally-spaced locations between them. In addition, soil cores will be collected from both ends of each transect at the top of the banks; the collection and analysis of the soil cores are discussed in Section 3.4.2. All sediment probing locations and the top of bank sample locations will be

surveyed. At each probed location, the water depth and sediment thickness will be measured and the sediment composition described. The sediment cores will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed, described using the USCS, and retained in frozen storage for potential future analysis. The sediment probing and core data will be used to assess the distributions of sediment type and thickness and allocate and select cores for laboratory analysis.

Based on the observed sediment characteristics, in conjunction with previous data, approximately 18 cores (an average of 3 cores per transect) will be selected for laboratory analysis. Cores will be selected to evaluate the PCB distribution and mass in the sediment bed, and will be biased toward fine-grained sediment. Approximately 75 percent of the selected cores will be from fine sediments, with the remaining 25 percent from other sediments. Selected cores will sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis. Sediment samples from two of the cores (determined as approved by USEPA) will be submitted for laboratory analysis of TCL/TAL constituents, and the surficial interval from those two cores will also be analyzed for SEM/AVS.

In addition to the transect sampling, Kalamazoo River sediment within this reach will be collected from the KPT transect locations that were first established and sampled in 1993/1994, and resampled in 2000 beginning at the 1993/1994 transect KPT-49 (see Figure 3-10). Surface sediment samples (0- to 2-inch interval) will be collected from the previous transect sampling locations to provide an updated characterization of PCB distribution and potential exposures and to evaluate changes in surface sediment PCB concentrations over time. At each of the targeted locations, a core will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed and described using the USCS for comparison with earlier data. The upper 2 inches of sediment will be sectioned from the core and submitted for laboratory PCB, TOC and particle size distribution analysis. All remaining core material will be retained in frozen storage for potential future use.

Phase 2: Based on Phase 1 results as well as previous data, a hot spot assessment will be carried out in this reach. One to three core locations will be targeted for further, localized sampling to characterize a specific area or sediment deposit. Locations will be selected as approved by USEPA. At each of these locations, sediment probing and field survey work will be performed during reconnaissance to characterize and map the bathymetry, sediment type, and thickness of targeted sediment deposits. These maps will be used to design a radial, grid-like

or other sampling scheme, as appropriate, fit to the delineated deposit. Four to eight cores will be collected from each of the targeted areas in similar manner as in Phase 1. All core collection locations will be surveyed. Cores will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

3.4.1.3 Portage Creek

New sediment sampling is also planned for the stretch of Portage Creek from Alcott Street to the confluence with the Kalamazoo River. As with the other efforts described in this Work Plan, the sampling will follow a phased approach. A mapping/reconnaissance effort will be first, followed by core collection and sampling, then a more specific assessment of potential hot spots if necessary. Portage Creek from Alcott Street to its confluence with the Kalamazoo River is shown in Figure 3-11.

Phase 1: The sediment distribution in this reach of Portage Creek will be assessed prior to sampling. Given its small size and the ability to visually observe all sediment deposits due to its shallow depth, the geographical sediment distribution in Portage Creek will be determined based upon a detailed continuous visual inspection. Channel transects will be established at 200 foot increments between Alcott Street and the confluence with the Kalamazoo River. At each transect, the endpoints will be surveyed, and the creek probed at 5 to 10 locations. At each probed location, the water depth and sediment thickness will be measured and the sediment composition described.

Between transects, sediment mapping will be accomplished by wading along the stream and physically probing with a rod for depositional areas. Areas that are penetrable with the rod will be considered sediment deposits. These deposits will then be probed further to determine the apparent average depth and extent of the deposit. Physical information obtained during probing will be recorded in the field logs. Sediment deposits identified during probing activities will be characterized with respect to texture (fine vs. coarse) as well as localized geomorphological characteristics of the Creek, including channel geometry, terraces, aggrading bars, and bank slopes. Each of the sediment classifications and geomorphological features will be mapped in relation to the nearest two transects.

In conjunction with Phase 1 activities, a map of the 100-year floodplain will be developed based on existing information, supplemented by field survey data where needed to address potential data gaps. Existing data adequacy for purposes of mapping the floodplain will be assessed prior to Phase 1 field work to determine where additional survey data may be needed.

Phase 2: Depending on the results of the Phase 1 inspection and mapping, probing and core collection locations will be selected to adequately represent the total area and volume of sediment, as discussed above, with a bias toward fine-grained sediment. Approximately 75 percent of the selected cores will be from fine sediments, with the remaining 25 percent from other sediments. A minimum of 40 sediment cores will be collected from Portage Creek and analyzed for PCB. Five of the 40 cores will be collected at the locations where the highest sediment PCB concentrations were observed in the 1993 RI samples (transect locations PPT1-1, PPT1-4, PPT8-3, PPT9-1, and PPT10-2). Exact sediment sampling locations will be subject to USEPA approval prior to sampling. At each of the locations identified, a core will be collected by driving Lexan® tubing into the sediment until refusal, creating a vacuum, and retrieving the sediment. Each core collected will be photographed and described using the USCS for comparison with earlier data. The core will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis. Sediment samples from two of the cores (determined as approved by USEPA) will be submitted for laboratory analysis of TCL/TAL constituents, and the surficial interval from those two cores will also be analyzed for SEM/AVS.

