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Comparative Analysis of River Remedies: Reroute Versus Dry Sediment Excavation

Moss-American Site
Milwaukee, Wisconsin

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MANAGERS DESIGNERS/CONSULTANTS

COMPARATIVE ANALYSIS OF RIVER REMEDIES: REROUTE VERSUS DRY SEDIMENT EXCAVATION MOSS-AMERICAN SITE MILWAUKEE, WISCONSIN

As agreed at our 13 December 1999 meeting, Roy F. Weston, Inc. (WESTON®), on behalf of Kerr-McGee Chemical LLC (KMC) has prepared this document which supports amendment of the existing Record of Decision (ROD) regarding the Little Menomonee River (LMR). A river remedy that consists of temporary surface water diversion followed by dry sediment excavation is shown to be preferable, with respect to National Contingency Plan (NCP) criteria, to the consent decree remedy of river reroute.

In Section 1 of the report the two remedial options are described in a level of detail appropriate for a feasibility study (FS) type of comparison. In Section 2, the two remedial options are compared with respect to compliance with NCP criteria for remedy selection.

1.0 DESCRIPTION OF ALTERNATIVES

The following subsections present the excavation, treatment and disposal standards, the general approach and the scope of work associated with the two river alternatives under consideration. In general, both alternatives focus on the reach of the LMR between Brown Deer Road & the LMR confluence with the Menomonee River, which is approximately 5 miles (6.0 river miles). The river reach in question is indicated in Figure 1.

1.1 CONSENT DECREE RIVER REROUTE

The river reroute alternative is embodied in the original ROD as the final remedy that will attain a level of cleanup capable of assuring the continued protection of human health and the environment. The consent decree directs KMC to adopt the river reroute alternative for remediating the LMR.

1.1.1 Excavation, Treatment and Disposal Standards

The excavation, treatment, and disposal standards associated with this alternative are part of the consent decree. These standards are as follows:

- Excavation Standards
  - excavate all "visibly contaminated" sediments from the rerouted portions of the old LMR.[1]

[1] The Consent Decree requires removal of all "visibly contaminated" sediments from the LMR, but only after this criterion is determined to be an effective method for identification of contaminated sediments. Predesign Task 12 (not yet completed) is devoted to an assessment of whether visual cues (i.e., stained, oily or discolored sediments) can be proven to be a reliable method of identifying creosote contaminated sediments when compared to analytical results from a fixed laboratory. Visual identification of contaminated sediments is assumed to be rapid and cost-effective, but unproven at this site.

- excavate all sediments containing more than 388 mg/kg total carcinogenic polycyclic aromatic hydrocarbons (CPAHs) from rerouted portions of the old LMR .
- excavate all soils that exceed background or Sediment Quality Criteria (SQC), whichever is greater, from the new channel. Since the 4 March 1998 correspondence between the Wisconsin Department of Natural Resources (WDNR) and the U. S. EPA establishes a value of 15 mg/kg total CPAHs as the background for the LMR, all soils exceeding 15 mg/kg total CPAHs in the new channel will require excavation.
- remove all soils (i.e. soils generated due to any construction activity such as clearing, access roads, stockpiling, and sampling activities, etc.) that contain total CPAHs in excess of background or 6.1 mg/kg total CPAHs, whichever is greater and all soil that is visibly contaminated.
- excavate all sediments exceeding 15 mg/kg total CPAHs from the portions of the LMR that are not rerouted.

- Treatment Standards
  - Treat all excavated soils and sediments (from new and old LMR) exceeding 15 mg/kg total CPAHs using thermal desorption.
  - Treat all excavated soils (generated due to construction activities) exceeding background or 6.1 mg/kg total CPAHs, whichever is greater using thermal desorption.
  - Treat all visibly contaminated soils using thermal desorption.

- Disposal Standards
  - cover all sediments that are not excavated and that contain 388 mg/kg total CPAHs or less with clean (< 6.1 mg/kg total CPAHs) soil removed from the new river channel.
  - treated soil shall be disposed of in the area of the former wood preserving plant on the west side of the river, outside the floodplain, and covered with 2 feet of clean soil and 6 inches of topsoil.
  - excavated soils and sediments containing less than 15 mg/kg total CPAHs shall be disposed of in the old channel of the Little Menomonee River and covered.

1.1.2 Location Of The New LMR Channel

For the purposes of this document, existing site conditions and results of Predesign Task 9 (Identify and Evaluate Alternative Alignments for the LMR) were used to select an appropriate alignment for the new river channel. The objective of the Predesign Task was to determine a potential realignment that will best meet the environmental objectives, while minimizing changes to the floodplain and/or temporary or permanent environmental damage. The Predesign Task 9 evaluated three alternative river alignments, namely Alternative Alignment A, Alternative Alignment B, and Alternative Alignment C, to replace the existing LMR. Results of Predesign Task 9 indicate that compared to Alternative Alignments A and B, Alternative Alignment C would have relatively less impact to the most sensitive environment. Therefore, Alternative Alignment C was considered appropriate for the purposes of this document. Alignment C was slightly modified to accommodate existing site conditions. Figure 1 shows the conceptual new alignment of the LMR. The alignment shown in Figure 1 would have the least impact on the existing ecological habitat.

1.1.3 Major Construction Tasks and Construction Sequence

The major construction tasks associated with this alternative include:

- Improving site access and preparing the site.
- Excavating the new river channel.
- Diverting flow from the existing river channel.
- Removing contaminated sediments, if any, from the existing river channel.
- Backfilling and grading the existing river channel.
- Site restoration.

The construction sequence for this alternative would include the following generalized sequence of work:

- Conduct site preparation work and provide access routes for heavy equipment.
- Restrict public access to the work areas.
- Excavate the new channel.
- Divert base river flow to the new channel, segment by segment as constructed.
- Divert tributary and secondary flows (including groundwater) from the existing river channel to the newly constructed river channel.
- Remove sediment and soil (where required) from the existing river channel.
- Backfill, regrade, and revegetate old river channel and areas disturbed by construction.

An approximately 40-foot wide strip would be cleared and grubbed (approximately 30 acres total) in order to facilitate construction of the approximately 25-foot wide new channel and an adjacent 15-foot wide gravel haul road. After site preparation activities are completed (i.e., haul roads, silt fences, etc.), the new channel would be excavated and prepared parallel to the existing LMR channel beginning with the northernmost contiguous section of existing LMR. Soil excavated from the first section of the new channel would be stockpiled and ultimately used for use as backfill for covering the sediment left in the existing channel. If soil excavated from the new channel contains greater than 15 mg/kg total CPAHs, it would be treated prior to on-site disposal. For the purposes of this document, WESTON assumes that no such soil will be encountered during the construction of the new LMR. Construction of the new river channel would require excavation of approximately 157,000 cubic yards (CY) (ex-situ volume) of soil. Approximately 943 characterization samples will be collected for determining the suitability of using excavated soil as clean backfill. It is estimated that approximately 118,000 CY of the excavated soil will be used for backfilling the existing channel. A 6-inch layer (13,630 CY; in-situ) of vegetated topsoil would be used to cover the backfilled channel. The remaining 39,000 CY of excavated soil require off-site disposal. The new channel would have a trapezoidal cross-section shape, surfaced

with approximately 2 inches of gravel overlying compacted floodplain soil. A conceptual schematic depicting a work zone layout is provided as Figure 2.

In certain locations the LMR will not be rerouted due to the presence of major infrastructure (i.e., bridges) or because the existing channel overlaps the footprint of the new channel. In areas where the LMR cannot be rechanneled, excavation of the sediment would be performed by diverting the water flow using pumps and pipes, dewatering the river section in question, excavating the sediment and restoring the channel. The anticipated technique for damming and temporary water diversion is described in detail in Section 1.2. Although the entire length of the LMR between the site and the confluence with the Menomonee River will be realigned, the diversion and dry excavation method of sediment removal from locations where the new channel footprint overlaps the existing channel will only be performed for the initial 3.5 miles of the river (through sediment sampling location SD04-0015) and between sediment sampling locations SD04-0001 and SD05-0020. Downstream of SD05-0020, sediment in the existing channel was not found to contain CPAHs at concentrations greater than 15 mg/kg in locations where the new and old channel overlap; therefore, this sediment will not be removed. It is estimated that approximately 0.75 river miles would require temporary diversion and dry sediment excavation under the consent decree river reroute alternative. The areas that would be rerouted and reaches requiring dry sediment excavation are indicated on Figure 1.

All loose sediment and 6 inches of underlying hardpan would be removed from locations where diversion and dry sediment excavation is implemented. Approximately 4,700 CY (ex-situ) of sediment would be removed from the existing channel in locations where diversion and dry excavation occurs. Sediment would be loaded into dump trucks equipped with seal-tight gates and transported to the site to undergo low-temperature thermal desorption (LTTD) treatment. Approximately 90 verification hardpan samples would be collected from the channel floor at regular intervals prior to restoring the channel.

Restoration of the areas requiring dry sediment excavation would be conducted by restoring the original channel floor elevation using fill soil covered with 6 inches of aggregate. "Riffle" areas would be created in selected portions of the LMR. Rapids would be created by backfilling the riffle areas with imported cobblestones or with cobblestones previously excavated from the LMR. Appropriate aggregate would be used for backfilling remaining areas of the channel. Riverbanks would be seeded and mulched to enhance bank stability.

