4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The analysis of alternatives is streamlined by combining both the screening level evaluation and detailed analysis of the assembled remedial alternatives. The Site lends itself to this simplified process due to the extensive removal work previously performed and the limited nature of the remaining exposure pathways.

In accordance with CERCLA Section 121, the NCP, and USEPA RI/FS guidance, the remedial alternatives are assessed against seven evaluation criteria. These include:

Threshold Criteria

- **Overall Protection of Human Health and the Environment –** This criterion assesses how well an alternative, as a whole, achieves and maintains protection of human health and the environment.
- **Compliance with ARARs –** This criterion assesses how the alternative complies with location-, chemical-, and action-specific ARARs, and whether a waiver is required or justified. The assessment also addresses other information from advisories, criteria, and guidance that the lead and support agencies have agreed is "to be considered."

Balancing Criteria

- **Long-Term Effectiveness and Permanence –** This criterion evaluates the long-term effectiveness of the alternative in maintaining protection of human health and the environment after response objectives have been met. This criterion includes consideration of the magnitude of residual risks and the adequacy and reliability of controls.
- **Reduction of Toxicity, Mobility and Volume through Treatment –** This criterion evaluates the effectiveness of treatment processes used to reduce toxicity, mobility, and volume of contaminated media of concern. It also considers the degree to which treatment is irreversible, and the type and quantity of residuals remaining after treatment.
- **Short-Term Effectiveness –** This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. It considers the protection of the community, workers, and the environment during implementation of remedial actions.
- **Implementability –** This criterion assesses the technical and administrative feasibility of an alternative and availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a

remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

- **Cost –** This criterion evaluates the direct and indirect capital, and annual operation and maintenance costs of each alternative. Present worth costs, using a 5% discount rate (consistent with USEPA guidance), are presented to help compare annual O&M and 5 year review costs on the basis of a single amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with remedial action over its planned life, assumed to be 30 years for the purpose of the detailed analysis. Cost estimates are intended to be within an accuracy range of plus 50 percent to minus 30 percent, unless otherwise noted.

Present worth costs for each remedial option are in Appendix D and include:

- Consulting costs including engineering design, plans and specifications, permitting, oversight, and documentation as a percentage of the construction capital costs.
- Estimates of the volume of contaminated media to be addressed.
- Annual operation and maintenance costs, if applicable.
- A 25% contingency on construction capital costs to account for unforeseen project complexities such as adverse weather, unexpected subsurface conditions increased standby times, etc.

Table 4 assembles the costs of each remedial alternative.

<u>**Modifying Criteria**</u>

- The modifying criteria, state acceptance and community acceptance, will be addressed by USEPA based on WDNR and public comments following USEPA's selection of a proposed remedial action plan (PRAP).
- **State Acceptance –** This criterion considers the state's technical and administrative issues and State concerns regarding each alternative, including comments on ARARs or proposed use of waivers. This criterion is evaluated following comment on the RI/FS report and the PRAP and will be addressed once a final decision is made and the ROD is being prepared.
- **Community Acceptance –** This criterion considers the issues and concerns community may have regarding each alternative. This criterion is evaluated following comment on the RI/FS report and the PRAP and will be addressed once a final decision is made and the ROD is being prepared.

4.1 Alternative 1

Alternative 1 (the no action alternative) is required by the NCP and is used as a baseline for comparison for other assembled alternatives. The major components of Alternative 1 are summarized below:

RAO	Action
RAO-1 Soil	No Action
RAO-2 Groundwater	No Action
RAO-3 Wisconsin River Sediment	No Action
RAO-4 Pfiffner Pioneer Pond Sediment	No Action

No remedial action will be implemented under Alternative 1. In accordance with CERCLA, Site reviews will be performed every five (5) years in Alternative 1.

4.1.1 Overall Protection of Human Health and the Environment

Risks to human health and the environment and will remain due to the presence of MGP-residuals under Alternative 1. As a result, Alternative 1 will not achieve the RAOs.

4.1.2 Compliance with ARARs

The no action alternative does not comply with or attain chemical-specific ARARs identified in Section 2.2. Location and action-specific ARARs are not relevant because there is no action associated with this alternative.