Contingent Phase 3: Based on Phase 1 and Phase 2 results as well as previous data, a hot spot assessment may be carried out in this reach. Core locations may be targeted for further, localized sampling to characterize a specific area or sediment deposit. The need for a hot spot assessment and the locations at which such an assessment would potentially be performed will be determined as approved by USEPA. The determination of whether or not a hot spot assessment is warranted will specifically include evaluation of the accuracy of delineation of potential hot spots for purposes of alternatives analysis in the FS. At each targeted location, Phase 1 results and additional sediment probing and field survey work will be performed (as necessary) to characterize and map the bathymetry, sediment type, and thickness of targeted sediment deposits. These maps will be used to design a radial, grid-like or other sampling scheme, as appropriate, fit to the delineated deposit. Four to eight cores will be collected from each of the targeted areas in similar manner in Phase 2. All core collection locations will be surveyed. Cores will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch

depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

3.4.2 River Bank and Floodplain Soil Sampling near Plainwell

Select bank and floodplain soil sampling will be performed as part of this Work Plan. In the vicinity of the Plainwell No. 2 Dam and immediately upstream, the extent of the historically inundated area upstream of the No. 2 Dam will be assessed, and the soil will be subsequently sampled. Downstream of the No. 2 Dam, bank soils will be collected during the sediment transect investigation. Each of these studies is described below.

3.4.2.1 Sampling of Area of Historic Inundation near Plainwell No. 2 Dam

Floodplain soil in the area historically inundated by the Plainwell No. 2 Dam will be sampled to assess the potential for historical PCB deposition.

Phase 1: In Phase 1, low-lying areas (i.e., the historically inundated area – see Figure 3-10) across the river from and upstream of the diversion structure to approximately KPT-49 will be surveyed in the field to map the extent of the historically inundated area during the time the No. 2 Dam was operable based on terrain, soil characteristics, physical observations, and vegetation types. Historical air photos and other pertinent information will also be used. The approximate extent of the floodplain will be mapped based on the survey data and other pertinent information and overlain with an unaligned random grid. Depending on the size of the area and spacing of the grid, locations will be selected (with approval by USEPA) for floodplain soil sampling. Soil cores will be collected in accordance with the Multi-Area FSP. Soil cores will be photographed, described, and segmented into the 0- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

Phase 2: Depending on the results of Phase 1, a Phase 2 radial, grid-like, or other sampling scheme, as appropriate and as approved by USEPA, may be developed for one targeted Phase 1 location. A determination of whether or not to conduct additional sampling around one of the Phase 1 locations will be made as approved by USEPA. The location of any Phase 2 cores would be surveyed and the cores collected will be sectioned into

the 0- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

3.4.2.2 Bank Soil Samples between the No. 2 Dam and Mill Race Confluence

Soil samples will be collected from the top of the river bank along the mill race and the Kalamazoo River channel between the No. 2 dam and the confluence of the mill race and the river. Bank soils will be collected from the top-of –bank location at each end of the 6 sediment transects established as part of the sediment investigation (see Section 3.4.1.2), for a total of 12 bank soil sample locations. At each location, Soil cores will be collected in accordance with the Multi-Area FSP. Soil cores will be photographed, described, and segmented into the 0- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

3.4.3 Sampling at the Crown Vantage Landfill Area

Investigatory work will be conducted in the low-lying area between the Crown Vantage Landfill and the Kalamazoo River, in response to field observations reported by USEPA of deposits of paper-making residuals and detected PCB concentrations in the sediment of the shallow flowage adjacent to the landfill in this area.

Phase 1: The first Phase of the Crown Vantage Landfill Investigation will be field reconnaissance to survey the area and delineate the extent of 1) any observable crash or construction debris that may have resulted from recent work at the landfill, or 2) sediment deposits or potential fine-grained sediment within the localized channel.

Phase 2: Following characterization and mapping of the area features, appropriate soil and or sediment sampling will be performed at locations selected based on review of the observations and USEPA approval. Sediment cores will be collected consistent with methods described in Section 3.4.1, and will be sectioned into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis. Soil sampling will be conducted in accordance with the FSP. It is anticipated that all soil samples will be analyzed for PCB.

3.4.4 Focused Sample Step-out Sampling between the Crown Vantage Landfill and Plainwell No. 2 Dam

Along the Kalamazoo River between the Crown Vantage Landfill and the Plainwell No.2 Dam, supplemental sampling will be performed to assess the extent of areas where PCB were observed in focused samples collected in 2000. Five focused sample locations will be revisited: FF-32, FF-35, FF-37, FF-40, and FF-42 (see Figure 3-9). At each of these locations, the surrounding soils or sediments will be probed and surveyed to determine the lateral and vertical extent of materials similar to that which was originally sampled, and to characterize its shape and depositional nature. Based on the presence and characteristics of the deposit or geomorphological feature, 4 to 8 cores will be collected at each of these five locations. Cores will be placed with the intention of characterizing the PCB concentration and PCB mass within the deposit, and may be in a radial pattern, a grid-based pattern, or other design, as appropriate and as approved by USEPA, and may not necessarily be geographically centered on the original focused sample location. Samples will be photographed, described, and segmented into the 0- to 2-inch depth interval, 2- to 6-inch depth interval, 6- to 12-inch depth interval, and subsequent 1-foot intervals to the bottom of the core; all samples will be submitted to the laboratory for PCB, TOC and particle size distribution analysis.

3.4.5 Sampling to Assess Effects of the Former Plainwell Impoundment Removal Action

Monitoring of water column solids, PCB concentrations, and sediment bed elevation changes related to the removal action in the former Plainwell Impoundment will be important in terms of establishing a new baseline for sediment and contaminant transport in and through this reach of the river, and to assess residual risks following the removal action. Specifically, monitoring will be performed to assess the transport of solids and PCB downstream attributable to the construction activities and to assess the changes in the river after the reach is restored to a free-flowing condition. Elements of this investigation are described below.

