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Ms. Margaret Gielniewski
USEPA Region 5 – SR-6J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

July 10, 2015
(1549)

RE: Feasibility Study Report Revision 0
Former Marinette Manufactured Gas Plant Site, Marinette, Wisconsin
Wisconsin Public Service Corporation

CERCLA Docket No. V-W-06-C-847
Site Spill ID – B5BT
CERCLIS ID – WIN000509952

Dear Ms. Gielniewski:

Natural Resource Technology, Inc. (NRT) is providing this Feasibility Study (FS) Report Revision 0 for the Wisconsin Public Service Corporation (WPSC) Former Marinette Manufactured Gas Plant (MGP) Site, Marinette, Wisconsin.

The enclosed FS addresses USEPA comments dated May 15, 2015 on the Site Specific Alternatives Array Screening (NRT, March 23, 2015). For ease of review, USEPA comments are presented in italics, followed by responses.

General Comment

1. *This AAS technical memorandum (TM) states that the feasibility study will include a preliminary list of applicable or relevant and appropriate requirements (ARAR). The feasibility study should distinguish "Applicable" from "Relevant and Appropriate" for each type of ARAR (chemical-specific, action-specific, and location-specific), and should also include an evaluation of likely compliance with each ARAR.*

Response: Table 1 provides the preliminary list of ARARs, distinguished as “applicable”, “relevant and appropriate”, or as “to be considered” with evaluation of the requirements to meet the intent.

Specific Comments

1. *Page 2, Site-Specific Logistical and Structural Constraints. The former MGP is within 700 feet of the river; however, the site is adjacent to the river. Please state this.*

Response: The Boom Landing portion of the Site is located along the Menominee River as indicated in the second bullet of Section 1.2.3. The Former MGP property is within 700 feet of the river.

2. *Page 4, Media and Associated Constituents of Concern, Paragraph 2, Bulleted List. Indoor Air should be included for the future residential land use scenarios.*

Response: Indoor air is not a media of concern as stated in the approved Baseline Risk Assessment (BLRA). Soil and groundwater RAOs address inhalation of vapors. Hypothetical future building construction will need to evaluate potential vapor intrusion concerns. Hypothetical future buildings will be notified of potential vapor intrusion concerns through institutional controls, such as the Wisconsin Department of Natural Resources’ (WDNR) GIS Registry, which is anticipated to be a component of the remedial action for the site.

3. *Page 4-5, Media and Associated Constituents of Concern, Soil. Wisconsin DNR views the zone for potential human exposure via direct contact is the top four feet (0-4 feet).*

Response: USEPA and WDNR reviewed and approved the multi-site risk assessment framework (RAF) in 2007 that established: "Exposures to soils and vapors will be evaluated as appropriate for upland portions of the sites. The exposure scenarios will rely on standard EPA methods and exposure assumptions for onsite workers, recreational users, and residents, as appropriate." Risk assessments completed at sites within this Superfund Alternative Site (SAS) program have used samples collected from 0-2 feet bgs to evaluate direct contact; including other Wisconsin sites such as Stevens Point and Manitowoc. Surface soil samples collected from 0-2 feet below ground surface (bgs) were also proposed in section 6.3.1 of the Marinette SSWP Revision 3 approved by USEPA and WDNR on July 11, 2012.

4. *Page 5, Media and Associated Constituents of Concern, Groundwater, Paragraph 2. The narrative states the contaminant trends are stable or decreasing but the RI Figures indicate the limits of groundwater contaminant plumes are increasing. Please explain.*

Response: Flat or decreasing groundwater concentration trends are discussed in detail in Section 4.2.2.5 and summarized on Table 12 of the USEPA-approved RI Report – Revision 2. Apparent increase in the limit of contaminant plumes on the figures is a result of contouring a sub-set of observations from the well. The naphthalene plume map appears to suffer the most from this apparent expansion in plume extent. It should be noted this plume map is primarily based on fluctuating concentrations at a single well (MW-311) and the surrounding wells clearly define the limit of groundwater impacts.

5. *Page 5, Media and Associated Constituents of Concern, Groundwater. There are multiple references in the AAS TM relative to geochemical conditions for monitored natural attenuation (MNA). It should be noted that microbial degradation of benzene and naphthalene under anaerobic conditions is feasible, but in many cases it is not optimal for removal of these compounds in groundwater. Removal of these compounds by aerobic process is far more efficient and should be the benchmark environmental condition under which the efficacy of MNA is assessed for the site. Where applicable, MNA references in the AAS TM text that could be amended or altered to reflect the preferred conditions for petroleum hydrocarbon degradation are noted.*

Response: While aerobic degradation may be more efficient at reducing concentrations of these compounds, monitored natural attenuation does not involve artificial processes to adjust subsurface or groundwater geochemistry. Given monitored natural attenuation does not involve artificial processes to adjust subsurface geochemistry, the description of conditions resulting in contaminant degradation is applicable.