4.1.3 Long-Term Effectiveness and Permanence

Potential risk to human health and the environment will remain. Alternative 1 does not provide long-term effectiveness or permanent control of potential risk.

4.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Previous remedial actions (Section 1.2.8) significantly reduced the toxicity, mobility, and volume of affected media. Natural recovery processes (i.e., natural sedimentation or biological groundwater processes) will reduce toxicity or mobility effectively but the effectiveness would not be monitored under this scenario.

4.1.5 Short-Term Effectiveness

The short term risk to human health and the environment from implementing Alternative 1 will not increase and there will be no short term disturbance to the community or environment from remedial action.

4.1.6 Implementability

No implementability issues exist as no action is conducted.

4.1.7 Cost

The only costs associated with Alternative 1 relate to the five-year review requirements. The five-year reviews are estimated to be $15,000 per year over 30 years (6 five-year review events) for a total remedy cost of approximately $42,000.

4.2 Common Remedial Alternative Components

The following remedial alternative components are common to one or more of the remaining assembled alternatives. To avoid repetitive discussion, these components are summarized below and will be referenced in the major components table (Section 4.3 through Section 4.5) for each assembled alternative, as appropriate.

4.2.1 Institutional Control – Soil

Institutional controls for soil are included in Alternatives 2, 3a, 3b, 4a, and 4b to address RAO-1. A residential land use is assumed to determine the area requiring institutional controls. Approximately 5.4 acres will be subject to institutional controls to address soil above the PRGs (Figure 5). Of this, approximately 2.4 acres are owned by the City of Stevens Point.

This alternative includes placing deed restrictions on properties to notify present and future property owners of the presence of affected subsurface soil. These deed restrictions will be properly recorded in the Property records and through WDNR's GIS Registry.

Under this alternative, WPSC will restrict the Property use to conservancy and non-residential use. Such restrictions will require third-party arrangements, because WPSC does not currently own the entire Site where affected soil is present. If the Site is to be developed or future construction or utility workers perform subsurface activities (i.e., utility construction or repairs), a soil management plan will be required to ensure the subsurface soil is properly managed (i.e., not brought to the surface where direct contact may occur). Soil institutional controls will also include restricting unauthorized excavations to limit potential direct contact (authorized excavations will required a health and safety plan and oversight).

Institutional controls will also be used to require future buildings to include vapor intrusion mitigation barriers or prevent buildings from being built on the former MGP property.

Under either the current Site conditions or anticipated future Site conditions (continued Site use as City Park/parking lots), use of institutional controls will be protective of human health and the environment.

An Institutional Control Implementation Plan (ICIP) will be developed to detail land-use restrictions and will document procedures for effectively implementing the institutional control. For cost estimating purposes, it is assumed that institutional controls will be assessed in the Five-Year Reviews for 30 years.

4.2.2 Institutional Control – Groundwater

Institutional controls for groundwater are included in Alternatives 2, 3a, 3b, 4a, and 4b. This remedial alternative relies on WDNR's GIS Registry to notify present and future property owners of the presence of affected groundwater (Figure 28 and 29 in Appendix C-1).

Under current Site conditions, the groundwater is not used for either drinking or industrial use. Under the current Site conditions or anticipated future Site conditions (no groundwater receptors and continued Site use as City Park/parking lots), the use of institutional controls will be protective of human health and the environment.

An ICIP will be developed to document procedures for effectively implementing the institutional control. For cost estimating purposes, it is assumed that institutional controls will be assessed in the Five-Year Reviews for 30 years.

The use of groundwater institutional controls is in conjunction with monitored natural attenuation (MNA). (See below)

4.2.3 Monitored Natural Attenuation – Groundwater

Monitored natural attenuation is included in Alternatives 2, 3a, 3b, 4a, and 4b to address groundwater. USEPA OSWER Directive 9200.4-179, Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Under Ground Storage Tank Sites, 1999, states the most important consideration regarding the suitability of MNA includes the stability of the groundwater containment plume and the potential for unacceptable human health risks. As previously discussed, groundwater does not pose a human health risk.