Bathymetric Monitoring – Bathymetric monitoring will be performed to assess the movement of the sediment following the removal action. To assess changes in bathymetry, the 10 transects established by the U.S. Geological Survey (Rheaume, et al., 2002) between the US-131 Bridge and the Plainwell Dam will be periodically revisited, and water and sediment elevations will be measured across each transect. Existing cross-section data collected at the 10 transects in the summer of 2006 will serve as pre-construction, baseline conditions. A during-construction survey will be performed at the end of the first construction season to monitor the changes for that year. Post-construction surveys will be conducted beginning immediately

following completion of the project at the end of the second construction season, and will occur every 6 months and after any flow event that exceeds the 2-year flood (3,845 cfs), as measured at the USGS gage in Comstock. The first bathymetric survey after construction is complete will serve as a post-construction baseline. Data from that survey will be used to calculate the volume of the mid-channel sediment prism left behind after the removal action; subsequent surveys will be compared to that baseline to evaluate the change in the prism volume and shape. Bathymetric monitoring will continue for 2 years following construction completion, for a minimum of four more surveys, or until an 80% decrease of the mid-channel sediment prism is observed, whichever occurs first.

Water Column Monitoring – To assess the effect of construction activities on PCB and solids transport in the Kalamazoo River, surface water will be monitored during construction. The objective of surface water monitoring is to quantify the increase of solids and PCB loads in the river downstream of Plainwell, if any, that may be attributable to construction activities. To meet this objective, surface water samples will be collected regularly upstream and downstream of construction activities. The upstream sampling location will be the Main Street Bridge in Plainwell, and the downstream sampling location will be the Farmer Street Bridge in Otsego. Sampling will be conducted every other day during the construction season, including weekends. At the upstream location, depth-integrated grab samples will be collected from the middle of the channel, as described in the FSP. At the downstream location, an ISCO automated sampling device will be used to collect 24 hourly samples from mid-channel, which will then be composited to represent the total downstream transport accounting for a time when no construction activities are occurring. All samples will be submitted to the laboratory for PCB Aroclor and TSS analysis. PCB and TSS data will be used in conjunction with USGS flow data to estimate solids and PCB transport, and evaluate the increase of loads, if any, caused by construction activities.

Yearling Fish Monitoring - To assess potential impacts associated with releases/erosion of sediments during and after construction of the proposed TCRA in the former Plainwell Impoundment in 2007 and 2008, composite samples of whole-body yearling smallmouth bass will be collected in the Otsego City Impoundment and analyzed for PCB in 2007 and 2008. The variance of PCB concentrations among yearling fish composite samples has been shown to be substantially smaller than the variance of PCB concentrations among adult fillet samples. Consequently, use of yearling fish sampling is expected to be more sensitive to detecting changes in PCB bioavailability that might otherwise go unnoticed by monitoring PCB levels in adult fish. Approximately 50 yearling smallmouth bass will be collected from the Otsego City Impoundment and analyzed as composite samples of seven fish each. The Otsego City Impoundment corresponds with Aquatic Biota Sampling Area

(ABSA) 6 from previous RI data collection. Depending on the availability of fish, the number of samples and possibly the number of fish per composite sample may be adjusted in the field; however, the number of fish per composite sample established in 2006 will be maintained in future yearling composite sample efforts. As approved by USEPA, yearling smallmouth bass PCB data collected by KRSG in 2006 will serve to represent baseline conditions, while similar sampling conducted in 2007 and 2008 will be used to evaluate the potential impacts of construction activities.

Samples will be collected using a variety of methods, including electro-fishing (boat-mounted), seining, and gill and trap/fyke netting techniques, as appropriate. Fish collection activities and field processing will be performed in a manner consistent with the new FSP (under development) and the standard operating procedures (SOPs) contained in that FSP. During collection activities and prior to field processing, all specimens of the appropriate size will be held in a live well or in a cooler on ice. All fish retained for laboratory analysis, including individual fish to be composited, will be photographed and examined for external anatomical abnormalities. Each fish will be measured and weighed to obtain total body length and weight. Whole-body composite samples will be packaged and shipped to the laboratory as described in the *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (ARCADIS BBL, 2007), Biota Sampling Plan (BSP; Camp, Dresser & McKee, Inc. [CDM], 1993) and analyzed for PCB Aroclors and percent lipids.

Post-Removal Sediment Sampling – As described in the *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (ARCADIS BBL, 2007), sediment sampling for PCB analysis will be conducted during and following the implementation of the removal action in the former Plainwell Impoundment. These data will be evaluated for utility in the assessment of residual risks for in-stream sediments in the former Plainwell Impoundment that is to be conducted as part of the SRI. If additional sampling is required for this purpose, and if sample-able quantities of sediment remain, additional sediment samples will collected according to a plan determined and as approved by USEPA.

3.4.6 Groundwater Sampling

Groundwater sampling will be conducted following the removal action as part of the post-removal monitoring activities in the former Plainwell Impoundment, as described in the *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (ARCADIS BBL, 2007). The goals of the sampling are to evaluate the potential presence of PCBs within the groundwater potentially impacted by materials left in place following the removal action to assess the migration of PCBs (if any) to the river.

Results from the 2-year monitoring program will be evaluated after all data have been collected and analyzed and will be included in the SRI Report. The data will be used to evaluate the presence of PCB in groundwater in the post-removal impoundment.

3.5 Sample Analysis and Data Validation

The FSP and QAPP will provide protocols and criteria related to sampling objectives, locations and frequency of proposed sampling, sampling and field procedures for each matrix of concern, sample handling and documentation, field QA/QC procedures (see FSP), as well as laboratory analytical and QA/QC procedures, sample and document custody procedures, data validation, and QA reporting (see QAPP).

3.5.1 Data Analysis

An analysis and summary of all the new data generated during the activities described in this Work Plan will be prepared and presented to the USEPA and MDEQ in a draft SRI Report. Comments made by USEPA and MDEQ will be addressed prior to submittal of the final SRI Report. The results and data from the SRI will be organized and presented in a logical manner to describe the relationships between the components of the Site investigations for each affected medium.

