NATIONAL REMEDY REVIEW BOARD
REMEDY SELECTION BRIEFING PACKAGE
SHEBOYGAN RIVER & HARBOR SITE,
SHEBOYGAN, WISCONSIN

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REGION 5

SECTION 1: SITE SUMMARY INFORMATION

Section 1.1 General Site Information

Site Name: Sheboygan River and Harbor
Location: Sheboygan, Wisconsin
CERCLIS #: WID980996367
Site Lead: PRP
Type of Site: River with PCB Contaminated Sediments
No. Of OUs: 1

Section 1.2 Introduction

The Sheboygan River and Harbor site (Site) contains 5 separate components; the Upper River, the Middle River, the Lower River and Harbor, Groundwater and Floodplain soils. Each one of these components requiring a specific remedy recommendation due to its unique character and contribution to the entire river system. This briefing package covers all 5 components of the Site.

The Wisconsin Department of Natural Resources (WDNR) and the Natural Resource Trustees; WDNR, National Oceanic and Atmospheric Administration (NOAA) and U.S. Fish and Wildlife (F&W), are working closely with US EPA to develop a comprehensive remediation and restoration plan for the Site. This package only represents the remediation portion of a more comprehensive strategy for the Site.

Section 1.3 Site Background and History

The Site is located on the western shore of Lake Michigan approximately 55 miles north of Milwaukee, Wisconsin, in Sheboygan County. See Figure 1-A The Site is located in portions of the cities of Sheboygan and Sheboygan Falls, and the village of Kohler. See Figure 1-B. The Sheboygan River (River) flows from west to east and discharges into the Sheboygan Harbor (Harbor), which subsequently discharges to Lake Michigan. The Site covers the lower 14 miles of the River from the Sheboygan Falls Dam downstream to, and including, the Harbor. During site investigations the River was divided into three sections based on its physical characteristics.

In 1974, USEPA conducted a sediment study that identified that moderate to high levels of lead, zinc, chromium, and arsenic in Harbor sediment. The presence of polychlorinated biphenyls (PCBs) and metals concentrations in the Lower River and Harbor was confirmed in a 1979 study by the United States Army Corps of Engineers (USACE). In addition, during routine study in 1977, the Wisconsin Department of Natural Resources (WDNR) found elevated PCB levels in Sheboygan River fish. Based on the results of these investigations, in October 1985, the USEPA notified three potentially responsible parties (PRPs) that the Site would be added to the National Priorities List (NPL). The Site has since been the focus of numerous investigations and response efforts by Tecumseh, the only participating PRP.

Tecumseh, a manufacturer of refrigeration and air conditioning compressors and gasoline engines, is located adjacent to the Sheboygan River in Sheboygan Falls. Tecumseh is considered a generator because polychlorinated biphenyls (PCBs) were found in sewer lines that lead to the River from Tecumseh and in hydraulic fluids used in Tecumseh Products Company's Diecast Division manufacturing processes. The contamination level is high in the sediments immediately surrounding the Tecumseh Plant, but decreases in concentration downstream. Tecumseh, prior to the issuance of regulations governing PCBs, used PCB contaminated soils to construct a dike located along the river downstream of the Sheboygan Falls Dam. Tecumseh voluntarily excavated and replaced the dike following the Environmental Protection Agency's issuance of regulations governing PCBs in the late 1970's. Tecumseh believes they've addressed the facility source material but the FS does include an evaluation of potential continuing releases. Other historical sources for PCBs have been identified but Tecumseh appears to be the furthest upstream source.

In April 1986 an Administrative Order on Consent was signed by Tecumseh. The following year Tecumseh conducted remedial investigations and developed the draft RI. Late 1989, Tecumseh conducted sediment removal and capping activities. These activities included the removal of approximately 3,800 cy of contaminated sediments. Two years later, in 1991, sediment removal activities were completed. Over the next six years numerous reports were developed and submitted to USEPA. The Feasibility Study (FS) was originally submitted in September 1997. A revised FS was submitted in April 1998.

Section 1.4 River Hydrology

The Sheboygan River Basin consists of the Sheboygan River and its two major tributaries: the Onion and Mullet Rivers. The total drainage area of these three watersheds is approximately 280 square miles. The bed of the Upper River generally is characterized by rock and cobbles, with discrete sediment pockets in between and over cobbles along some banks. The width of the Upper River averages approximately 100 to 120 feet, with the water depth ranging from 0.1 to 9.5 feet. Typical water depths are from 2 to 4 feet.

The Middle River is characterized by relatively rapid flow, shallow water depths, a gravel/rocky River bottom with sediment generally deposited intermittently in a relatively thin layer along the River banks. The width of the Middle River averages approximately 100 feet. Typical water depths range from less than 6 inches to 1 to 2 feet.

The Lower River and Harbor is characterized by deeper and slower moving water, with a more continuous sediment distribution along the Lower River banks as compared to the Middle River and a relatively continuous sediment bed throughout the Harbor area. The width of the Lower River averages approximately 150 feet and widens, on average to 300 feet, as it approaches the Harbor. The width of the Inner Harbor averages approximately 250 feet, with a water depth reaching 20 feet, typically averaging from 6 to 12 feet. The Outer Harbor water depth reaches 28 feet, typically averaging from 12 to 23 feet. Harbor water consists of near-shore Lake water and water from the Sheboygan River.

Between 1956 and 1969, sediment was dredged downstream of the Eighth Street Bridge. Sediments above the Eighth Street bridge have not been dredged since 1956. However, currents and wind-driven wave action produce an influx of some sand from Lake Michigan at the mouth of the harbor. Due to this influx, limited maintenance dredging, by the USACE, was performed to allow for recreational boating needs as recent as 1991.

Section 1.5 Summary of Remedial Investigation Results

Investigations were conducted from May 1987 to June 1988. The RI identified PCBs and eight heavy metals as constituents of concern in the River and Harbor sediments, with higher PCB concentrations in the Upper River than in downstream section. River reconnaissance activities identified 48 discrete sediment deposits in the Upper River. See Figure 3-3 for location of discrete sediment deposits. Due to the dynamic nature of the river, sediment deposits have shifted over time. Sediment data collected in 1997 show PCB concentrations ranging from 0.27 ppm to 460 ppm near the Tecumseh facility. Sediment concentrations over the entire river, fall within this range but tend to decrease as you move downstream. Exhibit 2 contains detailed sampling results from this 1997 WDNR event .

Soil samples collected from within the ten-year floodplain of the Sheboygan River were collected during a series of sampling events during the RI. Seven floodplain areas have been considered for remediation. The current surface weighted average concentration (SWAC) of total PCBs in these floodplain areas are as follows. See Figure 5-1 for the locations of these areas.

Floodplain Area	PCB SWAC	Floodplain Area	PCB SWAC
FPR-3	4 ppm	FPR-7	5 ppm
FPL-4	16 ppm	FPR-8	4 ppm
FPR-5	17 ppm	FPL-11	9 ppm
FPR-6	18 ppm		

Groundwater sampling completed in 1992 and 1993 indicated PCBs were locally present in the facility groundwater. Concentrations ranged from 0.05 ppb to 7.4 ppb.

Fish tissue samples taken between 1990 and 1998 show smallmouth bass and white sucker PCB concentrations ranging from 1.3 ppm to 18.3 ppm. In general, the highest fish tissue concentrations have been found near the Tecumseh facility with reductions in concentration as you move downstream. See Exhibit 3 for PCB fish tissue data.

Upon review of the RI and a screening report, the USEPA required that three sediment areas with the highest PCB concentrations be removed from the Upper River. In response, the participating PRP proposed a Pilot Study with the intent of further defining the origin and transport of PCBs and other chemical constituents in the River, investigate several potentially applicable remedial technologies for the Site, and remove the highest PCB concentration sediment areas, as required by USEPA. Soft sediments removed and/or armored as part of Pilot Study included areas 1-5, 5A, 7-11, and 13-18. See Figure 3-3 for locations of these deposits.

Field activities resulted in approximately 1,600 in-situ cubic yards of sediment being removed. The targeted sediments, as well as additional sediment associated with buffer zone removal were placed in constructed Confined Treatment Facility (CTF) for further study. In addition, 1,200 square yards of sediment were capped/armored during the Pilot Study activities.

The volume of sediment removed from the River during RI was greater than the initial estimates. As a result, there was insufficient capacity in the CTF for all the areas originally targeted for removal. A Sediment Management Facility (SMF) was constructed adjacent to the CTF in 1991 and filled with approximately 2,200 cubic yards of contaminated sediments bringing the total in-situ cubic yards of sediment removed from the River to 3,800.

After completing the investigative and removal activities, several site-related activities/studies were developed and implemented, including a resident and caged fish monitoring program referred to as the Interim Monitoring Program (IMP). The IMP was designed to complement fish monitoring activities performed under the investigation and continue until the Record of Decision was completed for the Site.

Section 1.6 River and Land Use

The rivers of the Sheboygan River Basin are located adjacent to industrial, agricultural and residential land uses. Agricultural used and related open space accounts for approximately 68% of the entire drainage area, woodlands account for approximately 8%, wetlands and surface waters cover another 15% and urban land used occupy 9%. Land use adjacent to the River consists of industries, residences, agricultural, and recreational areas, and also includes several municipal and industrial landfills. Upstream of the Site, land use is primarily agricultural with some industrial development.

The Sheboygan River is not used as a public water supply, although the river is a tributary to Lake Michigan which is a public water supply. The cities of Sheboygan and Sheboygan Falls, as well as the village of Kohler, receive their municipal water supplies from Lake Michigan. Recreation such as walking, jogging and bicycling occurs in parks along the River in Sheboygan and Sheboygan Falls. Much of the land near the River in the village of Kohler is privately owned, limiting public access in those areas. Also, there are no public beaches located at the Site.

The Lower River and Harbor are navigable, but Upper and Middle River traffic is typically restricted to canoes and kayaks. Public/recreational boat access is available at a number of locations. There is considerable seasonable fishing in the Middle and Lower River/Harbor areas. Fishing is more limited in the Upper River.

Section 1.7 Summary of Site Risks

Human Health Risks

Site risks were recently summarized in the May 1998 Fish Consumption Exposure Assessment Study for the Sheboygan River and Harbor site, by ATSDR. Elevated levels of PCBs measured in fish from the Sheboygan River and Harbor resulted in the state of Wisconsin issuing fish consumption advisories specific for this location, particularly for resident, non-migratory fish that live year round in the river. In 1992, fillets from Sheboygan River smallmouth bass had PCB concentrations ranging between 0.4 and 17 ppm, while composite samples of whole carp had PCB levels between 10.5 and 200 ppm. In contrast, PCB levels measured in fillets from lake-run brown trout, taken from the Sheboygan river in 1985, were as high as 4 ppm. Typical levels in fillets of Lake Michigan fish are 3 ppm for lake trout, 1.5 ppm for chinook salmon and 0.8 ppm for coho salmon.