Backfilling of the existing channel would be performed within the existing channel's footprint; however, 40-foot diameter truck turnarounds would be constructed adjacent to the existing channel at approximately 500-foot intervals. Excavation of approximately 700 CY of sediment containing CPAHs at concentrations greater than 388 mg/kg or sediment determined to be "visibly contaminated" would be performed during the backfilling operations. Highly impacted sediment removed from the existing channel will be transported to the site in dump trucks equipped with seal-tight gates for LTTD treatment.

A total of approximately 5,400 CY (ex-situ; 4700+700) of sediment would be transported to the site for LTTD treatment. Approximately 33 verification samples of treated sediment would be collected to ensure that the treatment objectives are attained. Subsequent to treatment this

material will be disposed of by placing under a 2.5-foot thick, vegetated soil cover on the west side of the site.

A 30-year groundwater and surface water monitoring program would be implemented to detect the potential migration of contaminants from the covered sediment in the original channel. Groundwater monitoring wells and/or surface water sampling locations would be installed between the existing and new LMR channels. The monitoring will involve quarterly sampling for the first two years and annual sampling thereafter.

Restoration activities will include habitat restoration, major modifications to the stormwater sewer outfalls located along the river, and restoration of the existing bike trail. Habitat restoration activities will be implemented along the 15-foot wide haul road and along the existing channel and associated truck turnaround locations (approximately 27 acres total). Appropriate restoration plans would be prepared and implemented. A wetland mitigation plan would be designed to minimize adverse impact on wetlands along the LMR. A wetland restoration plan would be designed to restore existing habitats and/or to allow natural plant succession to yield equivalent or higher quality wetlands. All wetlands would be replaced on a not less than one-to-one basis. Neither pristine wetlands or floodplain would be created nor establishment of exotic plant or animal species would be undertaken.

The time to complete the project will span over at least three construction seasons, based on the assumption that 500 feet of new channel can be excavated and prepared in one week (or diverted and dry excavated). The time estimate is also contingent upon concurrent clearing/grubbing and site preparation activities downstream and restoration activities upstream.

1.2 DRY SEDIMENT EXCAVATION REMEDY

The dry sediment excavation alternative is proposed as an alternate to the consent decree river reroute. This alternative is the result of our discussions with the agencies. In the past, the agencies have accepted that dry sediment excavation is a viable alternative to the consent decree reroute.

1.2.1 Excavation, Treatment and Disposal Standards

The excavation, treatment, and disposal standards associated with this alternative are based on our past discussions with the agencies. These standards are as follows:

- Excavation Standards
  - excavate all loose sediments and 6-inches of hard pan from 3.5 miles (4.2 river miles) of the LMR.
  - remove "hotspots" along the remaining 1.5 miles (1.8 river miles) of the LMR.

- Treatment Standards
  - solidify all excavated streambed soils and sediments exceeding 15 mg/kg total CPAHs.
  - treat all excavated sediments exceeding 388 mg/kg total CPAHs using thermal desorption.

- Disposal Standards
  - dispose of all treated and excavated sediments in a lined disposal cell equipped with a NR 504.07 cover.
  - reuse for backfilling purposes all excavated stream bed and bank soils containing less than 15 mg/kg total CPAHs.

1.2.2 Major Construction Tasks and Construction Sequence

The major construction tasks associated with this alternative include:

- Improving site access and preparing the site.
- Diverting flow from the existing river channel.
- Removing contaminated sediments, if any, from the existing river channel.
- Replacing the excavated soils and sediments and grading the existing river channel.
- Site restoration.

The construction sequence for this alternative would include the following generalized sequence of work:

- Conduct site preparation and provide access routes for heavy equipment.
- Restrict public access to the work areas.
- Isolate sections which would undergo remediation.
- Divert base river flow to the transfer line, segment by segment as constructed.
- Divert tributary and secondary flows (including groundwater) from the existing river channel.
- Remove sediment and soil (where required) from the existing river channel.
- Backfill regrade, and revegetate the river channel and areas disturbed by construction.

Under this alternative all sediments exceeding 15 mg/kg total CPAHs located within the proposed remediation work zone (from the site to sampling station SD04-0015) would be excavated and transported to the site for solidification and placement in a landfill cell on the northeast portion of the site. It is assumed that all sediment within the first 3.5 miles of river downstream of the site will require excavation. In addition, it is assumed that three "hotspots" within the last 1.5 miles of river will require excavation. These hotspots exist downstream of sediment sampling locations SD04-0008, SD04-0001, and SD05-0015.

Site preparation activities would include clearing and grubbing a 40-foot wide strip on one side of the river (approximately 19 acres total) to accommodate a 15-foot wide haul road and a 25-foot wide work zone along the bank.

Sediment would be excavated from the river by damming the river and diverting the river flow around an approximately 1000-foot long work zone. Several types of damming systems may be used to dam the river; sheet pile, Portadams®, and water-filled dams were identified as potential dam technologies that would be applicable. Diversion of the river flow would be conducted by preparing a collection sump upstream of the upstream dam and pumping the water around the work zone, discharging the water downstream of the downstream dam. The collection sump may be as simple as a shallow pit filled with riprap. The water would be pumped around the work zone using trailer-mounted centrifugal pumps. The pumps would be operated using a diesel-fueled, trailer mounted, power unit. Transfer line for the diverted water would consist of a flexible hose. Diverted water would be discharged downstream of the downstream dam through a manifold or onto a riprap breakwater to prevent entrainment of the sediment at the discharge point or bank erosion issues. Downstream of the discharge point, a turbidity curtain and sorbent booms would be implemented to protect the surface water quality.

An evaluation of the LMR flow data obtained from the U.S. Geologic Survey gauging station number 04087070 from 1974 – 1977, indicates that during the months of May through December, the flow rate was approximately 8000 gpm or less for 80% of the time and 16,000 gpm or less for 90% of the time. Based on this evaluation and on an assumption that most of the work would be conducted during the months of May through December, a pump with a pumping rate of 8,000 gpm would suffice to handle the LMR water flow 80% of the time. Since two pumps would be on hand for use in diversion of the LMR flow, total pump capacity would be 16,000 gpm. This cumulative pumping rate would be adequate to handle the river flow 90% of time during construction periods. If flows were expected to exceed 16,000 gpm due to an upcoming precipitation event, the entire work zone would be demobilized until the LMR stage subsides.

Sediment excavation would begin at Brown Deer Road and move downstream. All loose sediment and the upper 6 inches of the underlying hardpan would be excavated and directly loaded into dump trucks equipped with seal-tight gates for transportation to the site for solidification and on-site disposal. In addition, 3:1 bank slopes would be established by excavation of overbank soil. In wooded areas, which comprise approximately 50% of the river length, cutting the banks to a 3:1 slope would not be performed, as the bank soil is already stabilized by being rootbound by tree roots. Most excavation activities would be performed from the bank. Crane mats would be used if heavy equipment requires entry into the channel.

Approximately 10,800 CY (ex-situ) of loose sediment and 9,000 CY (ex-situ) of hardpan material will require solidification prior to on-site disposal. In addition, approximately 5,200 CY (ex-situ) of overbank material will require excavation and transportation to the site for on-site disposal. Bank soil will not be solidified prior to placement in the landfill cell because the moisture content of these soils is expected to be within normal range. Approximately 490 verification samples would be collected from the channel floor subsequent to sediment/hardpan excavation. Channel restoration would be conducted by restoring the original channel floor elevation using fill soil covered with 6 inches of aggregate. "Riffle" areas would be restored by using cobblestone to create rapids, whereas a gravel material would be used in the remainder of the channel. Riverbanks would be seeded and mulched to stabilize banks.

Solidification of the sediment and hardpan material would be conducted on-site on two 100-foot square concrete dewatering pads. The dewatering pads would be covered, bermed and lined, and include a leachate collection system. Leachate would be collected, pre-treated using a bag filter–activated carbon filter system, and discharged to the POTW. Solidification would be accomplished by using Portland cement in a ratio of 10 % by weight. The cement would be thoroughly mixed into the sediment/hardpan using a front-end loader or equivalent piece of equipment. Approximately 43 samples would be collected from the solidified material prior to placement in the landfill cell to ensure that free liquids are not present.

A small subset of the excavated sediment is considered highly impacted (containing greater than 388 mg/kg total CPAHs); therefore, this material will undergo LTTD treatment prior to placement in the sediment cell. This material will not require solidification.

The sediment cell would consist of a 2-foot thick, recompacted clay liner and a NR 504.07 cover. The 4.5-foot tall NR 504.07 cap would consist of, from top to bottom, 6 inches of vegetated topsoil, 18 inches of fill soil for frost protection, 30 inches of compacted clay; and a 6-inch grading layer consisting of fill soil. Based on the assumed maximum sediment layer thickness of 7 feet, the areal extent of the landfill cell would be approximately 2.4 acres (320-foot square). Geotechnical analyses (i.e., proctor tests) would be required as part of the landfill cell construction. In addition, maintenance of the cell during waste placement would be required. To restrict access to the cell, a chain-link fence would be constructed around the cell perimeter. A 30-year groundwater monitoring program would be implemented upon placement of the waste to detect contaminants potentially migrating from the sediment in the cell. Five monitoring wells, four downgradient and one upgradient, would be installed and sampled quarterly for the first two years and annual sampling thereafter. Annual maintenance of the vegetation and fencing would also be required.