The data from the SRI will be analyzed, and a summary of the type and extent of constituents within the study area (Morrow Dam to the Plainwell Dam and Portage Creek) will be prepared. This information will include a description of the nature and extent (including concentration data) of specific constituents. There will also be a description of activities and exposure pathways that may result in an increased risk to public health, welfare, or the environment. The SRI Report will also present results of human health and ecological risk assessments that will be prepared in accordance with the RA Framework. The risk assessments will include an assessment of residual risks in floodplain soil and sediment in the former Plainwell Impoundment following completion of the TCRA.

3.5.2 SRI Report

A draft of the SRI Report, developed based on the guidelines included in Task 3 of the SOW, will be prepared and submitted to USEPA in accordance with the project schedule. The draft report shall include the results of the SRI, and supporting information will be included as an appendix. A preliminary Table of Contents is presented below:

Executive Summary
Section 1 – Area Background
Section 2 - Study Area Investigation
Section 3 - Physical Characteristics of the Study Area
Section 4 - Nature and Extent of Contamination
Section 5 - Contaminant Fate and Transport
Section 6 - Human Health Risk Assessment
Section 7 - Ecological Risk Assessment
Section 8 - Summary and Conclusion

Any comments prepared by the USEPA and MDEQ regarding the draft report will be addressed prior to submittal of the final SRI Report.

4. Reporting and Schedule

4.1 Progress Reports

As described in the AOC and SOW, monthly written progress reports will be submitted to USEPA and MDEQ to describe the status of the project. The progress reports will be submitted by the 15th of each month, and will include, at a minimum:

- a description of the actions taken to comply with the AOC and SOW in the prior month;
- the results of all sampling and testing and other relevant data received in the prior month (provided as hard copies and electronic copies);
- a summary of the data received in the prior month;
- a description of the work planned for the next 2 months (including proposed schedules) and how the work relates to the overall schedule for completion; and
- a discussion of any difficulties encountered, actual or anticipated delays, and actions taken to address the difficulties and/or delays.

In addition to the monthly progress reports, the KRSG will submit Semi-Annual Progress Reports to the USEPA and MDEQ to summarize work performed in the reach from Morrow Dam to the Plainwell Dam, as well as any other areas of the Superfund Site where activities pursuant to the AOC and SOW have occurred.

Both the monthly and semi-annual progress reports will be submitted until the termination of the AOC, unless otherwise directed by USEPA.

4.2 Schedule

The SRI/FS schedule will accommodate the requirements of the AOC. The AOC requires the submission of a draft Multi-Area QAPP and Health and Safety Plan (HASP) 60 days after the effective date of the AOC, and draft Generalized CSM and Risk Assessment Framework reports 120 days after the effective date of the AOC. It is expected that these plans will be drafted, reviewed by USEPA, and completed in 2007. The data collection necessary to evaluate the effectiveness of the former Plainwell Impoundment removal action will commence in 2007. The other SRI sampling, including the post-removal action monitoring activities in the former Plainwell

Impoundment, will commence in 2008. The draft SRI will be submitted 6 months following the last post-construction bathymetric survey or the last groundwater sampling event, which ever occurs later.

5. References

ARCADIS BBL. 2007. *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (TCRA Report). (Syracuse, NY: February 2007).

BBL. 1994. *Technical Memorandum 3 – Results of the Floodplain Investigation.* Prepared for Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. (Syracuse, NY: February 1994).

MDEQ. 2002. *Technical Memorandum 10 - Sediment Characterization/Geostatistical Pilot Study*. Prepared for Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. (February 2002).

BBL. 2000a. *Remedial Investigation Report – Phase I* (RI Report). Prepared for Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site. (Syracuse, NY: October 2000).

BBL. 2000b. *Supplement to the Kalamazoo River RI/FS – Phase I.* Prepared for Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site. (Syracuse, NY: October 2000).

CDM. 1993. *Biota Sampling Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site* (Detroit, MI: October 1993).

Hayes, J.C. 1996. *Dam Safety Inspection Report - Plainwell Dam #1*. Lansing, MI: (December 18, 1996).

Johnson, D.C., D.E. Reynolds, and J. Dexter. 1989. *Kalamazoo River Basin - Fisheries Management Plan*. (July 1989).

MDEQ. 2004. Remediation and Redevelopment Division Operational Memorandum No. 1, Part 201 Cleanup Criteria, Part 213 Risk-based Screening Levels. Issued December 10, 2004. Available online at http://www.deq.state.mi.us/documents/deq-rrd-OpMemo_1.pdf

Rheaume, S.J., C.M. Rachol, D.L. Hubbell, and A.Simard. 2002. USGS Water-Resources Investigations Report 02-4098. *Sediment Characteristics and Configuration within Three Dam Impoundments on the Kalamazoo River, Michigan, 2000.*

USACE. 1979. *National Dam Safety Program Inspection Report, Kalamazoo River Basin, Plainwell No. 2 Dam*, August 1979.

USEPA. 2006. *Data Quality Assessment: A Reviewers Guide*. EPA/240/B-002 (February 2006).

Weston. 2002. Removal Assessment Report for Allied Paper – Kalamazoo River Site, Otsego/Plainwell, Michigan (February 2002).