Federal toxicologic evaluations of PCBs provide a means for putting these contaminant levels into perspective. ATSDR established their chronic Minimal Risk Level for PCBs at 0.0002 mg/kg/day. Thus, an adult eating two 8 ounce fillets of smallmouth bass would have a PCB exposure of 0.0037 mg/kg/day or 184 times greater than the chronic Minimal Risk Level. An adult who ate two similar 8 ounce bass fillets per month for 15 years would have a high increased lifetime excess cancer risk equivalent to 66 excess liver cancers for every 1,000 exposed individuals for a lifetime.

The human health risk assessment performed by US EPA considered the main contaminants of concern to be PCBs, a group of compounds called congeners which include those that exert PCB-type effects and those that exert dioxin-type effects. At this time, the analysis considered *only* the non-dioxin-like PCBs. To calculate dioxin-like PCBs and non-dioxin-like PCBs cleanup goals require more information on where these congeners are distributed and require a more complex consideration of toxicity. Combine that with data limitations and the results are felt to be too unreliable.

The cleanup goals consider only one type of exposure to the sediment contamination – consumption of fish contaminated by the sediment. This pathway is likely to yield the most protective cleanup goals, because as has been seen at several other PCB sediment sites, bioaccumulation up the food chain is a more sensitive and protective route than dermal contact. Therefore, it was concluded that cleanup goals based on fish consumption will be protective and appropriate for this site.

In looking at both cancer and non-cancer effects of the non-dioxin-like PCBs. US EPA set the risk range from 1×10^{-6} to $1X\ 10^{-4}$ for cancer and the hazard index for non-cancer (immunotoxic) effects at or below 1. It has been determined that a post-remediation contamination level of approximately 2 ppm in river sediments equates to a human health cancer risk of approximately 1.4×10^{-4} and a non-cancer hazard index of 0.57. A post-remediation contamination level of approximately 1 ppm equates to a human health cancer risk of approximately 7.13 x 10-5 and non-cancer hazard index of 0.3. Therefore, a post-remediation contamination level of less than 2 ppm should be targeted for river sediments based on human health concerns..

Ecological Risks

Aquatic Ecological Risk Assessment (AERA)

The objectives of the AERA are twofold: 1) to evaluate risk posed to aquatic organisms and piscivorous birds and mammals exposed to toxic substances in the River, and 2) to derive concentrations of PCBs and other contaminants of concern (COCs) in sediment that would be protective of the River ecosystem as assessed through surrogate receptor species. Potential ecological receptor species considered for the AERA included benthic invertebrates (flies, beetles midges and clams), fish, birds and mammals that depend on aquatic resources of the River. PCBs are considered a contaminant of concern (COC) for all the groups. PAHs are considered a COC for benthic invertebrates and fish. Metals are considered COCs for benthic invertebrates only. The River was divided into 6 river segments for the purposes of study design and data evaluation. See Figure 3-1.

Benthic Invertebrates

A sediment Triad assessment was conducted that focused on depositional areas in the River with all but two of the site stations located in the Lower River Segments 5 and 6. The Triad comprises three synoptic measures and is used to assess the probability of adverse effects o the benthic invertebrate community. Three site stations, T07, T13 and T19, showed clear evidence of adverse effect in three Triad legs, while 9 of the other 11 site stations showed evidence of adverse effect in the toxicity and chemistry measurements.

Fish

The results for all three approaches used to calculate HQs for PCBs-based on total PCB concentration in eggs, total PCB concentrations in whole-body adult fish, and TEQ concentrations in eggs-indicate potential reproductive effects in fish, particularly in Segments 2 and 3, where the PCB concentrations are most elevated and HQ are greater than 1 using all three analysis methods. The risk appears to be greater for smallmouth bass than for either the white sucker or longnose dace, probably because smallmouth bass are at a higher trophic level and have higher relative lipid content in their eggs. The potential for risk to smallmouth bass in Segment 5 is about half of that in Segments 2 and 3; for white sucker and longnose dace, the risks in Segments 2, 3, and 5 appear to be similar.

Potential risks to fish from PAHs were also evaluated since Segment 6 contained elevated concentrations of PAHs in sediment and a study Schrank et al. (1997) reported elevated PAH metabolites in white suckers collected from Segment 6 as well as hematological, biochemical, and histological alterations. Elevated concentrations of PCBs and DDE were also reported in Segment 6 white suckers in Schrank et al.

Piscivores (Mink and Great Blue Heron)

The mink and great blue heron represented the piscivorous wildlife community in this AERA. The assessment endpoint presented for mink and great blue heron focused on the potential for reduced reproduction due to dietary exposure to PCBs. Segments 2 and 3 provide beneficial physical habitat for the riparian and aquatic wildlife community. They may also offer the most suitable foraging territory for wildlife, because of the riparian plant community which provides cover and reduces the amount of human disturbance. Segments 2 and 3 are the areas most contaminated with PCBs. The attractive physical habitat, coupled with the elevated degree of contamination, increases the potential for exposure and harm to piscivorous wildlife in Segments 2 and 3.

In Segments 2/3 and 5/6, HQs for mink based on TEQs ranged from 6.2 to 290 and HQs based on total PCBs ranged from 15 to 1,000. In Segments 2/3 and 5/6, HQs for great blue heron based on TEQs ranged from 14 to 290 and HQs based on total PCBs ranged from 4.9 to 65.

Recommendations

For the protection of benthic invertebrates in depositional areas, two avenues for protective sediment concentration derivation were evaluated: 1) protective sediment concentrations based on Triad data, and 2) comparison of measured toxicity and chemistry data to sediment quality guidelines. For most stations investigated, correlations among the three Triad legs were not sufficiently good to use the total Triad data set to evaluate protective sediment concentrations. Instead, three sediment quality guidelines were evaluated to determine the likelihood of Type I or Type II errors if the guidelines were used as protective sediment concentrations for metals, PAHs, and PCBs.

For the protection of fish, the bioaccumulation model was used to back calculate protective sediment concentrations from no effects concentrations of specific congeners in juvenile smallmouth bass fish tissue. Based on this analysis, the probability of adverse impacts to fish from dioxin-like effects from coplanar PCB congeners appears to be low since the average measured TEQ or specific coplanar congener concentrations at depositional areas were less than the calculated protective sediment concentrations, except for Congeners 077 and 126 in Segment 2 which had concentrations greater than the NOAEL-based protective sediment concentrations.

For the protection of piscivores, the food web model and the bioaccumulation model were used in combination to calculate a range of protective sediment concentrations for mink and great blue heron based on NOAELs and LOAELs derived from the literature. In general, the congener-specific protective sediment concentrations for mink and great blue heron were similar, although the LOAEL-based protective sediment concentrations for great blue heron were somewhat lower for PCB Congeners 105 and 118. Most of the average congener concentrations measured in Segments 2, 3, and 5 were much higher than the protective sediment concentration range, indicating a high likelihood of risk to mink and great blue heron, especially near Segment 2. Congener concentrations were lower than or equal to protective sediment concentrations in the reference area, indicating that this area is unlikely to pose risks to mink and great blue heron.

Therefore, based on the analyses presented in the AERA, a sediment concentration of approximately 1 ppm is expected to be protective for the ecological receptors.

Total PCB Protective Sediment Concentrations in Segments 2, 3, and 5

	Fish		Heron		Mink	
PCB Congener	NOAEL (mg/kg dw)	LOAEL (mg/kg dw)	NOAEL (mg/kg dw)	LOAEL (mg/kg dw)	NOAEL (mg/kg dw)	LOAEL (mg/kg dw)
66	--	--	0.35 - 0.36	0.59 - 0.64	--	--
77	3.7 - 5.7	6.0 - 9.1	0.14 - 0.15	0.23 - 0.32	--	--
105	--	--	0.72 - 0.72	0.94 - 0.97	0.72 - 0.73	1.3 - 1.4
118	9.2 - 16	15 - 25	0.49 - 0.50	0.76 - 0.88	0.50 - 0.51	1.3 - 1.5
126	5.6 - 6.6	8.7 - 11	0.33 - 0.34	0.47 - 0.52	0.34 - 0.34	0.70 - 0.80
156	--	--	--	--	0.05 - 0.06	1.0 - 1.2
Overall Range	3.7 - 16	6.0 - 25	0.14 - 0.72	0.23 - ***0.97***	0.05 - 0.73	0.70 - 1.5

Note: – not calculated; no toxic equivalency factor available
LOAEL - lowest observed adverse effects level
NOAEL - no observed adverse effect level

Terrestrial Ecological Risk Assessment (TERA) for Floodplain Soils

The TERA is based on PCB congener-specific analyses of co-located earthworm and soil samples collected 11/2-3/97. The worm congener data is extrapolated to robin egg concentrations, which are compared with egg toxicity data in three ways: total PCBs, specific congeners, and dioxin toxicity equivalents (TEQs). The egg hazard quotients (HQs), based on hatchability and malformations, range from 13 to 48 for no observed adverse effect concentrations (NOAEC), and from 6 to 12 for lowest observed adverse effect concentrations (LOAEC) for the various approaches. HQs were also developed on the basis of oral dose to adult birds, but the results varied by as much as an order of magnitude. Since egg-based risk estimates are much less variable, the egg results are used to back-calculate soil ecologically protective remedial goals (PRGs).

The following PRGs have been calculated (all PRGs are expressed as ppm total PCBs)

Toxicity Basis	NOAEC-based PRG	LOAEC-based PRG
Total PCBs	1	1
Robin Foraging w/ nestlings	2	3
Robin Foraging w/ fledglings	3.5	5.5

The two congener-specific approaches vary in the biomagnification factors used to estimate egg congener concentration from the robin dietary concentration.

The total PCB PRGs were adjusted for foraging area use based on the floodplain delineation sampling performed in 1992 ("post-phases I and II"). Two extrapolations are performed: (1) for the robin foraging range during the time they are feeding nestlings, and (2) for the foraging range during the time they are caring for fledglings (the latter is a much larger area). The NOAEC-based PRG did not change, but the LOAEC-based PRG increased to 9 ppm for the fledgling-stage. The congener-specific (2) LOAEC-based PRG would increase to 12 ppm for the fledgling stage.

Remediation of floodplain PCBs equal or greater than 50 ppm results in only about a 25% decrease in the total number of foraging areas at risk. In contrast, remediation of floodplain PCBs equal or greater than 10 ppm result in a 90% decrease in the number of foraging areas at risk. Although the risk assessment focuses on robins as the measurement endpoint, they are indicative of risks to a range of species that feed on earthworms and other soil-related invertebrates.

A Surface Weighted Area Concentration (SWAC) calculation performed on a scale appropriate for robin foraging areas indicates that remediation of floodplain soil equal to or greater than 10 ppm PCB are expected to be result in a foraging SWAC at or below 5 ppm, with few exceptions. Remediation of floodplain soil PCB concentrations equal to or less than 50 ppm may be appropriate in select areas of high quality forested habitat on the basis of a risk management decision to balance risk reduction with habitat preservation, but it is not justifiable on the basis of SWAC for general application.