Infrastructure restoration activities will include minor repairs to the stormwater sewer outfalls and bike trail. Habitat restoration activities will be implemented along the 40-foot wide work zone/haul road corridor on the working side of the river, as well as a narrow strip along the opposite bank where overbank soil was cut (approximately 21 acres total).

The time to complete the project, if dry sediment excavation is implemented, will span over at least two construction seasons. This time estimate is based on the assumption that the dewatered work zone would be moved 500 feet downstream each week. The time estimate is also contingent upon concurrent clearing/grubbing and site preparation activities downstream, concurrent restoration activities upstream, and concurrent solidification/disposal at the site. The time estimate incorporates approximately one month of downtime to account for heavy precipitation events.

2.0 COMPARATIVE ANALYSIS

The purpose of this comparative analysis is to evaluate the relative performance of the consent decree river reroute alternative and the dry sediment excavation alternative with respect to seven of the nine NCP criteria. The two remaining criteria, namely state acceptance and community acceptance will be evaluated if the U. S. EPA selects the dry sediment excavation and issues an amended ROD. However, we note that representatives for the County of Milwaukee do not

object to a consideration of their property at the former wood-treating facility as a long-term storage location for excavated sediment.

Two of the seven criteria, namely the overall protection of human health and the environment, and compliance with ARARs, are categorized as threshold criteria under the NCP. A remedy must meet both of these criteria in order to be selected. The remaining five criteria (long-term effectiveness and permanance; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost) are known as the balancing criteria. The comparative analysis identifies the advantages and disadvantages of each alternative relative to one another so that key differences can be considered, thus providing a framework for the selection of an appropriate remedy for the site. The comparative analysis discussed in the following subsections is based upon the description and underlying assumptions of the two remedial alternatives described in Section 1.

2.1 THRESHOLD CRITERIA

2.1.1 Overall Protection of the Human Health and the Environment

This criterion requires that each alternative be assessed for its capability to adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with 40 CFR 300.430(a)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The following discussions analyze the protectiveness associated with these alternatives.

Both alternatives under consideration provide similar level of protection to human health and the environment. Under the consent decree river reroute alternative approximately 5,400 CY of contaminated sediments would be excavated and treated using thermal desorption. The remaining sediments would be covered in place. Floodplain soil that is generated during the construction of the new river channel and that does not exceed 15 mg/kg total CPAHs would also be deposited in the existing LMR channel and covered. Of the 5,400 CY of contaminated sediments that would require excavation, approximately 700 CY exceed 388 mg/kg total CPAHs. These sediments would be excavated from portions of the LMR that would undergo rerouting. The remaining 4,700 CY are sediments that exceed 15 mg/kg total CPAHs, which would be excavated from portions of the LMR that would not undergo rerouting. Treated sediments would be disposed of on-site and covered with 2.5 feet of clean soil.

Under the dry sediment excavation alternative, approximately 26,700 CY of contaminated sediments and potentially impacted overbank soil would be excavated. This ex-situ volume represents all loose sediments, 6 inches of underlying hardpan, and potentially contaminated bank soils from the first 3.5 miles of the LMR and the three "hotspot" locations in the last 1.5 miles of LMR. Except for bank soils, all excavated material would be dewatered and solidified. Solidified sediments as well as excavated bank soil would be disposed of in an on-site disposal cell. The disposal cell would be lined with two feet of clay and covered with a NR 504.07 soil cover.

The consent decree river reroute alternative adequately protects human health and the environment. Groundwater monitoring and periodic inspection and maintenance of the buried sediment would help mitigate any chemical of concern (COC) migration and maintain the adequacy and reliability of sediment cover in preventing contaminant movement from the buried sediment and potential human contact with the contaminated sediments, respectively.

The dry sediment excavation alternative entails removal of most of the contaminated sediments from the LMR and their subsequent treatment and disposal in a lined disposal cell. Overall protectiveness of the dry sediment excavation alternative would be slightly better than the river reroute alternative because both treatment and greater degree of containment would be used to prevent exposure. Solidification of the contaminated sediments as well as NR 504.07 soil cover for the lined disposal would provide assurance that infiltration does not result in degradation of groundwater quality.

While both alternatives under consideration provide an appropriate level of protection to human health and the environment, for the reasons set forth above, the overall protectiveness of the dry sediment excavation alternative is slightly better than that associated with the consent decree river reroute alternative.

2.1.2 Compliance with ARARs

CERCLA and the NCP require that each alternative meet all Federal and State ARARs unless a waiver is granted. Based on various studies conducted to date, both alternatives would meet all the ARARs. Therefore, in terms of compliance with ARARs, both alternatives are similar.

2.2 BALANCING CRITERIA

2.2.1 Long-term Effectiveness and Permanence

To evaluate long-term effectiveness, KMC examined the potential risks remaining at the site after remedial action has been implemented. The following factors were considered in the evaluation of long-term effectiveness:

- Magnitude of the residual risks remaining at the completion of remedial activities.
- Adequacy and long-term reliability of management and technical controls for providing continued protection from the residual risks.

Implementation of the dry sediment excavation remedy would result in the removal of most of the contaminated soil from the LMR. Threat of residual contamination to aquatic life of the river would be insignificant. Solidification of contaminated sediments and their subsequent disposal in a lined disposal cell equipped with a NR 504.07 soil cover would prevent migration of COCs into groundwater. Long-term reliability of the on-site disposal unit would depend on periodic maintenance and enforcement of land use restrictions to limit development in areas where contaminants are contained. The technologies proposed for this alternative are proven and well demonstrated.

Under the consent decree river reroute alternative, the adequacy and reliability of sediment cover in preventing contaminant movement from the buried sediment and potential human contact with the contaminated sediment would depend on periodic maintenance and enforcement of land use restrictions. Land use restrictions should readily be maintained because the old LMR channel is in the floodplain.

Overall, the long-term effectiveness and permanence of dry sediment excavation alternative may be somewhat superior to that of the consent decree river reroute alternative.

2.2.2 Reduction of Toxicity, Mobility and Volume Through Treatment

CERCLA states a preference for selecting remedial actions that principally employ treatment technologies to permanently and significantly reduce toxicity, mobility or volume of the hazardous substances at the site. The following considerations were applied to each alternative:

- The treatment processes the remedy will employ.
- The amount of hazardous materials that will be destroyed or treated, including how the principal threat(s) will be addressed.
- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude).
- The degree to which the treatment will be reversible.
- The type and quantity of treatment residuals that will remain following treatment.
- Whether the alternative would satisfy the statutory preference for treatment as a principal element.

The consent decree river reroute employs thermal desorption, an irreversible process, to treat 5,400 CY of contaminated sediments. The treated soil with reduced COC concentrations will undergo on-site disposal and covered with 2.5 feet of clean soil. The remaining sediments would be contained in place. The dry sediment excavation alternative would entail excavation, dewatering and solidification (also irreversible) of approximately 21,500 CY of contaminated sediments. Solidified sediments would be disposed of on-site in a lined disposal cell equipped with a NR 504.07 cover.

No reduction of toxicity or volume would occur under the dry sediment excavation alternative; however, a significant decrease in the mobility of the COCs would be attained through solidification and containment in the disposal cell. The river reroute reduces the toxicity and volume of impacted sediment by treating 5,400 CY using LTTD; however, the majority of the contaminated material is covered in place, resulting in no reduction of toxicity or volume of these sediments. Significant reduction in mobility is attained under the reroute alternative by covering the sediment in place and eliminating the sediment transport via surface water.

Overall, subject to the assumptions and conditions contained herein, the dry sediment excavation alternative is better when considering the reduction of mobility, toxicity, and volume criterion.

2.2.3 Short-term Effectiveness

The short-term impacts of alternatives were assessed by considering the following factors:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and time until protection is achieved.

Both the river reroute and dry sediment excavation alternatives have significant yet similar short-term impact to the local community with respect to noise, vehicular traffic, restricted use of parks and recreational facilities, and dust due to construction activities. Since the dry sediment excavation alternative entails excavation and management of significantly larger volume of impacted soil than that entailed by the river reroute alternative, it may have greater short-term impact on the community and workers.

Implementation of either alternative could affect the ecology and aquatic habitat of the LMR corridor. Both alternatives disturb a similar acreage of habitat (approximately 20 acres); however, the difference is in the types of habitats that would be impacted. Under the dry sediment excavation alternative, the work zone is focused along the forested riverside, whereas the river reroute alternative places the work zone away from the current river channel. The dry sediment excavation alternative requires clearing and grubbing of approximately 14 acres of forested habitat, whereas the river reroute only requires clearing and grubbing of approximately 7 acres of forested habitat. Since the forested habitat is more difficult to address with respect to habitat restoration, the area of forested habitat that is impacted is a significant factor when considering environmental impacts. Loss of forested habitat could be partially mitigated by designating specimen trees that would not be removed under implementation of either alternative. In order to protect individual trees at construction sites, a root protection zone roughly equivalent to the area within the drip line of a tree would be designated as off-limits to excavation and heavy equipment traffic.

