Superfund Program

Proposed Plan – June 2017
Allied Paper, Inc./Portage Creek/Kalamazoo River Site – Operable Unit 5, Area 2
Allegan County, Michigan

1. INTRODUCTION

The purpose of this Proposed Plan is to: (1) provide background information regarding the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site, with particular attention to Operable Unit 5 (OU5); (2) describe the various cleanup alternatives considered for cleaning up Area 2 of OU5 of the Kalamazoo River; (3) identify U.S. Environmental Protection Agency's (EPA's) preferred cleanup alternative for Area 2 and explain the reasons for that preference; and (4) solicit public review of and comment on the alternatives evaluated.

This document is issued by EPA, the lead agency for site activities. The Michigan Department of Environmental Quality (MDEQ) is the support agency. EPA will select a final remedy for Area 2 of OU5 after considering all comments submitted during a 60-day public comment period and providing MDEQ an opportunity to review and comment on the final remedy selected by EPA. The public comment period runs from July 1, 2017 through August 30, 2017.

EPA encourages the public to review and comment on this Proposed Plan. EPA also encourages community members to attend and participate in an open house and public meeting at the Otsego Public Library, located at 401 Dix Street in Otsego, Michigan, on July 25, 2017. The public meeting will be held at 6:00 pm. EPA will accept oral comments during the public meeting and written comments at any time during the public comment period.

EPA's decision on the final remedy for Area 2 of OU5 will be announced in local newspaper notices and presented in an EPA document called a Record of Decision (ROD). EPA's final cleanup decision for Area 2 could differ from the preferred alternative in this Proposed Plan depending on information or comments EPA receives during the public comment period, so it is important for the public to comment on all of the cleanup alternatives discussed in this document.

As described in more detail later in this Proposed Plan, EPA is proposing Alternative A-5 as the proposed alternative to remediate contamination in Area 2 of OU5. The proposed remediation measures focus on polychlorinated biphenyls (PCBs) as the primary contaminant of concern (COC) but also address dioxins and furans found in Area 2 of OU5. Alternative A-5 includes removal of the Otsego City Dam, river channel realignment and excavation of bank soil along the realigned channel, excavation of Gun River as well as floodplain soil areas exceeding remedial action levels (RALs)[1], capping of the northeast anabranches that are cut off from the main channel following Otsego City Dam removal and channel realignment, subaqueous capping of Pond G, and excavation of confirmed hot spots greater than 50 milligrams per kilogram (mg/kg) PCBs at Knife Blade Island as well as in the anabranch areas. Monitored natural recovery (MNR), institutional controls (ICs), and long-term monitoring (LTM) throughout

[1] A remedial action level or RAL is a value that would trigger cleanup.

Area 2 are also included in Alternative A-5. The proposed measures to remediate the contaminated sediment and soil in Area 2 of OU5 would be protective of human health and the environment, would meet applicable or relevant and appropriate requirements (ARARs), would be cost-effective, and would be effective in the long term.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes information that can be found in greater detail in the Supplemental Remedial Investigation (SRI) Report and the Feasibility Study (FS) Report and other documents contained in the Administrative Record file for Area 2 of OU5. EPA and MDEQ encourage the public to review these documents to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted at the site to date. Supporting documents for the site are available at any of the following locations:

Kalamazoo Public Library
315 S. Rose
Kalamazoo, MI 49007
(269) 342-9837
Call for Hours

EPA Region 5 Records Center
77 W. Jackson Blvd. (SRC-7J)
Chicago, IL 60604
(312) 353-1063
Mon-Fri: 8 am to 4 pm - *Call for appointment*

Charles Ransom Library
180 South Sherwood
Plainwell, MI 49080

Allegan Public Library
331 Hubbard Street
Allegan, MI 49010

Otsego District Library
219 South Farmer Street
Otsego, MI 49078

Waldo Library
Western Michigan University
1903 West Michigan Avenue
Kalamazoo, MI 49008

Saugatuck-Douglas Library
10 Mixer Street
Douglas, MI 49406

2. SITE BACKGROUND

The Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site was listed on the National Priorities List in August 1990 and consists of four disposal areas, five former paper mill properties, approximately 77 miles of the Kalamazoo River from the dam at Morrow Lake to Lake Michigan, and a 3-mile stretch of Portage Creek. The site is located in both Allegan and Kalamazoo Counties of southwest Michigan (see Figure 1).

EPA often divides complex cleanup sites into smaller, more manageable sections called operable units or OUs. This site is composed of six different OUs:

- OU1 – Allied Paper, Inc./Bryant Mill Pond;
- OU2 – Willow Boulevard/A-Site Landfill;
- OU3 – King Highway Landfill;
- OU4 – 12th Street Landfill;

- OU5 – 77 miles of the Kalamazoo River and a 3-mile stretch of Portage Creek; and
- OU7 – former Plainwell Paper Mill Property.

This Proposed Plan is for Area 2 of OU5.

Site History

This section of the Proposed Plan provides the history of the site and briefly discusses the various investigations that have been conducted in Area 2 of OU5.

The site is primarily contaminated with PCBs that were found in the waste stream at paper mills, although other industrial operations also used PCBs along the Kalamazoo River. The former paper mills recycled and/or de-inked and repulped various types of paper products including carbonless copy waste paper which, between the 1950s and 1970s, contained PCBs as an ink carrier. EPA has also identified pulp, paper and paperboard manufacture and recycling mills as sources of dioxin into the environment. For many years, the mill operators disposed of contaminated wastewater by discharging it directly into the Kalamazoo River and disposed of the dewatered wastes, commonly referred to as residuals, in on-site dewatering lagoons or placed the contaminated residuals in other land or wetland areas.

The Michigan Department of Natural Resources first became concerned about the presence of PCBs in the Kalamazoo River in 1971, after routine surface water and biota sampling at the mouth of the river indicated that PCBs were discharging to Lake Michigan via the Kalamazoo River and that the PCBs were widely bioavailable for uptake by fish and aquatic organisms. The primary risks associated with the site are from human consumption of PCB-contaminated fish which have become contaminated due to erosion and runoff of PCB-contaminated soil and sediment in Portage Creek and the Kalamazoo River.

Six former hydroelectric dams are located on the river within the site boundaries. In the 1970s, the State of Michigan partially dismantled three dams (Plainwell, Otsego, and Trowbridge). This dropped the river water level and the contaminated sediment that was once under water became exposed. Lowering of the dams also increased bank erosion. EPA and MDEQ currently estimate that there are approximately 113,000 pounds of PCBs in the river sediment and floodplain soil.

OU5 encompasses 77 miles of the Kalamazoo River from Morrow Dam east of Kalamazoo to the river mouth at Lake Michigan, plus a 3-mile stretch of Portage Creek in Kalamazoo. EPA divided OU5 into seven different areas (see Figure 2). This Proposed Plan focuses on Area 2.

Area 2 of OU5 is a 1.9-mile stretch of the Kalamazoo River located between the former Plainwell Dam and the Otsego City Dam (see Figure 3). This section of the river flows through forested wetland areas with predominately recreational land use, and ends at the City of Otsego. The 12th Street Landfill (OU 4) is located at the upstream end of Area 2.

To date, remediation work along the Kalamazoo River and the adjacent OUs has included multiple PCB source control and elimination activities in upstream Area 1. These activities, which include four different time-critical removal actions (TCRAs) in the Kalamazoo River

and/or Portage Creek as well remedial actions at other site OUs, have addressed the most significant known sources of PCBs and have helped support reductions in PCB levels in fish tissue.

Sediments and floodplain soils are the media of concern in Area 2. Groundwater is not a medium of concern (see discussion below in Section 3, *Area 2 Characteristics*).

Area 2 has two distinct sections: the upstream, free-flowing anabranched section (approximately 0.7 miles long) and the downstream section influenced by the current Otsego City Dam (approximately 1.2 miles long) (see Figure 3).

Past Investigations in Area 2

Over the years, various parties – including potentially responsible parties (PRPs), EPA, and the State – collected an extensive body of data from a variety of environmental media. At OU5 (Areas 1 through 7), more than 15,000 samples had been collected and analyzed prior to the start of the SRI work in 2007. The samples were analyzed for various constituents including PCBs, metals, polycyclic aromatic hydrocarbons, and pesticides.

Sediment data for Area 2 have been collected under various sampling programs, starting with the original remedial investigation (RI) work in 1993/1994. Data from the original RI were used to develop an understanding of spatial and historical PCB trends in sediment in Area 2. These data were supplemented in 2000 by additional sediment sampling. In 2001, as part of a two-phased investigation of Area 2, EPA collected and analyzed additional sediment and soil samples. In 2011, Weyerhaeuser Company (Weyerhaeuser) conducted additional sediment sampling in Area 2. From 2011 through 2012, Georgia Pacific (GP) conducted SRI field investigations that added more than 1,000 PCB data points for Area 2 sediment and soil. The primary intent of the SRI work was to address localized data gaps and further define the nature and extent of contamination.

As part of the Plainwell Impoundment TCRA in upstream Area 1, five quarterly[2] groundwater sampling events were conducted in a network of 15 monitoring wells between 2008 and 2009. PCBs were not detected in groundwater.

Enforcement Activities

In February 2007, GP and Millennium Holdings, LLC (Millennium) entered into an Administrative Order on Consent (AOC) with EPA to conduct a series of SRIs/FSs at OU5. Following its bankruptcy in 2009, Millennium stopped participating in the SRI/FS work.

In addition to enforcement activities related to Area 2 of OU5, EPA and/or MDEQ have engaged PRPs to conduct work at other site OUs, as follows:

- Millennium put in place interim remedial measures at the Allied Paper property (OU1) that effectively controlled the OU1 landfill wastes from entering Portage Creek.

[2] Quarterly sampling means sampling was conducted four times per year, roughly every 3 months.

- Millennium conducted RI/FS work at the Allied Paper property (OU1) until its bankruptcy; EPA subsequently took over completion of the FS and issued a ROD in September 2016.
- GP conducted the remedial design (RD) and remedial action (RA) work at the Willow Boulevard/A-Site Landfill (OU2) and the King Highway Landfill (OU3).
- Weyerhaeuser conducted the RD/RA work at the 12th Street Landfill (OU4), and is conducting the RD/RA work at the former Plainwell Mill (OU7).

Area 2 SRI/FS

As noted above, GP conducted the SRI/FS work for Area 2 under a 2007 AOC. In accordance with the 2007 SRI/FS AOC, GP submitted many reports that it then used to support the development and evaluation of remedial alternatives for sediment and floodplain soil in the FS. The major reports are listed below and included in the Administrative Record file for Area 2 of OU5.

- Area 2 Supplemental Remedial Investigation/Feasibility Study Work Plan
- Multi-Area FS Documents – To guide the FS process and provide consistency and efficiency across all seven areas of OU5, four Multi-Area FS Planning Documents were prepared as the first step in developing the FS reports.
- Area 2 SRI Report
- Area 2 Alternatives Screening Technical Memorandum
- Area 2 FS Report

EPA approved the Area 2 SRI Report on July 28, 2015, and approved the Area 2 FS Report on March 15, 2017.

Public Participation Activities

Since 2007, EPA has conducted two public meetings per year regarding cleanup activities within OU5. In addition, EPA has distributed fact sheets for all of the public meetings. EPA also conducted site tours for interested stakeholders during various TCRAs conducted in Areas 1 and 3 of OU5. Most recently, EPA held a public meeting on March 8, 2017, regarding the Area 2 FS Report. During the meeting, EPA presented all relevant information to the public and answered questions about the remedial alternatives under consideration.

3. AREA 2 CHARACTERISTICS

This section of the Proposed Plan summarizes the physical characteristics and the nature and extent of contamination in Area 2 of OU5. The significant findings and conclusions from the characterization activities completed during the SRI are summarized below. Additional details are available in the Area 2 SRI Report.

The physical characteristics of Area 2 are influenced by dams. The remains of the former Plainwell Dam mark the upstream boundary of Area 2, while the Otsego City Dam forms the

downstream boundary. The former Otsego City Impoundment was drawn down in 1982 when stop logs were removed from the Otsego City Dam and again in May 1991 when the dam was dismantled to its sill level. These actions are estimated to have lowered water levels by 3 to 5 feet.

Area 2 has two distinct sections, as shown on Figure 3: the upstream, free-flowing anabranched section (approximately 0.7 miles long) and the downstream section influenced by the current Otsego City Dam (approximately 1.2 miles long). Gun River is the only tributary to this section of the Kalamazoo River, entering the north bank approximately one-half mile upstream of the Otsego City Dam. There is a 2.6-acre pond that lies between the Gun River and the Area 2 study boundary. This pond, known here as Pond G, does not typically interact with the Gun River except during flooding events, when the pond drains to the Gun River. A distinctly shaped island, known here as Knife Blade Island, exists in the center of the Area 2 impoundment on the south side of the Kalamazoo River.

Area 2 is densely vegetated. Land use within Area 2 is primarily recreational, with some industrial property near the City of Otsego and a few residential properties bordering the study area.

The river bottom is predominantly sand and gravel with some fine-grained sediment. Fine-grained sediment occurs in areas along the channel margins and in side channels of the anabranched area. The average water depth in Area 2 of the Kalamazoo River ranges from 2 to 6 feet.

Based on groundwater monitoring conducted during the Area 1 Plainwell Impoundment TCRA, in conjunction with groundwater monitoring data from other site OUs and knowledge of the nature of the PCB contamination at the site, EPA has concluded that groundwater is not a medium of concern at Area 2 of OU5.

Nature and Extent of Contamination

This section summarizes the nature and extent of contamination in the sediment and floodplain soil within Area 2 of OU5. All PCB concentrations are reported as total Aroclors (total PCBs).

Sediment and Floodplain Soil Sampling Summary

As discussed above, from 1993 to 2012 there were significant sampling efforts site-wide. The SRI for Area 2 of OU5 focused on data gaps and further defining the nature and extent of contamination. As part of the SRI, 116 sediment cores were collected and yielded 567 sediment samples that were analyzed for PCB Aroclors, with a subset analyzed for total organic carbon (TOC) and grain size. In addition, a subset of samples was analyzed for mercury, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, pesticides, and polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (dioxins/furans). Sediment PCB concentrations ranged from non-detect (ND) to 111 mg/kg. The non-PCB constituents are discussed below in Section 5, *Summary of Site Risks*.

Soil cores were collected from 243 locations within the floodplain. Of these, 154 soil cores yielded 762 samples for PCB analysis, with a subset analyzed for TOC and grain size. In addition, a subset was analyzed for mercury, VOCs, SVOCs, metals, pesticides, and dioxins/furans. An additional 89 riverbank soil cores were analyzed for PCBs, with a subset analyzed for TOC, grain size, mercury, SVOCs, VOCs, metals, pesticides, and dioxins/furans. Soil PCB concentrations ranged from ND to 112 mg/kg.

Distribution of PCBs in Sediment

Sediments are defined as materials collected in areas with flowing or standing water. The spatial distribution of PCBs in Area 2 has been significantly influenced by historical changes in the water level elevation associated with the Otsego City Dam and geomorphology in this segment of the Kalamazoo River.

Area 2 sediment has been divided into 11 subareas based on geomorphic similarities and location (see Figure 4). They are as follows:

- Subarea A: Lower Main Channel
- Subarea B: Lower Anabranches and Unnamed Tributary
- Subarea C: Upper Main Channel
- Subarea C1: Upper Main Channel (Side Channel)
- Subarea D0: Upper Anabranches (Plainwell Dam Spillway)
- Subarea D1: Upper Anabranches (Northern Anabranches)
- Subarea D2: Upper Anabranches (Plainwell Anabranches)
- Subarea E: Cutoff Anabranches
- Subarea F: Lower Gun River
- Subarea F0: Upper Gun River
- Subarea G: Ponded Area

Detailed discussions of the PCB concentrations in each subarea are included in the Area 2 SRI Report. Table 1 presents a summary of the sediment concentrations in each subarea. Overall, 72 percent of sediment samples were ND or less than 0.33 mg/kg, and 82 percent of samples were less than 1 mg/kg. Lower PCB concentrations generally occurred in Subareas A, B, C1, and F0. Subarea B generally had PCB concentrations less than 1 mg/kg. Subarea F0 had concentrations that were ND. Most of Subareas A and C had PCB concentrations less than 1 mg/kg (likely due to flow preventing the settling of PCBs in this segment of the river), with the exception of individual high PCB concentrations mostly located along the river channel edges.

A transect with higher concentrations between 5 and 10 mg/kg is located in Subarea A approximately 100 feet upstream of the Otsego City Dam along the channel edges at the surface. Individual areas of discrete concentrations above 10 mg/kg also occur along the channel edges in Subarea C. Higher concentrations are also observed in Subareas D1, D2, and E throughout the depth profile. The maximum concentrations of PCBs in Area 2 were detected in these anabranch subareas (with the highest concentration being 111 mg/kg). PCB concentrations are also higher in Subareas F and G.

The vertical distribution of PCBs is directly related to the prevalence and thickness of sediment deposits in Area 2. In the upstream subareas where sediment is relatively thin, PCBs are predominantly located in the upper intervals. In the downstream areas, where sediment deposits are thicker, PCBs are detected at higher concentrations at depth.

The horizontal distribution of PCBs appears to be related to the formation of an anabranched region comprised of Subareas D1 and E. These subareas were subjected to significant changes over time resulting from water level management practices. The higher concentrations in Subarea A appear to be influenced by PCB concentrations in adjacent bank soils, as few sediments in the mid-channel exhibit PCB concentrations greater than 1 mg/kg. River edge sediment samples with elevated PCB concentrations often spatially coincide with bank soils with higher PCB concentrations. Physical processes such as erosion and sloughing, as well as varying water elevations, may explain the spatial distribution of PCBs in Subarea A.

Surface-Weighted Average Concentration of PCBs in Sediment

A surface-weighted average concentration (SWAC) is a method of spatially calculating the mean (average) concentration of a constituent in the sediment surface. Samples are collected throughout the area of concern, representative subareas are generated for each sample location, and a subarea-weighted average concentration is calculated to produce the SWAC. The subareas may be generated using several different methods such as grids or stream tubes. SWACs were generated for the main channel (Subareas A and C) using kriging. Mean concentrations were used rather than SWACs for the remaining subareas due to the often limited number of samples. The methodology for calculating SWACs is described in Appendix H of the Area 2 SRI Report, which is included in the Administrative Record file. Table 2 presents a summary of the sediment SWACs and mean concentrations in each subarea.

Based on the data collected during the SRI, SWACs in the main channel are less than 0.33 mg/kg. The anabranch subareas (Subareas D1, D2 and E) showed some of the highest average PCB concentrations in the top six inches, ranging from 3.91 to 7.84 mg/kg, indicating that the anabranch areas are a source of PCB contamination to the river.

Distribution of PCBs in Floodplain Soil

Soils are defined as materials collected in areas without standing water, and along the riverbank represent the area above the water line under normal flow conditions.