Groundwater quality and trends supporting MNA are discussed in Appendix C-1. A summary of groundwater quality and trends evaluation indicates the following:

- The groundwater plume is well defined by the well network;
- The regression plots and Mann-Kendall statistical tests indicate generally stable or decreasing trends, especially for wells on the outside of the plume in both the shallow and deep flow systems;
- The contaminant transport assessment indicates natural attenuation mechanisms (such as biodegradation, dispersion, and dilution) have restricted plume expansion over time; and,
- The MNA geochemical indicator parameters are confounding likely due to the presence of two groundwater flow systems that converge in the vicinity of the site.

Thus, the groundwater sampling results are evidence that natural attenuation mechanisms are present and the plume is stable rather than expanding at the site regardless of contaminant concentration variability in at individual wells.

To further support selection of MNA, analytical groundwater modeling was performed. The objective of the groundwater modeling was to evaluate plume stability and to estimate the time over which MNA would reduce concentrations of benzene and naphthalene to levels below the PRGs or demonstrate movement towards the PRGs. Modeling was performed using the MYGRT Version 3.1 analytical transport model. Detailed descriptions of the software, model construction, calibration, and results are presented in Appendix C-2. The model results are included on CD in Appendix C-2.

Two rounds of modeling were performed. The initial model compared relative MNA timeframes for benzene and naphthalene, demonstrating that the naphthalene time frame will be longer. The final modeling further evaluated the model sensitivity of naphthalene, and was used to predict when future concentrations of naphthalene would degrade to concentrations lower than the MCL. Both the initial and final modeling were developed using site-specific input values whenever possible, and calibrated to match observed concentrations in groundwater prior to and following the source removal remediation. Model sensitivity was evaluated over a range of groundwater velocity and fraction of organic carbon values. Several conservative assumptions were made while developing the models, such as assuming a residual source term remains throughout the modeling period; therefore, the predictions of MNA time frames are conservatively long.

The model-predicted time to achieve the MCL ranges from 38 to 114 years beginning in 2011. Significant concentration decreases are predicted for three of the four final model scenarios that were used in the final evaluation. Discussion of the model inputs, results, uncertainty, and conservatism is included in Appendix C-2.

Groundwater monitoring wells recommended to be included in the MNA monitoring well network include the following:

Monitoring Wells: OW-1, OW-2, OW-3R, OW-4, OW-5R, OW-6, OW-7A, OW-9, OW-10, OW-11, OW-12, OW-14, OW-15, OW-16, OW-17, OW-18, OW-19, OW-20, OW-21, TW-1 and TW-2

Piezometers: PZ-3B, P-5B, PZ-7B, PZ-9B, PZ-10B, PZ-11B, PZ-12B, PZ-13B, PZ-14B, PZ-15B, and PZ-16B

For cost estimating purposes, it is assumed that achievement of RAO-2 will be sufficiently demonstrated within 30 years of annual groundwater monitoring.

4.2.4 No Action – Sediment

Alternative 2 includes no action for sediment in the Pfiffner Pioneer Park Pond and Alternative 2, 3a, and 3b includes no action for sediment in the Wisconsin River.

As discussed in BLRA included in the RI Report – Revision 1 (NRT, May 2011), a small area of the Wisconsin River (approximately 0.4 acres) contains sediment with total PAH-13 concentrations above the PEC. The area of the river with sediment concentrations between the PEC and the TEC of 1.6 mg/kg is approximately 0.9 acres, beyond which represents ambient concentrations. The distribution of PAHs around the pond and decrease moving off shore corresponds to the outlet of the former slough as a historic input that no longer occurs and conditions are stable. The majority of the Wisconsin River sediments have not been affected by former MGP operations. The Wisconsin River is approximately 900 feet wide, allowing the benthic community and fish to access a wide area outside of the relatively small area affected with MGP residuals. In addition, the affected sediment in the Wisconsin River is generally sand and does not provide a stable substrate for benthic invertebrate colonization.

The most significant MGP-residuals are detected at T3-A1, in 2000 and in 20007 investigations. Nearby borings do not exhibit MGP-residuals and it is reasonable that the observed MGP residuals at T3-A1 are historic inputs that have not degraded because the residuals occur in sands and gravel that are more protected/un-weathered than soft sediment.