Tables

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Table 3-1 - Range of Concentrations for TCL/TAL Constituents - Kalamazoo River from Morrow Dam to Main Street Plainwell

Analyte	Samples (Detections)	Minimum	Maximum
Pesticides		**(ug/kg)**	
4,4'-DDD	5 (1)	ND	5.3
4,4'-DDE	5 (1)	ND	2.1
4,4'-DDT	5 (1)	ND	7.7
Aldrin	5 (0)	ND	ND
Alpha-Chlordane	4 (2)	ND	3
Dieldrin	5 (1)	ND	5.8
Endosulfan I	5 (1)	ND	1.4
Endrin Aldehyde	5 (2)	ND	8.1
Endrin Ketone	5 (1)	ND	7.7
Gamma-Chlordane	5 (3)	ND	4.2
Heptachlor Epoxide	4 (1)	ND	2.3
Semi-Volatile Compounds		**(ug/kg)**	
2-Methylnaphthalene	5 (1)	ND	64
2-Methylphenol	5 (1)	ND	48
4-Methylphenol	5 (3)	ND	4000
Acenaphthene	5 (2)	ND	110
Acenaphthylene	5 (1)	ND	70
Anthracene	5 (4)	ND	330
Benzo(a)anthracene	5 (4)	ND	1500
Benzo(a)pyrene	5 (4)	ND	1400
Benzo(b)fluoranthene	5 (4)	ND	2300
Benzo(g,h,i)perylene	5 (4)	ND	1200
Benzo(k)fluoranthene	5 (0)	ND	ND
bis(2-Ethylhexyl)phthalate	5 (4)	ND	2300
Butylbenzylphthalate	5 (2)	ND	86
Carbazole	5 (1)	ND	77
Chrysene	5 (4)	ND	1600
Dibenzo(a,h)anthracene	5 (4)	ND	370
Dibenzofuran	5 (2)	ND	68
Di-n-Butylphthalate	5 (0)	ND	ND
Di-n-Octylphthalate	5 (1)	ND	57
Fluoranthene	5 (5)	32	2600
Fluorene	5 (2)	ND	150
Indeno(1,2,3-cd)pyrene	5 (4)	ND	1000
Naphthalene	5 (1)	ND	82
Phenanthrene	5 (4)	ND	1600
Phenol	5 (1)	ND	190
Pyrene	5 (5)	100	3600

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Analyte	Samples (Detections)	Minimum	Maximum
Volatile Compounds		**(ug/kg)**	
2-Butanone	5 (0)	ND	ND
Acetone	5 (0)	ND	ND
Carbon Disulfide	5 (3)	ND	4
Chlorobenzene	5 (1)	ND	15
Methylene Chloride	5 (2)	ND	4
Tetrachloroethene	5 (3)	ND	3
Toluene	5 (3)	ND	5
Metals		**(mg/kg)**	
Aluminum	5 (5)	1300	5400
Antimony	5 (2)	ND	0.73
Arsenic	5 (5)	1.0	15
Barium	5 (5)	11	170
Beryllium	5 (2)	ND	0.060
Cadmium	5 (2)	ND	1.1
Calcium	5 (5)	25000	57000
Chromium	5 (5)	3.6	50
Cobalt	5 (5)	1.8	6.0
Copper	5 (5)	1.4	66
Cyanide	5 (0)	ND	ND
Iron	5 (5)	4300	21000
Lead	5 (5)	1.5	140
Magnesium	5 (5)	3900	11000
Mercury	5 (2)	ND	0.47
Manganese	5 (5)	110	1100
Nickel	5 (5)	2.9	20
Potassium	5 (5)	120	590
Selenium	5 (1)	ND	2.4
Silver	5 (1)	ND	0.70
Sodium	5 (0)	ND	ND
Thallium	5 (0)	ND	ND
Vanadium	5 (5)	4.7	15
Zinc	5 (5)	11	210

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Table 3-2 - Range of Concentrations for TCL/TAL Constituents - Portage Creek

Analyte	Samples (Detections)	Minimum	Maximum
Pesticides		**(ug/kg)**	
4,4'-DDD	4(3)	ND	0.0068
4,4'-DDE	2(1)	ND	0.0039
4,4'-DDT	4(3)	ND	0.0072
Aldrin	4(0)	ND	ND
Alpha-Chlordane	2(1)	ND	0.036
Dieldrin	4(2)	ND	0.0034
Endosulfan I	2(1)	ND	0.0019
Endrin Aldehyde	4(3)	ND	0.016
Endrin Ketone	4(1)	ND	0.018
Gamma-Chlordane	4(3)	ND	0.0085
Heptachlor Epoxide	2(1)	ND	0.0084
Semi-Volatile Compounds		**(ug/kg)**	
2-Methylnaphthalene	4(2)	ND	0.16
2-Methylphenol	4(0)	ND	ND
4-Methylphenol	4(0)	ND	ND
Acenaphthene	4(4)	0.11	1.3
Acenaphthylene	4(2)	ND	0.072
Anthracene	4(4)	0.26	2.9
Benzo(a)anthracene	4(4)	0.9	5.3
Benzo(a)pyrene	4(4)	0.77	5
Benzo(b)fluoranthene	4(4)	1	5.3
Benzo(g,h,i)perylene	4(4)	0.68	4.2
Benzo(k)fluoranthene	4(3)	ND	3.9
bis(2-Ethylhexyl)phthalate	4(3)	ND	0.5
Butylbenzylphthalate	4(3)	ND	0.1
Carbazole	4(4)	0.058	1.6
Chrysene	4(4)	0.97	5.6
Dibenzo(a,h)anthracene	4(4)	0.22	1.7
Dibenzofuran	4(4)	0.07	0.78
Di-n-Butylphthalate	4(3)	ND	0.12
Di-n-Octylphthalate	4(2)	ND	0.21
Fluoranthene	4(4)	1.6	13
Fluorene	4(4)	0.15	1.4
Indeno(1,2,3-cd)pyrene	4(4)	0.63	3.3
Naphthalene	4(4)	0.034	0.46
Phenanthrene	4(4)	1.7	13
Phenol	4(0)	ND	ND
Pyrene	4(4)	2.4	14

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Table 3-2 - Range of Concentrations for TCL/TAL Constituents - Portage Creek