Section 1.8 Proposed Cleanup Goals

Considering both human health and aquatic health risks, 1 ppm total SWAC for PCBs is the cleanup goal for all river sediments. Based on terrestrial risks of 5 ppm SWAC, a post-remediation contamination equal to or less than 10 ppm, is the cleanup goal for floodplain soils. Lastly, although no cleanup goal is currently being recommended for groundwater, it is recommended that additional investigations be performed to identify possible additional source area(s) and determine their effect and loading on the river.

SECTION 2: DESCRIPTION OF REMEDIAL ALTERNATIVES

As previously mentioned, the Site has been broken into 5 different components; upper river sediments, middle river sediments, lower river and harbor sediments, floodplain soils, and groundwater. The descriptions of the various remedial alternatives are organized by river component and delineate FS preferred alternatives with EPA recommended alternatives. Exhibit 4 contains detailed cost information for each of the EPA recommended alternatives.

Upper River Sediments

Alternative 1: No Further Action/Natural Recovery

No further action would be undertaken in the Upper River sediment beyond dredging and capping/armoring activities completed previously. It is assumed that the fish and waterfowl consumption advisories, currently in place, would remain until monitoring indicates that the advisories can be revised or removed. This alternative includes the disposal of the CTF and SMF sediments in a WDNR-approved Wisconsin landfill.

(Cost: $2.6 M)

Alternative 2: Natural Recovery/Monitoring **(PRP Preferred Alternative)**

This includes Alternative 1 with the additional of annual fish monitoring and sediment sampling every 5 years. The fish and sediment monitoring programs would continue for 30 years, and would be evaluated every 5 years during that period for potential modification or elimination. Periodic maintenance of the capping/armored areas would continue for a 30 year period. This alternative includes the disposal of the CTF and SMF sediments in a WDNR-approved Wisconsin landfill.

(Cost: $4.3 M)

Alternative 3: Removal

Five successive Upper River sediment removal scenarios have been developed based on PCB mass removal potential, volume addressed, and practicality of removal. Each of these scenarios involves a series of Upper River sediment deposits. All sediment removal alternatives include mechanical dredging, gravity dewatering in the existing CTF and SMF facilities, water filtration in the existing on-site CWTF, monitoring, consumption advisories, and natural processes. Figure 3-3 displays the upper river sediment deposits and access areas.

The various sediment removal alternatives are presented as a range. The low end of the range represents the utilization of an in-state disposal facility for all contaminated sediments and implementation of the dredging over a year. The high end of the range represents the figures presented in the FS which assume solids disposal in a WDNR-approved off-site Wisconsin landfill for PCBs < 50 ppm and an out-of-state facility for PCBs > 50 ppm and implementation to take a little over 3 years.

Alternative 3-I: Removal (Sediment Areas 21, 24, 26, 40, 42, and 45)

Implementation of this sub-alternative would remove approximately 5,400 cy of sediment and 90% of the PCB mass present in the Upper River.

(Cost: $5.5 to $12.2 M)

Alternative 3-II: Removal (Sediment Areas 2, 3, 4, 5A, 7, 8, 10, 11, 15A plus Alt. 3-I)

Implementation of this sub-alternative would remove approximately 7,500 cy of sediment and 95% of the PCB mass present in the Upper River.

(Cost: $7.0 to $15.6 M)

Alternative 3-III: Removal (Sediment Areas 35, 39 plus Alt. 3-II)

Implementation of this sub-alternative would remove approximately 8,900 cy of sediment and 96% of the PCB mass present in the Upper River.

(Cost: $7.8 to $17.4 M)

Alternative 3-IV: Removal (Sediment Area 31, plus Alt. 3-III)

Implementation of this sub-alternative would remove approximately 13,800 cy of sediment and 97% of the PCB mass present in the Upper River.

(Cost: $10.7 to $23.8 M)

Alternative 3-IV-A: Removal (Sediment Areas 44, 23, 1, 39 A/B, 41, 13, and 20A Plus Alt. 3-IV) **(EPA Developed / Recommended Alternative)**

Implementation of this sub-alternative establishes a removal performance standard of 98% of the PCB mass equating to approximately 18,200 cy of sediment in the Upper River.

(Cost: $13.7 to 30.5 M)

Alternative 3-V: Removal (Sediment Areas 5, 6, 9, 10, 12, 13, 14, 15, 15B, 16, 17, 18, 19, 19A, 20, 20A, 22, 23, 25, 27, 27A, 28, 29, 29A, 30, 32, 33, 34, 36, 37, 38, 39A, 39B, 41, 43, 44, 46 plus Alt 3-I, 3-II, 3-III, and 3-IV)

Implementation of this sub-alternative would remove approximately 22,500 cy of sediment and 99% of the PCB mass present in the Upper River.

(Cost: $15.6 to $34.6 M)

Middle River Sediments

Alternative 1: No Action **(PRP Preferred Alternative)**

Under this alternative, no action would be undertaken in the Middle River sediment. However, fish and select waterfowl consumption advisories currently in place would remain until monitoring results indicate that the advisories can be revised or modified.

(Cost: $ 0)

Alternative 2: Monitoring **(EPA Developed / Recommended Alternative)**

The approximate in-situ sediment volume present in the Middle River (Waelderhaus Dam to the C&NW railroad bridge) is estimated to be 35,000 cy. The sediment is present in a shallow layer which is intermittent along the River banks. The Middle River sediment contains PCBs and some metals, both at low levels. PCB concentrations ranging from less than 0.025 ppm to 8.8 ppm, with an average concentration of 2 ppm and standard deviation of +/- 2.4 ppm. WDNR collected two top 6-inch samples in 1995 with PCB concentrations ranging from 1.1 to 1.7 ppm (average of 1.4 ppm).

Due the presence of PCB contamination and the dynamic nature of the Sheboygan River environment as a whole, an extensive monitoring program must be implemented in the Middle River including, at a minimum, 1) resident fish monitoring of adult and young-of-year or juvenile fish; 2) caged fish studies using fathead minnows; 3) sediment sampling, and 4) PCB mass and sediment volume delineations on an annual basis. Monitoring must be conducted to gauge the health of the river and potential human health effects over time. In addition, monitoring in the Middle River will provide valuable information on changing conditions which may warrant the removal of sediment deposit(s) with high PCB concentrations or mass. It is premature at this time to exclude all potential future remedial actions for the Middle River without monitoring information.

A risk management approach would also be appropriate to manage levels of PCBs dispersed over a wide area in the Middle River. Although PCBs are at relatively low concentrations, they are dispersed over a large area and their total mass over the entire stretch of the Middle River may be significant. Such a risk management approach is presented in the Lower River and Harbor portion of this document. The risk management approach described for the Lower River and Harbor ultimately contributes to risk management of the Middle River and Upper River.

(Cost: $2.35 M)*

* does not include costs associated with potential future response actions

Lower River and Harbor Sediments

The cost ranges below represent the difference between in-state disposal of all contaminated sediments vs. in-state disposal of sediment less than 50 ppm and out-of-state disposal for sediments greater than 50 ppm. (similar rationale as the Upper River)

Alternative 1: No Action

Under this alternative, no action would be undertaken in the Lower River and Harbor sediment. However, fish and select waterfowl consumption advisories currently in place would remain until monitoring results indicate that the advisories can be revised or modified.

(Cost: $0 M)

Alternative 2: Natural Recovery and Monitoring **(PRP Preferred Alternative)**

This alternative would couple ongoing natural recovery processes in the Lower River and Harbor with monitoring. The river and harbor conditions would be evaluated through fish monitoring each year and sediment sampling every 5 years. The fish and sediment sampling would continue for 30 years, and would be evaluated every 5 years during that period for potential modification or elimination. Maintenance of fish and select waterfowl consumption advisories would continue until long-term results indicate that the advisories can be revised or removed.

(Cost: $1.3 M)

Alternative 3: Inner Harbor Engineering Capping

This alternative includes the installation of an engineering cap in the Inner Harbor (i.e Pennsylvania Avenue bridge to the mouth of the Inner Harbor). The capped area is estimated to be approximately 35 acres. The cap would consist of 2 layers. The bottom layer would consist of 20 inches of coarse-grained and the top layer would consist of 12 inches of 6- to 8- inch diameter stone. Due to the anticipated soft nature of the sediments, a geotextile fabric would be installed to understay the soft layer.

Post capping fish monitoring and each year and sediment sampling every 5 years would be used to evaluate the long-term effectiveness of this alternative, as well as the extent to which natural processes are continuing in the Lower River and Harbor. The fish and sediment monitoring program would be reevaluated every 5 years for potential modification or elimination.

(Cost: $16.6 M)

Alternative 4: Inner Harbor Removal

This alternative includes dredging, gravity dewatering, stabilization/solidification, water treatment, solids disposal in a WDNR-approved off-site Wisconsin landfill, monitoring, continuation of fish and select waterfowl consumption advisories, and the continuation of natural processes (post-remediation). Approximately 960,000 in-situ cy of sediment would be targeted for removal in the Inner Harbor area between the Pennsylvania Avenue bridge and the mouth of the Inner Harbor. The range of costs primarily represents the difference between in-state disposal and out-of-state disposal options.

(Cost: $153.3 to $340.7 M)

Alternative 5: Inner Harbor Removal - Sediment Trap **(EPA Developed / Recommended Alternative)**

This alternative is similar to Alternative 4 although it only calls for the removal of a portion of the approximately 960,000 cy of sediment in the Lower River and Harbor area. The USEPA divided the Inner Harbor into 10 zones based on contamination delineation and estimated the approximate mass of contaminant and volume of sediment for each zone. See Figure 2. A number of zone removal scenarios were evaluated. Removal of approximately 27,000 cy of sediment has been selected under this EPA developed alternative.

As described in the Middle River alternative #2, a risk management approach is appropriate to manage low levels of PCBs dispersed over a wide area in the Middle

River. In addition, sediment removal activities in the upper river will cause the short-term disturbance and migration of contaminated upper river sediments. The development of a sediment trap not only captures and reduces the volume of

contaminated sediments from making its way into Lake Michigan but also succeeds in removing approximately 3% to 10% of the PCB mass in the Inner Harbor depending on the location of the trap.

(Cost: $4.3 to $9.6 M)

Alternative 6: Inner Harbor Removal - Surface Sediments (EPA Developed Alternative)

Under this alternative only the first two feet, approximately 117,000 cy, of sediments would be removed from the Inner Harbor and backfilled with clean sediments. The purpose of this alternative is to reduce surficial sediment concentrations to a level protective of the risk goal of 1 ppm for the entire Inner Harbor. This alternative also include maintenance of the breakwaters.

(Cost: $28.7 to 63.8 M)

Breakwaters Maintenance

Any recommended alternative for the Lower River and Harbor needs to include efforts associated with maintenance of the North and South Breakwaters. The breakwaters restrict the agitation of Inner Harbor sediments from Lake Michigan. Long-term management of the site must include maintenance of the breakwaters. An examination of annual USACE costs from 1988 through 1997 reveal costs ranging from approximately $88,000 to $360,000, averaging $112,000 per year over 10 years or $3,360,000 over 30 years.