The floodplain areas within Area 2 were split into 11 geomorphic categories based on their physical characteristics and surface elevations in relation to historical water levels over time (see Figure 5). These floodplain subareas are as follows:

- Lower Terrace
- Lower Terrace-Gun River
- Medium Terrace
- Medium Terrace-Buffered
- Medium Terrace-Gun River
- Previous Channel

- Previous Main Channel
- Previous Main Channel-Anthropogenic
- Upland Area
- Upper Terrace
- Upper Terrace-Buffered

Detailed discussions of the PCB concentrations in floodplain soils are included in the Area 2 SRI Report. Table 3 presents a summary of the floodplain soil concentrations in each subarea. PCB concentrations are less than 10 mg/kg throughout the soil profile in the Medium Terrace-Gun River, Upland Area, and Upper Terrace-Buffered landforms. These areas have been protected from dispersion of PCB-laden sediments by dense vegetation and/or higher elevations.

Historical higher water elevations and flood events have dispersed higher concentration, PCB-containing sediments over the now-exposed floodplain next to the Otsego City Dam and in anabranched subareas. These areas are designated as Medium Terrace, Upper Terrace, Lower Terrace, Lower Terrace-Gun River, Previous Channel, Previous Main Channel, and Previous Main Channel-Anthropogenic. The maximum PCB concentrations in floodplain soils were found in the anabranched subareas (with the highest, 112 mg/kg, found in the Lower Terrace subarea). Multiple sampling events between 1993 and 2012 demonstrated variability in the results for various floodplain areas. This is a result of both flooding events redistributing sediment and channel movement in the anabranched area. As a result, there is uncertainty regarding the PCB distribution in floodplain soils. This was discussed in detail in Section 4.2.2.4 of the SRI Report. Pre-design sampling may be conducted to further delineate the distribution of PCBs in floodplain soils prior to remedial action.

Conceptual Site Model

A conceptual site model (CSM) was developed for Area 2 of OU5 based on site characteristics and results from the SRI investigations. The CSM tells the story of how and where the PCB contamination moved and what impacts such movement may have had upon human health and the environment.

As described in the CSM, PCBs are the primary COC. Site data shows that exposure to PCBs will drive risks at the site, and that the management of risks due to PCB exposure will also address risks associated with other non-PCB constituents. PCB levels in fish are linked to concentrations in sediment and surface water through the food chain. Risks to humans and aquatic ecological receptors are driven by the consumption of PCB-contaminated fish. Human health risk estimates show concentrations of PCBs in fish tissue result in exceedances of EPA target levels for both cancer and non-cancer risks; this will be further discussed in Section 5, *Summary of Site Risks*.

The primary transport mechanism is PCB uptake through the food chain via PCB-contaminated sediment that already exists in the river and that continues to enter the river by erosion of PCB-contaminated bank material. External sources of PCBs to Area 2 as well as background sources of PCBs from areas upstream of Area 1 (which have mean PCB background sediment concentrations of 0.31 mg/kg) are expected to sustain low levels of PCBs in fish tissue in the

long term, even with control of known potential source areas associated with historical papermaking operations.

The Area 2 CSM has been divided into two portions due to the geomorphic differences between the upstream and downstream portions of Area 2.

Upstream CSM

The upstream anabranched portion of Area 2 is composed of many hydraulic and geomorphic features. Changes in the channelization of Area 2 have occurred, especially since the lowering of the Otsego City Dam and the removal of the former Plainwell Dam. Backwater anabranched channel areas (segments of Subareas D1 and E) next to former channel sediments and Medium Terrace geomorphic features, especially in the north floodplain area, have elevated PCB concentrations and have limited hydraulic connection to the main flow of the Kalamazoo River. Under relatively infrequent, high flow events, these areas may be subject to erosive losses and may contribute uptake of PCBs in the aquatic food chain due to inundation during flooding. Due to high PCB concentrations near the surface, risks from exposure are also higher for these areas. In addition, some soils along the bank of the main channel contain elevated PCB concentrations.

Downstream CSM

The main channel contains sediments of varying thickness, ranging from fine sands with silt to coarse sands with some gravel. PCB concentrations in main-channel sediment are generally less than 1 mg/kg, with some channel edges exhibiting higher PCB concentrations. The banks of the main channel are easily flooded by a 2-year flow event, and field data indicates that some banks show signs of erosion. There is little evidence that PCBs or fine sediments build up in the main channel, and bed shear stresses are typically high enough to mobilize finer particles if the banks are unprotected by vegetation. Therefore, PCBs associated with fine sediments are likely to be transported downstream soon after these sediments are mobilized into the main channel by suspended flow, erosion, bank loss on the channel edges, or other mechanisms.

The media of concern in Area 2 are sediments and floodplain soils. PCB-contaminated sediments and bank soils both can lead to PCB uptake in fish. The targeted remediation areas in Area 2 are localized PCB deposits along the main channel, the anabranch channels, floodplain soils exceeding ecological risk criteria, bank soils, Knife Blade Island, Gun River, Pond G, and two private parcels extending into the study area. As noted earlier, the calculated SWACs in the main channel are less than 0.33 mg/kg total PCBs. The anabranch channels have the highest average PCB sediment concentrations in Area 2 and are targeted for remediation.

Principal Threat Wastes

The principal threat concept is applied to the characterization of "source material" at a Superfund site. Source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contaminants to ground water, surface water or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably

contained or would present a significant risk to human health or the environment should exposure occur.

EPA has not identified any principal threat wastes at OU5 of the site. The PCB-contaminated soil and sediment throughout OU5 are reworked and re-deposited materials that have been mixed with water, soil and sediment throughout Area 2. The concentrations of PCBs at OU5 are considered to be low-level threat wastes.

4. SCOPE AND ROLE OF THE ACTION

As described earlier, the Allied Paper, Inc./Portage Creek/Kalamazoo River site has been broken into a number of separate OUs. In keeping with EPA's policies regarding the management of contaminated sediment sites, EPA's approach has been to control the significant potential sources of PCBs to the river first, before addressing the contamination in the river (OU5). A number of response actions have been taken at other site OUs that effectively control releases from those OUs to OU5. The remediation of OU5 no longer depends on the sequencing of work at any of the other OUs.

OU5 of the site has been broken into seven different areas, with Area 1 being the furthest upstream and Area 7 being the furthest downstream. While SRI/FS work is being conducted concurrently in several of the OU5 areas, EPA intends to make final cleanup decisions and conduct cleanup actions in the river in one area at a time, from upstream to downstream.

No removal actions have been conducted to address contaminated sediment or soil within Area 2 of OU5. The proposed remedial action in this Proposed Plan will address the PCB-contaminated sediment and soil in Area 2 and is intended to be the final response action for Area 2. It does not address the other OUs at the site nor other river areas (Areas 1, 3, 4, 5, 6, 7) within OU5.

5. SUMMARY OF SITE RISKS

This section summarizes the risks to human health and the environment that are posed by the contamination.

Contaminants of Concern

As described in the generalized CSM, PCBs are the primary COCs. The available data indicate that exposure to PCBs will drive risks at the site, and that management of risks due to PCB exposure will also address risks associated with other non-PCB constituents.

During the investigation of Areas 1 and 2 of OU5, samples collected from various media and biota in and along Portage Creek and the Kalamazoo River, including soil, sediment, surface water, and fish tissue, were selectively analyzed for non-PCB constituents. Samples were analyzed for metals, VOCs, SVOCs, pesticides, and dioxins/furans. Many non-PCB constituents were detected in all media, likely from multiple point and non-point sources in the industrialized portions of the watershed (and general anthropogenic deposition throughout the watershed), and may not be directly linked to the PCB releases.

On April 2, 2015, EPA approved the *Area-Wide Non-PCB Constituent Screening Evaluation.* Sediment and soil samples collected in Areas 1, 2, and 3 and analyzed for non-PCB constituents were pooled to produce a statistically relevant data set for this evaluation. The purpose of this document was to screen out non-PCB constituents in soil and sediment based on background and human health and ecological screening values. The evaluation demonstrated that total PCBs will drive risk management and remedial decisions for sediment and soil in Area 2.

In addition, dioxin-like PCBs and dioxin/furans were further addressed through a collocation mapping exercise in the *Technical Memorandum - Collocation Mapping of PCB Dioxin-Like Compound TEQs, Dioxins/Furans, and Total PCBs*, which was submitted to EPA and MDEQ on April 16, 2015. The collocation mapping showed that concentrations of dioxin-like PCBs and dioxins/furans would be included in the PCB remediation footprint. As a result, EPA believes that risk management and remedial decisions based on total PCBs will address dioxin-like PCBs and dioxins/furans.

Baseline Human Health Risk Assessment

The baseline human health risk assessment (BHHRA) for the site was completed by MDEQ's contractor, CDM, in 2003 as part of the original RI. The BHHRA evaluated potential current and future risks to people who may live or engage in recreational activities near the Kalamazoo River and its floodplains along all seven areas of OU5, including risks to subsistence and sport anglers who may consume fish caught from the Kalamazoo River. Additionally, the Michigan Department of Community Health (MDCH) prepared a Health Consultation for the site in 2002.

GP's contractor, ARCADIS, updated the BHHRA in 2012 as part of the Area 1 SRI to reflect the results of additional fish tissue samples collected since the publication of the 2003 BHHRA. The updated BHHRA provided updated risk and hazard estimates for subsistence and sport anglers associated with exposures to PCBs released into the Kalamazoo River system. GP's current contractor, Amec Foster Wheeler, updated the BHHRA in 2015 based upon data collected in 2011 from Area 2 of the river.

In addition to fish consumption by anglers, several other potential exposure pathways were described in the 2003 BHHRA that are relevant to Area 2, as follows:

- *Consumption of turtles:* Although this pathway was evaluated qualitatively as a potential exposure pathway, the BHHRA concluded that the overall exposure and risks to receptors ingesting turtles would be less than that of anglers. The analytical data that exist for turtle tissue indicate that PCB concentrations are less than that for smallmouth bass and carp fish tissue.
- *Consumption of waterfowl*: This exposure pathway was considered in the BHHRA. However, because of data limitations with waterfowl samples, CDM did not complete a qualitative evaluation or quantify risk estimates for this exposure pathway.
- *Direct contact with river sediment (by swimmers or waders):* Direct contact exposures to river sediment during recreational activities (swimming, wading) were determined not to

be important means of exposure to PCBs, based on the Health Consultation prepared by the MDCH. As a result, such exposures were not evaluated further in the BHHRA.

- *Exposure to in-stream surface water (by swimmers or waders):* Due to the relatively low ingestion rates of surface water, the low solubility of PCBs in water, and the low dermal absorption of PCBs, the BHHRA concluded that this pathway could be assumed to be without risk.
- *Exposure to air:* Inhalation of particulates and volatile emissions from exposed floodplain soil and sediment were quantitatively evaluated in the BHHRA, but inhalation of volatile emissions from surface water was not quantitatively evaluated.
- *Direct contact with floodplain soil and exposed sediment:* Two residential developments exist adjacent to the floodplains in Area 2. The BHHRA quantitatively evaluated direct contact pathways (dermal contact and incidental ingestion) that may be relevant to residents (the most highly-exposed receptor group) or recreational visitors.

Fish Advisory

MDCH has issued a fish advisory for parts of Portage Creek and the Kalamazoo River, extending from Morrow Lake Dam to Lake Michigan. For the river area from Morrow Lake Dam to the Allegan Dam (which is located in Area 6), and on Portage Creek downstream of Monarch Mill Pond (which is located just upstream of OU1), the advisory currently recommends that the general population not consume carp, catfish, suckers, smallmouth bass, or largemouth bass from these areas. Between Allegan Dam and Lake Michigan, the advisory recommends that the general public not consume carp, catfish or northern pike. Healthy adult males are advised to eat no more than one meal per week of all other species. For women of childbearing age and children under 15 years of age, no consumption of any species is recommended for fish caught above Allegan Dam, including Area 2.

MDCH's fish consumption advisory is only a recommendation, is not legally binding, and has limited effectiveness in protecting human anglers from Kalamazoo and Allegan Counties. A survey from 1994 showed that anglers ate on average two meals per month of various species taken from contaminated reaches of the river, including bass, catfish, panfish, bullheads, and carp. More than 10 percent of anglers ate more than one meal per week of these various species. This survey confirmed that the Kalamazoo River is an important recreational resource and may serve as an important source of food for certain human subpopulations.

BHHRA Conclusions

The likelihood of any kind of cancer resulting from exposure to carcinogens at a Superfund site is generally expressed as an upper bound incremental probability, such as a "1 in 10,000 chance" (expressed as 1×10^{-4}). In other words, for every 10,000 people exposed to the site contaminants under reasonable maximum exposure conditions, one extra cancer may occur as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risk of cancer individuals face from other causes such as smoking or too much sun. The risk of cancer from other causes has been estimated to be as high as one in three. The potential for non-cancer health effects is evaluated by comparing an exposure level over a

specified time period (such as a lifetime) with a "reference dose" derived for a similar exposure period. A reference dose represents a level that is not expected to cause any harmful effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that the dose from an individual contaminant is less than the reference dose, so non-cancer health effects are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (such as the liver). An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, non-cancer health effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health. EPA's acceptable risk range is defined as a cancer risk range of 1×10^{-6} to 1×10^{-4} and an HI < 1. Generally, remedial action at a site is warranted if cancer risks exceed 1×10^{-4} and/or if non-cancer hazards exceed an HI of 1.

The BHHRA for the site (including Area 2) presented estimated cancer risks and non-cancer hazards for several populations of anglers consuming fish from the Kalamazoo River and for residential and recreational receptors exposed to floodplain soil adjacent to the former Plainwell, Otsego, and Trowbridge Impoundments.

Risk characterization for anglers was performed for three potential populations: central tendency sports anglers, high-end sports anglers, and subsistence anglers.[3] Two exposure scenarios for the three angler populations were included in the BHHRA: the first assumed a diet of 100 percent pelagic (non-bottom feeding) fish species and the second assumed a mixed species diet (76 percent pelagic species and 24 percent bottom-feeding species).

The updated BHHRA for Area 2 showed that potential excess cancer risks and non-cancer hazards exceeded acceptable levels for the fish ingestion pathway for all three angler populations. Cancer risks and non-cancer hazards were highest for the subsistence angler (4×10^{-4} and an HI of 18, respectively). Cancer risks and non-cancer hazards were lowest for the central tendency sport angler (5×10^{-5} and an HI of 2, respectively). Adverse health effects associated with PCB exposure include increased risk of liver cancers and reproductive and immunological impairment.

The BHHRA for Area 2 did not update floodplain risk information provided in the 2003 BHHRA, as risk estimates for the fish ingestion pathway were approximately 60- to 70-fold greater than risk estimates for floodplain soil pathways for residents and recreational receptors. The 2003 BHHRA evaluated the floodplain areas around the former Plainwell and Plainwell 2 impoundments, the Otsego Dam, and the Trowbridge Dam. Estimated risks for residents exposed to average floodplain surface soil concentrations were within EPA's acceptable risk range but were greater than MDEQ's cancer risk threshold of 1×10^{-5}. Excess cancer risk estimates exceeded the acceptable risk range when the maximum detected concentration for each area was used.

For residential receptors exposed to floodplain soil via multiple routes (i.e., ingestion, dermal contact, and inhalation of fugitive dust), HIs for the reproductive endpoint exceeded 1 for all three areas when maximum concentrations were used, but were less than 1 using average

[3] Central tendency sports anglers were estimated to consume an average of 0.015 kg fish tissue/day (24 half-pound meals/year). High-end sports anglers were estimated to consume 0.078 kg fish tissue/day (125 half-pound meals/year). Subsistence anglers were estimated to consume 0.11 kg fish tissue/day (179 half-pound meals/year).

floodplain soil concentrations. HIs for immunological endpoints exceeded 1 for all three areas using both average and maximum floodplain soil concentrations.

Excess cancer risks and non-cancer hazards for recreationists exposed to average floodplain surface soil concentrations were within EPA's acceptable risk range and less than MDEQ's cancer risk threshold of 1×10^{-5} in all three areas evaluated. When the maximum floodplain soil concentration was used, potential cancer risks were within EPA's acceptable risk range but were greater than MDEQ's cancer risk threshold. HIs were greater than 1 when maximum soil concentrations were used.

As noted earlier, fish advisories are currently in place to address risks to humans from consumption of fish. There are currently no restrictions in place to control human exposures to sediment, soil, or surface water.

In summary, the fish ingestion pathway poses unacceptable risks and hazards to anglers. Additionally, potential exposure to maximum floodplain soil concentrations may pose unacceptable risks and hazards to residents and recreationists. The BHHRAs made assumptions using best professional judgment and available scientific literature on risk assessments.

Baseline Ecological Risk Assessment

As part of the original RI, CDM prepared a baseline ecological risk assessment (BERA) for OU5 that identified terrestrial and aquatic receptors and exposure pathways. During the Area 1 SRI, an updated terrestrial BERA (TBERA), covering terrestrial birds and mammals, was conducted. The methods and approaches incorporated in the Area 1 TBERA built on the information in the BERA and the CSM. The TBERA also accounted for updated risk assessment guidance and scientific research, additional sampling results, a December 2008 peer review panel report, two completed TCRAs in Area 1, and source control activities completed or underway at the former mill properties and landfill OUs in Area 1 since the BERA was completed. The Area 1 TBERA did not revisit the aquatic portion of the BERA but carried forward those associated conclusions. As part of the Area 2 SRI, the TBERA was updated to incorporate recent Area 2 data.

Summary of OU5 BERA

The BERA was conducted to evaluate potential adverse effects to terrestrial and aquatic ecological receptors associated with PCB exposures in surface water, sediment, surface soil, and biota. Representative ecological receptors included aquatic plants, aquatic macroinvertebrates, game fish, forage fish, rough fish, terrestrial invertebrates, small burrowing omnivorous mammals, semi-aquatic herbivorous mammals, small semi-aquatic carnivorous mammals, and top mammalian and avian predators. The BERA evaluated complete exposure pathways that included the following:

- Surface water – direct contact, uptake, ingestion, or ingestion of prey
- In-stream sediment/interstitial water – direct contact, ingestion, or ingestion of prey
- Surface soil/floodplain sediment and soil – direct contact, ingestion, or ingestion of vegetation/prey

The BERA concluded the following:

- Most aquatic biota, such as invertebrates and fish, are not expected to be adversely affected by direct contact with and ingestion of surface water because of relatively low PCB toxicity to most aquatic biota.
- PCB contamination of surface water and streambed sediment may adversely affect sensitive piscivorous predators, such as mink, through the consumption of PCB-contaminated fish.
- Terrestrial and semi-aquatic biota are potentially at risk from floodplain sediment and surface soil, depending on life cycle characteristics (e.g., foraging behavior, diet, mobility) and predicted sensitivity to PCBs.