Analyte	Samples (Detections)	Minimum	Maximum
Volatile Compounds		**(ug/kg)**	
2-Butanone	4(1)	ND	0.018
Acetone	4(1)	ND	0.089
Carbon Disulfide	4(4)	0.001	0.002
Chlorobenzene	4(4)	0.001	0.005
Methylene Chloride	4(4)	0.005	0.037
Tetrachloroethene	4(3)	ND	0.005
Toluene	4(4)	0.008	0.048
Metals		**(mg/kg)**	
Aluminum	4(4)	2200	3700
Antimony	4(3)	ND	1.1
Arsenic	4(4)	5.1	12
Barium	4(4)	35	49
Beryllium	4(3)	ND	0.130
Cadmium	4(3)	ND	0.28
Calcium	4(4)	23000	33000
Chromium	4(4)	6.8	12
Cobalt	4(4)	2.2	3.9
Copper	4(4)	11	44
Iron	4(4)	6800	11000
Lead	4(4)	36	100
Magnesium	4(4)	5400	6000
Mercury	4(3)	ND	0.1
Manganese	4(4)	170	450
Nickel	4(4)	4.4	22
Potassium	4(4)	190	480
Selenium	4(0)	ND	ND
Silver	4(0)	ND	ND
Sodium	4(0)	ND	10
Vanadium	4(4)	6	13
Zinc	4(4)	55	78

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Table 3-3 - Summary of Proposed Sediment and Soil Sampling Plan

Reach	Phase	Activity	Number of Cores	Sample Intervals	Number of Samples	Analyses
GP Mill to Crown Vantage	Phase 1	Sediment Transects - Establish 10 transects, probe and collected sediment core from 8 locations per transect, include both edge-of-waters, characterize sediment, retain cores	80	NA	NA	NA
	Phase 2	Transect Sediment Analysis - Select average 3 cores per transect based on sediment texture and distribution from transect probing.	30	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	120	PCB, TOC, particle size [2 cores for TCL/TAL at all intervals, and SEM/AVS at the surface]
		Random Core Collection - Collect 20 agency-directed cores based on Transect sample results and previous information	20	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	80	PCB, TOC, particle size
		Re-sample surficial sediment form 2000 sediment sample locations	67	0- to 2-inch	67	PCB, TOC, particle size
	Phase 3	Sediment "Hot Spot" Assessment - Based in Phase 2 data and previous information, select 6-8 locations for further study, probe and survey to map deposits, collect 4 to 8 cores surrounding each location	42	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	168	PCB, TOC, particle size
Crown Vantage to Plainwell No. 2 Dam	Phase 1	Focused sampling areas assessment - Return to FF-32, FF-35, FF-37, FF-40 and FF-42, probe and survey to map deposits, collect 4 to 8 cores surrounding each location	25	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	100	PCB, TOC, particle size
Plainwell No. 2 Dam to Mill Race Confluence	Phase 1	Sediment Transects - Establish 6 transects, probe and collected sediment core from 10 locations per transect, include both edge-of-waters and top-of-banks, characterize sediment, retain cores	60	NA	NA	NA
		Identify and map floodplain near No.2 Dam, establish unaligned random grid	NA	NA	NA	NA
	Phase 2	Transect Sediment/Soil Analysis - Select average 5 cores per transect based on sediment texture and distribution from transect probing. Include top-of-bank cores for all transects	30	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	120	PCB, TOC, particle size [2 cores for TCL/TAL at all intervals, and SEM/AVS at the surface]
		Re-sample surficial sediment form 2000 sediment sample locations	17	0- to 2-inch	17	PCB, TOC, particle size
		Collect soil cores from the unaligned random grid.	TBD	TBD	TBD	TBD
	Phase 3	Perform step-out sampling around Phase 1 and Phase 2 sample locations as needed.	TBD	TBD	TBD	TBD
Portage Creek	Phase 1	Sediment Characterization and Mapping - Walk creek and map sediment deposits and characteristics between Alcott Street and the Kalamazoo River. Include floodplain on maps.	NA	NA	NA	NA
	Phase 2	Sediment Core Collection - Collect 40 sediment cores based on characterization of sediment, to represent major deposits and sediment types, bias samples toward fine-grained sediment.	40	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	120	PCB, TOC, particle size [2 cores for TCL/TAL at all intervals, and SEM/AVS at the surface]
	Phase 3	Perform step-out sampling around Phase 2 sample locations as needed.	TBD	TBD	TBD	TBD
Crown Vantage Area	Phase 1	Field Reconnaissance - assess and delineate the extent of wastes on land and sediment in side channel adjacent to the Crown Vantage site	NA	NA	NA	NA
	Phase 2	Collect soil and sediment samples as necessary based on Phase 1 results to characterize the potential extent of PCB and waste material.	TBD	0- to 2-inch, 2- to 6-inch, 6- to 12-inch, 12-inches	TBD	PCB, TOC, particle size

Notes:
TBD - To be determined
NA - Not applicable

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Table 3-4 - Proposed Sediment Re-Sampling Locations