(Cost: $3.4 M)

Floodplain Soils

The cost ranges below represent the difference between in-state disposal of all contaminated soils vs. in-state disposal of soils less than 50 ppm and out-of-state disposal for soils greater than 50 ppm. (similar rationale as the Upper River)

Alternative 1: No Action

Under this alternative, no action would undertaken and floodplain bank soils would remain in their current state.

(Cost: $0)

Alternative 2: Bank Soil Stabilization **(PRP Preferred Alternative)**

This alternative includes the removal of the upper 12 inches of bank soil and rehabilitation of the bank a potentially erodible areas. At each location an area extending from the waterline to the establishment of mature vegetation at the top of the bank would be removed.

(Cost: $0.7 M)

Alternative 3: Removal of Soil > 50 ppm

Under this alternative, the top 6 inches of floodplain soils containing PCBs at concentrations greater than 50 ppm would be removed and disposed of off-site at an approved TSCA landfill. The FS has proposed floodplain areas FPL-4, FPR-5, FPR-6, and FPR-11 with an estimated total soil volume of 2,600 cy as the target areas. This alternative includes restoration and a 30 year O&M period.

(Cost: $0.9 to $2.1 M)

Alternative 4: Removal of Soil > 10 ppm **(EPA Recommended Alternative)**

Under this alternative, the top 6 inches of floodplain soils containing PCBs at concentrations greater than 10 ppm would be removed and disposed of off-site at an approved TSCA landfill. The estimated total soil volume is 10,790 cy. However, remediation of floodplain soil PCB concentrations equal to or less than 50 ppm may be appropriate in select areas of high quality forested habitat on the basis of balancing risk reduction with habitat preservation. This alternative also includes restoration and a 30 year O&M period.

(Cost: $2.3 to $5.2 M)

Groundwater

Alternative 1: No Action

Under this alternative, no action would be undertaken for facility groundwater. It is assumed that the existing city of the Sheboygan Falls municipal code (Section 13.10 - Ordinance No. 4; revised April 1998) that restricts the use of private water supply wells will remain in place. The No Action alternative, through natural processes would be expected to reduce/limit the current PCB concentration in groundwater over time, and thus PCB concentrations in the groundwater potentially discharging to the Sheboygan River.

(Cost: $0)

Alternative 2: Investigation/Natural Attenuation/Source Identification and Control **(PRP Preferred Alternative)(EPA Recommended Alternative)**

Under this alternative, additional groundwater investigations in the facility area would occur. Current PCB concentrations in the existing facility monitoring wells would be assessed. If the groundwater sampling were to determine that PCBs are present in groundwater at the facility, additional borings/monitoring wells would be installed to further define the lateral extent of the groundwater that contains PCBs and to more closely assess the hydrogeologic parameters at the facility. In conjunction with the groundwater investigation, an investigation would be performed to identify potential PCB sources to facility groundwater. Following completion of the investigation a determination will be made concerning an appropriate remedy.

(Cost: $0.6 M)*

* does not include potential future source control response actions

Alternative 3: Collection Trench and Treatment

This alternative would include the installation of a groundwater collection trench, recovery of groundwater, and groundwater treatment in the existing CWTF. Additional characterization of facility hydrogeologic conditions would be completed. This characterization would required the installation of approximately 8 additional groundwater monitoring wells.

(Cost: $1.9 M)

Alternative 4: Facility Perimeter Cut-off Wall

This alternative would include the installation of a cut-off wall to be constructed along the perimeter of the Tecumseh facility. The objective of the wall would be to isolate the facility groundwater. In addition to the cut-off wall, a series of 5 dewatering wells would be installed to maintain an inward hydraulic gradient. Additional characterization of facility hydrogeologic conditions would be completed as described in Alternative 3.

(Cost: $ 3.7 M)

SECTION 3: RATIONALE FOR RECOMMENDED ALTERNATIVE

Upper River Sediments

The primary contaminant of concern at the site are PCBs in soft sediment deposits and flood plain soils. Soft sediment deposits are located in discrete deposits throughout the four mile stretch of river from Sheboygan Falls through the town of Kohler (See Figure 3-3). The primary goals for the remedial action at the site are to reduce risk and to remove as much of the PCB source mass as technically feasible.

During a removal action in the early 1990s, 17 sediment deposits containing the highest PCB concentrations were dredged, totaling about 3,800 cubic yards of sediment. Current calculations presented in the FS report indicate that about 84% of the PCB mass has been removed via this action from the Upper River. Based on this calculation, approximately 700 pounds of PCBs still remain in the upper river. The current estimate of the remaining volume of sediment in the upper river is about 23,000 cubic yards.

The dredging efficiency, in terms of the percentage of PCB mass removed, for each deposit ranged from 96.0% to 99.9% averaging 98.4%. The range and average are based on 13 deposits. The 13 deposits selected for the calculation most accurately represent the conditions of the deposits still remaining in the river in terms of PCB mass and concentration.

The FS report presents seven alternatives for the Upper River sediments. Five of the alternatives present dredging scenarios and differ in the amount of sediment removed, percent PCB mass removed, cost and time to implement. The cleanup goal is 1 ppm SWAC for sediments. A mass removal approach gets as close to a risk cleanup number as possible. However, a cleanup to 1 ppm may not be technically feasible. Post-remedial action verification sampling and risk calculations will be done to determine that the area is within the acceptable risk range and to determine how close the cleanup got to the original risk reduction estimation and the overall cleanup goal of 1 ppm. It is assumed that over time, through natural recovery (i.e., clean sediment covering the small amount of PCBs left behind), the residual risk would be addressed.

Because of the dynamic nature of the upper portion of the Sheboygan River, the PCB mass removal goal is applicable to the entire stretch of the upper river as a whole and does not necessarily target specific sediment deposits. In other words, the objective is to remove PCB contaminated sediment until a specified percentage of PCB mass has been removed. However, for the purposes of costing out this alternative, a variation of FS Alternative 3-IV is proposed. Alternative 3-IV-A would include the dredging of approximately 18,820 cy of contaminated sediments in the upper river. Implementation of this alternative is expected to enable the agency to meet the risk goal of approximately 1 ppm SWAC. See Exhibit 1.

The party implementing the action would be responsible for pre- and post construction sampling to verify that the specified PCB mass goal has been achieved, regardless of which deposits and/or how many deposits have been removed.

Middle River Sediments

As presented in the FS, the approximate in-situ sediment volume in the middle river is estimated to be 35,000 cy. This sediment is generally present in a shallow layer which is intermittent along the river banks. The city of Sheboygan collected sediment samples from the Middle River near the County Trunk PP bridge, along the proposed alignment of a new interceptor sewer line that will cross the River. The results presented in the "City of Sheboygan North/South Interceptor Project Final Report" note that PCBs were detected at the very low concentration of 0.04 ppm only in the top 2 feet of the 10-foot River bed core.

The Middle River sediment contains PCBs and some metals, both at very low concentrations (e.g., PCB concentrations ranging from less than 0.025 ppm to 8.8 ppm, with an average concentration of 2 ppm and a standard deviation of ±2.4 ppm based on RI data). WDNR collected two top 6-inch samples from the Middle River in 1995 with PCB concentrations ranging from 1.1 to 1.7 ppm.

In 1997, WDNR collected 10 samples from four locations in the Middle River. It is unclear whether these samples are sediment or River bed samples. At two of these locations, samples were collected from approximately the top 2 inches. At the remaining two locations, samples were segmented over the core depth resulting in four samples from each location. Surficial PCB concentrations ranged from 0.64 to 5.8 ppm (top 2 or 4 inches), while samples at depth ranged from 0.59 ppm (4 to 10 inches) to 37 ppm (16 to 22 inches).

Like the Upper River, the clean up goal is 1 ppm SWAC and as with the Upper River the Middle River is a dynamic environment undergoing continuous change in terms of sediment deposition, erosion and PCB distribution. The presence of PCBs and the dynamic nature of the Sheboygan River environment warrants an more up-to-date delineation of soft sediments along with the implementation of an extensive monitoring program. In addition to focusing on PCB concentrations and its distribution in the Middle River, monitoring would track PCB mass and associated sediment volumes in the Middle River over time. Information collected from this monitoring may indicate the need for remedial actions in the future.

A risk management approach would also be important to manage PCBs dispersed over the wide area in the Middle River. Such a risk management approach is presented in the Lower River and Harbor section.

Based on current contamination information in the Middle River, the remedy recommendation of delineation and monitoring does not immediately meet the clean up goal of 1 ppm SWAC. It is however expected that with the removal of contaminated sediment in the Upper River, reduction of contaminated floodplain soils (see floodplain recommendation), and migration of cleaner sediments into the Middle River that the 1 ppm SWAC goal can be achieved over time. In addition, any Middle River recovery will be further enhanced with the potential removal of Middle River contaminated sediments as a result of delineation and monitoring.

Lower River and Harbor Sediments

The recommended remedy for the Lower River is similar to the Middle River. As with the other river sediments, the clean up goal is 1 ppm.

The nature of the Inner Harbor area is unlike the dynamic environments of the middle and upper river segments as demonstrated by the large volume of depositional sediment. Based on the depositional nature of the Inner Harbor and its current relative state of equilibrium, the most heavily contaminated sediments, and sediments in excess of 50 ppm, are found below the 2.5 foot depth. Based on available data, the agency has calculated an overall SWAC concentration of approximately 6 ppm for the Inner Harbor.

Various remediation alternatives would address meeting this cleanup standard to different degrees. Natural Recovery and Monitoring would allow ongoing natural processes to achieve the cleanup goal over time. These natural processes would be enhanced with the removal of contaminated sediments in the upper river.

Engineering capping would provide a structural barrier between the most heavily contaminated sediments and the cleaner sediments making its way from up river. However, over the long-term surficial sediments on top of the cap would be similar to sediments deposited through natural recovery. In addition, natural recovery or capping would not meet potential future commercial shipping needs as it would require excavation to navigation depth.

Complete excavation of contaminated sediments in the Inner Harbor would remove over most of the contaminated sediments in the entire river system and meet commercial navigational depth needs. However, the depositional nature of the Inner Harbor will continue to collect up river sediments effectively making the surficial bio-available sediments the same as natural recovery or capping. In addition, current problems with finding an in-state disposal option, for TSCA materials greater than 50 ppm, make this alternative cost prohibitive.

The agency's sediment trap alternative incorporates a valuable risk management component to the overall river remediation as it would collect contaminated river sediments and reduce their migration into Lake Michigan. In addition, the development and management of a sediment trap removes up to 10% of the Inner Harbor PCB mass depending on its location. The in-state vs. out-of-state disposal option, isn't as large of a issue as the volume of contaminated sediments is not as significant as some of the other Lower River and Harbor alternatives. But similar to the other alternatives, long-term surficial sediments will be the same as natural recovery, capping or completed excavation.