Based on the nature of the sediment surface (gravel, debris, etc.) as noted in the Wisconsin River sediment borings and the divers survey (refer to Appendix H of the Completion Report (NRT, 2006), lack of sheen observations, and the area and magnitude of affected sediment when comparing 2000 and 2007 data, the sediment conditions are stable. Stability is further supported by the rip-rap observed on the river bottom during the drawdown in 2008 (see photos in Appendix B-2) which is substantial in the area at the mouth of the former slough where the elevated PAH concentrations are detected in sediment. Therefore, it is reasonable to expect the sediment is stable in this area.

The Pfiffner Pioneer Park Pond (approximately 0.2 acres) contains sediment with total PAH-13concentrations of sediment above the PEC that may cause toxicity to sensitive benthic invertebrates. However, benthic invertebrates were observed in the pond during the site reconnaissance. Based on the small size of the pond and the way it is maintained, it provides very minimal aquatic habitat and would not have any real effect on the health of the benthic invertebrate or fish populations of the adjacent Wisconsin River.

While there are specific areas that exceed generic screening levels and may pose a risk to the benthic invertebrates in the immediate vicinity of the sediment exceeding the screening levels, on a community basis, which the risk assessment is to consider the ***community***, not the individual, there is a lower risk. Based on the relative size of affected sediment (0.4 and 0.2 acres in the Wisconsin River and Pfiffner Pioneer Park, respectively) compared to the larger water body system and the short-term disruption to the aquatic eco-system potentially outweighing the ***net benefit*** of isolating or removing affected sediment, it is appropriate to consider a no action remedy for Pfiffner Pioneer Park Pond and the Wisconsin River.

4.3 Alternative 2

The major components of Alternative 2 are summarized below:

RAO	Action
RAO-1 Soil	Institutional Controls
RAO-2 Groundwater	Institutional Controls/Monitored Natural Attenuation
RAO-3 Wisconsin River Sediment	No Action
RAO-4 Pfiffner Pioneer Pond Sediment	No Action

Institutional controls for soil and groundwater are described in Section 4.4.1 and 4.4.2, respectively. Section 4.4.2 includes description of the groundwater monitoring included in this remedial alternative. The no action alternatives for sediment are discussed in Section 4.4.4.

NATURAL RESOURCE TECHNOLOGY

4.3.1 Overall Protection of Human Health and the Environment

Alternative 2 is protective of human health in the short-term and long-term due to institutional controls and groundwater monitoring. Alternative 2 is protective of the environment when considered as a whole.

4.3.2 Compliance with ARARs

Alternative 2 complies with and attains chemical-specific ARARs identified in Table 1. Alternative 2 does not trigger location-specific or action-specific ARARs.

4.3.3 Long-Term Effectiveness and Permanence

Institutional controls will adequately satisfy RAO-1 and RAO-2 and provide long-term effectiveness. As discussed in Appendix C-1, the groundwater plume has been demonstrated to be stable.

Natural processes are likely to reduce or isolate MGP-residuals and the overall magnitude of the potential risk from the sediment is relatively small in the context of the larger aquatic system with respect to benthos and considering the Site as a whole, no action is able to achieve the goal of maintaining the ecosystem (RAO 3 and RAO 4).

4.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Previous remedial actions (Section 1.2.8) significantly reduced the toxicity, mobility, and volume of affected media. MGP-residuals also degrade under natural processes in soil, groundwater and sediment (USEPA, December 2010, WDNR, March 2003).

4.3.5 Short-Term Effectiveness

Alternative 2 will satisfy RAO-1 and a portion of RAO-2 as soon as the ICIP is prepared and the site is entered on the GIS Registry. For cost estimating purposes, demonstrating achievement of RAO-2 will be satisfied within 30 years of annual groundwater monitoring. Although, as discussed in Appendix C-2 and Section 4.2.3, achieving the PRGs for benzene and naphthalene is estimated to be between 38 to 114 years. Implementing Alternative 2 will not increase human health or environmental risk and will not disturb the current benthic community in either the Pfiffner Pioneer Park Pond or the Wisconsin River (RAO-3 and RAO-4).

4.3.6 Implementability

Alternative 2 is technically and administratively implementable. Arrangements with third parties will be required to implement institutional controls. The effectiveness of this alternative can be evaluated through groundwater monitoring.