BBL ID	Reach	Recovery (feet)	Northing (feet)	Easting (feet)	Class
GP Mill Lagoons to Crown Vantage					
KP2C-9	A1	6.4	290,805.6	12,800,078.4	Coarse
KP2C-10	A1	1.4	291,395.8	12,798,479.0	Coarse
KP3F-1	A2	1.1	297,816.9	12,797,217.9	Fine
KP3C-1	A2	0.2	304,913.2	12,795,088.0	Coarse
KP3C-2	A2	1.4	297,787.2	12,797,339.4	Coarse
KP3F-2	A2	0.9	299,893.6	12,797,058.6	Fine
KP3C-3	A2	2.3	297,791.1	12,797,320.7	Coarse
KP3F-3	A2	1	299,894.9	12,797,030.0	Fine
KP3C-4	A2	1.3	299,917.2	12,797,161.4	Coarse
KP3F-4	A2	0.8	293,844.3	12,796,963.3	Fine
KP3C-5	A2	1.5	299,907.5	12,797,117.2	Coarse
KP3F-5	A2	2.6	303,608.1	12,795,372.9	Fine
KP3F-6	A2	2.1	303,611.0	12,795,352.6	Fine
KP3C-6	A2	2	293,836.5	12,797,082.7	Coarse
KP3F-7	A2	1.3	303,613.2	12,795,332.5	Fine
KP3F-8	A2	1.8	303,615.2	12,795,310.6	Fine
KP3C-8	A2	1.2	301,513.5	12,796,569.3	Coarse
KP3C-9	A2	1.8	301,595.9	12,796,678.9	Coarse
KP3C-10	A2	3.5	301,623.3	12,796,713.1	Coarse
KP3C-11	A2	1.4	305,096.9	12,795,419.7	Coarse
KP3C-12	A2	0.6	303,616.7	12,795,286.4	Coarse
KP4F-1	A2	0.6	317,926.9	12,796,691.4	Fine
KP4C-2	A2	0.2	313,368.1	12,796,333.6	Coarse
KP4F-2	A2	0.2	313,372.0	12,796,471.8	Fine
KP4F-3	A2	0.6	313,361.8	12,796,108.7	Fine
KP4C-3	A2	0.5	314,790.7	12,796,256.6	Coarse
Plainwell No. 2 Dam Area to Mill Race Confluence					
KP6F-7	A2	1.4	340,777.4	12,782,317.5	Fine
KP6C-8	A2	1	339,721.6	12,784,893.6	Coarse
KP6F-8	A2	3	341,789.8	12,781,219.3	Fine
KP6F-9	A2	1.4	341,709.4	12,781,200.3	Fine
KP6F-10	A2	2.6	341,689.9	12,781,193.9	Fine
KP6C-11	A2	1.4	342,174.7	12,781,996.4	Coarse
KP6C-12	A2	1.1	342,171.2	12,781,987.2	Coarse
KP6C-13	A2	3	342,168.0	12,781,975.6	Coarse
KP6C-14	A2	3	341,751.4	12,781,216.3	Coarse
KP7C-1	A2	1.1	344,325.3	12,780,366.4	Coarse
KP7F-1	A2	1.5	344,326.4	12,780,426.6	Fine
KP7C-2	A2	1.9	343,509.0	12,779,434.6	Coarse
KP7F-2	A2	1	344,322.8	12,780,329.4	Fine
KP7F-3	A2	1.1	345,887.7	12,778,209.7	Fine
KP7C-3	A2	0.2	343,504.2	12,779,417.8	Coarse
KP7C-4	A2	0.2	343,496.8	12,779,396.5	Coarse
KP7F-4	A2	0.2	345,910.8	12,778,168.6	Fine
KP7C-7	A2	0.5	345,900.9	12,778,191.7	Coarse

Note:
Northings and Eastings are International Feet, State Plane NAD 83 Michigan south

Figures

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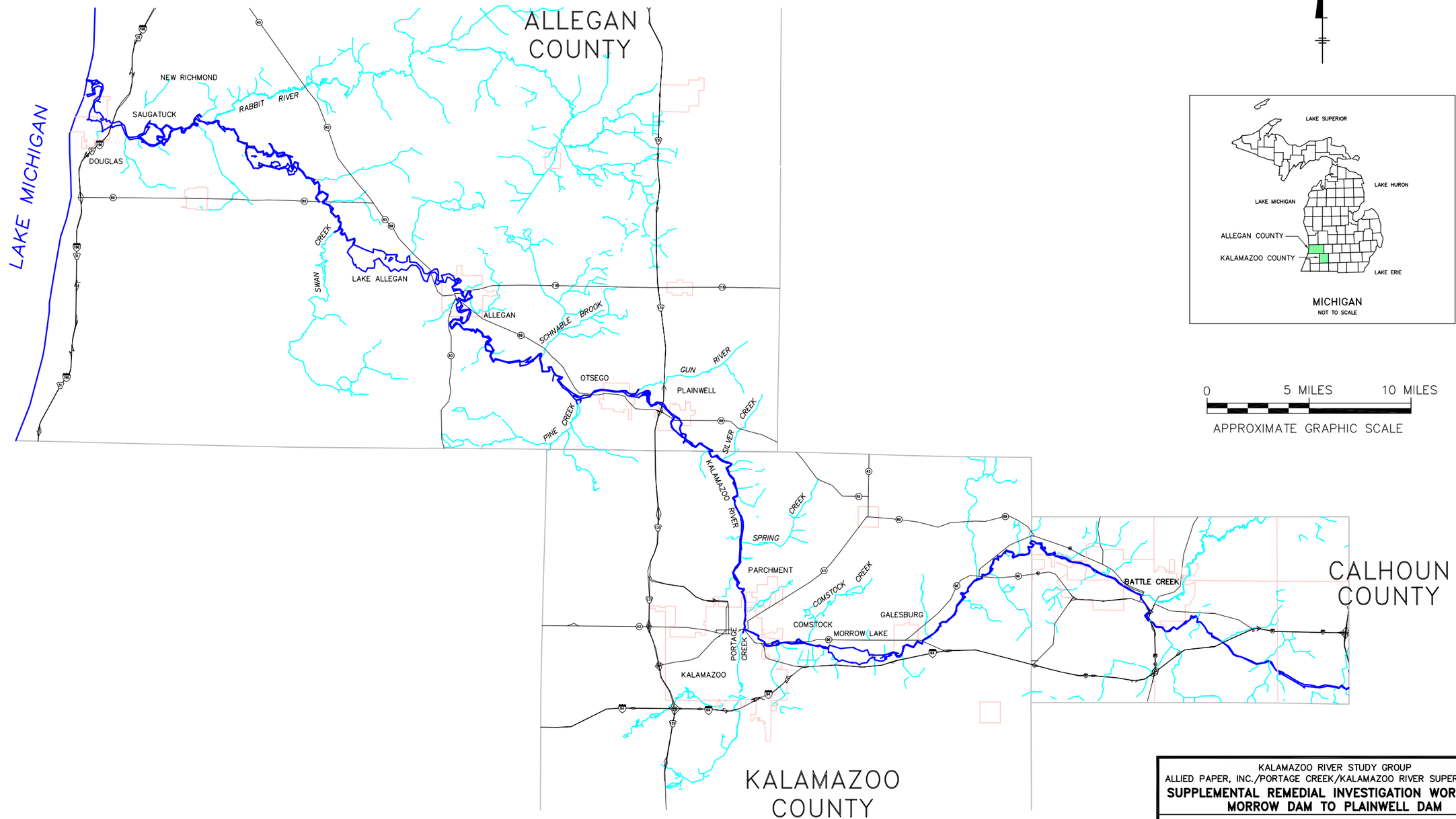