6. *Page 6, Sediment, Bullet 1. The text notes that because of the placement of the residual sand cover, human and ecological receptors under current conditions do not have the potential for exposure to MGP-affected sediments. Does this statement take into account potential burrowing aquatic ecological receptors? The latest post-removal action monitoring data show areas with polycyclic aromatic hydrocarbon (PAH) levels above criteria within 6 inches of the surface.*

Response: USEPA-approved RI Report – Revision 2 Figure 27 summarizes the analytical samples of the sediment surface collected prior to sand placement, and sand layer samples collected during subsequent monitoring events. There are no PAH exceedances of the remedial action level of 22.8 milligrams per kilogram (mg/kg) for the Non-Time Critical Removal Action (NTCRA) in the top 6 inches of the residual sand layer, the biologically active zone. With the exception of one location in the October 2013 event, all surface sand samples are less than 1 mg/kg total PAH(13). It is unclear what data USEPA is evaluating when making the statement that "the latest post-removal action monitoring data show areas with polycyclic aromatic hydrocarbon (PAH) levels above criteria within 6 inches of the surface". The Residual Sand Cover Monitoring Results letter further discusses the sand cover monitoring results (NRT, 2015).

7. *Page 6, Sediment, Bullet 1. The text states, "Following 2 years of monitoring, results of sand cover sampling meet the conditions for monitoring to cease until the Five-Year Review as described in the approved residual sand cover monitoring plan". Please clarify this statement. Because the sand cover was placed in March 2013, 2 years of monitoring would end in March 2015. Is there another round of monitoring data available? The most recent data provided was collected in October 2014, and it showed evidence in some locations that either sand was being eroded and/or PAHs were migrating upward.*

Response: As indicated in the USEPA-approved Technical Memorandum for Residual Sand Cover Monitoring Plan, the sampling events were conducted in the Spring and Fall of years 2013 and 2014 (four events). Further, the most recent bathymetric survey (April 2015) and the sand thickness measurements collected in Spring and Fall 2013 and 2014 indicate greater than 10 inches of sand is present with the exception of one location in October 2014, which was 9.6 inches. The Residual Sand Cover Monitoring Results letter further discusses the sand cover monitoring results (NRT, 2015).

8. *Page 7, Media-Specific Constituents of Concern, Table. The chemicals indicated with an "x" in the groundwater column do not match those in Table 1 of the baseline human health risk assessment (HHRA). This table should be edited to match the table in the baseline HHRA.*

Response: Table 1 of the BLRA includes Tap-water RSLs, which are a screening tool, and are not appropriate or enforceable cleanup levels. Therefore, Table D in Section 2.3.2 includes enforceable federal or state groundwater standards. Iron and manganese are do not have enforcement standards, therefore, are not considered COPCs for this Site.

9. *Page 8, Assessment of Potential Migration Pathways and Receptors, Bullet List. The exposure pathways listed here do not include all the pathways presented in Section 2.3 of the baseline HHRA. Add the missing exposure pathways.*

Response: Section 2.1.1 includes the exposure pathways consistent with the BLRA.

10. *Page 9, Assessment of Potential Migration Pathways and Receptors, Groundwater Bullet. As previously stated, MNA of petroleum hydrocarbons under anaerobic conditions is feasible but not an optimal scenario for treatment of benzene and naphthalene.*

Response: See response to USEPA Specific Comment 5.

11. *Page 10, Preliminary Remedial Action Goals (PRGs), Soil. The table identifies PRGs that differ from those commonly used in Wisconsin. Wisconsin cleanup standards can be found in Chapter NR 720, Wis. Adm. Code: https://docs.legis.wisconsin.gov/code/admin code/nr/700/720.*
    a. *The following resources are also used:*
        i. *Soil Residual Contaminant Level Determinations Using the U.S. EPA Regional Screening Level Web Calculator, PUB-PR-890, January 23, 2014: http://dnr.wi.gov/files /pdf /pubs /rr /rr890.pdf*
        ii. *Update to RR-890 and RCL Spreadsheet, June 2014: http://dnr.wi.gov/topic/brownfields /documents /tech /rclupdate.pdf*
        iii. *Resources for Environmental Professionals: http://dnr.wi.gov/topic/brownfields /professionals.html #tabx2*

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Response: Table C in Section 2.3.1 provides the PRGs developed by modifying the USEPA Regional Screening Level Web Calculator default exposure assumptions with the more conservative WDNR NR 720 RCL exposure assumptions in accordance with the WDNR technical guidance document *Update to RR-890 and RCL Spreadsheet – June 2014.*

12. *Page 11, Preliminary Remedial Action Goals (PRGs), Soil Gas, Paragraph 1. PRGs for soil gas should be developed at this time to address changes in building use and occupancy, to address future residential land use, and to address future buildings in areas where buildings are not currently present.*

Response: See response to USEPA Specific Comment 2.

13. *Page 11, PRGs. PRGs for indoor air should be developed at this time to address future residential and industrial buildings.*

Response: See response to USEPA Specific Comment 2.