4.3.7 Cost

Capital costs are $64,000 to implement the institutional controls for soil and groundwater. The annual costs for groundwater monitoring are $57,000 and are anticipated for 30 years. Overall, the present worth cost of Alternative 2 is $982,000. Appendix D provides unit cost of each remedial action component and Table 4 provides a summary of the overall costs to implement Alternative 2.

4.4 Alternative 3a and 3b

The major components of Alternative 3a and 3b are summarized below and presented on Figure 6:

RAO	Action
RAO-1 Soil	Institutional Controls
RAO-2 Groundwater	Institutional Controls/ Monitored Natural Attenuation
RAO-3 Wisconsin River Sediment	No Action
RAO-4 Pfiffner Pioneer Pond Sediment	6-inch Sand Cap (Alt. 3a) 6-inch Sand Cap with Activated Carbon (Alt. 3b)

Alternative 3a includes use of institutional controls for soil and groundwater along with monitored natural attenuation, no action with respect to Wisconsin River sediments and placement of a 6-inch sand cap in Pfiffner Pioneer Park Pond. Alternative 3b is identical to Alternative 3a but includes activated carbon in the sand cap for Pfiffner Pioneer Park Pond. The application rate of activated carbon would be assessed as part of the design but for cost estimating purposes, it is assumed 6 pounds of activated carbon will be placed per square yard of sand layer. Although the BLRA indicated human health was not at risk for sediment exposure in Pfiffner Pioneer Park Pond, there is some potential for human health receptors to encounter affected sediment. The Wisconsin River does not present a human health pathway for sediment due to the water depths (greater than 4 feet) and swift currents near shore.

The presence of the sand cap in Pfiffner Pioneer Park Pond will be assessed to support the Five-Year Review process for 30 years.

4.4.1 Overall Protection of Human Health and the Environment

Alternative 3a and 3b are protective of human health due to institutional controls and groundwater monitoring. Alternative 3a and 3b are protective of the environment due to placement of sand in Pfiffner Pioneer Park Pond, however adverse short term effects to the existing benthic invertebrates in the pond may outweigh the overall net benefit. Alternative 3a and 3b are protective of the overall environment in the Wisconsin River.

4.4.2 Compliance with ARARs

Alternative 3a and 3b comply with and attain chemical-specific ARARs identified in Table 1. Alternative 33a and 3b will meet the requirements of the action-specific ARARs.

4.4.3 Long-Term Effectiveness and Permanence

Institutional controls satisfy RAO-1 and RAO-2 and provide long-term effectiveness. As discussed in Appendix C-1, the groundwater plume has been demonstrated to be stable.

Alternative 3a and 3b address RAO-4 through capping. Alternative 3b may have increased long term effectiveness as a result of the activated carbon increasing PAH sequestration compared to the sand layer alone. RAO-3 is met through natural processes which will continue to reduce MGP-residuals in the very limited affected area.

4.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Previous remedial actions (Section 1.2.8) significantly reduced the toxicity, mobility, and volume of affected media. In both Alternative 3a and 3b, placement of 6 inches of sand in Pfiffner Pioneer Park pond will result in a new biologically active zone (conservatively considered as the top 0-6 inches) and an incomplete exposure pathway for benthic invertebrates and the remaining affected sediment. Placement of the sand will reduce the availability of the contaminants and therefore, may reduce the toxicity. The physical process of placing sand will physically reduce risk of the remaining sediment by containing contaminants in place. (USEPA, December 2005). . MGP-residuals such as benzene and PAHs (e.g. naphthalene) will also degrade under natural processes in soil, groundwater and sediment. Natural attenuation processes of such constituents have been well documented (USEPA, December 2005, WDNR, March 2003).

The activated carbon included in the sand cap of Alternative 3b will sequester PAHs, further reducing toxicity, beyond the sand layer alone.

4.4.5 Short-Term Effectiveness

Alternative 3a and 3b will satisfy RAO-1 and portions of RAO-2 as soon as the ICIP is prepared and the site is entered on the GIS Registry. For cost estimating purposes, demonstrating achievement of RAO-2 will be satisfied within 30 years of annual groundwater monitoring. Although, as discussed in Appendix C-2 and Section 4.2.3, achieving the PRGs for benzene and naphthalene is estimated to be between 38 to 114 years. Implementing Alternative 3a and 3b will not increase human health risk.