The agency developed alternative of removing the top 2 feet of sediments and replacement of 1 foot of clean sediments would more immediately meet risk based cleanup goals, but like the other alternatives, will result in a similar long-term surficial sediment concentration. Because the top few feet of sediment contamination does not trigger TSCA disposal requirements, an in-state disposal option is achievable. However, the volume of sediments removed make this alternative cost prohibitive. It also does not address commercial navigational shipping needs.

Balancing the various alternatives results in the recommendation of the sediment trap alternative for the Inner Harbor. While some uncertainty remains with respect to its effectiveness this will be further examined. The development of a sediment trap in the Inner Harbor significantly enhances the overall risk management aspect of the remedy, provides a mechanism for the collection and management of contaminated up river sediments, and removes a portion of the PCB mass. Long-term surficial sediments will be equivalent to the other alternatives. As with other alternatives, however, this recommendation does not meet potential commercial navigational depth needs.

Based on current contamination information in the Lower River and Inner Harbor, the remedy recommendation of delineation, monitoring and a sediment trap does not immediately meet the clean up goal of 1 ppm SWAC. However, it is expected that with the removal of contaminated sediment in the Upper River, reduction of contaminated floodplain soils (see floodplain recommendation), and migration of upstream sediments into the Lower River and Inner Harbor that the 1 ppm SWAC goal can be achieved over time. Any Lower River and Harbor recovery will be further enhanced with the potential removal of Lower River contaminated sediments as a result of delineation and monitoring.

Floodplain Soils

Potential human health risks associated with direct exposure to floodplain soils were found to be of marginal concern in the 1990 Endangerment Assessment (EA) and 1993 USEPA Risk Assessment (RA). Specifically, in the 1990 EA, potential carcinogenic risks associated with soil ingestion and dermal contact were estimated to be approximately $5x10^{-6}$ based on representative soil concentrations (i.e., 8ppm PCBs) and about $2x10^{-5}$ based on maximum soil concentrations (i.e., 71 ppm PCBs). Similarly, in the 1993 USEPA RA, potential risks from dermal exposure to floodplain soils in Esslingen and Kiwanis Parks were estimated to be about $3x10^{-6}$ to $4x10^{-6}$ under a reasonable maximum scenario and less that $1x10^{-6}$ under a typical exposure scenario.

Although current and reasonably expected future risks are low with respect to human health concerns, removal of floodplain soils with PCB concentrations exceeding 50 mg/kg would reduce these risks further. Based on information presented in the FS report, potential human health carcinogenic risks from direct contact with floodplain soils would fall within a $1x10^{-6}$ to $1x10^{-5}$ range in all floodplain areas, if all floodplain soils with PCB concentrations greater than 50 mg/kg were removed.

The Wisconsin Department of Heath and Family Services (DHFS) previously concluded that in order to be protective of human health, remediated floodplain soils should contain no more than 3.5 ppm of total PCBs. This is based on the adoption of the 1×10^{-6} risk level when deriving the remediation goals. DHFS has recommended that US EPA adopt a floodplain soil PCB concentration goal between 3.5 ppm and 10 ppm.

Based on conclusions derived from the terrestrial ecological assessment, remediation of floodplain soils equal to or greater than 10 ppm are expected to result in a foraging SWAC at or below 5 ppm.

Of the alternatives presented in the FS, Alternatives I and II do not address risk from the floodplain soils. Alternative 3: Removal of Soil > 50 ppm is not protective of terrestrial ecological health risks. Only Alternative 4: Removal of Soil >10 ppm meet both ecological and human health risks. The determination to excavate specific floodplain soils will be balanced with considerations for existing habitat quality.

Groundwater

The presence of PCB contamination in ground water at the facility implies the possibility that contamination will be left in place. Under the NCP, this warrants, at a minimum, long term monitoring. Therefore, Alternative I (no action) in not appropriate.

Although PCB concentrations in groundwater samples collected during the ground water study are relatively low and mass flux calculations to the river vary, the study did positively identify PCBs in groundwater samples. However, there is no known or hypothetical complete human exposure pathway to PCBs in facility groundwater. The only remaining issue related to groundwater at the site is whether groundwater, sewer lines and/or soils at the facility are a continuing and/or significant source(s) of PCBs to the Sheboygan River. Therefore, additional source investigative studies are necessary and justified.

Alternative II addresses the need for additional source investigations. In addition, Alternative II is the only alternative that actually addresses the potential for source removal (e.g., cleaning and grouting sewer lines, soil removal). Source removal is preferable over source control. If a source(s) can be identified and removed / stabilized, the need for source control is eliminated. Implementation of a ground water investigation as part of Alternative II is also recommended to determine current and long-term ground water contamination trends at the site in relation to sources and/or source removals and to better quantify ground water flux to the Sheboygan River. The quantification of the ground water flux portion of Alternative II is critical to help determine whether PCB mass from the groundwater is adding significant PCB mass to the Sheboygan River over time, regardless of any source identification and/or removal.

The possible recommendation of source removal and/or containment with respect to the groundwater component of the site will be made upon conclusion of the groundwater investigation.

Site Recommendations

The following table presents the recommended river component alternatives and estimated cost.

SHEBOYGAN RIVER & HARBOR ALTERNATIVE RECOMMENDATIONS		
River Component	Estimated Cost	
	WDNR IN-STATE PROPOSAL	FS OUT-OF-STATE FOR > 50 PPM
Upper River Sediments (98% Mass Removal)	$13,700,000	$30,500,000
Middle River Sediments (Delineation and Monitoring)*	$2,400,000	$2,400,000
Lower River & Harbor Sediments		
Lower River Sediments (Delineation and Monitoring)*	$1,200,000	$1,200,000
Harbor Sediments (Sediment Trap and Monitoring)	$5,500,000	$10,800,000
Maintenance of Breakwaters	$3,400,000	$3,400,000
Floodplain Soils (Removal of Soil > 10 ppm)	$2,200,000	$5,200,000
Groundwater (Investigation/Attenuation/Source Identification and Control) *	$600,000	$600,000
Total	$29,000,000	$54,100,000

* does not include costs associated with potential future response actions

SECTION 4: STATE AND COMMUNITY ACCEPTANCE

The site has a Technical Advisory Group (TAG). The TAG has met with EPA on a number of occasions to discuss the site. Tecumseh Products Company, a PRP, has been implementing the RI/FS under an AOC with EPA. Both the TAG and Tecumseh Products Company have been notified of their opportunity to submit written comments for consideration by the Remedy Review Board. The Region will forward any comments it receives from these entities prior to the scheduled March meeting.

Based on a recent meeting and conference calls with WDNR, there is general concurrence by the state on the US EPA's recommendation for all components of the Sheboygan River and Harbor Superfund Site.

Attachments

Exhibit 1 — Upper River SWAC Calculations

Exhibit 2 — FS Table D-1 -1997 Sediment Sampling - WDNR

Exhibit 3 — 1998 IMP Table 1 Mean PCB Concentrations in Smallmouth Bass and White Suckers

Exhibit 4 — Cost Estimates for EPA Recommended Alternative 3-IV-A

Figure 1-A — Sheboygan, WI Location Map

Figure 2 — Inner Harbor Zones

Figure 1-B — Site Map with River Segments Delineated (oversized)

Figure 3-1 — Six River Segments & Fish Sampling Areas (oversized)

Figure 3-3 — Upper River Sediment Deposit Areas (oversized)

Figure 5-1 — Floodplain Soil Areas (oversized)

EXHIBIT 1

Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations

Removal Alternative / Volume of Sed. Removed	Area	(A) Sediment Volume (cy)	Cumulative Sediment Vol.	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	(D) (B) * (C) SWAC 1997 EIGHT	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	ASSUME 98% REDUCTION (G) 0.02 * (D) SWAC POST WEIGHT	(H) Cumulative SWAC (ppm)
Current conditions								3.6		3.6
I	26	2148	2148	3.1	19775	60512	6051	3.4	1210	3.4
	42	1050	3197	1.0	12900	12642	1264	3.4	253	3.3
	21	150	3347	5.5	2300	12604	1260	3.3	252	3.3
	45	1508	4855	5.1	20325	103251	10325	3.0	2065	3.0
	24	236	5091	4.6	3150	14616	1462	3.0	292	2.9
23.8%	40	269	5360	3.7	3875	14415	1442	2.9	288	2.9
II	10	501	5861	2.4	2000	4700	470	2.9	94	2.9
	5A	486	6347	2.4	2625	6169	617	2.9	123	2.8
	11	241	6587	2.4	1050	2468	247	2.9	49	2.8
	8	205	6792	2.4	1000	2350	235	2.9	47	2.8
	15A	404	7196	1.9	5850	11232	1123	2.9	225	2.8
	Island Area	68	7263	27.7	960	26630	2663	2.8	533	2.7
	4	80	7344	2.4	1200	2820	282	2.8	56	2.7
	2	48	7391	2.4	1500	3525	353	2.8	71	2.7
	7	60	7451	2.4	400	940	94	2.8	19	2.7
33.2%	3	34	7485	2.4	360	846	85	2.8	17	2.7
III	35	874	8359	3.9	9250	35705	3571	2.6	714	2.6
39.3%	39	502	8860	4.8	5450	25888	2589	2.6	518	2.5
IV 61.0 %	31	4882	13742	2.7	66100	179131	17913	2.0	3583	1.9
V	44	2099	16105	4.3	28700	123697	12370	1.7	2474	1.5
	23	544	16649	5.6	8400	46956	4696	1.5	939	1.4
	1	263	14005	2.4	2800	6580	658	1.5	132	1.3
	39A	72	16721	16.0	1500	24000	2400	1.5	480	1.3
	39B	246	16967	4.0	5450	21691	2169	1.4	434	1.2
	41	677	17761	2.3	9225	21310	2131	1.3	426	1.1
	13	267	18425	5.8	2750	16005	1601	1.3	320	1.1
IV-A 83.6 %	20A	395	18820	1	7700	11319	1132	1.2	226	1.0
	36	116	17083	18.9	3100	58590	5859	1.1	1172	0.9
	25	397	18158	2.0	5750	11558	1156	1.0	231	0.8
	37	22	18842	8.9	3000	26700	2670	1.0	534	0.7
	19	311	19153	3.7	6000	22080	2208	0.9	442	0.7
	22	249	19402	4.4	6250	27250	2725	0.8	545	0.6
	20	252	19654	6.1	4650	28365	2837	0.7	567	0.5
	30	615	20269	1.0	8550	8379	838	0.7	168	0.5
	33	136	20405	3.9	2975	11573	1157	0.7	231	0.4
	15	224	20629	2.0	6000	11820	1182	0.6	236	0.4
	32	143	20773	3.1	1500	4605	461	0.6	92	0.4