Although dry sediment excavation would result in impact to nearly twice the area of forested habitat as river realignment, implementation of the river reroute alternative has the potential to change the hydrological characteristics as well as the ecology and aquatic habitat of the LMR corridor as it exists today. The new channel of the LMR will be excavated such that the floor of the new channel will be at the same elevation as the existing channel at parallel locations. This will ensure that a similar hydraulic gradient exists in the new channel as in the existing channel. Since the existing channel is typically the lowest point in the LMR floodplain and the banks of the new channel will be at a slightly higher elevation than the existing channel, a topographical gradient will be present between the banks of the existing and new channels. If the new channel banks are upgradient of the elevation of the existing channel banks, the topographical change of

the floodplain may not facilitate adequate flow of surface water from the entire floodplain into the new channel. This condition may cause ponding of surface water or saturated soil conditions in the location of the existing channel and along the strip of the floodplain between the new and existing channels. This in turn may result in the loss of existing habitats as well as creation of habitats, aquatic or otherwise, that are different than the existing habitats. Even with careful design and planning it would be difficult to maintain the existing hydrology of the floodplain. Adverse environmental impacts would be similar in magnitude for both the alternatives.

Since the river reroute alternative will require an additional construction season of work than required by the dry sediment excavation remedy, short term impacts due to the time required to complete the project (i.e., vehicular traffic, noise, etc.) are greater for the river reroute than the dry sediment excavation alternative.

Overall, the short-term effectiveness of the dry sediment excavation alternative may be greater than the river reroute alternative.

2.2.4 Implementability

The ease or difficulty of implementing the alternatives was assessed by considering factors such as technical feasibility, administrative feasibility and availability of services and materials.

The dry sediment excavation alternative entails significant amount of construction activities adjacent and possibly, within the LMR. Work in the river areas would require skilled design and planning as well as significant amount of coordination with several Federal, state, and local agencies. Various construction activities including temporary diversion of LMR, excavation and treatment of contaminated sediment, backfilling of the LMR, construction of an on-site disposal unit, and post-construction restoration are technically feasible with conventional construction equipment. The services and materials associated with these activities are also readily available. The administrative feasibility may be time-consuming but is not unusual. Coordination and approval of local regulatory agencies would be required to construct haul roads or for access control, as well as to ensure land use restrictions are effectively implemented, maintained, and monitored.

The river reroute alternative does not require that all construction activities be conducted adjacent to or within the LMR. However, since nearly 0.75 miles would require implementation of dry sediment excavation techniques, the technical implementability issues encountered under the dry sediment excavation alternative would still apply to the river reroute alternative.

One implementability difference between the alternatives is associated with the magnitude of the sediment/soil quantities involved with the alternatives and the associated time required to complete the remedy. Considerably less soil/sediment management is required under the dry excavation alternative than the river reroute remedy. Due to the difference in the amount of material that requires handling under the alternatives, the river reroute remedy requires one more construction season to implement than does the dry excavation remedy. Therefore, when considering the amount of material requiring management and the associated time to complete the project, the dry excavation alternative would be easier to implement.

Overall, the implementability of both the alternatives would be similar.

2.2.5 Cost

The types of costs that were assessed include the following:

- Capital costs, including both direct and indirect costs.
- Annual operation and maintenance costs.
- Net present value of capital and O&M costs.

CERCLA and the NCP regulations require that the selected remedial action be cost-effective provided that the action first satisfies the threshold criteria of overall protectiveness and compliance with ARARs in accordance with the NCP to the extent practicable. A remedial action is cost effective if its costs are proportional to its overall effectiveness (40 CFR §300.430(f)(1)(ii)(D)).

Both the alternatives meet the threshold criteria; however, river reroute is anticipated to be approximately $6.1 million (50 percent) greater than the dry sediment excavation alternative. Completion of the dry sediment excavation alternative is anticipated to cost $12.3 million, whereas the river reroute alternative is expected to cost $18.4 million. Therefore the dry sediment excavation alternative would be a more cost-effective alternative than the consent decree river reroute alternative. Detailed cost estimates are presented in Tables A-1 and A-2 of Appendix A.

3.0 CONCLUSIONS

Based on the above discussions, both alternatives comply with ARARs and have similar implementability. In terms of overall protectiveness, long-term effectiveness and permanence, reduction in the toxicity, mobility, and volume of material, and short term effectiveness the dry sediment excavation alternative is marginally superior to the consent decree reroute alternative. In terms of cost, the dry sediment excavation alternative is clearly superior to the consent decree river reroute alternative. Since the dry sediment excavation alternative is a cost-effective alternative, KMC/WESTON recommend that the U. S. EPA appropriately amend the existing ROD with respect to the river remedy.

Appendix A
Detailed Cost Estimates

Table A-1
River Reroute Remedy
Moss-American Site
Milwaukee, Wisconsin

WORK ELEMENT	QUANTITY	UNIT	UNIT COST	EXTENDED COST	COMMENTS/ASSUMPTIONS
PRE-PLANNING					
REMEDIAL DESIGN & SURVEYING	1	Lump Sum	$ 700,000	$ 700,000	
EASEMENTS & ACCESS AGREEMENTS	1	Lump Sum	$ 75,000	$ 75,000	
LOCAL REQUIREMENTS	1	Lump Sum	$ 50,000	$ 50,000	
CONTRACTOR PROCUREMENT	1	Lump Sum	$ 50,000	$ 50,000	
PRE-PLANNING SUBTOTAL				$ 875,000	
CONSTRUCTION MANAGEMENT					
CONSTRUCTION MANAGEMENT					
Resident Engineer	15,120	Hour	$ 90	$ 1,360,800	3 engineers @60 hours/week for 21 months (3 construction seasons).
Construction Manager	5,040	Hour	$ 90	$ 453,600	60 hours/week for 21 months (3 construction seasons).
Health and Safety Officer	5,040	Hour	$ 90	$ 453,600	60 hours/week for 21 months (3 construction seasons).
Post-Construction Documentation and Certification	1,000	Hour	$ 90	$ 90,000	
Site Security	9,072	Hour	$ 40	$ 362,880	14 hr/night (6 nights/week) & 24 hrs on Sunday for 16 months.
Per Diem	21	Month	$ 6,000	$ 126,000	5 @ $600/mo for rooms, 5 @ $25/day for meals.
Auto Rental	630	Day	$ 200	$ 126,000	3 cars (includes 1 4X4).
REMEDIAL CONSTRUCTION					
MOBILIZATION	1	Lump Sum	$ 75,000	$ 75,000	Heavy equipment, job trailers, etc.; 3 mobilizations.
SITE PREPARATION AND IMPROVEMENTS					
Temporary Facilities					
Office Trailer	42	Month	$ 800	$ 33,600	$400/month for two trailers.
Office Furnishings	42	Month	$ 300	$ 12,600	
Utilities	21	Month	$ 500	$ 10,500	
Sanitary Facilities	21	Month	$ 200	$ 4,200	
Clearing and Grubbing for Bank Access, New Channel Footprint, and Haul Roads - 40' wide on one side of river for 3,725' of diversion and dry excavation plus 28,200 ft X 40 ft for new channel => ~32,000 ft X 40 ft.					
Bulldozer	5	Month	$ 18,000	$ 90,000	Includes operator.
Loader	5	Month	$ 19,000	$ 95,000	Includes operator.
Logger	5	Month	$ 3,850	$ 19,250	
Chipper	2.5	Month	$ 24,500	$ 61,250	
Laborers	2400	Hour	$ 40	$ 96,000	2 workers @ 60 hours/week for 20 weeks.
Construction of Haul Roads					
Bulldozer	1.25	Month	$ 18,000	$ 22,500	Includes operator. Grading 32,000 feet.
Gravel	8,730	CY	$ 15	$ 130,950	32,000' x 15' x 6".
Compactor	0.625	Month	$ 10,164	$ 6,353	Includes operator; one pass to compact gravel.
Street Access - Ramps to paved roadways.					
Bulldozer	0.05	Month	$ 18,000		Includes operator.
Loader	0.05	Month	$ 19,000		Includes operator.
Compactor	0.05	Month	$ 10,164		Includes operator.
Gravel	300	CY	$ 15		Assumed quantity.
Temporary Fencing/Security	50	LF	$ 18		
Street Acess (Total)	13	Each	7,758	$ 100,857	