Placement of the sand will affect the benthic community in the pond (RAO-4) in the short term, but the exposure pathway will be incomplete immediately after the sand is placed (conservatively estimated as 3 days). Construction worker exposure to affected sediment is expected to be minimal because the sand will be mechanically placed from land.

Alternative 3a and 3b do not provide additional protection to the benthic community, beyond what will naturally occur in the Wisconsin River (RAO-3). Placement of the sand in Pfiffner Pioneer Park Pond may affect water column quality in the Wisconsin River over the short term (while sand is placed) due to the hydraulic connection.

4.4.6 Implementability

Alternative 3a and 3b are technically and administratively implementable. Agreements with third parties will be needed to implement institutional controls.

Institutional controls are commonly used to address residual contamination after remedial actions have been performed. Through groundwater monitoring, the effectiveness of this alternative can be assessed to achieve RAO-2.

Placement of the sand layer and monitoring the presence of the sand can be readily implemented, although placing granular activated carbon may be difficult to incorporate evenly through the material due to the low density of the material.

4.4.7 Cost

The present worth cost of Alternative 3a is approximately $1,198,000 and Alternative 3b is approximately $1,213,000. Capital costs for Alternative 3a are approximately $246,000 to implement the institutional controls for soil and groundwater and place a 6-inch sand layer in Pfiffner Pioneer Park Pond. Capital costs for Alternative 3b are approximately $261,000 to implement the institutional controls for soil and groundwater and place a 6-inch sand layer with activated carbon in Pfiffner Pioneer Park Pond. The annual costs for MNA groundwater monitoring are approximately $57,000 per year for 30 years. Verifying the presence of sand in Pfiffner Pioneer Park Pond is approximately $7,000. The cost estimates do not include maintenance of the sand cap. Appendix D provides unit cost of each remedial action component and Table 4 provides a summary of the overall costs to implement Alternative 3a and 3b.

4.5 Alternative 4a and 4b

The major components of Alternative 4a and 4b are summarized below and presented on Figure 7:

RAO	Action
RAO-1 – Soil	Institutional Controls and Excavation and Landfill Disposal of a Limited Area of Former Slough
RAO-2 – Groundwater	Institutional Controls/Groundwater Extraction and Ex-Situ Treatment
RAO-3 – Wisconsin River Sediment	6-inch Sand Cover (Alt. 4a) 6-inch Sand Cover with 6-inch Armor (Alt. 4b)
RAO-4 – Pfiffner Pioneer Pond Sediment	Dredging and Sand Layer

Alternative 4a and 4b include institutional controls for soil and groundwater as described in Section 4.4.1 and 4.4.2, respectively, limited soil excavation, groundwater extraction with ex-situ treatment, and sand cover placement without and with armoring, and pond dredging/cover. Assumptions made for cost estimation are discussed by media below.

<u>Limited soil excavation</u>:

- An area of approximately 0.4 acres would be excavated in the vicinity of the former slough near Pfiffner Pioneer Park Pond to a depth of approximately 16 feet.

- Temporary shoring to facilitate the excavation and temporary removal and stockpiling of overburden soil is assumed suitable for re-use. Deeper soil containing MGP residuals would be removed and loaded for off-site disposal at an approved landfill.

- Water that has contacted MGP residuals would be treated on-site and discharged to the publically owned wastewater treatment plant.

- The excavation would be restored to grade with a combination of stockpiled material deemed suitable for re-use and imported fill.

- Surface restoration of either grass or asphalt pavement (the excavation would need to extend into Crosby Avenue and the City Park). Following the soil excavation, it is expected that the rest of the Site soil will be addressed through institutional controls, as described in Section 4.4.1.

<u>Groundwater extraction/treatment system</u>:

- Two extraction wells approximately 400 feet apart, each with a pumping rate of 25 gpm (total of 50 gpm)[1]

- A pump test and related analysis would be required as part of design efforts to more reliably determine pumping rate, number of wells, and location of wells to achieve an optimized well layout scheme for the desired drawdown and radius of influence.