Summary of Area 2 TBERA

The updated Area 2 TBERA builds upon the prior OU5 BERA and the Area 1 TBERA. The updated Area 2 TBERA for terrestrial birds and mammals is included as Appendix M of the Area 2 SRI Report. The methods, inputs, and approaches incorporated in the updated Area 2 TBERA are the same as those employed in the Area 1 TBERA. The updated Area 2 TBERA incorporates current Agency guidance, current science, and new data collected to support the SRI activities. Representative receptors were selected as the most highly-exposed species likely to inhabit Area 2. The representative receptors included insectivorous birds (house wren), vermivorous mammals (short-tailed shrew), vermivorous birds (American robin and American woodcock), carnivorous mammals (red fox), and carnivorous birds (red-tailed hawk).

The Area 2 TBERA conclusions are summarized as follows:

- Overall, the Area 2 TBERA found no unacceptable risk to moderate or low-sensitivity insectivorous (e.g., house wren) or vermivorous (e.g., American robin, American woodcock) birds in Area 2.
- Possible, but unlikely, risk was identified for high-sensitivity insectivorous (e.g., gray catbird, European starling) and vermivorous birds, if present. (Note: no highly-exposed, high-sensitivity vermivorous birds have been documented at the site, although these species could potentially occur at the site.) Many of these species have not been classified based on their sensitivity to PCBs or dioxin-like compounds. As a result, there is a possibility that high-sensitivity vermivorous birds, if they occur at the site, may have a potential for risk.
- The TBERA did not address aquatic receptor uptake when the floodplains are inundated by flooding because the frequency and duration of flooding is not of sufficient duration.
- While possible risk was identified for vermivorous mammals (e.g., short-tailed shrew), it is unlikely due to the low frequency of possible home ranges with high HQs. These areas correspond to geomorphic categories of Medium and Upper Terraces in the east portion of Area 2 (among the anabranches) and Lower Terrace areas in the northwest portion of Area 2, north of the main river channel approaching the Otsego City Dam.

Because there is potential risk to ecological receptors exposed to PCB-contaminated floodplain soils, remedial alternatives to protect ecological receptors were developed and evaluated in the FS and are discussed in this Proposed Plan.

Basis for Taking Action

It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

6. REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are goals for protecting human health and the environment. RAOs are developed to address the contaminant levels and exposure pathways that present unacceptable current or potential future risk to human health and the environment. The development of RAOs and proposed cleanup levels, known as preliminary remediation goals (PRGs), is the first step in identifying and screening remedial alternatives for addressing the COCs and media of concern.

Remedial Action Objectives for Area 2

The following five RAOs have been developed for PCB-containing media and biota in Area 2:

- **RAO 1: Protect people who consume Area 2 Kalamazoo River fish from exposure to PCBs that exceed protective levels.** This RAO is expected to be progressively achieved over time by meeting the following targets for fish tissue and sediment:
  - Reduction in fish tissue to the Michigan fish advisory level for smallmouth bass to two meals per month (0.11 mg/kg total PCB concentration) within 30 years[4].
  - Achievement of a non-cancer HI of 1 and a 10^{-5} cancer risk within 30 years for the high-end sport angler (100 percent bass diet; 125 meals/year)[5].
  - The above fish tissue goals for bass will be achieved by protecting fish from exposure to sediment PCB SWACs above 0.33 mg/kg in Area 2 following completion of the remedial action.
- **RAO 2: Protect aquatic ecological receptors from exposure to concentrations of PCBs in sediment that exceed protective levels for local populations.** This RAO is designed to protect fish-eating birds and mammals by reducing fish tissue PCB concentrations to levels that do not harm the sustainability of local populations of these receptors[6].

[4] This specific target is a goal of the remedial action, but it is not a PRG.

[5] The non-cancer and cancer risk levels described here are what drive the PRGs for RAO 1.

[6] See the PRG table on page 20.

- **RAO 3: Protect terrestrial ecological receptors from exposure to concentrations of PCBs in soil that exceed protective levels.** This RAO is intended to protect local populations of birds and mammals by reducing PCB concentrations in soil to levels that do not harm the sustainability of local populations of these receptors.
- **RAO 4: Reduce transport of PCBs from Area 2 to downstream areas of the Kalamazoo River and Lake Michigan.** This RAO includes reducing the potential for erosion and downstream migration of PCB-impacted sediment and riverbank soil.
- **RAO 5: Protect people that reside in Area 2 from exposure to PCBs that exceed protective levels.** This RAO is intended to protect local residents from exposure to PCB concentrations that may cause a carcinogenic risk greater than 10^{-5} or an HI greater than 1.

Preliminary Remediation Goals

PRGs are risk-based or ARAR-based chemical-specific concentrations that help further define the RAOs. PRGs are considered "preliminary" remediation goals until a remedy is selected in a ROD. The ROD establishes the final remedial goals and/or cleanup levels. PRGs are also used to define the extent of contaminated media requiring remedial action, and are the targets for the analysis and selection of long-term remedial goals.

The BHHRA developed a series of risk-based concentrations (RBCs) for total PCBs in fish, sediment, and floodplain soil intended to be protective of anglers, recreationists, and residents, while the BERA and TBERA developed RBCs for sediment and floodplain soil intended to be protective of sensitive wildlife receptors. The RBCs are calculated, chemical-specific concentrations below which no significant health effects are anticipated for a receptor. For human receptors, Area 2 RBCs correspond to a target risk for carcinogenic effects of 1×10^{-5} and a target HI of 1 for non-carcinogenic effects. For ecological receptors, RBCs correspond to a target HQ of 1. RBCs for ecological receptors represent a risk range based on "No Observed Adverse Effects Level" and "Lowest Observed Adverse Effects Level" risk estimates for each receptor group.

Selection of Fish Tissue Preliminary Remediation Goals

The selection of a fish tissue PRG for total PCBs was a multi-step process that considered the RBC_{fish} values generated for each receptor, the likely exposure scenario to be frequently encountered, and the background levels of PCBs in fish tissue. Although a subsistence angler scenario was included in the calculation of RBC_{fish}, this pathway represents a worst-case scenario that is not expected to be frequently encountered compared to sport anglers. The RBC_{fish} would likely reflect a diet that is weighted toward the 100 percent smallmouth bass consumption scenario (over a mixed carp and bass species scenario) because the smallmouth bass is a popular sport fish on the Kalamazoo River. The range of RBC_{fish} for sport anglers is from 0.042 mg/kg to 0.187 mg/kg (non-lipid corrected). The upper end of this range is similar to the mean background concentration in smallmouth bass fillets in Morrow Lake immediately upstream of Area 1 (0.23 mg/kg). Another background reference area further upstream of Area 1 (Ceresco) had mean smallmouth bass fillet concentrations of 0.03 mg/kg. The upper end of this range is also

protective of women of childbearing age and young children consuming one half-pound meal a month from the site.

For RAO 1, the recommended fish tissue PRGs for total PCBs are 0.042 mg/kg for carcinogenic effects (based on a risk of 1×10^{-5}) and 0.072 mg/kg for non-carcinogenic effects (based on an HI of 1). These PRGs are based on risk estimates to sports anglers and sensitive populations, and take into account background considerations[7].

For RAO 2, the recommended fish tissue PRG for total PCBs is 0.6 mg/kg, which is protective of mink (the most sensitive ecological receptor).

Selection of Sediment PRGs

The selection of a sediment PRG for total PCBs considered the human health RBC_{sed} values associated with the human receptors who consume fish. MDEQ conducted an independent evaluation and has recommended a sediment PRG of 0.33 mg/kg. MDEQ concluded that this PRG value is appropriate for sediment because it is sufficiently protective of the high-end sports angler. This PRG value also corresponds to MDEQ's historical PCB detection limit that has previously been used as a sediment screening and target level in Michigan under Michigan's Natural Resources and Environmental Protection Act, Part 201. Based upon the aforementioned information and discussions between EPA and MDEQ, a PRG of 0.33 mg/kg was selected. Further, this PRG is close to the mean background sediment concentration of 0.31 mg/kg.

A sediment PRG of 0.33 mg/kg for total PCBs is protective of both human and ecological receptors. Sediment concentrations below 0.33 mg/kg are not likely to bioaccumulate in fish tissue to levels that present unacceptable risks and hazards to human populations, and will promote the achievement of the fish tissue RAOs over time.

Selection of Floodplain Surface Soil PRGs

The selection of a floodplain surface soil PRG for total PCBs was based on the range of site-specific RBC_{soil} values calculated for human recreationists and ecological receptors, with the ecological RBC_{soil} values driving the selection of the PRG because they were much lower than the values for human receptors. Although ecological risk was predominantly associated with high-sensitivity insectivorous and vermivorous birds and vermivorous mammals in the Area 2 TBERA, a range of RBC_{soil} was calculated based on the protection of multiple wildlife receptors. The uncertainty associated with the TBERA RBCs is summarized in the Area 2 FS Report.

A floodplain soil PRG of 11 mg/kg for total PCBs is based on protectiveness of 1-acre home ranges for maximum exposed mammals. Based on the analysis presented in the Area 2 FS Report, a PRG of 11 mg/kg is expected be protective of 99.5% of the possible 1-acre home ranges for maximally exposed mammalian receptors (i.e., the shrew). A PRG of 11 mg/kg PCBs is also assumed to be protective of avian receptors as it represents a balance between risk and uncertainty associated with the various methodologies and assumptions used in the TBERA to

[7] The high-end sports angler is assumed to consume 125 meals/year.

calculate risk to avian receptors. Therefore, the proposed PRG of 11 mg/kg in floodplain soil is protective of the various ecological receptors.

A floodplain soil PRG of 11 mg/kg for total PCBs is also protective of human recreational receptors. However, for floodplain surface soil in current or potential residential use areas, a PRG of 2.5 mg/kg is recommended to protect residential receptors.

For the reasons noted in Section 5, *Summary of Site Risks*, EPA believes that risk management decisions based on total PCBs will also address risks associated with other non-PCB constituents. However, in the event that dioxins are found in floodplain surface soils in current or potential residential use areas located outside the PCB remediation footprint, a PRG of 50 parts per trillion (ppt) is recommended to protect residential receptors, based on current EPA Regional Screening Levels.

Summary of PRGs

The table below summarizes the various PRGs that are proposed for Area 2. The ability to meet the various risk-based fish tissue PRGs will be evaluated during the five-year review process following the Area 2 remedial action. These reviews will consider factors identified during LTM that may limit overall fish tissue and sediment recovery (e.g., fish tissue or sediment concentrations approaching background levels, which include atmospheric deposition and/or other non-site sources of PCBs to the river system).

Recommended PRGs for Area 2 of OU5	
Media/Biota	**PRG for Total PCBs**
Fish Tissue	0.042 mg/kg (RAO 1, cancer risk of 1 x 10^{-5}) 0.072 mg/kg (RAO 1, non-cancer HI of 1) 0.6 mg/kg (RAO 2, ecological receptors)
Sediment	0.33 mg/kg (SWAC in each river section)
Floodplain Soil	11 mg/kg (all areas except residential) 2.5 mg/kg (residential areas)
Media	**PRG for Dioxin (if needed)**
Floodplain Soil	50 ppt (residential areas)

Remediation Areas

For purposes of developing potential remedial alternatives, the FS identified the various sediment and floodplain areas that would require remediation based on the RAOs and PRGs that were developed for Area 2.

The PCB SWAC analysis was used as a screening tool to evaluate the distribution of PCBs in sediment and to identify potential sediment remediation locations in Area 2. The SWACs provide predictions of the average exposure concentration in a specified area.

Area 2 is unique within the Kalamazoo River system because it includes anabranches with average sediment PCB concentrations above the sediment PRG of 0.33 mg/kg and a main channel with sediment SWACs below this PRG. The other areas of OU5 that have been investigated to date (Areas 1, 3, and 4) have main channel sediment SWACs above 0.33 mg/kg and require (or may require) remediation in the main channel. These other areas do not have anabranches to the same extent as Area 2, but rather are single-channel reaches. The highest average SWAC in an Area 2 main channel interval is 0.16 mg/kg. Because the sediment PRGs are currently being met in the main channel but fish tissue concentrations are elevated, it is likely that fish migrate to and from the anabranches where they are exposed to soil/sediment containing higher PCB concentrations. Therefore, the remedial alternatives evaluated for Area 2 sediment focus on remediation of the anabranches rather than the main channel.

The remedial alternatives evaluated for floodplain soil focus on locations that exceed ecological or human exposure PRGs, and on bank soil that could contribute, via erosion, to the transportation of PCBs to downstream areas.

Single Channel Design

Potential remediation areas were identified based on the evaluation of the Area 2 sediment and soil PCB data. An important consideration for selecting the remedial areas is the future river location following the removal of the Otsego City Dam. Dam removal is desired by the City of Otsego and the State of Michigan for several reasons, including reducing long-term dam maintenance and restoring natural free-flowing conditions to the river. Removal of the dam would result in the anabranches not conveying water under normal flow conditions (1,000 cubic feet per second (cfs)). As such, fish would no longer have routine access to these areas with higher PCB concentrations. However, with the dam removed, the bed slope in Area 2 would increase, and the main channel would likely erode, becoming more entrenched in the floodplain and unstable. In addition, during high flow events the anabranches would continue to erode PCB-contaminated material and transport it downstream into the river.

Due to the unique circumstances in Area 2 described above, EPA believes that removing the dam and constructing a single stable channel are necessary to meet the RAOs. Therefore, options for realigning the river in Area 2 to create a stable single channel with dam removal were evaluated for inclusion in the remedial alternatives to prevent the river from regularly forming unstable anabranches, and to protect the floodplain from future erosion due to channel migration. The goal would be to create a channel that conveys the bankfull flow of a 1.2-year return period (approximately 2,500 to 2,700 cfs), maintains adequate shear stress to convey the bedload of the river, and remains in a fixed location over time. Such a stable channel would maintain the applicability of the soil PRG in the dam-out floodplain across Area 2.

Channel realignment would be accomplished using modern natural channel design and restoration approaches to promote a stable channel and ecosystem that is self-sustaining over time. Such design features include energy dissipation structures, main channel bank/bed erosion protection, bank and riparian zone vegetation/restoration, and connectivity with the natural floodplain. Beneficial reuse of materials removed for channel realignment may include sediment, soil, vegetation, and woody debris.

Three channel realignment options were evaluated, and details about the three different options are provided in the Area 2 FS Report. Channel Option 3 (Figure 6) was selected for incorporation into the remedial alternatives that were developed for Area 2. In Option 3, the upstream half of Area 2 is provided with two meander curves, natural bank treatments with point bars, floodplain connection, and benches in the former impoundment at the bankfull flow elevation. The second meander curve in Option 3 serves as additional buffer for Knife Blade Island, allowing further deposition within and isolation of this island, to prevent the PCB contamination at Knife Blade Island from eroding into the river. Following the meandering section, the downstream layout closely follows the northern bank of the existing channel to the current dam location. Channel Option 3 was selected as the basis for remedial alternative development because it balances the effort and cost to achieve a stable single channel for remedial alternative development by providing a larger buffer area for Knife Blade Island than the other two options while also following the existing channel bed in the downstream reach. The actual design for channel realignment will likely be different in some respects from that shown in Figure 6 based on additional data collection and evaluation during the RD. However, general elements of the design should include protection of Knife Blade Island and a designed meander in the upstream portion to maintain a stable single channel through the currently anabranched area.

Construction of Channel Option 3 includes an estimated cut and fill volume of 144,000 and 62,000 cubic yards (cy), respectively, encompassing 59.1 acres. The total cost of channel realignment is $26,000,000 and the total cost to remove the Otsego City Dam is estimated at $3,840,000. Therefore, the total combined cost of Otsego City Dam removal and construction of Channel Option 3 is $29,840,000.

Remedial Areas for Evaluation

The remedial footprints selected for the comparative evaluation of remedial alternatives were based on the data collected during the SRI. These remedial footprints represent approximate areas for comparative evaluation of remedial alternatives and were based on PCB concentrations greater than 50 mg/kg, maximum PCB concentrations at any depth, and the 0- to 24-inch natural neighbor interpolation for floodplain soils. The actual remedial footprints to be addressed by the remedy selected in the ROD will be refined during the RD as determined by additional sampling.

The remedial areas are depicted on Figure 7 and include the following portions of Area 2 (some of which are labeled on Figure 3):

- main river channel
- northeast anabranches
- Gun River
- Pond G
- Knife Blade Island
- banks soils
- floodplain soil exceeding human health and ecological PRGs

7. SUMMARY OF REMEDIAL ALTERNATIVES

A range of alternatives was developed for soil and sediment to achieve the Area 2 RAOs. Remedial alternatives were developed by assembling combinations of appropriate remedial technologies. The Area 2 remedial alternatives are described below and summarized on Table 4. Additional details about all the remedial alternatives are available in the Area 2 FS Report.

EPA is recommending Alternative A-5 as the remedy for Area 2 of OU5.

Common Elements

Eight remedial alternatives were evaluated in the Area 2 FS report. Components that are common to Alternatives A-3 through A-7 are presented here as a group in order to limit redundancy in the subsequent discussion of the individual alternatives. The common components of Alternatives A-3 through A-7 are:

- Identification and confirmation of the remedial area footprints through additional sampling during the RD;
- RD sampling at SRI sample locations that exceeded 50 mg/kg PCBs to confirm the presence and extent of such hot spots for targeted removal;
- An LTM program and maintenance of ICs and engineering controls (ECs) until long-term goals are achieved. The LTM program would confirm the ongoing effects of natural processes and document the continued declines in PCB concentrations in various media, resulting in reductions in risk and ecological exposures. It is anticipated that the monitoring program would be designed to supplement the current program that includes fish and water column monitoring. The final components of the LTM program would be defined during the RD. For purposes of developing cost estimates, it was assumed that the LTM program would include the following activities:
    - Fish monitoring twice every 5 years during the LTM period. Fish samples would be collected in Area 2 and the reference/background areas. The actual sampling locations would be specified during the RD. Smallmouth bass and carp would be collected at each sampling location. Adult carp and both adult (fillet) and young-of-year (whole-body) smallmouth bass would be collected and analyzed for total PCBs and lipid content.
    - Surface water quality monitoring annually for the first five years, then once every five years for the remainder of the LTM period to support EPA's periodic five-year reviews. Surface water monitoring stations for OU5 are currently located at the upstream and downstream ends of Area 2 (in Areas 1 and 3, respectively). Surface water samples would be analyzed for total PCBs.
    - Sediment samples would also be collected to support EPA's five-year reviews by monitoring ongoing recovery conditions and natural attenuation in Area 2.
    - Visual inspections of riverbank erosion along the newly-constructed channel annually for the first five years after dam removal, then once every five years for the remainder of the LTM period. Additional inspections would be conducted after major storm/flooding events, as necessary.