Table A-1
River Reroute Remedy
Moss-American Site
Milwaukee, Wisconsin

Environmental Controls					
Silt Fence	32,000	LF	$ 3	$ 96,000	Installed along working side of river bank.
PREPARATION OF NEW CHANNEL					
New Channel Excavation and Preparation					
Excavation	157,143	CY	$ 10	$ 1,571,429	In situ volume = 136,846 cy, 15% factor applied for overexcavation and expansion.
Soil Sampling - PAHs	943	Each	$ 500	$ 471,429	Sampling of each 200 cy of soil excavated top prepare new channe; includes +20% for QA/QC samples.
Soil Transport to Stockpile	39,286	CY	$ 5	$ 196,429	Assumes 25% of soil excavated to prepare new channel requires stockpiling.
Soil Transport to Old Channel for Backfilling	117,857	CY	$ 7	$ 825,000	Assumes 75 % of soil excavated to prepare new channel may be directly backfilled into old channel.
Well-Point System	1	Lump Sum	$ 20,000	$ 20,000	Assumed cost, includes labor for installations.
Compaction of Channel Floor	78,333	Square Yar	$ 2	$ 156,666	Average channel width (25 ft) X Length of rerouted sections (28,200 ft).
Gravel/Cobblestone	5,220	CY	$ 27	$ 140,940	Includes $10/cy for placement; added 20% for waste; 2" lift across 78,300 square yards; Cobblestone cost used.
Backfilling of Old Channel & Treatment of Impacted Soil					
Placement and Compaction	117,857	CY	$ 10	$ 1,178,571	75 % of excavated soil used to backfill old channel.
Cover of Old Channel - 6" topsoil	13,050	CY	$ 22	$ 287,100	No revegatation required (covered under Habitat Restoration line item); 78,300 sq yd x 6".
Excavation of Impacted Sedimentfrom Old Channel	690	CY	$ 15	$ 10,350	In situ volume = 600 cy; +15% for overexcavation and expansion, includes transportation to site.
LTTD Treatment of Impacted Sediment	5,400	CY	$ 150	$ 810,000	600 cy from old channel hot spots + 4,100 cy from D&DE; +15% overexcavation/expansion factor applied.
Sampling of Treated Sediment - PAHs	33	Each	$ 500	$ 16,500	One verification sample per 200 cy of treated material; includes +20% for QA/QC samples.
Placement of Treated Sediment	5,400	CY	$ 15	$ 81,000	Includes transportation from treatment system to area on west side of facility, placement, & compaction.
Cover for Treated sediment - 24" fill soil	3,208	CY	$ 18	$ 57,744	Sediment placed in 190' x 190' x 4' cell, Includes +20% for waste & sideslopes.
Cover for Treated sediment - 6" topsoil	802	CY	$ 22	$ 17,644	Sediment placed in 190' x 190' x 4' cell, Includes +20% for waste & sideslopes.
Seeding/Mulching of Sediment Cover	1.0	Acre	$ 2,500	$ 2,500	200'x200'
Installation of Groundwater Monitoring Wells	56	Each	$ 3,000	$ 168,000	One well every 500 feet of covered old channel.
Groundwater & Surface Water Monitoring (quarterly)	8	Event	$ 50,000	$ 370,253	Quarterly monitoring for first two years; present worth indicated; includes sampling, analysis, validation, report.
Groundwater & Surface Water Monitoring (annually)	28	Event	$ 50,000	$ 606,856	Annual monitoring for years 3 - 30; present worth indicated; includes sampling, analysis, validation, report.
Disposal of Excess Soil in Stockpiles					
Soil Management	39,286	CY	$ 20	$ 785,714	Disposal as non-hazardous solid waste at local Subtitle D landfill; includes transportation; 25% of excavated soil.
RIVER SECTION DEWATERING AND DIVERSION					
Water-filled Dams	2	Each	$ 8,000	$ 16,000	5 ft tall, 40 oz Superiordam, 40 ft long; includes delivery; capital expenditure.
Turbidity Control - 15 installations (2 rainouts).					
Riprap	80	CY	$ 20	$ 1,600	40 CY for breakwater, reuse at all discharge points.
Sorbent Booms	15	Each	$ 150	$ 2,250	40'/package; one package/discharge location.
Turbidity Curtains	15	Each	$ 750	$ 11,250	One curtain wall per discharge location.
Excavator	0.7	Month	$ 22,000	$ 15,400	Includes operator; 1 day to install/remove each breakwater.
Dump Truck	0.7	Month	$ 19,200	$ 13,440	15 cy off-road dump truck; 1 day/breakwater.
Laborers	300	Hour	$ 40	$ 12,000	2 workers @ 10 hr/worker for each discharge location.
Sump and Pump Installations - 15 installations (2 rainouts).					
Excavator	0.6	Month	$ 22,000	$ 13,200	Includes operator; 1 day per sump installation.
Riprap	80	CY	$ 20	$ 1,600	Installed @ sump & discharge points, reuse for each segment.
Laborers	300	Hour	$ 40	$ 12,000	2 workers @ 10 hours/installation.
8,000 gpm Pump	2	Each	$ 8,600	$ 17,200	Capital expenditure; 16", centrifugal, trailer-mounted, variable speed; includes delivery.
Diesel Power Unit for 8,000 gpm pumps	2	Each	$ 22,100	$ 44,200	Capital expenditure; 75 hp, trailer-mounted, variable speed; includes delivery.
800 gpm Pump	1	Each	$ 4,600	$ 4,600	Capital expenditure; 4", centrifugal, trailer-mounted, variable speed; includes delivery.
Diesel Power Unit for 800 gpm pumps	1	Each	$ 17,100	$ 17,100	Capital expenditure; 10 hp, trailer-mounted, variable speed; includes delivery.
Transfer Pipe Installation					
Transfer Pipe (16")	1,700	LF	$ 32	$ 54,400	Capital expenditure; 850' for each 8,000 gpm pump; flexible hose.
Transfer Pipe (4")	850	LF	$ 14	$ 11,475	Capital expenditure; for 800 gpm pump; flexible hose.
Pipe Clamps	3	Each	$ 65	$ 195	One clamp for each pump; capital expenditure.
Laborers	300	Hour	$ 40	$ 12,000	2 workers @ 10 hr/worker for each installation.
Loader	0.7	Month	$ 19,000	$ 13,300	Includes operator; 1 day/installation.

Table A-1
River Reroute Remedy
Moss-American Site
Milwaukee, Wisconsin

Pump Operation and Maintenance					
Laborers	1,404	Hour	$ 40	$ 56,160	14 hr/night (6 nights/week) & 24 hrs on Sunday for 13 weeks (rainouts not included).
Fuel Truck/AST and Secondary Containment	1	Lump Sum	$ 20,000	$ 20,000	Assumed cost.
Fuel	17,472	Gallon	$ 1	$ 13,978	2 @ 4 gal/hr (8,000 gpm pumps) 24 hr/day for 11 weeks (rainouts not included).
Diversion and Dry Excavation of Sediment (4,100 cy in-situ volume)					
Excavator	5.00	Month	$ 22,000	$ 110,000	
DumpTrucks	10.0	Months	$ 600	$ 6,000	2 @ 15 cy off-road dump trucks; transport to old channel or stockpile location.
Crane Mats	1	Lump Sum	$ 20,000	$ 20,000	Assumed cost; capital expenditure.
TEMPORARY TRAFFIC CONTROL AND BARRICADING					
Street Sweeping	1	Lump Sum	$ 25,000	$ 25,000	Contract service. Assumed cost.
Barricades and Warning Signs	1	Lump Sum	$ 5,000	$ 5,000	Capital expenditure.
RESTORATION					
Backfilling & Regrading Riverbed - Diversion and dry excavation areas only (in situ volume = 4,100 cy).					
Fill Soil - Hardpan Replacement	2,550	CY	$ 18	$ 45,900	Replace 100 % of hardpan material; includes $10/cy for placement & compaction.
Aggregate - Sediment Replacement	2,040	CY	$ 22	$ 44,880	Replace 100 % of loose sediments, 80 % of river not riffled; includes placement/compaction.
Cobblestone - Sediment Replacement (riffle areas)	510	CY	$ 25	$ 12,750	Replace 100 % of loose sediments, 20 % of river has riffles; includes placement/compaction.
Revegetation					
Bank Seeding and Mulching	14.7	Acre	$ 2,500	$ 36,750	32,000' x 20' for riverbanks.
Habitat Restoration	29.2	Acre	$ 35,000	$ 1,022,000	Haul roads (32,000' x 15'), old channel (28,200' x 25'), truck turnarounds (2 acres).
Bike Trail Restoration	1	Lump Sum	$ 30,000	$ 30,000	
Storm Sewer Modifications	1	Lump Sum	$ 1,000,000	$ 1,000,000	
SAMPLING AND ANALYSIS					
Sediment - PAHs	90	Each	$ 500	$ 45,000	One sample every 50' of river in dry excavation areas, includes + 20% for QA/QC samples.
Water - Turbidity	91	Each	$ 50	$ 4,550	Daily samples for 13 weeks for diverted water only.
Auto Sampler	1	Lump Sum	$ 1,125	$ 1,125	Capital expenditure.
DEMOBILIZATION					
Site Cleanup and Rubbish Disposal	10	Load	$ 200	$ 2,000	
Office Trailers	6	Each	$ 300	$ 1,800	
Heavy Equipment	3	Lump Sum	$ 20,000	$ 60,000	3 construction seasons.