EXHIBIT 1

Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations

		(A)		(B)	(C)	(D)	(E)	(F)	ASSUME 98% REDUCTION (G)	(H)
						(B) * (C)	0.1 * (D)		0.02 * (D)	
Removal Alternative / Volume of Sed. Removed	Area	Sediment Volume (cy)	Cumulative Sediment Vol.	individual SWAC (ppm) 1997	Total Sediment Area (sq. ft.)	SWAC 1997 WEIGHT	SWAC POST WEIGHT	Cumulative SWAC (ppm)	SWAC POST WEIGHT	Cumulative SWAC (ppm)
V (continued)	34	83	20856	1.0	1600	1616	162	0.6	32	0.4
	28A	145	21001	11.2	2600	28990	2899	0.5	580	0.3
	5	163	21163	2.4	1500	3540	354	0.5	71	0.3
	16	62	21225	5.4	1500	8040	804	0.5	161	0.2
	9	83	21308	3.2	3000	9600	960	0.5	192	0.2
	12	356	21664	0.9	2400	2136	214	0.5	43	0.2
	19A	153	21817	1.4	2850	3962	396	0.5	79	0.2
	6	2	21819	21.0	250	5250	525	0.4	105	0.2
	46	26	21845	2.0	1300	2600	260	0.4	52	0.2
	27A	147	21991	1.7	2775	4634	463	0.4	93	0.1
	27	119	22111	1.1	2700	2970	297	0.4	59	0.1
	43	173	22284	1.1	3600	3960	396	0.4	79	0.1
	29	116	22400	1.4	2125	2996	300	0.4	60	0.1
	28	13	22412	4.0	1500	5940	594	0.4	119	0.1
	18	14	22426	2.9	320	938	94	0.4	19	0.1
	17	9	22435	14.9	240	3574	357	0.4	71	0.1
	15B	74	22509	0.2	1250	250	25	0.4	5	0.1
100.0%	14	15	22524	1.6	600	978	98	0.4	20	0.1
	TOTAL	22524			306480	1094893				

Note: * = within the FS, 1989 values were inadvertently used; these values have been corrected herein to reflect 1997 values. Cumulative SWAC changes resulting from corrected values are within rounding accuracy, except for Removal Alternative II which changes from 2.7 ppm (as presented in the FS) to 2.8 ppm, as noted herein.

EXHIBIT 2

FS TABLE D-1 1997 Sediment Sampling -WDNR

Table D-1

Sheboygan River and Harbor
Feasibility Study Report
1997 Sediment Sampling - WDNR[1]

General Sample Location	Specific Sample Location/ Description[2]	Sample Location Category[3]	Sample #	PCB Concentration (mg/kg - dry weight)	Notes
Near Onion River confluence	**"riffle off Area 3-4"**	**O**	**SR-1**	**4.3**	**(typ. 0-5 cm) petite ponar (composite of 4)**
Rochester Park between island and overlook	"raised oil slick"	O	SR-23-A	120[4]	(0-10 cm) piston corer (composite of 2)
Rochester Park between island and overlook	"raised oil slick"	O	SR-23-B	460[4]	(10-56 cm) piston corer (composite of 2)
Opposite Area 15, RDB	"unidentified deposit"	S	SR-7	110	(0-51 cm) piston corer
Opposite Area 15, RDB	**"mid-channel between area 15 and sediment traps"**	**O**	**SR-22**	**0.27**	**(typ. 0-5 cm) petite ponar (composite of 4)**
Horse farm riffle area	**"riffle material"**	**O**	**SR-2**	**1.3**	**(typ. 0-5 cm) petite ponar (composite of 4)**
Horse farm riffle area	**"shelf deposits on RDB (out of water)"**	**O**	**SR-20-A**	**2.2**	**(0-10 cm) shovel (1 location and homogenized)**
Horse farm riffle area	"shelf deposits on RDB (out of water)"	O	SR-20-B	13	(55-82 cm) piston corer, "after digging a pit to 55 cm below soil surface" and homogenized
Sediment Area 16, RDB	"refilled sediment in area"	R	SR-3	1.4	(0-31 cm) piston corer (1 location and homogenized)
Sediment Area 16, RDB	"refilled sediment in area"	R	SR-4	3.3	(0-72 cm) piston corer (1 location and homogenized)
Between Sediment Area 19 and 20, RDB	**"run sample"**	**O**	**SR-5**	**0.32**	**(typ. 0-5 cm) petite ponar (composite of 4)**
Between Areas 30 and 31	"mid-channel run"	O	SR-6	1.9	(typ. 0-5 cm) petite ponar (composite of 4)
Sediment Area 34	5' off RDB	S	SR-14-A	11	(0-10 cm) piston corer (composite of 2)
Sediment Area 34	5' off RDB	S	SR-14-B	2.9	(10-42 cm) piston corer (composite of 2)
Sediment Area 34	10' u/s of SR-14; 5' off RDB	S	SR-15-A	12	(0-10 cm) piston corer (composite of 2)

See notes on page 3 of 3.

Table D-1
(cont'd)

Sheboygan River and Harbor
Feasibility Study Report
1997 Sediment Sampling - WDNR[1]

General Sample Location	Specific Sample Location/ Description[2]	Sample Location Category[3]	Sample #	PCB Concentration (mg/kg - dry weight) Notes
Sediment Area 34	10' u/s of SR-14; 5' off RDB	S	SR-15-B	9.2 (10-26 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	"75' u/s of island on deposit (Area 35); 15' from bank"	S	SR-8-A	5.6 (0-10 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	"75' u/s site of island on deposit (Area 35); 15' from bank"	S	SR-8-B	13 (10-25 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	"75' u/s site of island on deposit (Area 35); 15' from bank"	S	SR-8-C	210 (25-56 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	60' u/s of island (Area 35); 6' from RDB	S	SR-9-A	2.3 (0-10 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	60' u/s of island (Area 35); 6' from RDB	S	SR-9-B	6.1 (10-25 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	60' u/s of island (Area 35); 6' from RDB	S	SR-9-C	140 (25-61 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	**"riverside of island, 8' off island bank (drove through gravel)"**	**O**	**SR-10-A**	**3.0 (0-10 cm) piston corer (composite of 2)**
500 yds u/s CTH PP Access	"riverside of island, 8' off island bank (drove through gravel)"	O	SR-10-B	1.8 (10-25 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	"riverside of island, 8' off island bank (drove through gravel)"	O	SR-10-C	0.2 (25-52 cm) piston corer (composite of 2)

See notes on page 3 of 3.

Table D-1
(cont'd)

Sheboygan River and Harbor
Feasibility Study Report
1997 Sediment Sampling - WDNR[1]

General Sample Location	Specific Sample Location/ Description[2]	Sample Location Category[3]	Sample #	PCB Concentration (mg/kg - dry weight)	Notes
500 yds u/s CTH PP Access	**"center channel between island and shore"**	**O**	**SR-11-A**	**5.3**	**(0-10 cm) piston corer (composite of 2)**
500 yds u/s CTH PP Access	"center channel between island and shore"	O	SR-11-B	6.2	(10-25 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	"center channel between island and shore"	O	SR-11-C	4.2	(25-46 cm) piston corer (composite of 2)
500 yds u/s CTH PP Access	**"mid-channel riffle u/s Area 35"**	**O**	**SR-12**	**2.0**	**(typ. 0-5 cm) petite ponar (composite of 4)**
500 yds u/s CTH PP Access	**"run sample taken 25' off RDB; center of riffle"**	**O**	**SR-13**	**0.76**	**(typ. 0-5 cm) petite ponar (composite of 6)**

Notes:

1. All information obtained from WDNR Oracle database received on February 6, 1998, and clarified with subsequent conversations and fax from Linda Talbot (WDNR) on March 4, 1998. Samples outlined in bold are those used in the SWAC calculations, and exclude the samples collected within the sediment areas or refilled areas.

2. Sample descriptions are provided as follows:
   RDB = right descending bank
   LDB = left descending bank
   u/s = upstream
   d/s = downstream

3. Sample categories determined by BBL, to the best of its ability, based on sample descriptions provided in WDNR's Oracle database.

   O = outside sediment area
   S = within sediment area
   R = refilled area

4. Samples SR-23-A and SR-23-B are not included in the SWAC calculations because: 1) the samples "raised an oil slick," and therefore are believed to be anomolous of River bed materials.

typ. = typically

EXHIBIT 3

1998 IMP TABLE 1 Mean PCB Concentrations in Smallmouth Bass and White Suckers

Table 1

Sheboygan River and Harbor
Interim Monitoring Program

Mean PCB Concentrations(1) in Smallmouth Bass and White Suckers
Collected from the Sheboygan River - 1990-1996, 1998(2)

Location/Species	Year	Mean Total PCB (mg/kg)(3)	Mean Lipid-Normalized PCB (mg/kg-lipid)(3)
Smallmouth Bass(4)			
Rochester Park	1990	6.2 (ab)	916 (ab)
	1991	10.3 (ab)	969 (ab)
	1992	6.5 (ab)	600 (ab)
	1993	4.6 (ab)	450 (b)
	1994	7.5 (ab)	875 (ab)
	1995	9.6 (ab)	854 (ab)
	1996	3.4 (a)	341 (b)
	1998	10.7 (b)	1294 (a)
Between Kohler Dams	1990	4.7 (ab)	571 (ab)
	1991	7.3 (a)	848 (a)
	1992	5.2 (ab)	417 (b)
	1993	5.4 (ab)	562 (ab)
	1994	5.6 (ab)	523 (ab)
	1995	3.6 (b)	335 (b)
	1996	3.9 (ab)	361 (b)
	1998	3.1 (b)	416 (b)
Kiwanis Park	1990	2.3 (ab)	217 (ab)
	1991	3.7 (a)	355 (ab)
	1992	2.4 (ab)	283 (b)
	1993	3.0 (ab)	733 (a)
	1994	2.5 (ab)	219 (b)
	1995	2.0 (b)	163 (b)
	1996	2.3 (ab)	249 (b)
	1998	1.9 (b)	186 (b)
White Sucker(5)			
Rochester Park	1994	7.9 (a)	409 (a)
	1995	7.4 (a)	375 (a)
	1996	8.1 (a)	354 (a)
	1998	18.3 (b)	1091 (b)
Between Kohler Dams	1994	8.7 (a)	437 (a)
	1995	6.2 (b)	330 (ac)
	1996*	6.1	242
	1998	6.8 (b)	349 (bc)
Kiwanis Park	1994	3.9 (a)	208 (a)
	1995	3.4 (a)	197 (a)
	1996	1.9 (c)	74 (b)
	1998	1.3 (b)	53 (b)

See notes on Page 2

Table 1

Sheboygan River and Harbor
Interim Monitoring Program

Mean PCB Concentrations(1) in Smallmouth Bass and White Suckers
Collected from the Sheboygan River - 1990-1996, 1998(2)
(cont'd)

Notes:
(1) PCB concentrations reported on a wet-weight basis.
(2) Samples were not collected in 1997. Scientific Collectors Permit Application was not approved.
(3) Arithmetic Mean.
(4) Smallmouth bass samples prepared as skin-on, scales-off fillets.
(5) White sucker samples prepared as whole-body composites consisting of two fish per composite.
The letters in parentheses denoting statistical differences (for each analysis) apply to the data presented in each column for each location. Within each location, means with different letters are significantly different (ANOVA, Scheffe, 95% Confidence).
* Not included in statistical analysis. Only one sample collected from this location.