- Site-specific fish consumption advisories established and publicized by the State of Michigan would continue to manage risks posed to anglers and their families from consumption of PCB-containing fish.[8] These advisories, which include warning signage posted along the river, are already in place for Area 2, and the advisory for each fish type would remain in effect until fish tissue PCB concentrations achieve RAOs for the fish specified. The advisories would be reviewed and verified annually as a component of the site ICs;
- In addition to fish consumption advisories, other ICs would be implemented and maintained. Land use restrictions to prevent future residential use and limit human exposure to recreational scenarios may be implemented where concentrations greater than 2.5 mg/kg will remain in the floodplain soil. In addition to the two private parcels in the northeast portion of Area 2, there are industrial-zoned and recreational parcels along the downstream portion (some owned by the City of Otsego and Otsego Township) for which ICs may be required.
- Use of a proposed RAL for PCBs of 20 mg/kg for floodplain soil. The RAL value of 20 mg/kg is based on an assessment of the following factors: the incremental risk reduction that would be achieved; the desire to protect 95% to 100% of the receptors (i.e., shrew, wren, and robin); and the incremental area and soil volume associated with each potential RAL value. A RAL of 20 mg/kg would provide the largest incremental risk reduction in the impounded floodplain area.

Remedial Alternatives

A-1: No Action

Regulations governing the Superfund program require that the "no action" alternative be evaluated generally to establish a baseline for comparison. The No Action remedial alternative, A-1, would rely on natural recovery processes ongoing in the river, as a result of completed and ongoing remedial actions in Area 1 and other upstream OUs. Ongoing natural recovery processes include deposition of cleaner sediment from the watershed and mixing of surface and cleaner sediment. No active remediation or monitoring would be conducted under this alternative. The time to reach protective levels and compliance with PRGs is estimated to be a minimum of 35 years, but no monitoring would be conducted to document progress toward achievement of PRGs. No cost is associated with this alternative.

A-2: Monitored Natural Recovery, Institutional Controls, and Long-Term Monitoring

This alternative includes the removal of the Otsego City dam followed by MNR, ICs and LTM. It relies on natural processes ongoing in the river, including reduced PCB loading from upstream sources as a result of completed and ongoing remedial actions in Area 1 and the other upstream OUs. Ongoing natural recovery processes include deposition of cleaner sediment from the watershed and mixing of surface and cleaner sediment. The LTM program for MNR would be robust to confirm stability of PCB deposits and to measure and track recovery in Area 2 PCB-impacted media/biota. The time to reach protective levels and compliance with PRGs under

[8] The fish consumption advisories issued by MDCH are only a recommendation, are not legally binding, and have limited effectiveness in protecting human health. Fish advisories, alone, would not be an appropriate remedial alternative.

Alternative A-2 is estimated to be a minimum of 35 years after ROD issuance. The estimated cost of this alternative is $12,500,000.

A-3: Capping, Channel Realignment, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM

The components of Alternative A-3 are discussed in detail below and shown on Figure 8. In summary, Alternative A-3 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- RD sampling as approved by EPA
- Excavation of confirmed PCB hot spots in areas to be capped
- Capping of the northeast anabranches, Pond G, and floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint
- Excavation of Gun River sediment and bank soil
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs (as discussed above in the *Common Elements* section)
- LTM and maintenance (as discussed above in the *Common Elements* section)

Alternative A-3 includes approximately 33 acres of capping and 12,900 cy of excavation over a total remedial footprint spanning approximately 36 acres.

Cap soil is assumed to mostly consist of clean cut material recovered from the channel realignment. Prior to placement of the cap, a non-woven geotextile layer would be placed over the existing ground surface to serve as a demarcation layer. To support habitat restoration, a topsoil layer would be created by entraining organic material (e.g., chipped vegetation, peat, and other organic detritus) recovered during clearing and channel realignment activities into the top six inches of fill. Caps in floodplain and anabranches would consist of a two-foot-thick soil cap (including topsoil layer) over a geotextile. For Pond G, the subaqueous cap would consist of an 18-inch layer of soil overlain with six inches of sand or gravel.

Some excavation at the interface between the anabranches and the main channel would occur prior to capping as part of channel realignment activities. RD sampling would be used to confirm locations of potential hot spots with PCB concentrations greater than 50 mg/kg identified during the SRI sampling. Footprints of confirmed hot spots exceeding 50 mg/kg PCBs on Knife Blade Island and in proposed cap areas would be excavated and backfilled prior to installing caps.

Gun River would be modified as part of channel realignment. Due to the uncertainty regarding the extent of current PCB contamination in Gun River, a cost range representing excavation of half of the channel sediment and along the left bank to the full width of the channel and both banks was considered. A mid-point cost has been included in the cost estimate for this alternative.

The LTM program for this alternative includes visual inspections, fish sampling, and maintenance activities for caps, bank treatments, and/or vegetation restoration. This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to

complete construction would be approximately 5 years. The estimated cost of this alternative is $43,800,000.

A-4: Capping, Bank RAL Excavation, Channel Realignment, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM

Alternative A-4 is the same as A-3 with the addition of excavation of bank soil along the realigned channel path that exceeds a RAL of either 5 or 10 mg/kg total PCBs.

The components of Alternative A-4 are discussed in detail below and shown on Figure 9. In summary, Alternative A-4 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- Bank RAL Excavation
- RD sampling as approved by EPA
- Excavation of confirmed PCB hot spots in areas to be capped
- Capping of the northeast anabranches, Pond G, and floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint
- Excavation of Gun River sediment and bank soil
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs (as discussed above in the *Common Elements* section)
- LTM and maintenance (as discussed above in the *Common Elements* section)

Alternative A-4 includes approximately 33 acres of capping and 16,900 to 22,300 cy of excavation over a total remedial footprint spanning approximately 38 acres.

Bank soil along the realigned channel would be excavated to a RAL of either 5 or 10 mg/kg total PCBs in a 10-foot swath along the bank. This additional bank soil excavation would provide an additional buffer between the newly-realigned channel and floodplain soils as a measure of added protection – above that provided by the natural channel design – to prevent migration of PCBs from floodplain/bank soil to the river. While bank treatment alone would protect the bank and floodplain soils, excavation to the bank soil RAL in the 10-foot swath would allow additional time to respond to maintenance concerns before bank failure could potentially occur.

Bank soil RALs for PCBs of both 5 mg/kg and 10 mg/kg were analyzed for additional protection along the realigned channel. Both RALs have been estimated to be protective. The cost range for performing bank excavation to a RAL of 10 or 5 mg/kg was estimated to be $570,000 to $1,330,000, respectively, based on an estimated 4,000 cy to 9,400 cy of excavation (including contingency and management costs). The cost range reported for this alternative reflects the difference in cost between a bank RAL for PCBs of 10 mg/kg and 5 mg/kg.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 5 years. The estimated cost range of this alternative is $44,400,000 to $45,200,000.

A-5: Capping, Bank RAL Excavation, Channel Realignment, Floodplain Soil Excavation, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM (THIS IS EPA'S RECOMMENDED ALTERNATIVE)

Alternative A-5 is the same as A-4, except that the floodplain soil areas exceeding the RAL of 20 mg/kg for PCBs would be excavated instead of capped.

The components of Alternative A-5 are discussed in detail below and shown on Figure 10. In summary, Alternative A-5 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- Bank RAL Excavation
- RD sampling as approved by EPA
- Excavation of confirmed PCB hot spots in areas to be capped
- Excavation of floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint
- Capping of the northeast anabranches and Pond G
- Excavation of Gun River sediment and bank soil
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs (as discussed above in the *Common Elements* section)
- LTM and maintenance (as discussed above in the *Common Elements* section)

Alternative A-5 includes approximately 28 acres of capping and 23,800 to 29,200 cy of excavation over a total remedial footprint spanning approximately 38 acres.

Remedial footprints in the Area 2 floodplain were identified based on reducing potential exposure to soil for ecological and human receptors to meet RAOs 3 and 5. The RAL evaluation in the FS was performed based on the 0- to 6-inch and 0- to 24-inch natural neighbor PCB concentrations to determine remedial action levels necessary to improve home range protectiveness. Details of the full evaluation can be found in Appendix C of the Area 2 FS.

The floodplain soil RAL evaluation consisted of identifying areas with natural neighbor interpolated concentrations in the 0- to 6-inch and 0- to 24-inch intervals including the anabranch sediment exceeding the selected RAL value. The concentrations in these areas were then replaced with a backfill value to represent conditions after excavation or capping. A backfill PCB concentration of 0.078 mg/kg was used to represent the measured average in off-site backfill as documented during implementation of the Area 1 TCRAs. Following backfill replacement, the moving window analysis was repeated for the four home range scenarios (2 acres for the 0- to 6-inch interval, and 1, 2, and 11 acres for the 0- to 24-inch interval), and the home-ranges-protected percentages for that RAL were calculated. A RAL of 20 mg/kg for PCBs was initially selected as this would also be protective of human recreational receptors (the PRG for recreational exposure is 23 mg/kg PCBs). At the RAL of 20 mg/kg, 99.5 to 100% of home ranges for the four receptor scenarios were protected by achieving the PRG of 11 mg/kg. Based on this result, it was not necessary to evaluate other RALs. The RAL soil footprint was then identified by combining the 0- to 6-inch and 0- to 24-inch natural neighbor areas exceeding 20 mg/kg PCBs.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 5 years. The estimated cost range of this alternative is $45,600,000 to $46,400,000.

A-6: Capping, Bank RAL Excavation, Channel Realignment, Anabranch Excavation, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM

Alternative A-6 is the same as A-4, except that the anabranch areas would be excavated instead of capped.

The components of Alternative A-6 are discussed in detail below and shown on Figure 11. In summary, Alternative A-6 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- Bank RAL Excavation
- RD sampling as approved by EPA
- Excavation of confirmed PCB hot spots in areas to be capped
- Excavation of the northeast anabranches
- Capping of Pond G and floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint
- Excavation of Gun River sediment and bank soil
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs (as discussed above in the *Common Elements* section)
- LTM and maintenance (as discussed above in the *Common Elements* section)

Alternative A-6 includes approximately 8 acres of capping and 124,900 to 130,300 cy of excavation over a total remedial footprint spanning approximately 38 acres.

The remediation footprint selected in the region of the northeast anabranches comprises the anabranch subareas D0, D1, D2 and E. The area in and around the D1 Subarea has the largest number of samples in Area 2 with maximum PCB concentrations above 50 mg/kg widely distributed at various depths in the soil and sediment along the banks of the various anabranches. Data in Subareas D0, D2, and E is less dense, with both high and low concentrations distributed throughout. RD sampling would be required to refine and further define the final remedial footprint in these areas. Excavation would occur in these anabranch areas, followed by backfilling to restore grade and riparian habitat restoration.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 5 years. The estimated cost range of this alternative is $66,900,000 to $67,700,000.

A-7: RAL-Based Excavation in Remedial Areas, Channel Realignment, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM

The components of Alternative A-7 are discussed in detail below and shown on Figure 12. In summary, Alternative A-7 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- Bank RAL Excavation
- RD sampling as approved by EPA
- Excavation of the northeast anabranches, Pond G, floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint, and soil with PCB concentrations exceeding 2.5 mg/kg on one of the two private parcels in the northeast corner of Area 2
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs (as discussed above in the *Common Elements* section)
- LTM and maintenance (as discussed above in the *Common Elements* section)

Alternative A-7 includes 162,100 to 167,500 cy of excavation over a total remedial footprint spanning approximately 42 acres.

This alternative would include excavation of the northeast anabranches, Pond G, floodplain soil exceeding the 20 mg/kg RAL outside the realigned channel footprint, and soil exceeding 2.5 mg/kg on one of the two private parcels in the northeast corner of Area 2.[9] After excavation, backfilling would occur to restore grade and riparian habitat restoration would be performed.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 5 years. The estimated total cost range of this alternative is $74,500,000 to $75,300,000.

A-8: Area-Wide Aggressive Excavation, ECs, ICs, and LTM

The components of Alternative A-8 are discussed in detail below and shown on Figure 13. In summary, Alternative A-8 includes:

- Otsego City Dam removal
- Area-wide excavation throughout Area 2 of sediment and floodplain soil with PCB concentrations exceeding 0.33 mg/kg, backfilling to restore the floodplain with grading for drainage to the post-dam main channel, and restoration of floodplain areas as riparian habitat
- ECs including erosion controls for rebuilt banks along the main channel
- RD sampling as approved by EPA
- ICs (as discussed above in the *Common Elements* section)
- Access agreements including rental and/or purchase of property
- LTM and maintenance (as discussed above in the *Common Elements* section)

[9] The owner of the second private parcel is amenable to implementing a restrictive covenant prohibiting residential use of the impacted portion of the property, which is used for recreational activities.

Alternative A-8 includes 1,260,000 cy of excavation over a total remedial footprint spanning approximately 250 acres.

Aggressive excavation would include an area-wide removal of sediment and floodplain soil exceeding 0.33 mg/kg. Although the dam would be removed, there would be no channel realignment. The goal of this alternative would be to achieve the sediment PRG throughout the floodplain and allow the river to migrate and meander without LTM or maintenance of bank treatments, soil, or sediment.

Excavated floodplain areas would be backfilled to pre-excavation grade, banks would be rebuilt (using ECs), and the area would be vegetated to restore the destroyed riparian habitat. The LTM program for this alternative would include visual inspections, fish sampling, and verification of ICs.

The extended construction timeframe and aggressive excavation work would mean invasive floodplain-wide impacts to habitat. Habitat and wildlife recovery times would be lengthy. The potential of invasive species to propagate may make a full recovery unlikely.

This alternative would reach PRGs for smallmouth bass within 40 years after ROD issuance. The time to complete construction would be approximately 10 years. The estimated cost of this alternative is $325,000,000.

8. EVALUATION OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they evaluate protection of human health and the environment or compliance with federal and state ARARs (threshold criteria), consider technical or economic merits (primary balancing criteria), or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria). These nine criteria are described below, followed by a discussion of how each alternative meets or does not meet each criterion.

Explanation of the Nine Evaluation Criteria

Threshold Criteria

1. ***Overall Protection of Human Health and the Environment*** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed by the site are eliminated, reduced or controlled through treatment, engineering, or institutional controls.

2. ***Compliance with Applicable or Relevant and Appropriate Requirements*** addresses whether a remedy will meet the applicable or relevant and appropriate federal and state requirements, known as ARARs.

Primary Balancing Criteria

3. ***Long-Term Effectiveness and Permanence*** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. ***Reduction of Toxicity, Mobility, or Volume Through Treatment*** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. ***Short-Term Effectiveness*** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction of the remedy until cleanup levels are achieved. This criterion also considers the effectiveness of mitigative measures and time until protection is achieved through attainment of the RAOs.

6. ***Implementability*** addresses the technical and administrative feasibility of a remedy from design through construction, including the availability of services and materials needed to implement a particular option and coordination with other governmental entities.

7. ***Cost*** includes estimated capital costs, annual operation and maintenance (O&M) costs, and the net present value of the capital and O&M costs, including long-term monitoring.

Modifying Criteria

8. ***State Agency Acceptance*** considers whether the state support agency supports the preferred alternative presented in the Proposed Plan and concurs with the selected remedy.

9. ***Community Acceptance*** addresses the public's general response to the remedial alternatives and the preferred alternative presented in the Proposed Plan.

Comparison of Alternatives

Each of the nine evaluation criteria are discussed below with respect to the alternatives under consideration for this remedial action. In addition, Table 5 provides a qualitative summary of how the cleanup alternatives compare against the first seven criteria; the remaining two criteria will be evaluated following the public comment period for the Proposed Plan. More details

regarding the evaluation and comparison of the cleanup alternatives against the nine criteria can be found in the Area 2 FS Report.

Overall Protection of Human Health and the Environment

Alternatives A-1 and A-2 are not protective of human health and the environment. These alternatives would not improve, reduce, or control risk to human health or ecological receptors beyond that initiated by the remedial work completed in the river to date. Although PRGs might be met in 35 years, no monitoring would occur with Alternative A-1, so any recovery rates and the achievement of protective levels would not be documented. Alternatives A-1 and A-2 would not address RAO 4, as they would not reduce the transport of PCBs from Area 2 to downstream areas of the Kalamazoo River and Lake Michigan. Sediment in the anabranch areas containing high concentrations of PCBs would continue to erode and migrate downstream with floods above the normal surface water elevation. Fish would then continue to be exposed to PCBs in or from the anabranch sediment. Dam removal may also increase the possibility of bed and bank erosion, especially in the short term.

Alternatives A-3 through A-7, which include removal of the Otsego City dam and realignment of the river channel, are protective of human health and the environment. These alternatives would immediately disconnect the anabranched sections from the main channel, eliminating exposure of fish to anabranch sediment and downstream migration of PCBs in anabranch sediment. Alternatives A-3 through A-5 would also include capping the former anabranches, which would raise their elevation further with respect to the main channel, cutting flow off at even higher water elevations. In addition to precluding contact with receptors, the capped elevation would reduce flood frequency, inundation time, and depth, as well as floodplain soil erosion. Alternatives A-6 and A-7 would include excavating the former anabranches to remove any possibility of PCBs from these areas entering the river system. Alternatives A-3 through A-7 all would achieve the PRGs in 32 years.

Alternative A-4 would provide additional protection compared to Alternative A-3 with the addition of bank excavation to a 5 or 10 mg/kg RAL for PCBs, as an additional buffer to the bank treatments installed along the realigned channel.

Alternative A-5 would provide protection comparable to Alternative A-4, with floodplain soils exceeding the 20 mg/kg RAL for PCBs excavated and disposed off site instead of capped.

Alternative A-6 would provide protection comparable to Alternatives A-4 and A-5, with the anabranches excavated and disposed off site instead of capped.

Alternative A-7 would provide protection comparable to Alternatives A-3 through A-6, with all remedial areas exceeding RALs excavated and disposed off site.

Alternative A-8 would be protective, as aggressive excavation would be performed throughout Area 2 to remove sediment and soil with PCB concentrations exceeding 0.33 mg/kg. This alternative would take the longest to achieve PRGs (40 years), with achieving protection

hampered by the long construction period (10 years). The extensive construction activities could negatively impact wildlife habitat and make full recovery unlikely.

Compliance with ARARs

Alternatives A-1 and A-2 might eventually meet most ARARs through natural recovery. Since no monitoring would be conducted under Alternative A-1, compliance with ARARs under that alternative would not be documented.

Alternatives A-3 through A-7 would meet ARARs but would require a risk-based disposal equivalency demonstration for compliance with Toxic Substances Control Act ARARs. Appropriate control measures would be implemented during construction such that the substantive requirements of the action- and location-specific ARARs would be achieved.

Alternative A-8 would comply with ARARs, but it would take longer to meet them (compared to Alternatives A-3 through A-7) due to the longer construction period.

Long-term Effectiveness and Permanence

Alternative A-1 would not provide for tracking or confirmation of future achievement of RAOs, so long-term effectiveness would not be demonstrated or documented.

Alternative A-2 might eventually meet PRGs but would not be effective, as the downstream migration of PCBs would continue through erosion of PCB materials from the river banks and anabranched area after dam removal.