SUBTOTAL - Construction Costs	$ 11,236,290
SUBTOTAL - Construction Management & Planning Costs	$ 3,847,880
SUBTOTAL - Capital Expenditures	$ 227,995
TOTAL - Without Contingency	$ 15,312,165
Contingency (20%)	3,062,433.07
TOTAL - With 20% Contingency	$ 18,375,000

Table A-2
Dry Sediment Excavation Remedy
Moss-American Site
Milwaukee, Wisconsin

WORK ELEMENT	QUANTITY	UNIT	UNIT COST	EXTENDED COST	COMMENTS/ASSUMPTIONS
PRE-PLANNING					
REMEDIAL DESIGN & SURVEYING	1	Lump Sum	$ 500,000	$ 500,000	
EASEMENTS	1	Lump Sum	$ 75,000	$ 75,000	
LOCAL REQUIREMENTS	1	Lump Sum	$ 50,000	$ 50,000	
CONTRACTOR PROCUREMENT	1	Lump Sum	$ 50,000	$ 50,000	
PRE-PLANNING SUBTOTAL				**$ 675,000**	
CONSTRUCTION MANAGEMENT					
CONSTRUCTION MANAGEMENT					
Resident Engineer	12,240	Hour	$ 90	$ 1,101,600	3 engineers @60 hours/week for 17 months (2 construction seasons).
Construction Manager	4,080	Hour	$ 90	$ 367,200	60 hours/week for 17 months (2 construction seasons).
Health and Safety Officer	4,080	Hour	$ 90	$ 367,200	60 hours/week for 17 months (2 construction seasons).
Post-Construction Documentation and Certification	1,000	Hour	$ 90	$ 90,000	
Site Security	7,344	Hour	$ 40	$ 293,760	14 hr/night (6 nights/week) & 24 hrs on Sunday for 17 months.
Per Diem	17	Month	$ 6,000	$ 102,000	5 @ $600/mo for rooms, 5 @ $25/day for meals.
Auto Rental	510	Day	$ 200	$ 102,000	3 cars (includes 1 4X4).
REMEDIAL CONSTRUCTION					
MOBILIZATION	1	Lump Sum	$ 50,000	$ 50,000	Heavy equipment, job trailers, etc.; 2 mobilizations.
SITE PREPARATION AND IMPROVEMENTS					
Temporary Facilities					
Office Trailer	17	Month	$ 800	$ 13,600	$400/month for two trailers.
Office Furnishings	17	Month	$ 300	$ 5,100	
Utilities	17	Month	$ 500	$ 8,500	
Sanitary Facilities	17	Month	$ 200	$ 3,400	
Clearing and Grubbing for Bank Access and Haul Roads - 40' wide on one side of river (20,400 linear feet)					
Bulldozer	4	Month	$ 18,000	$ 72,000	Includes operator.
Loader	4	Month	$ 19,000	$ 76,000	Includes operator.
Logger	4	Month	$ 3,850	$ 15,400	
Chipper	2	Month	$ 24,500	$ 49,000	
Laborers	1920	Hour	$ 40	$ 76,800	2 workers @ 60 hours/week for 16 weeks.
Construction of Haul Roads					
Bulldozer	1	Month	$ 18,000	$ 18,000	Includes operator. Grading 20,400 feet.
Gravel	5,667	CY	$ 15	$ 85,005	20,400' x 15' x 6".
Compactor	0.5	Month	$ 10,164	$ 5,082	Includes operator, one pass to compact gravel.
Street Access - Ramps to paved roadways.					
Bulldozer	0.05	Month	$ 18,000		Includes operator.
Loader	0.05	Month	$ 19,000		Includes operator.
Compactor	0.05	Month	$ 10,164		Includes operator.
Gravel	300	CY	$ 15		Assumed quantity.
Temporary Fencing/Security	50	LF	$ 18		
Street Acess (Total)	11	Each	7,758	$ 85,340	

Table A-2
Dry Sediment Excavation Remedy
Moss-American Site
Milwaukee, Wisconsin

Dewatering Pad Construction - 100' x 100'; lined; bermed; leachate collection.					
Sand Cushion	185	CY	$ 8		6" x 100' x 100'.
20 mil HDPE Liner	11,000	SF	$ 0.35		105' x 105'
Geotextile Fabric	11,000	SF	$ 0.30		105' x 105'
4-inch Drain Pipe	100	LF	$ 0.36		One side of sloped pad only.
Collection Sump	1	Each	$ 150		
Gravel	185	CY	$ 15		6" x 100' x 100'.
Concrete	122	CY	$ 250.00		100' x 100' x 4".
Bulldozer	0.1	Month	$ 18,000		Includes operator.
Compactor	0.1	Month	$ 10,164		Includes operator.
Laborers/Technicians	240	Hour	$ 40		2 workers @ 60 hours/week for 2 weeks.
Dewatering Pad Construction (Total)	2	Each	$ 54,507	$ 109,015	100' x 100'; lined; bermed; leachate collection.
Tent Structures	3	Each	$ 100,000	$ 300,000	100' x 100' tents for dewatering pads (including existing asphalt pad). Assumed cost. Capital expenditur
Environmental Controls					
Silt Fence	20,400	LF	$ 3	$ 61,200	Installed along working side of river bank.
RIVER SECTION DEWATERING AND DIVERSION					
Water-filled Dams	4	Each	$ 8,000	$ 32,000	5 ft tall, 40 oz Superiordam, 40 ft long; includes delivery; capital expenditure.
Turbidity Control - 52 installations (one every 500 ft of river => 41 + 12 rainouts).					
Riprap Breakwater	80	CY	$ 20	$ 1,600	40 CY for breakwater, reuse at all discharge points.
Sorbent Booms	52	Each	$ 150	$ 7,800	40'/package; one package/discharge location.
Turbidity Curtains	52	Each	$ 750	$ 39,000	One curtain wall per discharge location.
Excavator	2	Month	$ 22,000	$ 44,000	Includes operator; 1 day to install/remove each breakwater.
Dump Truck	2	Month	$ 19,200	$ 38,400	15 cy off-road dump truck; 1 day/breakwater.
Laborers	1,040	Hour	$ 40	$ 41,600	2 workers @ 10 hr/worker for each discharge location.
Sump and Pump Installations - 52 installations (one every 500 ft of river => 40 + 12 rainouts).					
Excavator	2	Month	$ 22,000	$ 44,000	Includes operator; 1 day per sump installation.
Riprap	80	CY	$ 20	$ 1,600	Installed @ sump & discharge points, reuse for each segment.
Laborers	1,040	Hour	$ 40	$ 41,600	2 workers @ 10 hours/installation.
8,000 gpm Pump	2	Each	$ 8,600	$ 17,200	Capital expenditure; 16", centrifugal, trailer-mounted, variable speed; includes delivery.
Diesel Power Unit for 8,000 gpm pumps	2	Each	$ 22,100	$ 44,200	Capital expenditure; 75 hp, trailer-mounted, variable speed; includes delivery.
800 gpm Pump	1	Each	$ 4,600	$ 4,600	Capital expenditure; 4", centrifugal, trailer-mounted, variable speed; includes delivery.
Diesel Power Unit for 800 gpm pumps	1	Each	$ 17,100	$ 17,100	Capital expenditure; 10 hp, trailer-mounted, variable speed; includes delivery.
Transfer Pipe Installation					
Transfer Pipe (16")	2,200	LF	$ 32	$ 70,400	Capital expenditure; 1,100' for each 8,000 gpm pump; flexible hose.
Transfer Pipe (4")	1,100	LF	$ 14	$ 14,850	Capital expenditure; for 800 gpm pump; flexible hose.
Pipe Clamps	3	Each	$ 65	$ 195	One clamp for each pump.
Laborers	1,040	Hour	$ 40	$ 41,600	2 workers @ 10 hr/worker for each installation.
Loader	2	Month	$ 19,000	$ 38,000	Includes operator; 1 day/installation.
Pump Operation and Maintenance					
Laborers	7,344	Hour	$ 40	$ 293,760	14 hr/night (6 nights/week) & 24 hrs on Sunday for 17 months.
Fuel Truck AST Rental & Secondary Containment	1	Lump Sum	$ 10,000	$ 10,000	Assumed cost.
Fuel	97,920	Gallon	$ 1	$ 78,336	2 @ 4 gal/hr (8,000 gpm pumps) & 1 @ 0.5 gal/hr (800 gpm pump), 24 hr/day for 16 months.
SEDIMENT MANAGEMENT					
Sediment/Bank Soil Excavation and Transportation to Dewatering Pads Onsite					
Excavator	12	Month	$ 22,000	$ 264,000	Includes operator; one workweek per 500' section.
Dumptrucks	36	Month	$ 19,200	$ 691,200	3 @ 15 cy off-road dump trucks.
Crane Mats	1	Lump Sum	$ 20,000	$ 20,000	Assumed cost; capital expenditure.

Table A-2
Dry Sediment Excavation Remedy
Moss-American Site
Milwaukee, Wisconsin

Sediment Dewatering, Solidification, and Treatment - Total of 17,200 cy (in situ) @120 pcf = 27,864 tons.

Solidification Agent - Portland cement	3,000	Ton	$ 100	$ 300,000	Cement added at 10 % by mass.
Water Management & Disposal	2,000,000	Gallon	$ 0.20	$ 400,000	Pre-treated on-site & discharged to MMSD.
Solidification - Mixing	21,500	CY	$ 10	$ 215,000	Includes 1,482 cy Portland cement @150 pcf; includes +15% for expansion and overexcavation.
Thermal Desorption of Highly Impacted Sediment	690	CY	$ 150	$ 103,500	Sediment > 388 ppm CPAHs = 600 cy; 15% expansion/overexcavation factor applied.
Sampling - CPAHs	4	Each	$ 600	$ 2,400	One sample per 200 cy of treated soil.
Sampling - Free Liquid (paint filter test)	43	Each	$ 50	$ 2,150	One sample per 500 cy of solidified soil.