EXHIBIT 4

COST ESTIMATES FOR EPA RECOMMENDED ALTERNATIVE 3-IV-A

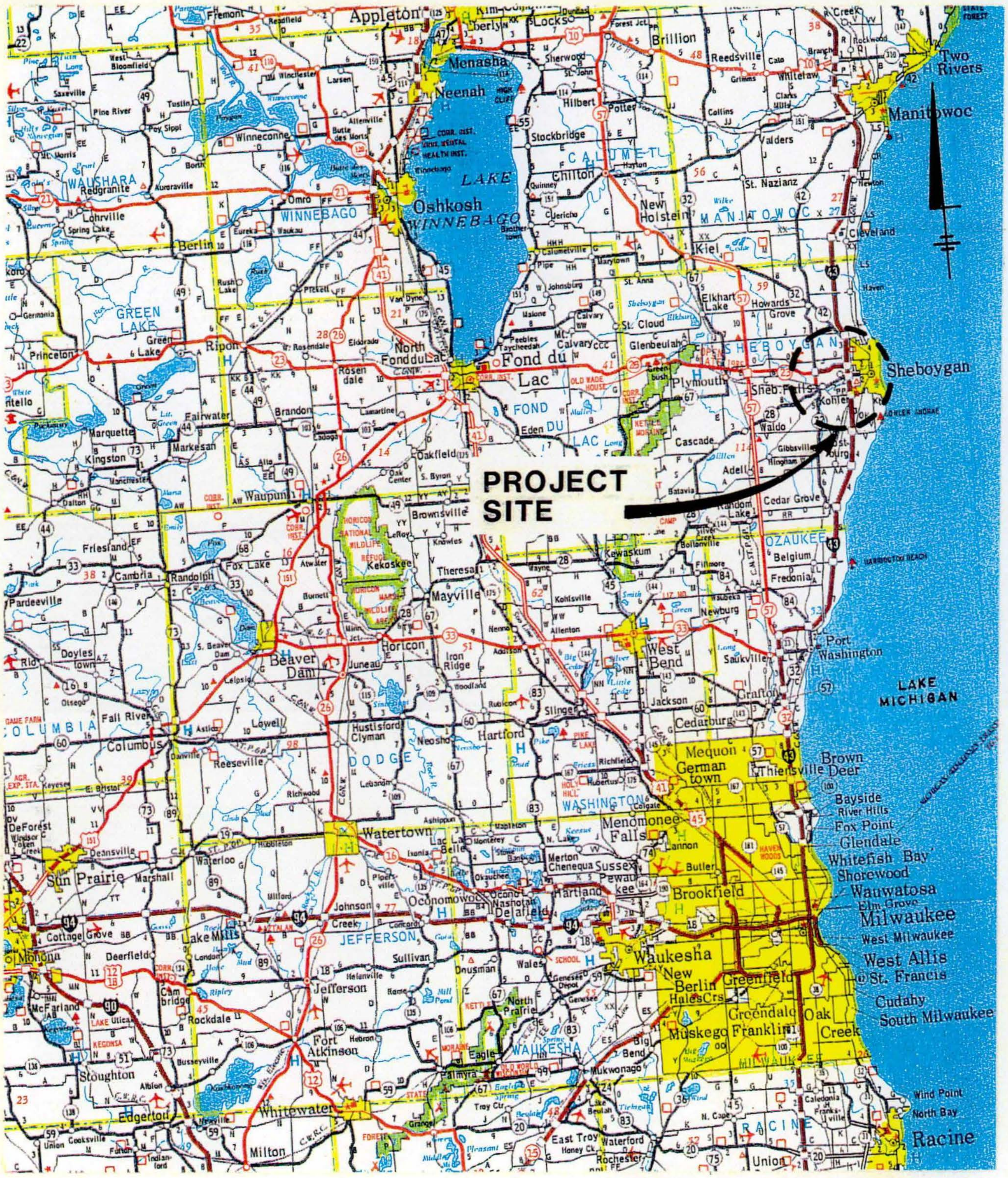
Alt. 3-IV-A: UPPER RIVER SEDIMENT REMOVAL COSTS BASED ON WDNR IN-STATE DISPOSAL CONTRACT BID RECEIVED ON LOWER FOX RIVER

Item No.	Description	Estimated Quantity*	Units	Unit Price	Estimated Costs
1	Mobilization/Demobilization	1	L.S.	$666,000.00	$666,000.00
2	Access Areas Development	225,000	SF.	$2.45	$551,250.00
3	Prepare/Perform Dredging	**18,820**	CY	$102.00	$1,919,640.00
4	Transport Sediment to CTF	**18,820**	CY	$35.00	$658,700.00
5	Monitoring During Dredging	**18,820**	CY	$16.00	$301,120.00
6	**Sediment Dewatering**	23,120	CY	$57.00	$1,317,840.00
	Water Treatment	23,120	CY	$16.00	$369,920.00
7	Labor Support	0	MO	$30,000.00	$0.00
8	Load Stabilized Sediment and CTF/SMF Materials in Trucks	23,120	CY	$28.00	$647,360.00
9	CTF Liner Replacement & Mainten.	0	L.S.	$225,000.00	$0.00
10	Decommission/Dismantle CTF/SMF	1	L.S.	$650,000.00	$650,000.00
11	Portable Truck Scale Purchase	1	L.S.	$30,000.00	$30,000.00
12	Transport and Dispose Dewatered Sediment at an In-State Facility	23,120	TON	$100.00	$2,312,000.00
12	Transport and Dispose Dewatered Sediment at an Out-of-State Facility	0	TON	$140.00	$0.00
	SUBTOTAL				$9,423,830.00
13	Engineering/Design	12%			$1,130,859.60
14	Construction Management	0	MO	$37,000.00	$0.00
15	Contingency	10%			$942,383.00
	TOTAL CAPITAL COSTS				$11,497,072.60
16	Operations & Maintenance				$2,249,700.00
	TOTAL ALTERNATIVE				**$13,746,772.60**

Alt. 3-IV-A: UPPER RIVER SEDIMENT REMOVAL BASED ON FS COSTS

Item No.	Description	Estimated Quantity*	Units	Unit Price	Estimated Costs
1	Mobilization/Demobilization	1	L.S.	5%	$841,135.00
2	Access Areas Development	225,000	SF.	$4.40	$990,000.00
3	Prepare/Perform Dredging	**18,820**	CY	$450.00	$8,469,000.00
4	Transport Sediment to CTF	**18,820**	CY	$110.00	$2,070,200.00
5	Monitoring During Dredging	**18,820**	CY	$125.00	$2,352,500.00
6	Stabilization of All Sediment - System Purchase	1	L.S.	$850,000.00	$850,000.00
	Stabilization of All Sediment - Materials	9,400	TON	$20.00	$188,000.00
7	Labor Support	45	MO	$30,000.00	$1,350,000.00
8	Load Stabilized Sediment and CTF/SMF Materials in Trucks	29,800	CY	$10.00	$298,000.00
9	CTF Liner Replacement & Mainten.	1	L.S.	$225,000.00	$225,000.00
10	Decommission/Dismantle CTF/SMF	1	L.S.	$650,000.00	$650,000.00
11	Portable Truck Scale Purchase	1	L.S.	$30,000.00	$30,000.00
12	Transport and Dispose Dewatered Sediment at an In-State Facility	22,500	CY	$40.00	$900,000.00
12	Transport and Dispose Dewatered Sediment at an Out-of-State Facility	22,500	CY	$140.00	$3,150,000.00
	SUBTOTAL				$22,363,835.00
13	Engineering/Design	10%			$2,236,383.50
14	Construction Management	40	MO	$37,000.00	$1,480,000.00
15	Contingency	10%			$2,236,383.50
	TOTAL CAPITAL COSTS				$28,316,602.00
16	Operations & Maintenance				$2,249,700.00
	TOTAL ALTERNATIVE				**$30,566,302.00**

FIGURE 1A



SCALE: 1" = 13 MILES (APPROX.)