Alternatives A-3 through A-7 would be effective in the long term and permanent, and all would have a relatively comparable degree of long-term effectiveness and permanence. All of these alternatives include removing the Otsego City dam and realigning the channel. Alternatives A-3 through A-5 include capping the former anabranches, which would prevent contact by receptors, prevent erosion of floodplain soil, sediment, and bank soil, and reduce flooding frequency, inundation depth and time in the former anabranches for the long term. Alternatives A-6 and A-7 include excavating the former anabranches instead of capping them, which would remove this PCB contamination from the river system. Alternative A-7 has less long-term maintenance than Alternatives A-3 through A-6 due to the excavation of all the remedial areas as opposed to capping some of them. For Alternatives A-3 through A-7, channel realignment and bank treatments would prevent erosion or exposure to remaining PCB deposits in the banks and floodplain soil for the long term. Alternatives A-4 through A-7 would provide somewhat greater long-term effectiveness than Alternative A-3 due to the 10-foot bank excavation buffer associated with these alternatives, which would provide additional protection from PCB release into the river should bank erosion occur. Alternatives A-3 through A-7 would achieve fish tissue PRGs for smallmouth bass within 32 years. LTM and ICs would remain in place until fish tissue PRGs are achieved.

Alternative A-8 would have a high degree of long-term effectiveness and permanence, as all sediment and floodplain soil exceeding 0.33 mg/kg total PCBs would be removed. The time to

achieve the fish tissue PRGs for smallmouth bass is longer than the other alternatives, estimated at 40 years, due to the long construction timeframe. However, short-term and long-term impacts to habitat would be substantial and may outweigh the benefits of PCB removal.

Reduction of Toxicity, Mobility, or Volume through Treatment

None of the alternatives employ treatment technologies to reduce the toxicity, mobility or volume of the contaminated materials. However, Alternatives A-3 through A-8 would remove significant volumes of PCB-contaminated sediment and soil from Area 2, thereby reducing the ability of the PCB-contaminated sediment to be mobilized into the river in the future. Due to the nature of the contamination, the PCB-contaminated sediment and soil does not lend itself to cost-effective treatment.

Short-term Effectiveness

Alternatives A-1 and A-2 would have no adverse short-term impacts, as no active construction work is associated with these alternatives. However, the time to achieve RAOs is also considered as part of the short-term effectiveness criterion, and neither of these alternatives would achieve all of the RAOs. For this reason, Alternatives A-1 and A-2 are not considered effective in the short term.

Alternatives A-3 through A-5 would have the same relative degree of short-term effectiveness. Dam removal and channel realignment would immediately disconnect the anabranches from the main river channel, eliminating fish exposure to anabranch sediment. These alternatives would prevent contact to receptors immediately upon completion. Erosion prevention, as well as reductions to flooding frequency, and inundation depth and time in the anabranches would also be immediate. Temporary, reversible, and limited impact would occur to habitat areas where the cap is applied and in support areas such as staging areas and construction roads. These would be addressed by revegetating the disturbed areas to initiate habitat recovery. Risks to workers during construction activities would be controlled through safe work practices and training. The implementation period for Alternatives A-3 through A-5 would be approximately 5 years.

Alternative A-6 includes dam removal and channel realignment which would provide similar short-term benefits as mentioned for Alternatives A-3 through A-5. However, Alternative A-6 is less protective in the short term as it includes excavation and restoration of the anabranches which would result in a lower ground surface elevation than capping. The lower ground surface would immediately increase frequency of flooding, inundation depth, and the potential for soil erosion. The large footprint for excavation in this alternative yields a more extensive short-term impact to habitat and wildlife than Alternatives A-3 through A-5. The implementation period for Alternative A-6 is the same as for Alternatives A-3 through A-5, approximately 5 years.

Alternative A-7 would have a somewhat greater degree of potential short-term adverse impacts than Alternatives A-3 through A-6 due to the larger volume of material to excavate and transport off site. The implementation period for alternative A-7 would be the same as Alternatives A-3 through A-6, approximately 5 years.

Alternative A-8 would have the greatest degree of short-term impacts because of the long construction period, estimated at 10 years, and the extensive excavation work throughout Area 2. Compared to the other alternatives, Alternative A-8 requires extensive and invasive floodplain-wide excavation and habitat impact. Potential PCB migration during excavation work would be increased under Alternative A-8. Risks to workers during construction activities would be controlled through safe work practices and training.

Implementability

Alternatives A-1 and A-2 could be easily implemented. No active measures are associated with Alternative A-1, and Alternative A-2 would include only LTM and inspections.

Alternatives A-3 through A-7 are all readily implementable.

Alternative A-3, which includes the construction of access roads and staging areas, capping and excavation work, channel realignment, and dam removal, is readily implementable using standard construction techniques. Negotiations with property owners for access agreements for remedial activity and channel realignment would be required spanning Area 2. Although the on-site remedial action work would not be subject to the permit approval process, the remedial action would need to meet the substantive requirements of otherwise applicable permits for dam removal, channel realignment, and capping in the floodplain. Floodplain elevation changes would need to be evaluated against the post-dam removal and realigned channel water elevations and flooding potential. Work would be performed using conventional, readily available equipment and practices. Transport of dewatered material for disposal to approved landfills would be required. Cap placement in hard-to-access and swampy areas would be a concern. However, cap placement would be much easier using application methods such as broadcasting via an air or water slurry. These methods would reduce handling difficulties, time, and costs as well as the impact to habitat.

Alternative A-4 would be somewhat more difficult to implement than Alternative A-3, as the additional river bank buffer excavation would increase the volume of material requiring dewatering, transport and disposal.

Alternative A-5 would be slightly more difficult to implement than Alternatives A-3 and A-4, as in addition to the additional river bank buffer excavation, floodplain soils exceeding the 20 mg/kg PCB RAL would be excavated. This would increase the volume of material requiring dewatering, transport and disposal.

Alternative A-6 would be somewhat more difficult to implement than Alternatives A-3 through A-5 since this alternative requires excavation of the northeast anabranches. This would increase the volume of material requiring dewatering, transport and disposal.

Alternative A-7 would be somewhat more difficult to implement than Alternatives A-3 through A-6 since this alternative requires excavation of all remedial areas. This would increase the volume of material requiring dewatering, transport and disposal.

Alternative A-8 would be the most difficult to implement. This alternative requires an extensive network of access roads and staging areas as well as a significant volume of material to be dewatered, transported, and disposed. A significant volume of borrow or imported material would be required for backfill. Negotiations with private parcel owners would be more intensive due to the extent and invasive nature of the remediation. It is possible that rental or purchase of properties may be required to gain access and implement this alternative. Floodplain changes would need to be evaluated against the post-dam removal water elevations and flooding potential. Work would be performed using conventional, readily available equipment and practices, but the implementation time would be lengthy. Additionally, parcel owners may be unwilling to allow substantial destruction of their property.

Cost

The estimated total costs for each alternative are FS-level cost estimates that have an expected accuracy of +50% to -30%. Costs for the alternatives range from zero to $325 million, as listed below. A 7% discount factor was used to develop the cost estimates.

Alternative A-1	$0
Alternative A-2	$12,500,000
Alternative A-3	$43,800,000
Alternative A-4	$44,400,000 to $45,200,000
Alternative A-5	$45,600,000 to $46,400,000
Alternative A-6	$66,900,000 to $67,700,000
Alternative A-7	$74,500,000 to $75,300,000
Alternative A-8	$325,000,000

Alternative A-8 is the highest cost alternative because 1,260,000 cy of sediment and soil would be removed throughout Area 2 and transported for off-site disposal. The estimated costs for Alternatives A-3 through A-7 are an order of magnitude lower than the cost for Alternative A-8. Alternatives A-3 through A-5 are similar in cost. The costs of Alternatives A-6 and A-7 are significantly higher than Alternatives A-3 through A-5 due to the increase volume of excavated materials associated with those alternatives. Other than the "no action" alternative, Alternative A-2 is the least costly alternative because the only remedy components that have associated costs are dam removal, LTM and inspections.

As noted earlier, Alternatives A-3 through A-7 all include removal of the Otsego City Dam and channel realignment. The estimated cost of channel realignment (Option 3) is $26,000,000 and the estimated cost of dam removal is $3,840,000, making the total combined cost of these common components of Alternatives A-3 through A-7 an estimated $29,840,000.

The final cost estimate for the selected remedy will be developed and refined during the RD.

State Agency Acceptance

The State of Michigan's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 2 of OU5.

Community Acceptance

The local community's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 2 of OU5.

9. EPA's PREFERRED ALTERNATIVE

This section describes EPA's preferred alternative and explains the rationale for those preferences. As noted earlier in this Proposed Plan, EPA has not identified any principal threat wastes at OU5 that need to be addressed.

EPA's Preferred Alternative – Alternative A-5: Capping, Bank RAL Excavation, Channel Realignment, Floodplain Soil Excavation, Gun River Excavation, Targeted Excavation of Knife Blade Island, ICs and LTM

Based on the evaluation of the various remedial alternatives summarized in Section 8, *Evaluation of Alternatives*, EPA believes that Alternative A-5 is the most appropriate cleanup alternative for Area 2 of OU5.

The components of Alternative A-5 are discussed in detail below and shown on Figure 10. In summary, Alternative A-5 includes:

- Otsego City Dam removal
- Channel realignment (Option 3)
- Bank RAL Excavation to 5 mg/kg along the realigned channel (recommended bank RAL is discussed in item #3 below)
- RD sampling as approved by EPA
- Excavation of confirmed PCB hot spots in areas to be capped
- Excavation of floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint
- Capping of the northeast anabranches and Pond G
- Excavation of Gun River sediment and bank soil
- Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island
- ICs including fish consumption advisories and signage, and possible land use restrictions where PCB concentrations greater than 2.5 mg/kg will remain in the floodplain soil
- Long-term monitoring and maintenance

Alternative A-5 includes approximately 28 acres of capping and 29,200 cy of excavation over a total remedial footprint spanning approximately 38 acres.

Alternative A-5 includes the following main components:

1. Otsego City Dam removal: Removal of the dam would result in the northeast anabranches not conveying water under normal flow conditions (1,000 cfs). As such, fish would no longer have routine access to these areas with higher PCB concentrations. Dam removal is also desired by the City of Otsego and the State of Michigan for several

reasons, including reducing long-term dam maintenance and restoring natural free-flowing conditions to the river.

2. Channel realignment (Option 3): Realigning the river in Area 2 to create a stable single channel with dam removal would prevent the river from regularly forming unstable anabranches, and would protect the floodplain from future erosion due to channel migration. Removing the dam and constructing a single stable channel are believed to be necessary to meet the RAOs for Area 2. The goal would be to create a channel that conveys the bankfull flow of a 1.2-year return period (approximately 2,500 to 2,700 cfs), maintains adequate shear stress to convey the bedload of the river, and remains in a fixed location over time. This stable channel would therefore maintain the applicability of the soil PRG in the dam-out floodplain across Area 2. Channel Option 3 balances the effort and cost to achieve a stable single channel for remedial alternative development by providing a larger buffer area for Knife Blade Island and by following the existing channel bed in the downstream reach. The design for channel realignment will likely be modified from that shown as Option 3 (in Figure 6) based on additional data collection and evaluation during the RD.

3. Bank RAL Excavation: Bank soil along the realigned channel would be excavated to a RAL of 5 mg/kg total PCBs in a 10-foot swath along the bank. This additional bank soil excavation would provide an additional buffer between the newly realigned channel and floodplain soils as a measure of added protection above that provided by the natural channel design to prevent migration of PCBs from floodplain bank soil to the river. While bank treatment alone would protect the bank and floodplain soils, excavation to the bank soil RAL in the 10-foot swath allows additional time to respond to maintenance concerns before bank failure could potentially occur.

   Bank soil RALs for PCBs of both 5 mg/kg and 10 mg/kg were analyzed for additional protection along the realigned channel. Both RALs have been estimated to be protective. The cost difference between implementing the different RALs is small ($570,000 vs $1,330,000) relative to the total cost of the remedy. Given the uncertainty of the natural channel design (particularly in upstream reaches of Area 2), as well as the uncertainty in the RAL calculations, EPA believes the RAL of 5 mg/kg is most appropriate for long-term effectiveness and permanence of the remedy and ensuring a clean buffer exists between the river and the floodplain.

4. RD sampling as approved by EPA: Sampling will include the identification of the remedial area footprints, as well as targeting the SRI sample locations that exceeded 50 mg/kg PCBs to confirm the presence and extent of such hot spots for targeted removal.

5. Excavation of confirmed PCB hot spots in areas to be capped: The footprints of confirmed hot spots exceeding 50 mg/kg on Knife Blade Island and in proposed cap areas would be excavated and backfilled prior to installing caps.

6. Excavation of floodplain soil exceeding the 20 mg/kg RAL for PCBs outside the realigned channel footprint: Remedial footprints in the Area 2 floodplain would be

identified based on reducing potential exposure to soil for ecological and human receptors to meet RAOs 3 and 5. A RAL of 20 mg/kg for PCBs would be protective of human recreational receptors (the PRG for recreational exposure is 23 mg/kg), and would protect an estimated 99.5 to 100% of home ranges for the four receptor scenarios at the PRG of 11 mg/kg. The 20 mg/kg RAL soil footprint would combine the 0- to 6-inch and 0- to 24-inch natural neighbor areas exceeding 20 mg/kg total PCBs.

7. Capping of the northeast anabranches and Pond G: The northeast anabranches that are cut off from the main channel following Otsego City Dam removal and channel realignment would be capped to prevent ecological exposure. Cap soil is assumed to mostly consist of clean cut material recovered from the channel realignment. Prior to placement of the cap, a non-woven geotextile layer would be placed over the existing ground surface to serve as a demarcation layer. To support habitat restoration, a topsoil layer would be created by entraining organic material (e.g., chipped vegetation, peat, and other organic detritus) recovered during clearing and channel realignment activities into the top six inches of fill. Caps in the floodplain and anabranches would consist of a two-foot-thick soil cap (including topsoil layer) over a geotextile. For Pond G, the subaqueous cap would consist of an 18-inch layer of soil overlain with six inches of sand or gravel.

8. Excavation of Gun River sediment and bank soil: Gun River will be modified as part of channel realignment. Due to the uncertainty regarding the extent of current PCB contamination in Gun River, a cost range representing excavation of half of the channel sediment and along the left bank to the full width of the channel and both banks was considered. A mid-point cost has been included in the cost estimate.

9. Targeted excavation of soil/sediment with PCB concentrations exceeding 50 mg/kg at Knife Blade Island: Additional RD sampling would be conducted to confirm the hot spot locations and identify any additional hot spot areas to be excavated.

10. ICs include continuation of fish consumption advisories and warning signage until fish tissue goals are met, and possible land use restrictions at certain properties to prevent future residential use and limit human exposure where contamination is left in place at levels unsuitable for unrestricted residential use (i.e., at concentrations greater than 2.5 mg/kg). Site-specific fish consumption advisories established and publicized by the State of Michigan would continue to manage risks posed to anglers and their families from consumption of PCB-containing fish. These advisories are already in place for Area 2, and the advisory for each fish type would remain in effect until fish tissue PCB concentrations achieve RAOs for the fish specified. The advisories would be reviewed and verified annually as a component of the site ICs.

11. Long-term monitoring would include visual river bank and channel inspections, and maintenance activities for caps, bank treatments, and/or vegetation restoration, as well as monitoring surface water, fish tissue and sediment until fish tissue levels attain PRGs, which is estimated at 32 years after ROD issuance.

The time to complete construction would be approximately 5 years, at an estimated total cost of $46,400,000.

Summary of Rationale for the Preferred Alternative

EPA believes that Alternative A-5 provides the best balance of the evaluation criteria among all the alternatives. Alternative A-5 would be protective of human health and the environment, would meet all federal and state ARARs, would achieve the RAOs for this proposed remedial action, would be straightforward in its implementation, and would be effective in the long term and permanent.

Alternative A-5 would provide long-term and permanent protection against exposure to contaminated materials by removing the Otsego City Dam and realigning the channel consistent with Option 3 described above. This would reduce fish access to the northeast anabranches and reduce erosion of PCB soil downstream. The construction of the 10-foot buffer along the realigned channel would provide an additional measure of protection above that provided by the natural channel design to prevent migration of PCBs from floodplain bank soil to the river. In addition, Alternative A-5 includes excavating approximately 29,200 cy of PCB-contaminated sediment and soil and capping approximately 28 acres, reducing potential exposure to soil for ecological and human receptors to meet RAOs 3 and 5. Alternative A-5 includes capping of the northeast anabranches and Pond G, and excavating floodplain soil exceeding the 20 mg/kg PCB RAL, Gun River and hot spot areas exceeding 50 mg/kg. These remedial activities along with natural recovery processes, in conjunction with ICs and LTM, would ensure the PRGs and RAOs are achieved over time.

Alternative A-5 would be effective in the short term, as it would prevent contact to receptors immediately upon completion. Erosion prevention, as well as reductions to flooding frequency and inundation depth and time in the anabranches, would also be immediate. Alternative A-5 would be administratively and technically implementable and could be completed within 5 years, while posing easily manageable risks to workers and the local community during implementation.

Alternative A-5 is cost-effective because it would have less extensive impact on habitat and is significantly less costly compared to Alternatives A-6, A-7 and A-8. Alternative A-5 would achieve PRGs for smallmouth bass within 32 years, which is the same timeframe as Alternatives A-3, A-4, A-6 and A-7, but 8 years sooner than Alternative A-8. Alternative A-5 is slightly more expensive but comparable in cost to Alternatives A-3 and A-4, but incorporates an additional 10-foot buffer along the realigned channel for added protection and removes additional PCB contaminated floodplain soil.

Alternative A-5 does not reduce the toxicity, mobility or volume of the contamination through treatment, as the relatively low-level PCB contamination that is present in Area 2 of OU5 does not lend itself to any cost-effective treatment.

Summary

Based on the information currently available, EPA believes the preferred alternative identified above meets the threshold criteria and provides the best balance of tradeoffs among the other

alternatives with respect to the balancing and modifying criteria. EPA expects the preferred alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met.

There have already been two site-wide five-year reviews completed for the Allied Paper, Inc./Portage Creek/Kalamazoo River site. Since it will be several years before fish tissue concentrations attain PRGs, and since PCBs in floodplain soils will remain above levels that allow for unlimited use and unrestricted exposure (i.e. residential use), Area 2 of OU5 will be included in future site-wide five-year reviews.

Next Steps

EPA, in consultation with MDEQ, will evaluate public comments to the preferred cleanup alternative during the public comment period before selecting a final remedial alternative as the Area 2 remedy. Based on new information or public comments, EPA may modify its preferred alternative or choose another, so EPA encourages the public to review and comment on all of the cleanup alternatives.

EPA will respond in writing to all significant comments in a Responsiveness Summary which will be part of the ROD. EPA will announce the selected cleanup alternative in local newspaper advertisements and will place a copy of the ROD in the local information repositories and on EPA's website at www.epa.gov/superfund/allied-paper-kalamazoo.