Sediment and Bank Soil Disposal at Site - Approximately 21,500 cy of solidified material and 5,200 cy bank soil = 26,700 cy (total requiring cover, includes + 15% for expansion & overexcavation).

Sediment Cell Excavation and Grading	14,800	CY	$ 15	$ 222,000	Assumes 18" sediment below grade plus clay liner.
Soil Sampling (Excavated Soil) - PAHs/BTEX	36	Each	$ 600	$ 21,600	One characterization sample every 500 cy of excavated soil + 20% for QA/QC samples.
Sediment Transportation from Dewatering Pad	26,700	CY	$ 5	$ 133,500	Assumes bank soil is staged on dewatering pad, but does not require solidification.
Sediment Placement and Compaction	26,700	CY	$ 5	$ 133,500	Placed in 320' x 320' x 7' cell.
24" Compacted Clay Liner	9,100	CY	$ 22	$ 200,200	Includes + 20% for side slopes; includes placement & compaction @ $10/cy.
NR 540 Cover - 6" Fill Soil Grading Layer	2,300	CY	$ 18	$ 41,400	Includes + 20% for side slopes; includes placement & compaction @ $10/cy.
NR 540 Cover - 30" Compacted Clay	11,500	CY	$ 22	$ 253,000	Includes + 20% for side slopes; includes placement & compaction @ $10/cy.
NR 540 Cover - 18" Fill Soil Frost Layer	6,900	CY	$ 18	$ 124,200	Includes + 20% for side slopes; includes placement & compaction @ $10/cy.
NR 540 Cover - 6" Topsoil	2,300	CY	$ 22	$ 50,600	Includes + 20% for side slopes; includes placement & compaction @ $10/cy.
NR 540 Cover- Seeding and Mulch	2.4	Acre	$ 2,500	$ 6,000	320' x 320'.
Maintenance of Clay Liner Prior to Waste Placement	1	Lump Sum	$ 100,000	$ 100,000	Labor & materials to maintain integrity of the landfill cell prior to waste placement.
Geotechnical Testing	1	Lump Sum	$ 50,000	$ 50,000	Assumed cost for clay compaction tests.
Monitoring Well Installation	5	Each	$ 3,000	$ 15,000	One upgradient, four downgradient.
Groundwater Monitoring - Quarterly	8	Event	$ 15,100	$ 111,816	Quarterly sampling for 1st 2 years; present worth indicated.
Groundwater Monitoring - Annually	30	Event	$ 15,100	$ 183,270	Annual sampling for years 3-30; present worth indicated.
Fencing	1400	Linear Foot	$ 18	$ 25,200	Around cell perimeter; 350' x 350'.
Annual O&M of Fence & Vegetation	30	Year	$ 2,000	$ 22,516	Mowing & fence repairs; present worth indicated.

TEMPORARY TRAFFIC CONTROL AND BARRICADING

Street Sweeping	1	Lump Sum	$ 25,000	$ 25,000	Contract service. Assumed cost.
Barricades and Warning Signs	1	Lump Sum	$ 5,000	$ 5,000	Capital expenditure.

RESTORATION

Backfilling & Regrading Riverbed - Concurrent with remediation activity.

Fill Soil - Hardpan Replacement	7,800	CY	$ 18	$ 140,400	Replace 100 % of hardpan material; includes $10/cy for placement & compaction.
Aggregate - Sediment Replacement	7,520	CY	$ 22	$ 165,440	Replace 100 % of loose sediments, 80 % of river not riffled; includes placement/compaction.
Cobblestone - Sediment Replacement (riffle areas)	1,880	CY	$ 25	$ 47,000	Replace 100 % of loose sediments, 20 % of river has riffles; includes placement/compaction.

Revegetation

Bank Seeding and Mulching	4.7	Acre	$ 2,500	$ 11,750	20,400' x 5' on each bank.
Habitat Restoration (Wetland and Woodland Areas)	21	Acre	$ 35,000	$ 735,000	20,400' x 40' on working side, 20,400' x 5' for other bank; includes haul road removal.

Drainage Structure Stabilization and Restoration

Riprap	100	CY	$ 25	$ 2,500	Assumed quantity, includes $10/cy for placement.
Loader	0.25	Month	$ 19,000	$ 4,750	Includes operator.
Laborers	120	hours	$ 40	$ 4,800	2 workers @ 60 hr/wk for 1 week.

Bike Trail Restoration	1	Lump Sum	$ 10,000	$ 10,000	

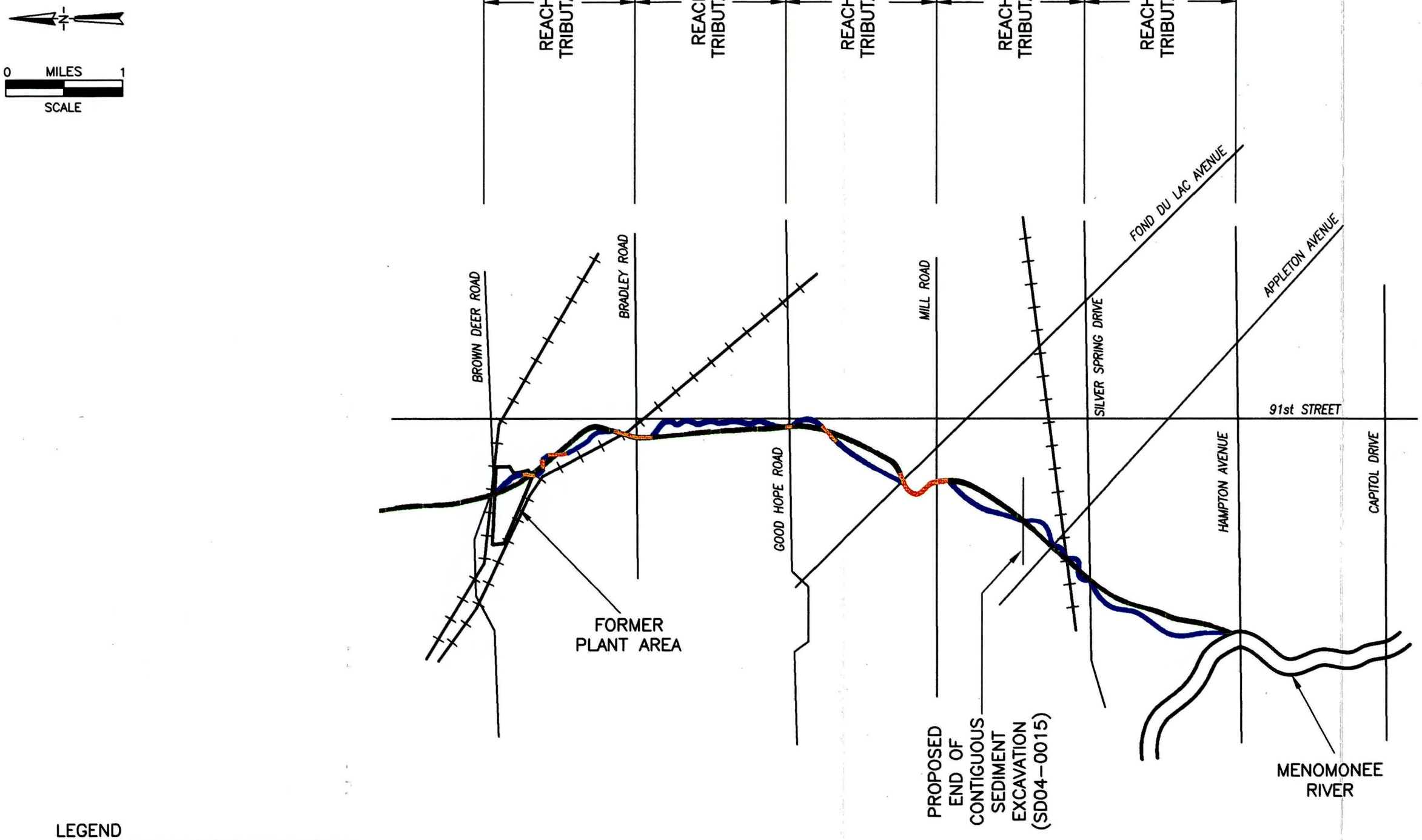
SAMPLING AND ANALYSIS

Sediment - PAHs	490	Each	$ 500	$ 245,000	One sample every 50' of river => 408 samples + 20% for QA/QC samples (+82 samples).
Water - Turbidity	480	Each	$ 50	$ 24,000	Daily samples for 16 months (30 day/mo) (does not include rainout periods).
Auto Sampler	1	Lump Sum	$ 1,125	$ 1,125	Capital expenditure.

Table A-2
Dry Sediment Excavation Remedy
Moss-American Site
Milwaukee, Wisconsin

DEMOBILIZATION					
Site Cleanup and Rubbish Disposal	10	Load	$ 200	$ 2,000	
Dewatering Pad Removal					
Loader	0.25	Month	$ 19,000	$ 4,750	Includes operator
Disposal	1,655	Ton	$ 30	$ 49,650	Includes transportation.
Office Trailers	2	Each	$ 300	$ 600	
Heavy Equipment	2	Lump Sum	$ 20,000	$ 40,000	2 construction seasons.