- Each extraction well is 30 feet deep, extending to bedrock.

- Horizontal directional boring of groundwater extraction conveyance piping would be necessary across Water Street.

- Extracted groundwater to be treated using a filter system (e.g. bag filter) and activated carbon or air stripper to meet discharge pre-treatment requirements.

- Discharge the treated groundwater to the publically owned wastewater treatment plant via the City's sanitary sewer system.

- Annual operation and maintenance costs include measurement of water levels quarterly to confirm containment, annual groundwater monitoring of the existing well network for benzene and PAHs, and collection of treatment system influent and effluent quarterly for BTEX, PAHs and total suspended solids.

<u>Sediment cover/pond dredging</u>:

- Covering a localized area of the Wisconsin River affected sediment with a minimum of 6-inches of sand (Alternative 4a). Additional placement of 6 inches of armor (Alternative 4

[1] Well spacing and flow rate were determined based on the Theis pumping test method for an ideal aquifer using a steady pumping rate, aquifer hydraulic conductivity of `9.2 ft/day calculated transmissivity of757ft^2/day and storativity of 0.22. This analysis estimated a 3 foot drawdown at 200 feet from the extraction wells but does not account for surface water affects on the system (due to the river or recharge).

b only). The armor size will be evaluated in remedial design but for cost estimating purposes, it is assumed to be of 3-inch clear stone. Removal of up to 3.5 feet of sediment in Pfiffner Pioneer Park Pond, performed in the wet, followed by a 6-inch sand layer (Alternatives 4a and 4b). Dredged sediment would be stabilized on site with amendments, if required, and loaded for off-site disposal at an approved landfill. As discussed in Section 4.4, this will provide additional protection against potential human health exposures.

- Dredging the pond in the dry is not considered necessary because there is no flow in the pond, the materials to be removed are solids, no visual evidence of MGP-residuals was observed that would require additional management of free product or liquids such as NAPL, there is no need to observe the excavation bottom, and the sediment is easily accessible on land with a backhoe. If dredging in the dry is to be required, sheet piles will be installed between the western edge of the pond and pond water will be pumped directly to the Wisconsin River. Contact water generated during excavation/dewatering activities will be treated on site and then discharged to the Wisconsin River.

No monitoring or maintenance will be required in Pfiffner Pioneer Park Pond or to assess the presence of the sand in the Wisconsin River.

4.5.1 Overall Protection of Human Health and the Environment

Alternative 4a and 4b are protective of both human health and the environment.

4.5.2 Compliance with ARARs

Alternative 4a and 4b comply with and attain chemical-specific ARARs identified in Table 1. Alternative 4a and 4b will meet the requirements of the action-specific ARARs.

4.5.3 Long-Term Effectiveness and Permanence

Institutional controls satisfy RAO-1 and RAO-2 and provide long-term effectiveness. Removal of soil in the vicinity of Pfiffner Pioneer Park pond will minimize the residual MGP-materials remaining on-site.

Groundwater extraction systems can be an effective remedial strategy for plume containment, but it is well documented that an extraction system does not provide long term effectiveness for accomplishing site remediation goals. Given the high permeability of the aquifer, it is expected the extraction system would effectively remove groundwater and associated contaminants from pore spaces in the most permeable zones. As preferential flow paths are established, areas of lower permeability (less connected pore space) retain contaminants and groundwater concentrations will re-bound when the system is off. Hence, in the long-term, the extraction system may not provide long-term effectiveness and permanence.

RAO-3 and RAO-4 are satisfied through removal and sand covers. Alternative 4b includes an armor layer to further enhance the long term performance of the sand cover and address potential scour concerns.

4.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Previous remedial actions (Section 1.2.8) significantly reduced the toxicity, mobility, and volume of affected soil and groundwater.

Alternative 4a and 4b further reduce the volume of affected soil and sediment, although the removed material is disposed in a landfill and not treated.

The groundwater extraction system will reduce contaminant mass in the groundwater from the most transmissive zone; however, will generate a contaminated waste that will require disposal (i.e., bag filters and activated carbon) or air emissions (i.e., air stripper vent or reactivation process of carbon).