Figure 1: Allied Paper, Inc./Portage Creek/Kalamazoo River Site

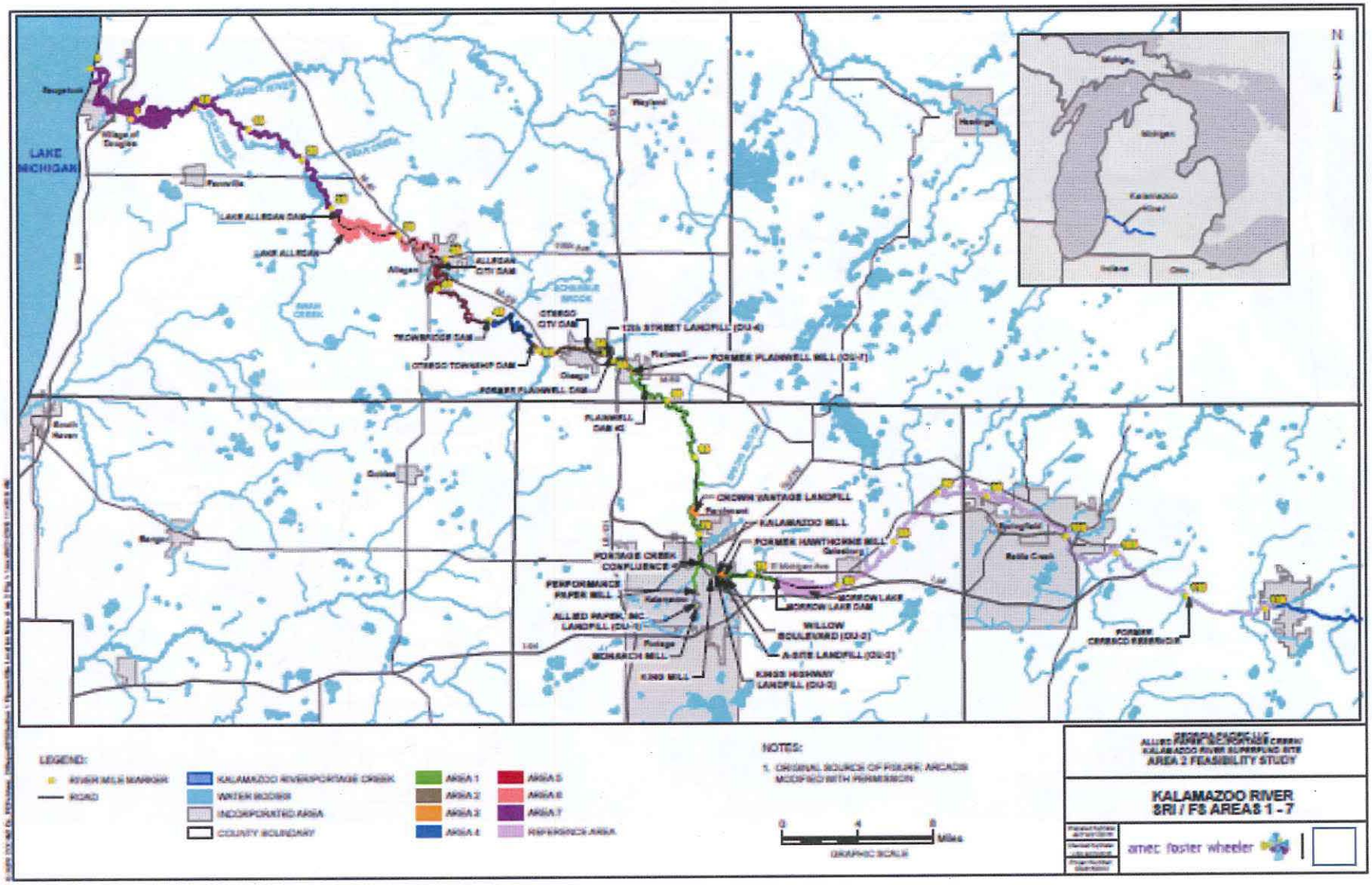

Figure 2: Operable Unit 5

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

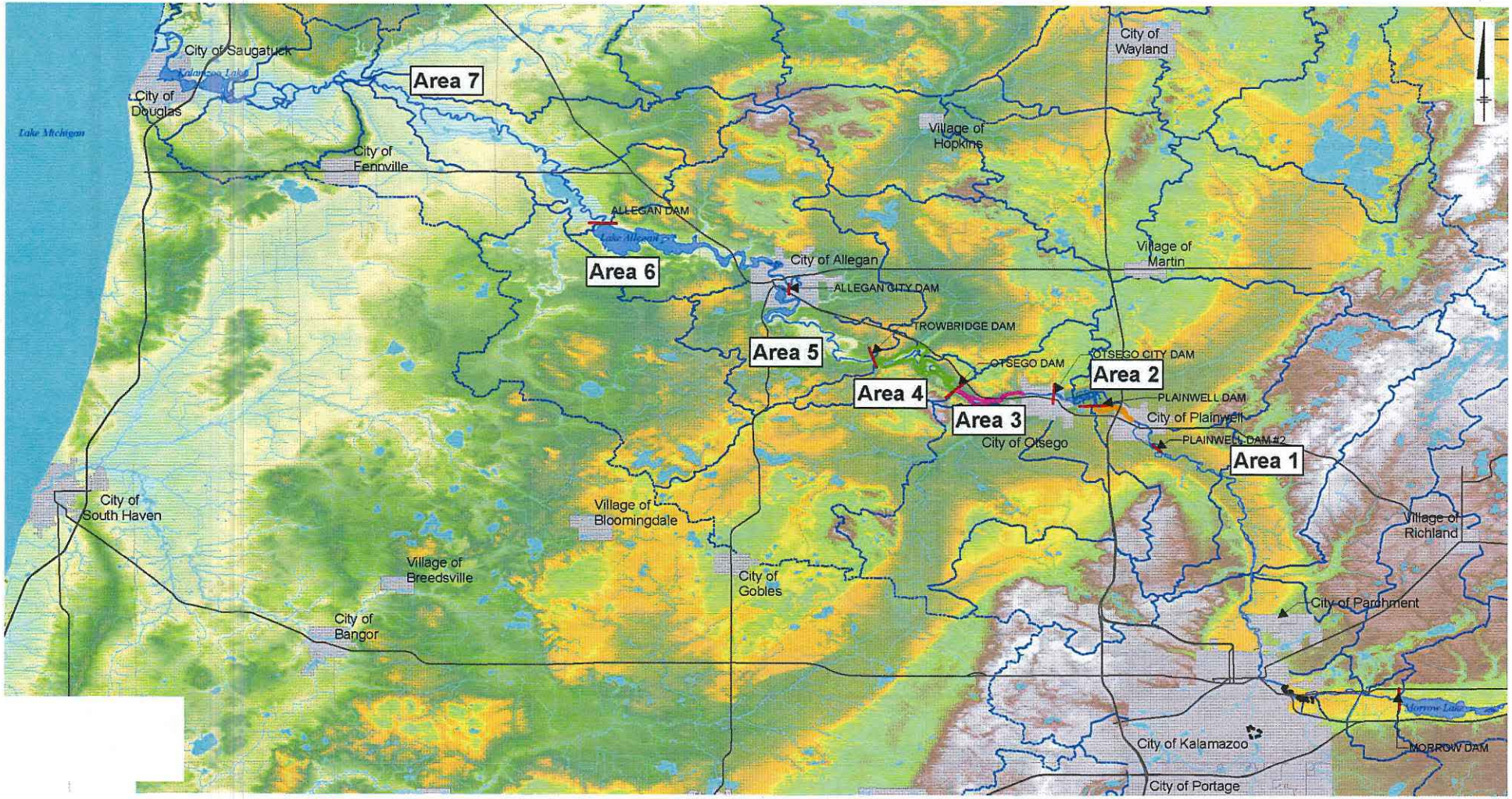

Figure 3: Area 2

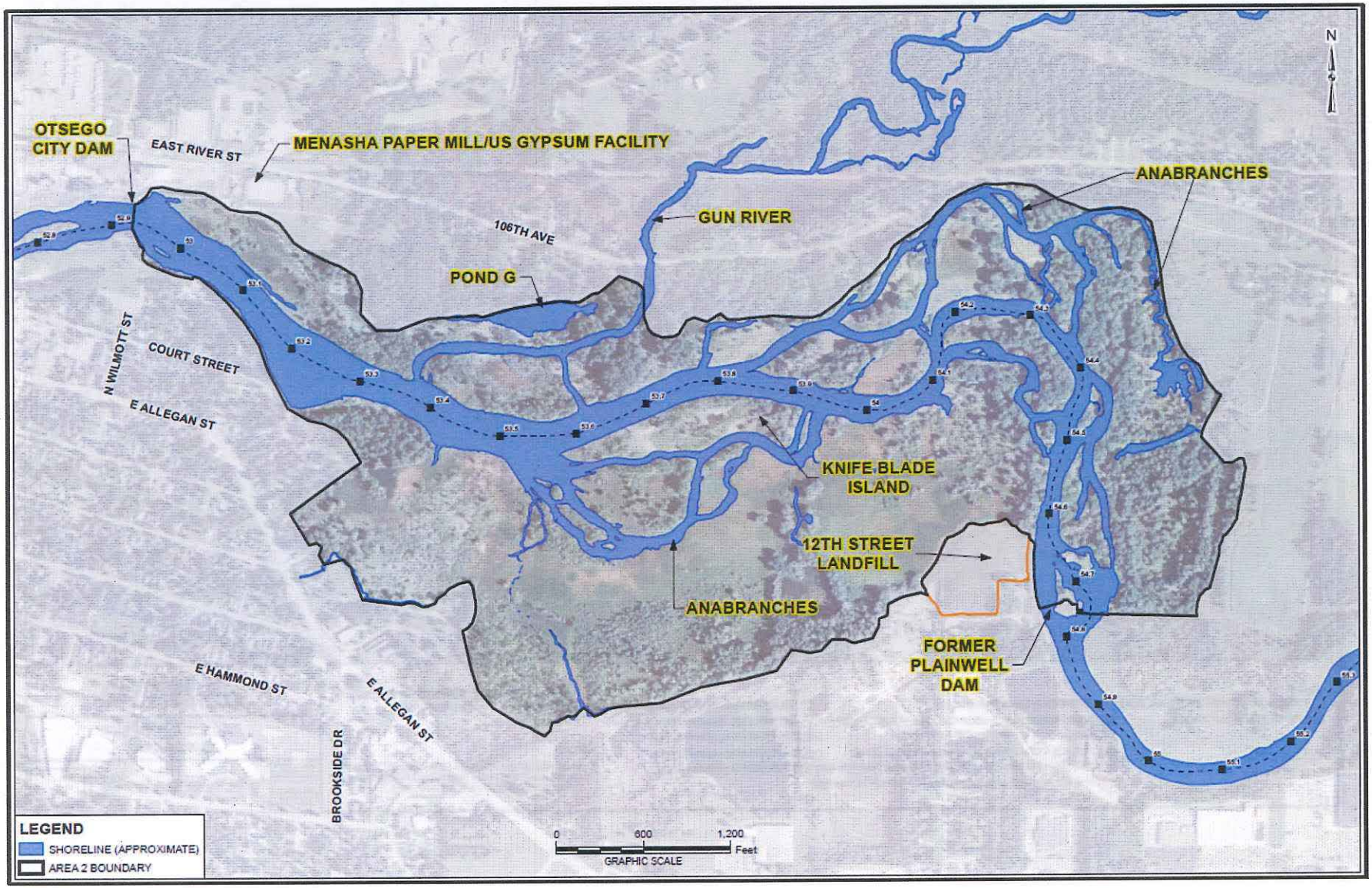

Figure 4: Area 2 Sediment Subareas

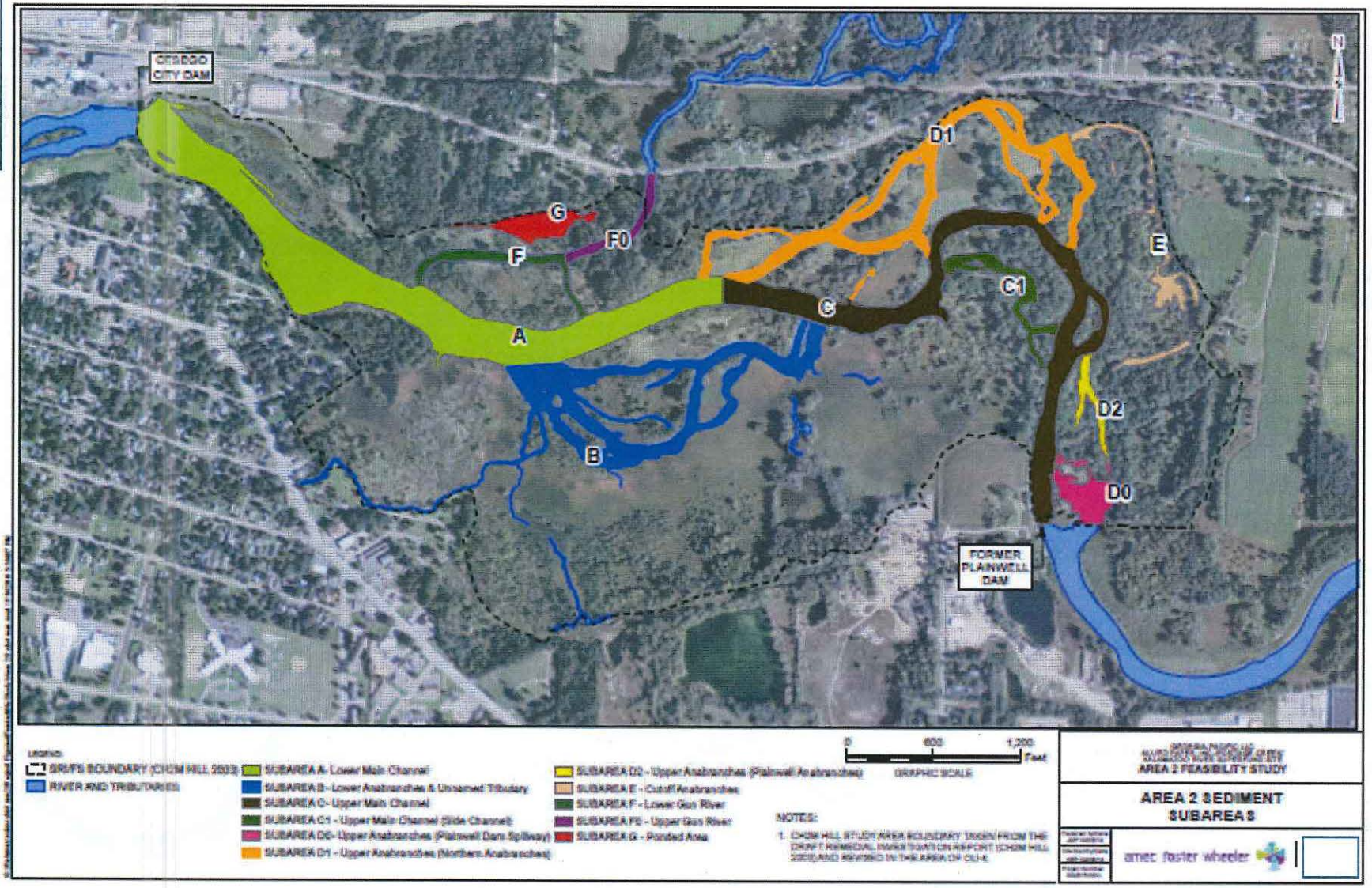

Figure 5: Area 2 Floodplain Soil Subareas

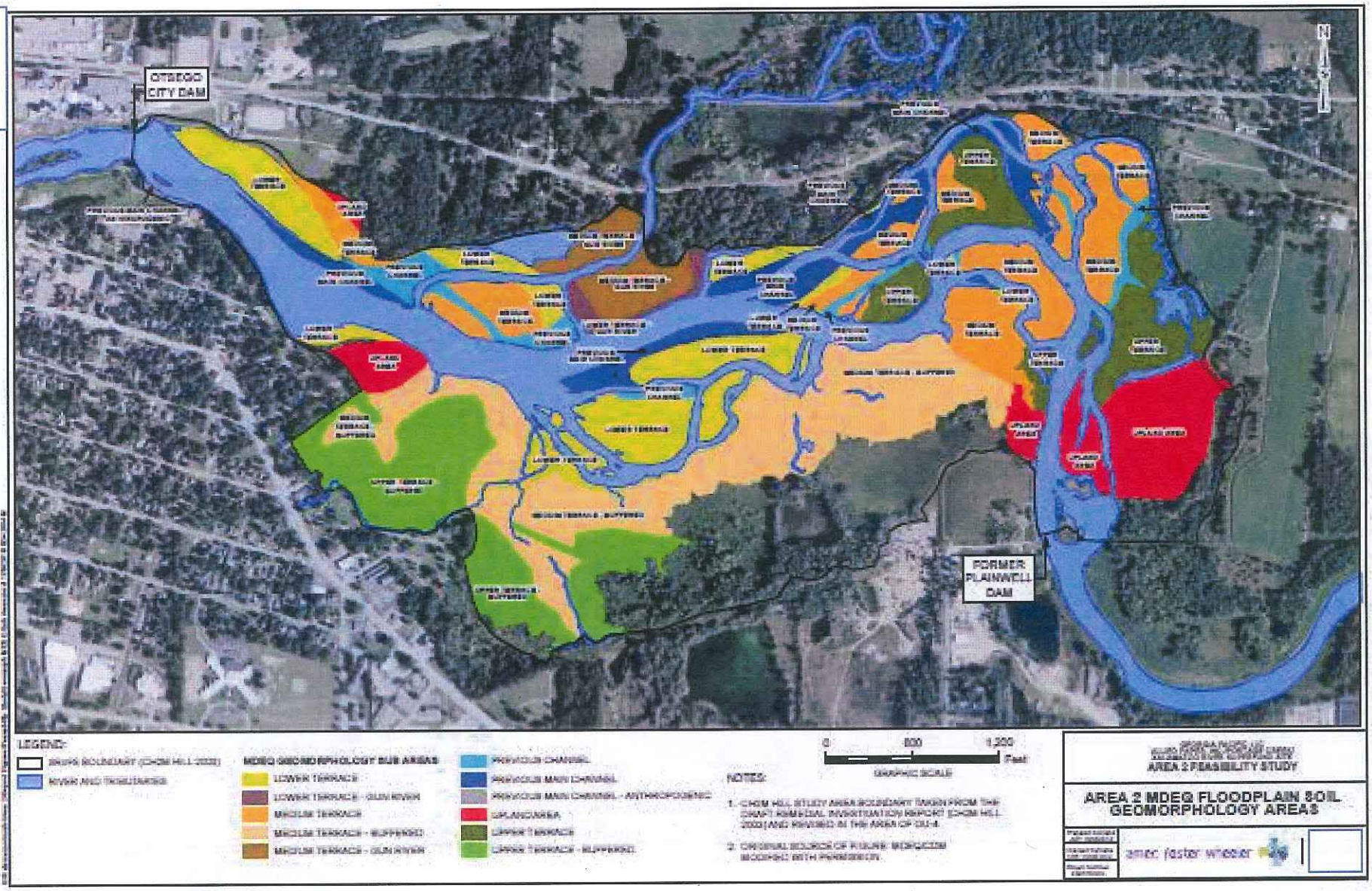

Figure 6: Realigned Channel Option 3

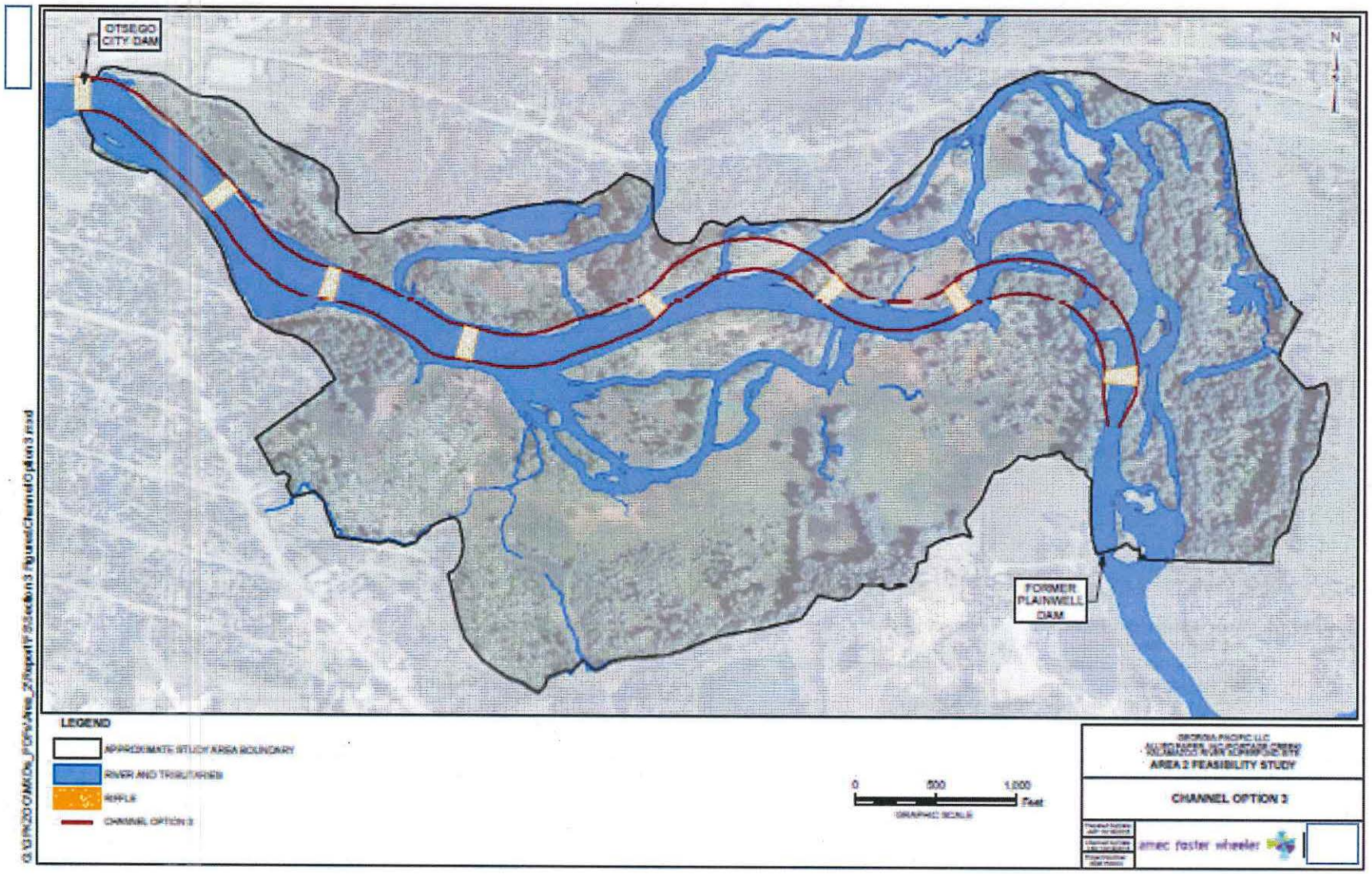

Figure 7: Remedial Areas with Channel Option 3

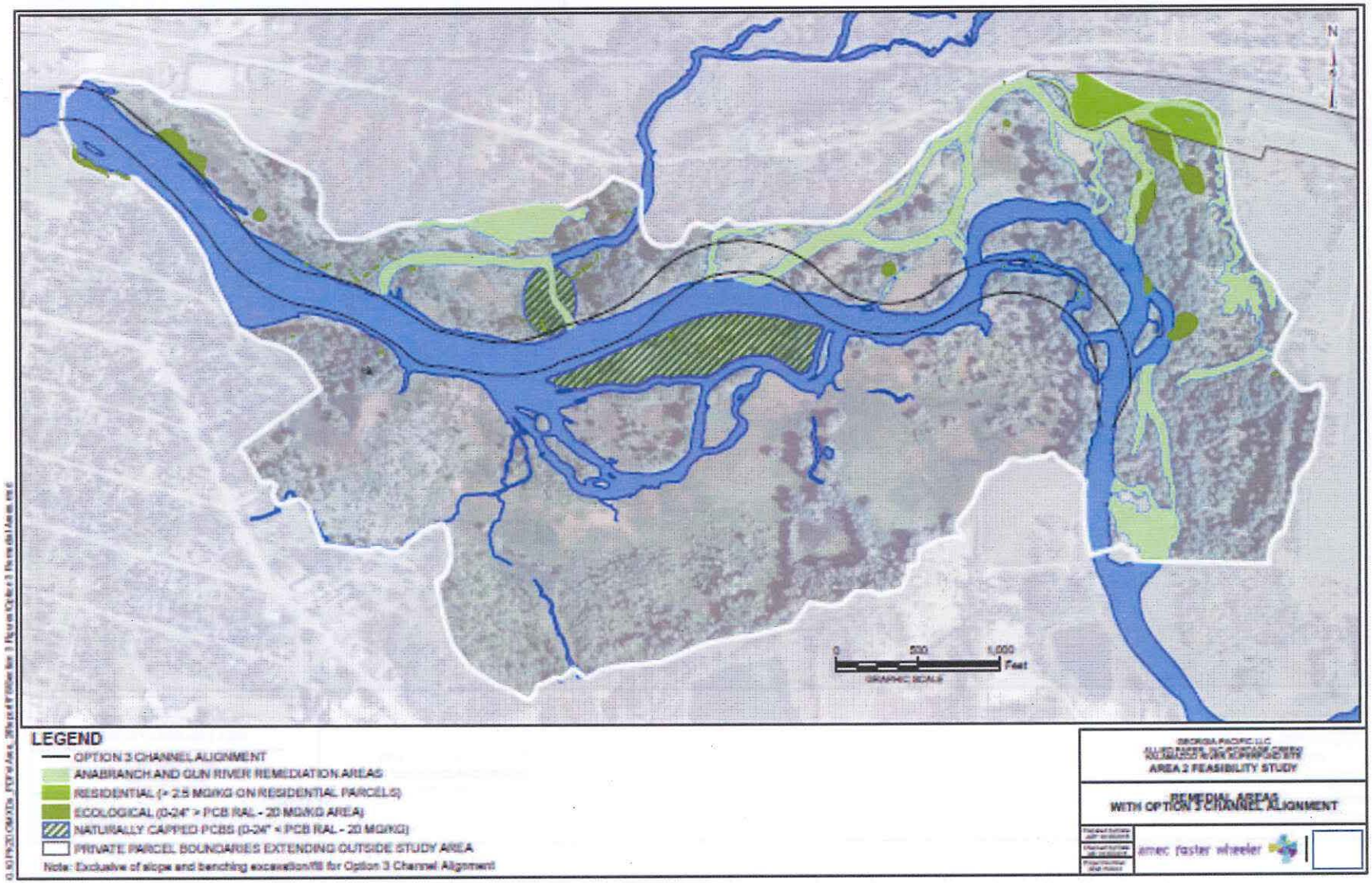

Figure 8: Alternative A-3

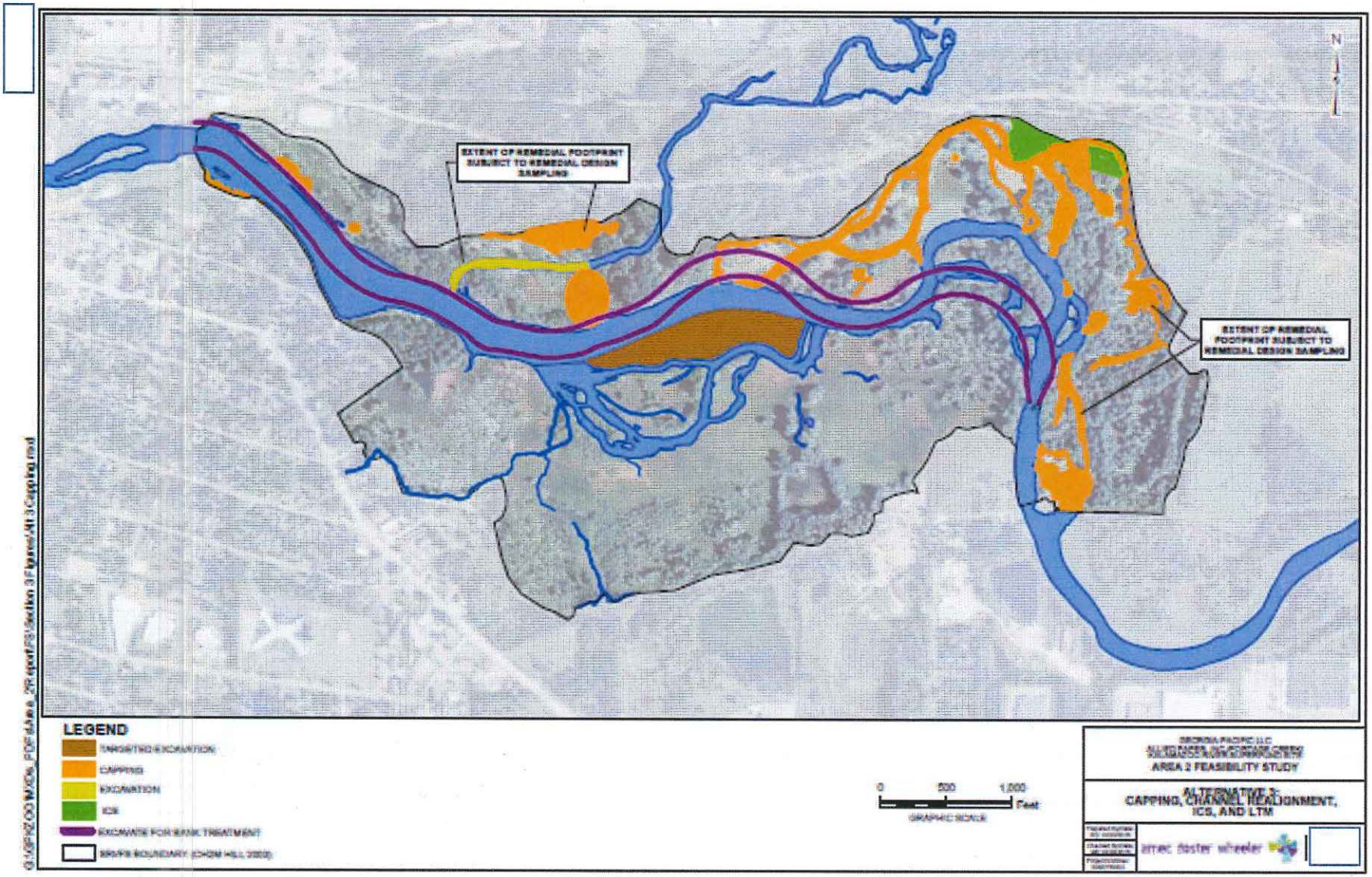

Figure 9: Alternative A-4

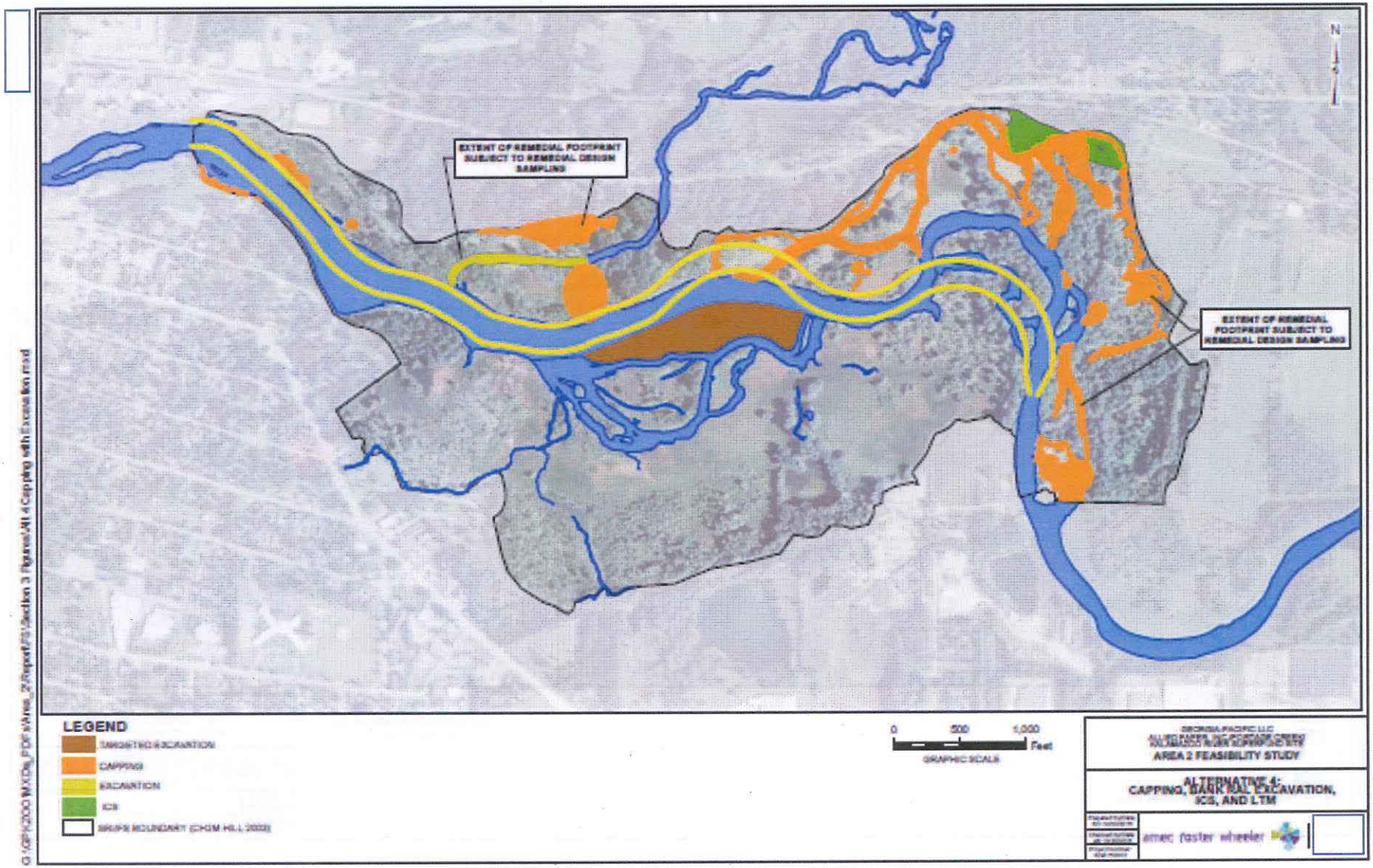

Figure 10: Alternative A-5

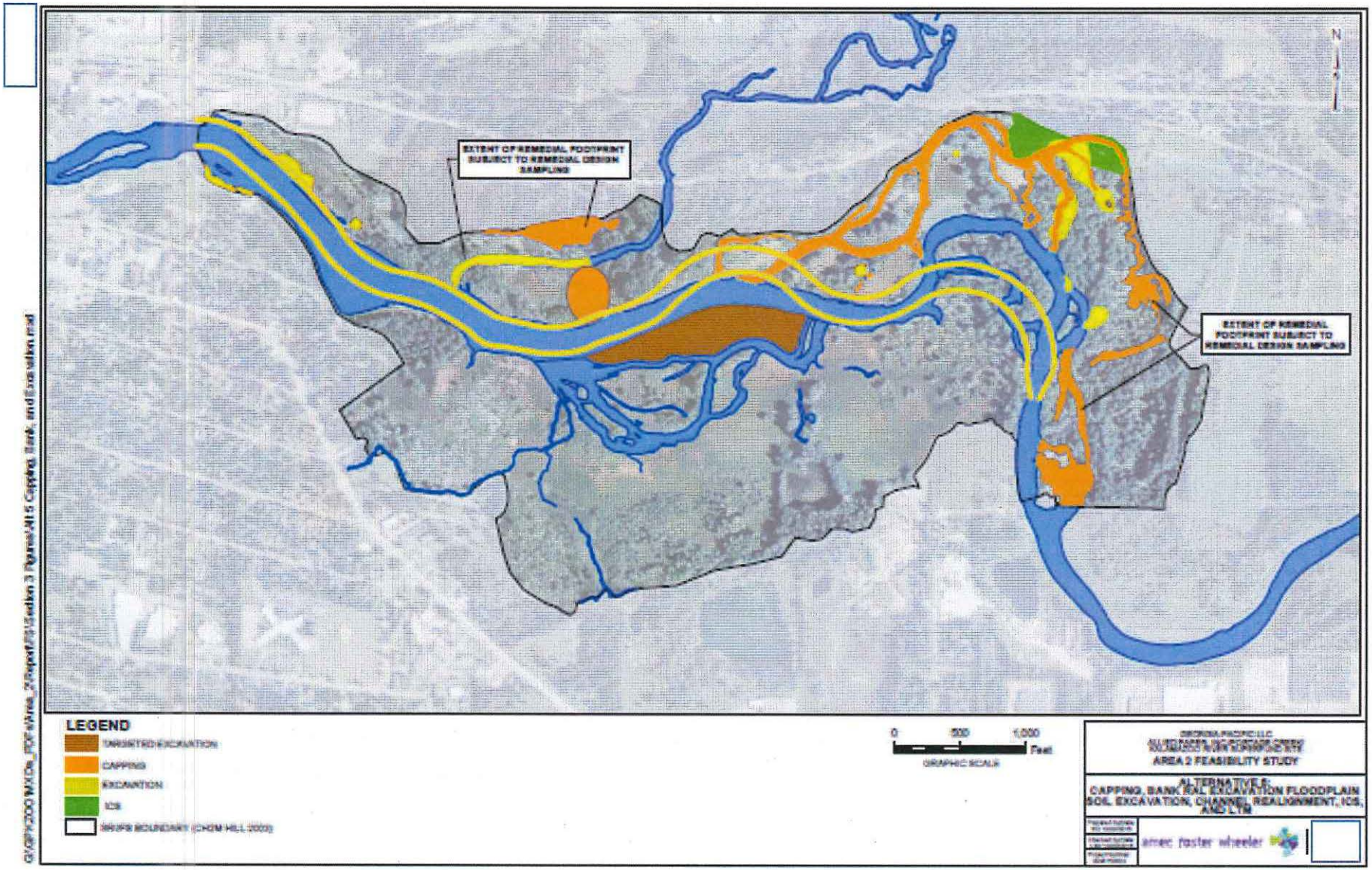

Figure 11: Alternative A-6

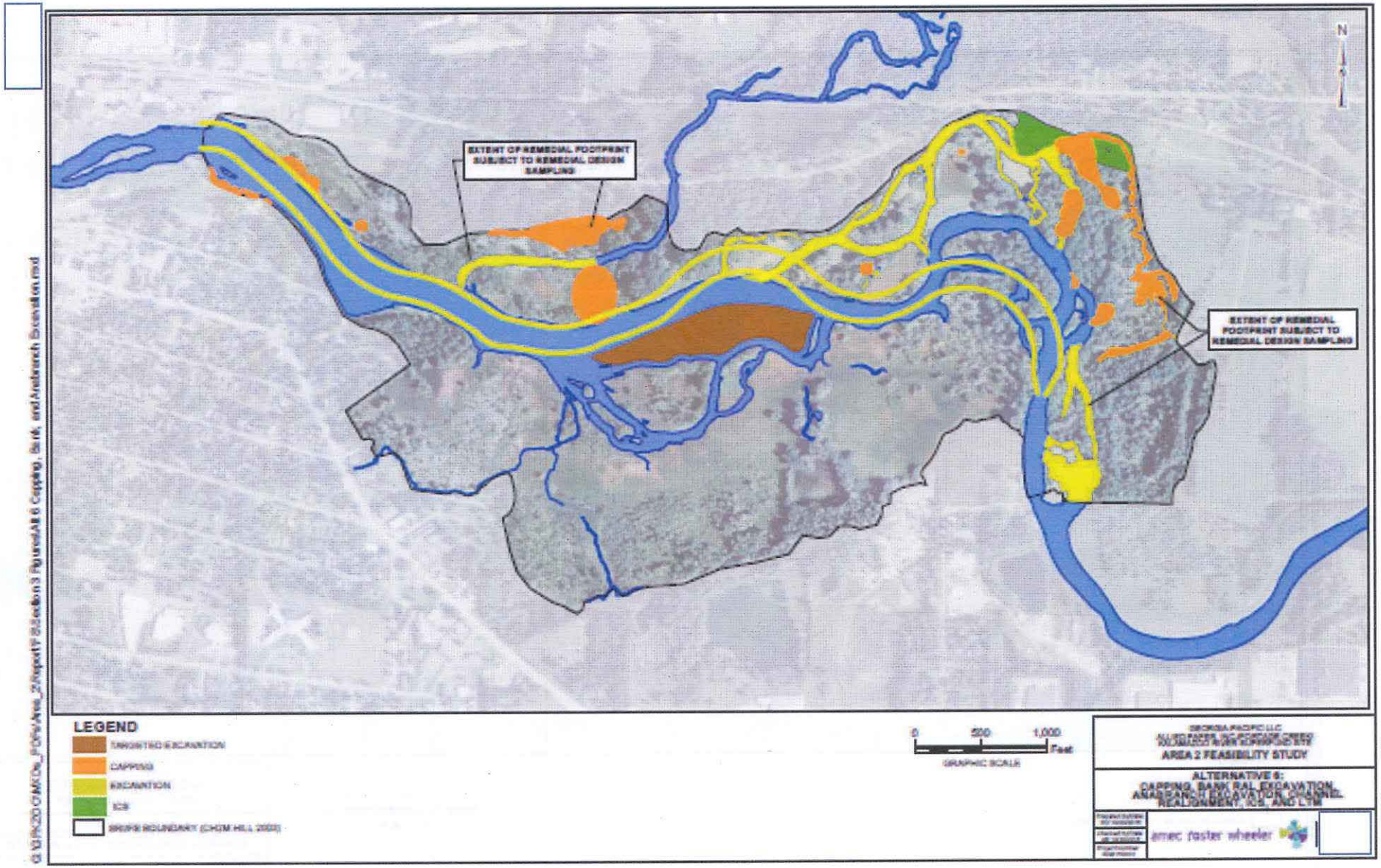

Figure 12: Alternative A-7

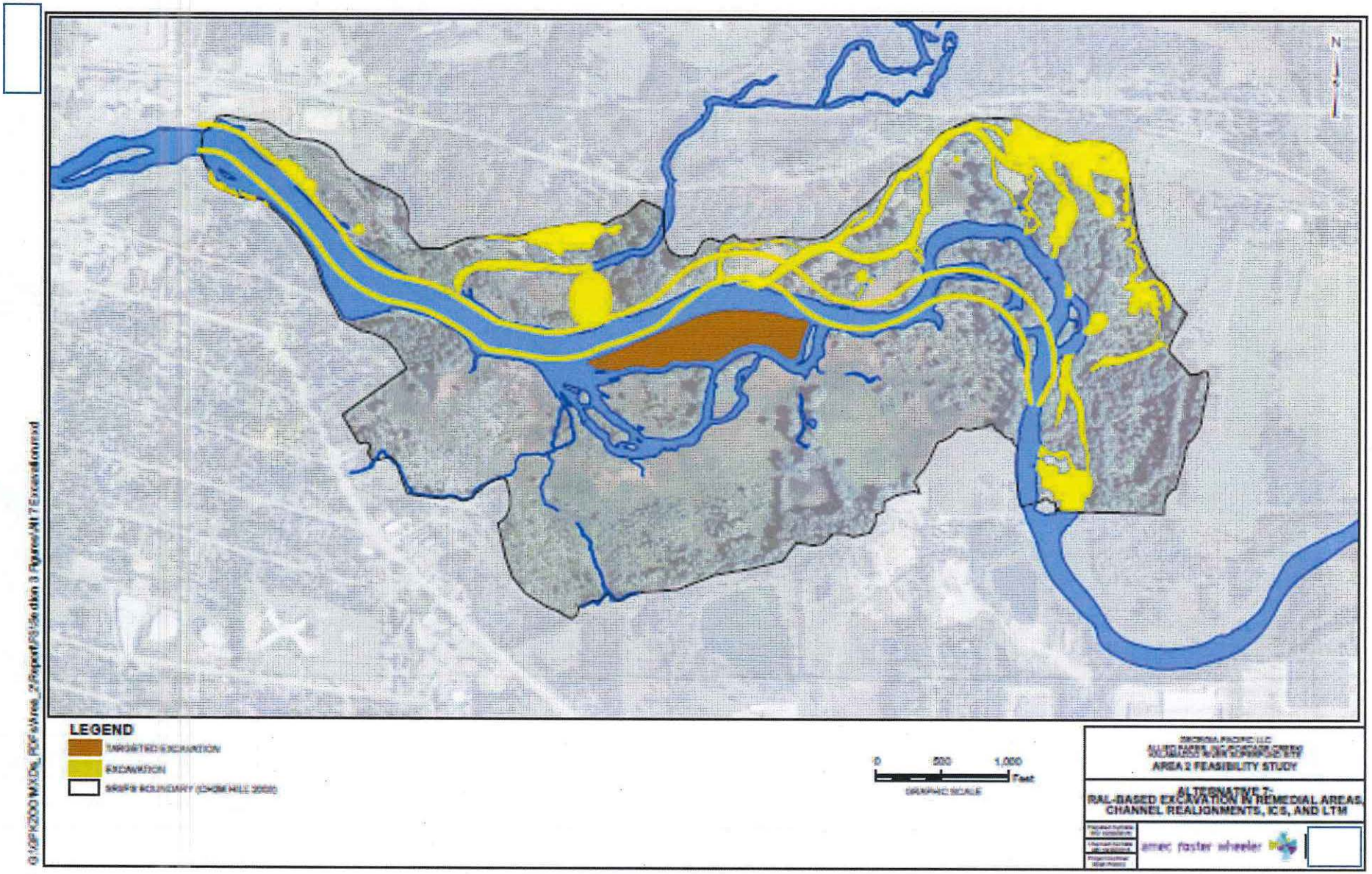

Figure 13: Alternative A-8

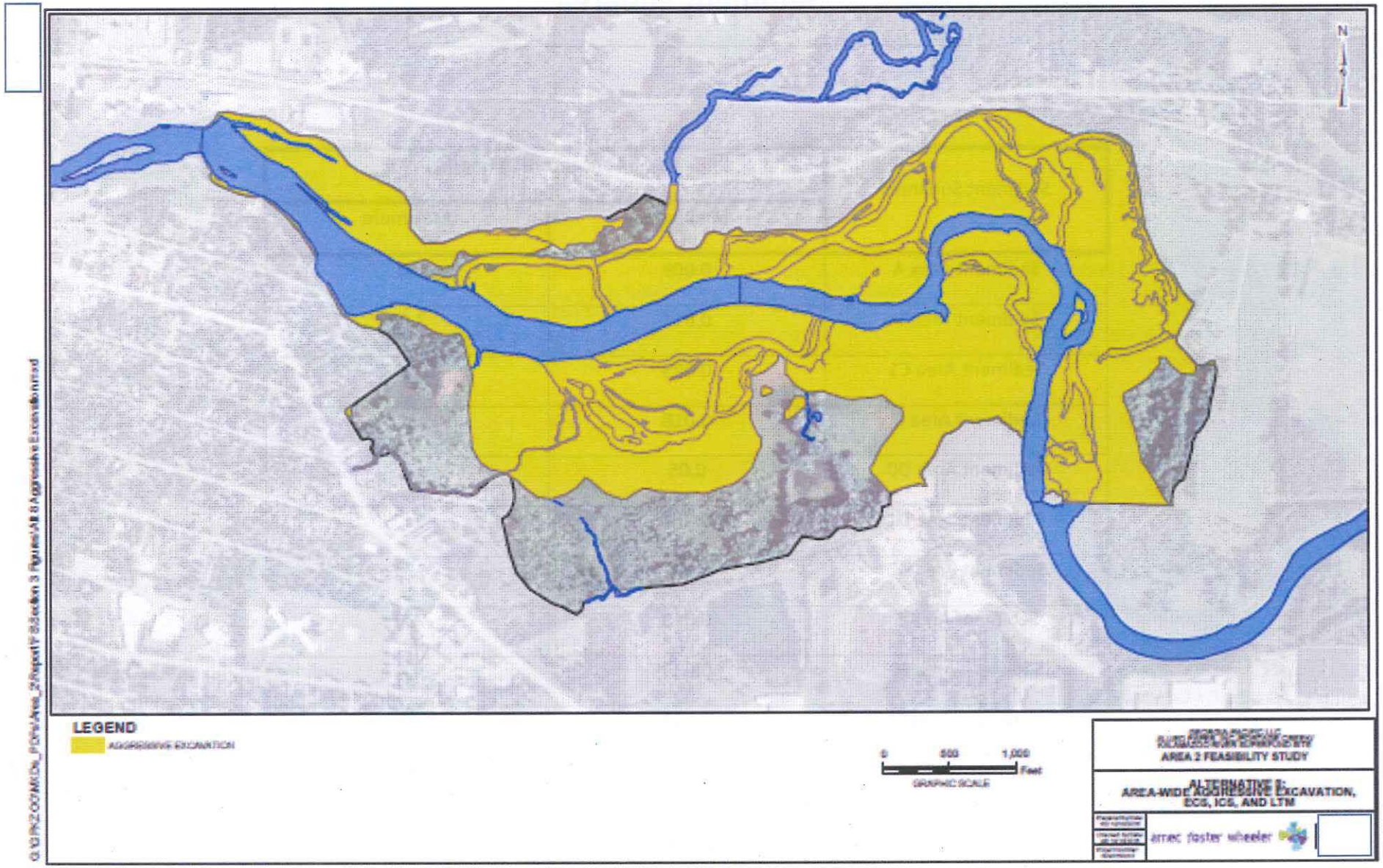

Table 1: PCB Concentrations by Sediment Subarea

Sediment Subareas	PCB Concentration (mg/kg)	
	Minimum	Maximum
Sediment Area A	0.009	94
Sediment Area B	0.011	3.07
Sediment Area C1	0.025	14.03
Sediment Area C	0.018	59
Sediment Area D0	0.05	17.5
Sediment Area D1	0.021	111
Sediment Area D2	0.081	27.8
Sediment Area E	0.018	73.5
Sediment Area F0	0.039	0.047
Sediment Area F	0.018	85
Sediment Area G	0.022	59.9

Table 2: PCB SWAC and Mean Concentrations by Sediment Subarea

Sediment Subareas	SWAC and Mean PCB Concentration (mg/kg)	
	0-6" Interval	6-12" Interval
Sediment Area A	0.08	0.2
Sediment Area C	0.22	0.08
Sediment Area A &C (Main Channel)	0.13	0.16
Sediment Area B	0.46	0.28
Sediment Area C1	0.92	0.05
Sediment Area D0	2.14	0.55
Sediment Area D1	3.91	4.88
Sediment Area D2	5.87	3.34
Sediment Area E	7.84	9.76
Sediment Area F	12.39	21.94
Sediment Area F0	0.02	0.02
Sediment Area G	1.22	9.05

Table 3: PCB Concentrations by Floodplain Soil Subarea

Floodplain Soil Subareas	PCB Concentration (mg/kg)	
	Minimum	Maximum
Lower Terrace	0.019	112
Lower Terrace Gun River	0.018	60.9
Medium Terrace	0.019	69
Medium Terrace Buffered	0.006	26.8