SUBTOTAL - Construction Costs	$	6,639,430
SUBTOTAL - Construction Management & Planning Costs	$	3,098,760
SUBTOTAL - Capital Expenditures	$	526,670
TOTAL - Without Contingency	$	10,264,860
Contingency (20%)	$	2,052,972
TOTAL - With 20% Contingency	$	12,318,000



LEGEND

- REROUTED RIVER (CONCEPTUAL)
- RIVER SEGMENT REQUIRING DIVERSION AND DRY EXCAVATION UNDER EITHER REMEDY
- EXISTING RIVER CHANNEL

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FIGURE 1

WESTON MANAGERS DESIGNERS/CONSULTANTS

Three Hawthorn Parkway
Vernon Hills, Illinois
60061

POTENTIAL RIVER ALIGNMENTS
MOSS-AMERICAN SITE
Milwaukee, Wisconsin

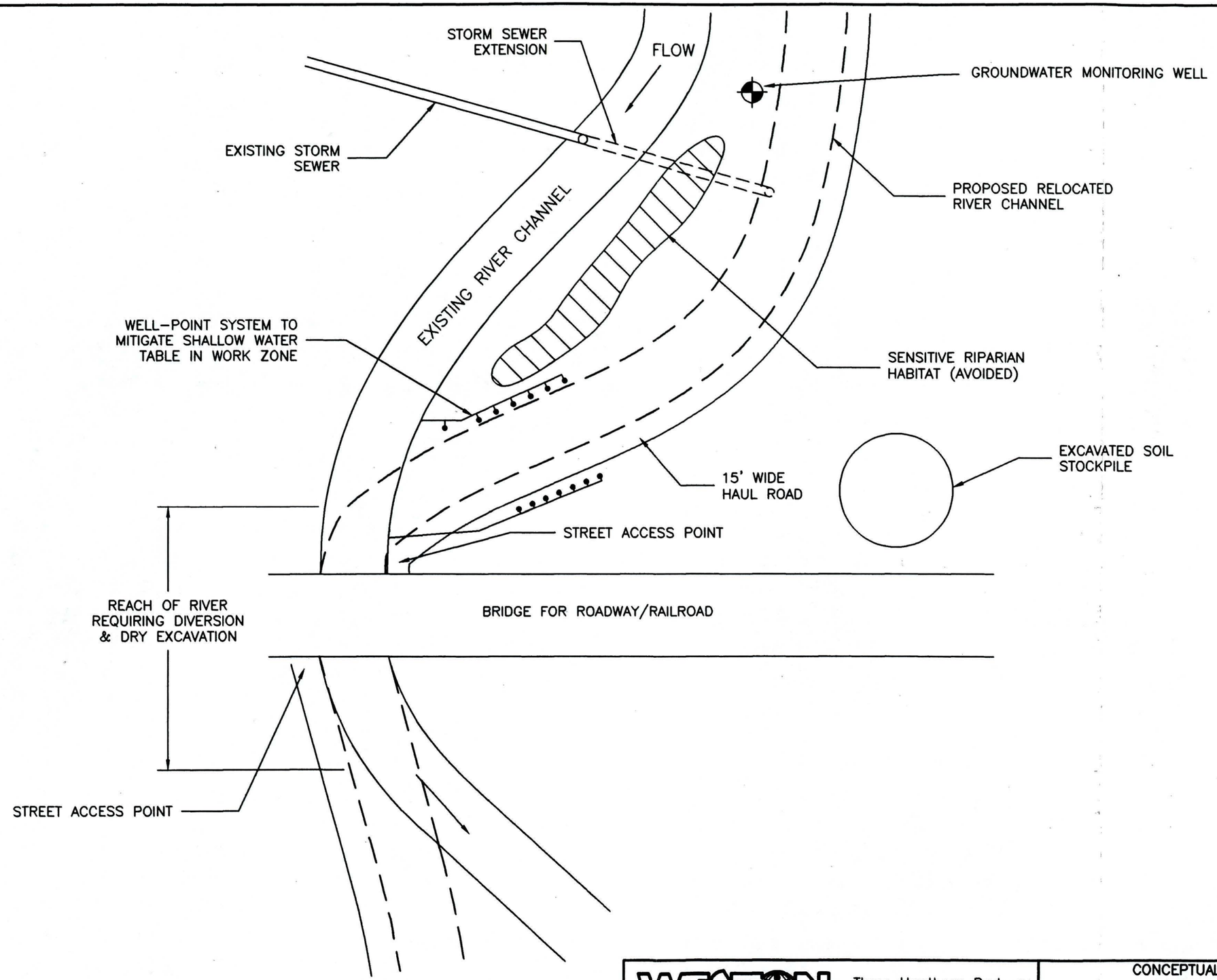

FIGURE 2

WESTON MANAGERS DESIGNERS/CONSULTANTS

Three Hawthorn Parkway
Vernon Hills, Illinois
60061

CONCEPTUAL LAYOUT OF RIVER REROUTE WORKZONE
MOSS-AMERICAN SITE
Milwaukee, Wisconsin

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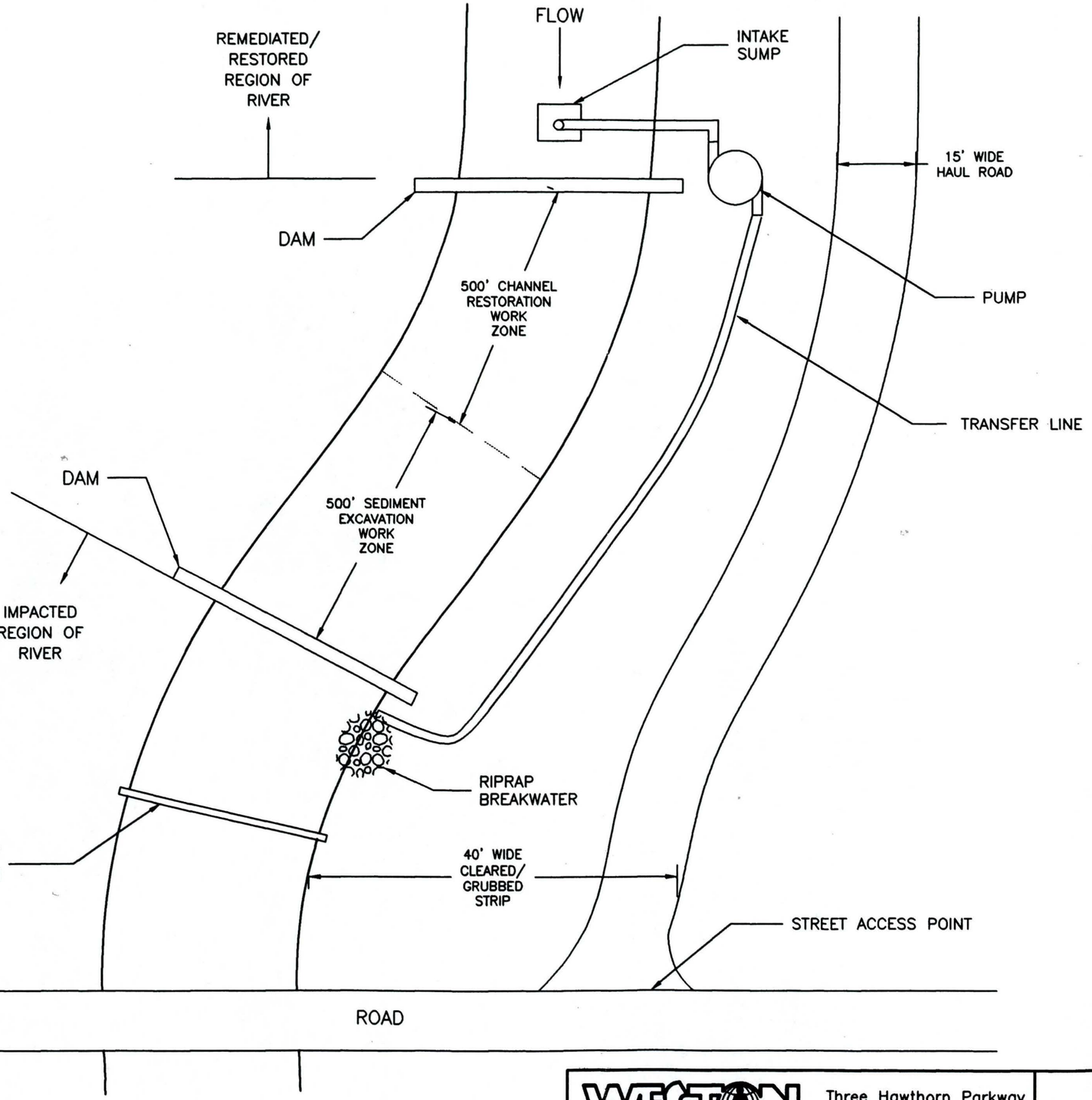

FIGURE 3

WESTON MANAGERS DESIGNERS/CONSULTANTS

Three Hawthorn Parkway
Vernon Hills, Illinois
60061

CONCEPTUAL LAYOUT FOR DRY
SEDIMENT EXCAVATION WORKZONE
MOSS–AMERICAN SITE
Milwaukee, Wisconsin

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