In both Alternative 4a and 4b, placement of 6 inches of sand in Pfiffner Pioneer Park pond and the Wisconsin River will result in a new biologically active zone (conservatively considered as the top 0-6 inches) and an incomplete exposure pathway for benthic invertebrates and the remaining affected sediment. Placement of the sand will reduce the availability of the contaminants and therefore, may reduce the toxicity. The physical process of placing sand will physically reduce risk of the remaining sediment by containing contaminants in place. (USEPA, December 2005).

The dredging of soft sediment from the pond up to 3.5 feet accomplishes no further reduction of toxicity, mobility or volume through treatment. Visual observations of MGP residuals were not observed in the pond and the elevated PAH concentrations are likely associated with the quality of the fill material used to fill in the slough.

MGP-residuals such as benzene and PAHs (e.g., naphthalene) will also degrade under natural processes in soil, groundwater and sediment. Natural attenuation processes of such constituents have been well documented (USEPA, December 2005, WDNR, March 2003).

4.5.5 Short-Term Effectiveness

Alternative 4a and 4b will satisfy RAO-1 and portions of RAO-2 as soon as the ICIP is prepared and the site is entered on the GIS Registry.

However, soil excavation and sediment dredging creates the potential for direct contact exposure during excavation/dredging, fugitive volatile organic emissions and nuisance odors. Transporting affected soil and sediment to the landfill creates a short-term effect on the communities due to increased truck traffic, noise and the potential for increased accidents.

For cost estimating and comparison purposes, it is assumed the soil and sediment excavation will be approximately 3 months. Implementing Alternative 4a and 4b may increase human health risk during the construction. Institutional controls will still be required to address residuals in soil across the remaining portions of the Site.

For cost estimating and comparison purposes, it is assumed the groundwater extraction system will operate for 30 years and groundwater institutional controls will still be required. Placement of the sand cover (RAO-3) in Alternative 4a and 4b and armor in Alterative 4b will adversely affect the potential benthic community and the water column in the Wisconsin River. In addition, removal of sediment in the pond and placement of a sand layer (RAO-4) will remove the existing benthic community in the short term. The potential exists for construction worker exposure to affected sediment during dredging, loading and disposal. Construction worker exposure to affected sediment is expected to be minimal because the sand and gravel will be mechanically placed from land. It is assumed the short term effects while placement of sand and armor will range from 1 to 2 weeks.

Finally, Alternative 4a and 4b may adversely affect water column quality in the short term during dredging of the pond and placement of the sand cover in the pond and placement of the sand and armor in the River.

4.5.6 Implementability

Alternative 4 is technically and administratively implementable. Agreements with third parties may be needed. Disposal facilities, materials and contractors required to implement Alternative 4 are available.

Removal of the material in the vicinity of Pfiffner Pioneer Park Pond will require closing and re-construction of Crosby Avenue. Closing Crosby Avenue for up to two months will require the agreement of the City. In addition, removal of the soil to 16 feet below ground surface requires sheet pile shoring system and pumping a significant volume of water from the excavation and during backfill activities as a result of the sandy subsurface conditions. Backfilling and compacting the excavation to depths of 16 feet bgs may require aggregate materials to be used until compaction of existing material is practical.

Sand covering the localized area of the Wisconsin River would be difficult due to the small area and swift current.

Trenching or horizontal directional boring of conveyance piping for the groundwater extraction system across Water Street would be difficult to implement due to the potential for conflicts with underground utilities and crossing utility easements.

Dredging of Pfiffner Pioneer Park Pond and placement of the sand layer can be implemented.

4.5.7 Cost

The present worth cost of Alternative 4a is approximately $8,009,000 and Alternative 4b is approximately $8,048,000. Capital costs of Alternative 4a are approximately $4,660,000 (Wisconsin River with sand cover only) and Alternative 4b (Wisconsin River with sand cover and 6-inch armor) is approximately $4,699,000. If the pond is dredged in the dry, capital costs increase approximately $100,000. The annual costs for operation and maintenance of groundwater extraction and treatment system and groundwater monitoring are approximately $215,000 per year for 30 years. Appendix D provides unit cost of each remedial action component and Table 4 provides a summary of the overall costs to implement Alternative 4.