Medium Terrace Gun River	0.018	4.32
Previous Channel	0.017	108
Previous Main Channel	0.018	134
Previous Main Channel Anthropogenic	0.023	59
Upland Area	0.018	2.48
Upper Terrace	0.011	49
Upper Terrace Buffered	0.021	2.88

Table 4: Area 2 Alternatives

Remedial Alternative	Description	Channel Realignment	Remedial Action: Banks > RAL	Gun River	KBI Areas > 50 mg/kg	Pond G	Floodplain Soil > RAL 20 mg/kg	Northeast Anabranches	Private Parcel Soil > 2.5 mg/kg	Years to Reach Fish Tissue Goal	Total Cost
A-1: No Action	Required by USEPA to compare with other alternatives.	No	None	None	None	None	None	None	None	35	**$0**
A-2: MNR,ICs, and LTM	No physical cleanup; relies on natural processes and site restrictions.	No	None	MNR	MNR	MNR	MNR	MNR	ICs	35	**$12.5 million**
A-3: Capping, ChannelRealignment, Gun RiverExcavation, KBI Targeted Excavation, ICs, and LTM	Capping and/or bank channel protection in the northeast anabranches, Pond G, and floodplain soil exceeding RAL of 20 mg/kg PCBs; main river channel realignment to stabilize channel and protect floodplains.	Yes	Protect + Stabilize	Excavate	Excavate	Cap	Cap	Cap	ICs	32	**$43.8 million**
A-4: Capping, Channel Realignment, Bank RAL/Gun River Excavation, KBI Targeted Excavation, ICs, and LTM	Same as A-3 with addition of bank soil excavation above a RAL.	Yes	Excavate	Excavate	Excavate	Cap	Cap	Cap	ICs	32	**$44.4 million - $45.2 million**
A-5: Anabranch Capping, Channel Realignment, Bank RAL/Floodplain Soil/Gun River Excavation, KBI Targeted Excavation, ICs, and LTM	Same as A-4 except floodplain soils above RAL 20 mg/kg will be excavated.	Yes	Excavate	Excavate	Excavate	Cap	Excavate	Cap	ICs	32	**$45.6 million - $46.4 million**
A-6: Floodplain Capping, Channel Realignment, Bank RAL/Floodplain Soil/Anabranch/Gun River Excavation, KBI Targeted Excavation, ICs, and LTM	Same as A-4 except anabranch areas will be excavated.	Yes	Excavate	Excavate	Excavate	Cap	Cap	Excavate	ICs	32	**$66.9 million - $67.7 million**