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN
MORROW DAM TO PLAINWELL DAM

KALAMAZOO RIVER
BATTLE CREEK TO LAKE MICHIGAN

ARCADIS BBL
infrastructure, environment, facilities

FIGURE
1-1

[SYR-85-LEAD] SYR-85-AK KMD RCA LAYER: ON=*, OFF=*REF*
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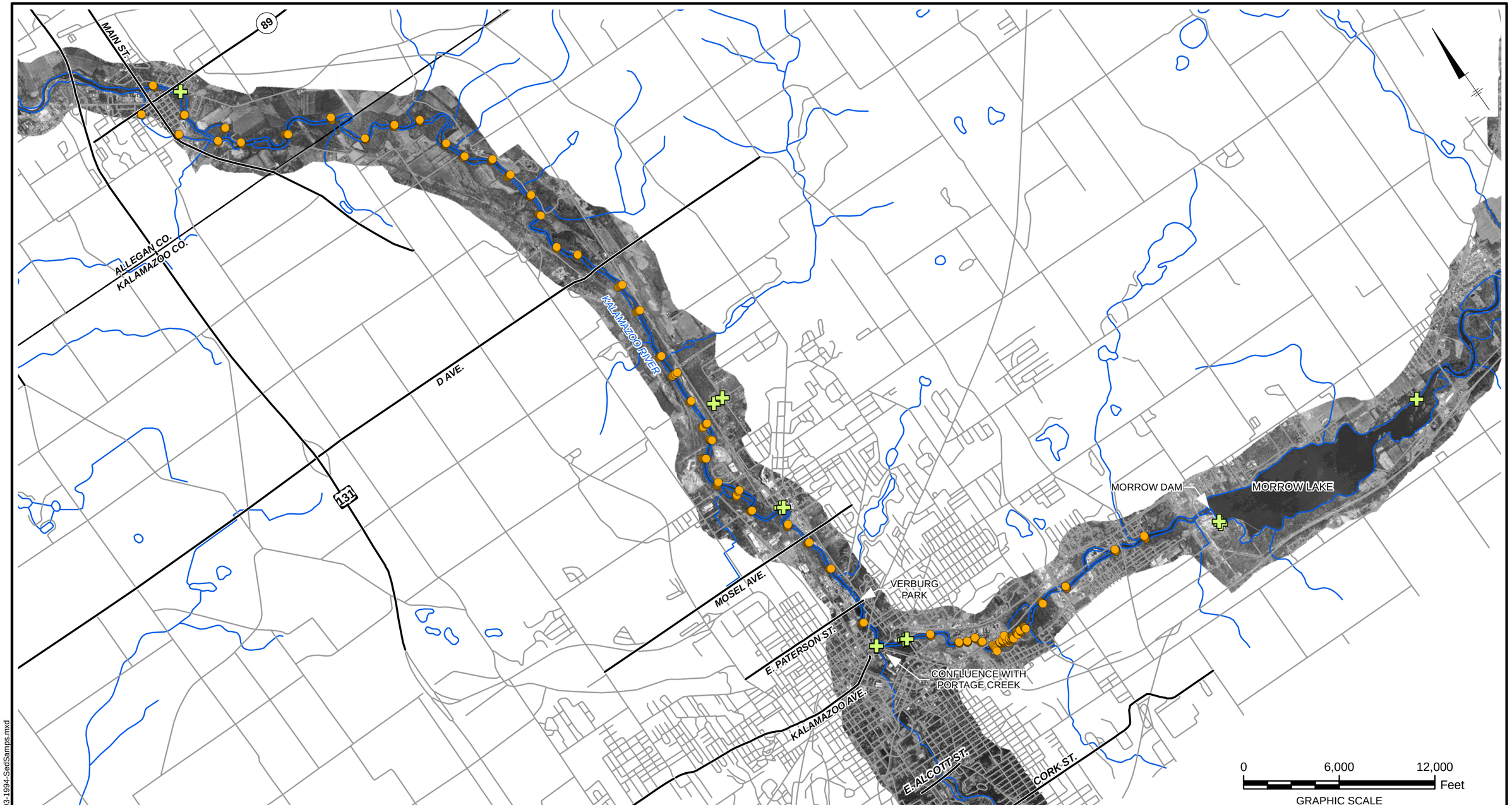

LEGEND:

- 1993, 1998 KALAMAZOO RIVER SOURCE INVESTIGATION SAMPLE LOCATION
- 1993-1994 KALAMAZOO RIVER SEDIMENT SAMPLE LOCATION

NOTE:

1. AERIAL IMAGE DERIVED FROM ORTHOGRAPHIC DATA BY AIR LAND SURVEYS, INC., KALAMAZOO RIVER FLOWN 4/24/99, PORTAGE CREEK FLOWN 4/27/00.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/
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SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN
MORROW DAM TO PLAINWELL DAM

1993-1994 SEDIMENT SAMPLE LOCATIONS FOR MORROW LAKE TO MAIN STREET PLAINWELL

ARCADIS BBL
Infrastructure, environment, facilities

FIGURE
3-1

2/8/07 SYR-85 EAB
Kzoo [ROCH-85 EAB]
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