SHEBOYGAN RIVER AND HARBOR

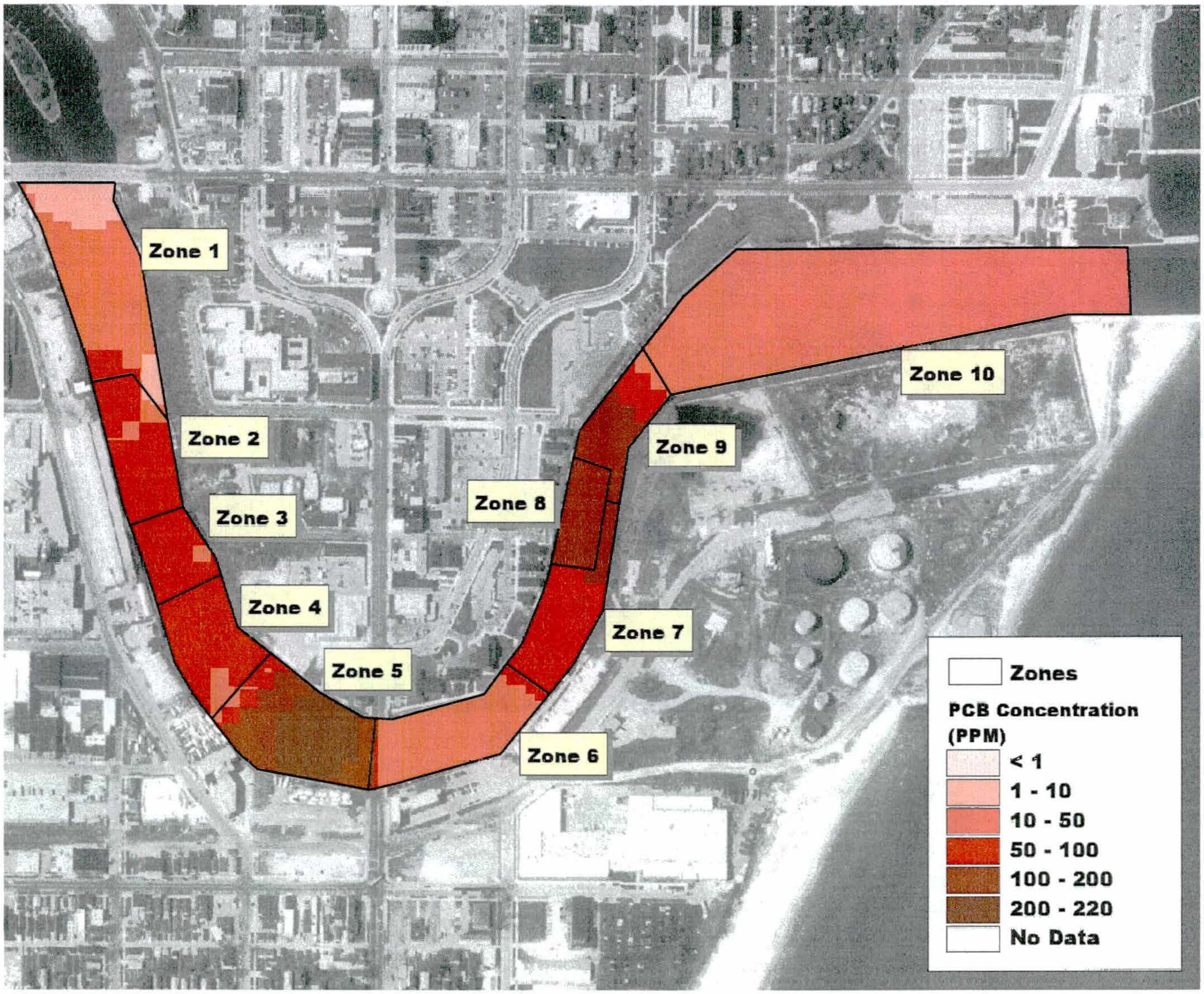
ALTERNATIVE SPECIFIC REMEDIAL INVESTIGATION REPORT

LOCATION MAP

OCT. 1995
176.07.08

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

Sheboygan River Inner Harbor
Maximum PCB Concentration per Location



Sheboygan River Inner Harbor Volume and Mass Calculations				
Zone	Volume of PCB contaminated sediment (yd^3)*	Mass of PCB (lbs)**	% Volume of Inner Harbor	% Mass of Inner Harbor
1	71,565	2,234	10.0	4.1
2	57,721	3,080	8.0	5.7
3	27,214	1,812	3.8	3.4
4	37,236	2,693	5.2	5.0
5	80,925	17,091	11.3	31.6
6	49,019	1,803	6.8	3.3
7	61,722	5,210	8.6	9.6
8	29,510	4,320	4.1	8.0
9	46,297	4,976	6.4	9.2
10	256,967	10,841	35.8	20.1
Total	*718,176*	*54,060*	*100.0*	*100.0*

70 0 70 140 Yards

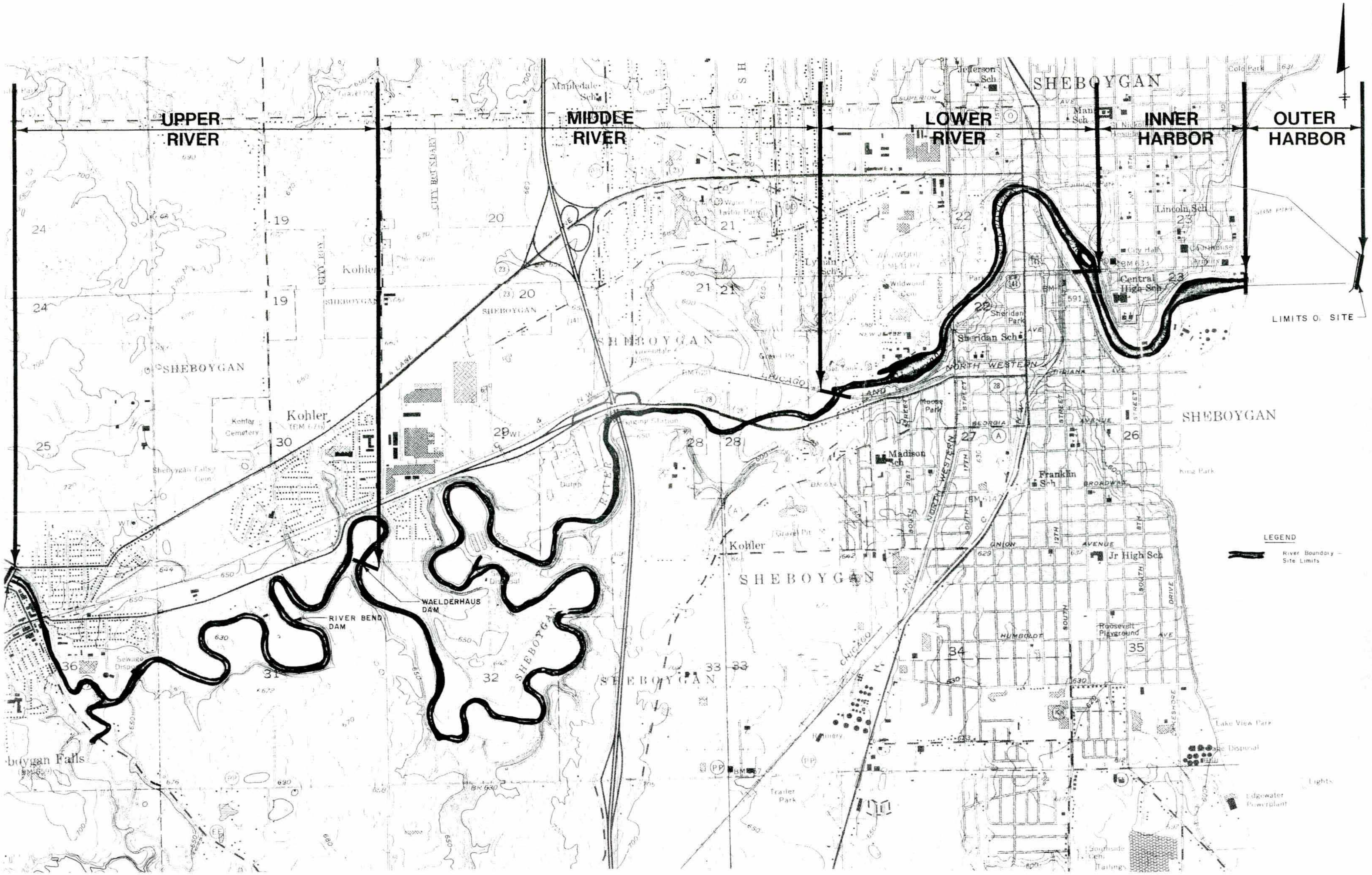
N

* Volume calculations assume sediment depth is represented by end depths of samples

** Mass is calculated by dividing each zone into intervals (6 inch surface, 24 inch remaining intervals) and using depth-weighted averages. Mass calculations based on dry sediment density of 2779 lb/yd3 (based on 1982 sample points).

Nicole Tehrany, US EPA, Region 5, Arts Branch, FIELDS (02/09/99)

Figure 2



1000' 2000'	
...HEREON EXCEPT ...ON 7209 SUBDIVISION ...EDUCATION LAW	

No.	Date	Revisions	Init

In charge of ____
Designed by ____
Drawn by ____
Checked by ____

BLASLAND & BOUCK ENGINEERS, P.C.
Syracuse, New York
White Plains, New York

SHEBOYGAN RIVER AND HARBOR
ALTERNATIVE SPECIFIC REMEDIAL INVESTIGATION REPORT

SITE MAP

File Number: 176.07.08
Date: OCTOBER 1995
Figure: 1B

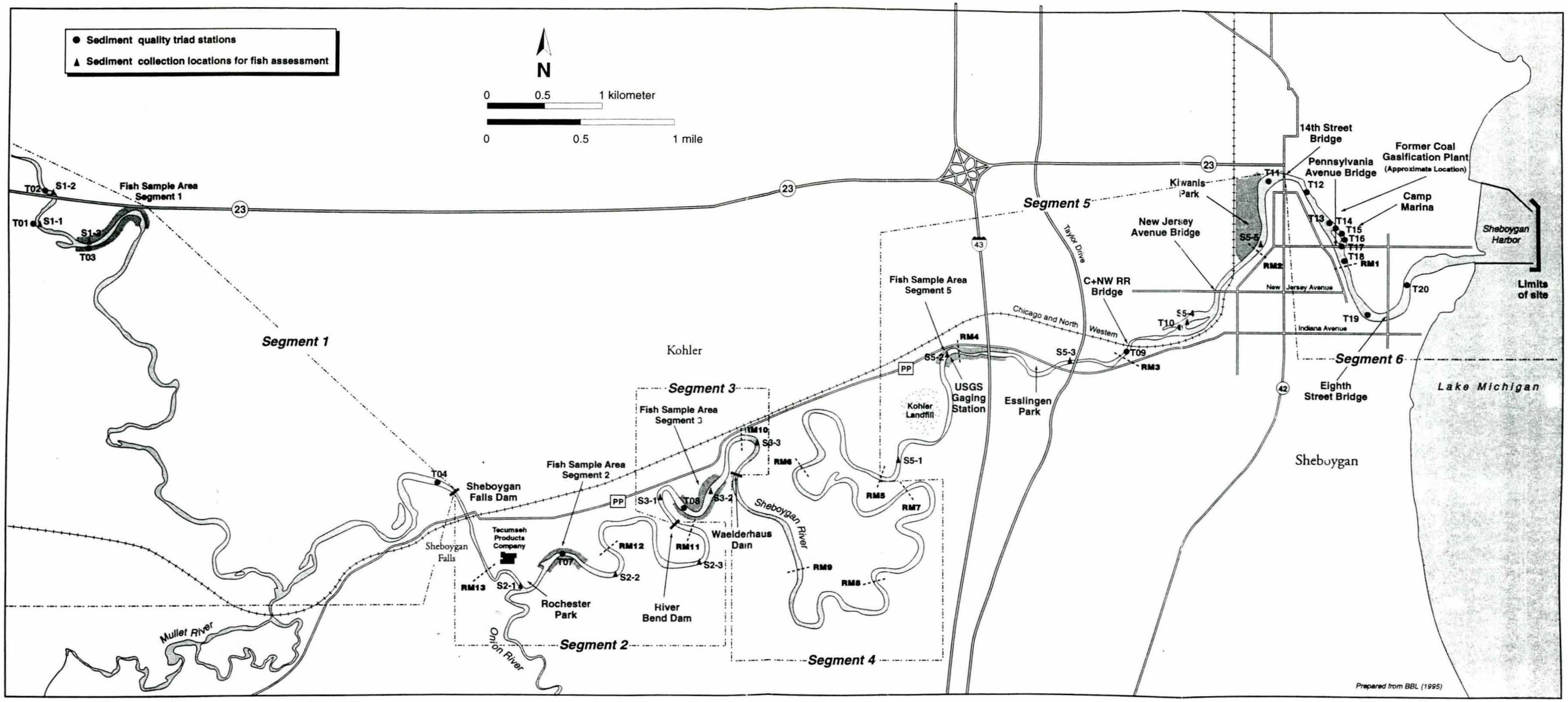


Figure 3-1. Sampling locations for ERA sampling conducted in August 1997

Note: In text and tables sediment samples for the fish assessment are designated by an S as in S2-1 (sediment sample 1 from Segment 2); fish tissue samples are designated by an F as in F2-1 (fish tissue sample 1 from Segment 2).