A-7: Floodplain, Anabranch,Bank RAL Excavation,Channel Realignment, Gun River Excavation, KBI Targeted Excavation, ICs, and LTM	Excavation with backfilling to restore grade and riparian habitat restoration in: former anabranches, Pond G, floodplain soil > RAL 20 outside channel realignment footprint, and soil > 2.5 mg/kg on the private parcel in the northeast portion of the area.	Yes	Excavate	Excavate	Excavate	Excavate	Excavate	Excavate	Excavate	32	**$74.5 million - $75.3 million**
A-8: Area-Wide Aggressive Excavation, ECs, ICs, and LTM	Area-wide removal of sediment and flooplain soil exceeding 0.33 mg/kg, achieving the sediment PRG throughout the floodplain and without channel realignment.	No	Excavate	Excavate	Excavate	Excavate	Excavate	Excavate	Excavate	40	**$325 million**

Definitions:

ECs - Engineering Controls
ICs - institutional Controls
KBI - Knife Blade Island
LTM - Longterm Monitoring
mg/kg - milligram per kilogram
MNR - Monitored Natural Recovery
RAL - Remedial Action Level

Table 5: Alternatives Comparative Analysis

Alternative	Capping Area (acres) / Removal Volume (cy)	Years to Reach PRGs for Smallmouth Bass	Overall Protection of Human Health and the Environment	Compliance with ARARs	Short-term Effectiveness	Long-term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Implementability	Total Cost
A-1	None	35	Undocumented	Undocumented	Not Effective	Undocumented	No treatment	Nothing to implement	$0
A-2	None	35	Not Protective, ongoing bank erosion	Complies	Not Effective	Not Effective	No treatment	Readily implementable	$12,500,000
A-3	33 / 12,900	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment	Readily implementable	$43,800,000
A-4	33 / 16,900-22,300	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment	Readily implementable	$44,400,000 to $45,200,000
A-5	28 / 23,800-29,200	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment	Readily implementable	$45,600,000 to $46,400,000
A-6	8 / 124,900-130,300	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment	Readily implementable	$66,900,000 to $67,700,000
A-7	0 / 162,100-167,500	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment	Readily implementable	$74,500,000 to $75,300,000
A-8	0 / 1,260,000	40	Protective, longer timeframe, extensive habitat destruction	Compliance delayed	Not Effective	Effective	No treatment	Requires extensive effort	$325,000,000