14. *Page 11, PRGs for groundwater. The table references Ch. NR 140, Wis. Admin. Code, enforcement standards. Wisconsin DNR also relies on Ch. NR. 140, Wis. Admin. Code, preventive action limits (PALs). Please include PALs in the table. Groundwater quality standards (enforcement standards and PALs) for Wisconsin can be found in Ch. NR. 140, Wis. Adm. Code: https:/ /docs.legis.wisconsin.gov /code/admin_code/nr /100/140*

Response: See response to USEPA Specific Comment 8. The groundwater standards have been established per the hierarchical approach presented in the Multi-Site MGP RAF (Exponent, 2007) and includes the WDNR Enforcement Standard and the Federal MCLs.

15. *Page 11, Preliminary Remedial Action Objectives (RAOs), Due to current zoning and current land use, it is recommended that the site be evaluated using non-industrial residual contaminant levels.*

Response: The RAOs (Section 2.4) address current and future land use (industrial and hypothetical future residential land use).

16. *Page 12, Preliminary Remedial Action Objectives (RAOs), RAO-2. This RAO for groundwater includes ingestion, which is not consistent with previous text stating that the groundwater is not considered a potential source of drinking water. The supporting prior text should be revised accordingly.*

Response: Ingestion is incorporated into the RAOs to target unrestricted and unlimited use.

17. *Page 12, Preliminary Estimation of Remedial Quantities and Areas. The extent of MGP residuals is not delineated to the southwest beyond Ludington Street, towards the former Goodwill Building. Soil borings SB347 and SB353 indicated that residuals are present in this portion of the site. Additional delineation is required prior to making a determination regarding soil vapor and its potential impacts to structures in that portion of the site. Although delineation was performed along Ludington Street, delineation towards the former Goodwill Building was temporarily delayed due to the potential for access issues in the parking lot to the southwest. However, delineation towards the former Goodwill Building is now needed so that volumes associated with remedial goals based on a target risk level of 10^{-6} can be calculated. In addition, additional vapor sampling may be necessary to adequately evaluate the potential for vapors within the Marinette Housing Authority Building (page 15).*

Response: The results of supplemental soil sampling completed to evaluate the extent of MGP residuals presented in Section 4.1.3 of USEPA –approved RI Report Revision 2 provides evidence that the lateral extent of soil impacts observed at SB347 are limited and forensic data show these soil impacts are not derived from MGP or tar-like sources. No additional delineation is required to make a determination regarding soil vapor in this area for the following reasons:

- Soil gas samples collected from neighboring MGP property and former structures SG03, SG04, and SG09 were all below the 10^{-6} industrial screening levels.
- Groundwater south of Ludington Street does not exceed groundwater to vapor screening levels.
- The depth to groundwater (based on observations from MW05) is greater than 6 feet, the vadose zone is sandy, and oxygen concentrations from neighboring soil gas probes are greater than 10%; conditions that are favorable for attenuation of petroleum volatile organic compounds (PVOC).
- Exceedances of VOCs observed in soil at SB347 were not observed in neighboring borings SB352, SB353, and SB354 which are located between the former Goodwill property and SB347.

Similarly, no further evaluation of the Marinette housing authority property is required for the following reasons:

- The property intersects the naphthalene groundwater to vapor screening level, yet falls outside of the benzene groundwater to vapor screening level.
- Soil gas samples collected from 4 to 4.5 feet below ground surface at SG13 have been below industrial and residential screening levels with the exception of naphthalene which was detected above the residential screening level and/or had a detection limit above the residential screening level.
- The depth to groundwater from MW306 is between 4 and 5 feet below ground surface, the vadose zone is sandy, and oxygen concentrations collected from SG13 are greater than 7%; conditions favorable for attenuation of petroleum VOCs.

18. *Page 14, Preliminary Estimation of Remedial Quantities and Areas, Groundwater, Paragraph 3: Please add RI Table 10 as an attachment to this document.*

Response: RI Revision 2, Table 10, is included in Appendix A3, as indicated in Section 2.5.2.

19. *Page 15, Assessment of General Response Actions (GRA) Relative to Meeting the RAOs, Sediment Bullet No action for sediment may not be appropriate simply because a previous action was completed. Please discuss the main components of the long-term monitoring plan, including contingency actions to be taken if monitoring criteria are exceeded, in this section (note: Monitoring and Land use controls are included as a GRA retained in Table 1). Specifically, the concentrations in the lower segment of sample A1B36 appear to be increasing over time. Also, limited data is available in the areas of the reactive core mat and sand cover.*

Response: Section 3.1 provides the General Response Actions and correspond to Table 3, comparing GRAs to RAOs. With respect to the long-term monitoring plan, the Residual Sand Cover Monitoring Results letter (NRT, 2015) further describes the residual sand cover monitoring. Samples collected at A1B36 only indicate one sample out of three has a higher concentration and does not necessarily represent a trend. Further, it is the surface sand sample (0 to 6 inches) that is the performance metric per the Residual Sand Cover Monitoring Plan. Based on the results of the first two years of monitoring and the decision tree of the Residual Sand Cover Monitoring Plan, monitoring is proposed to cease until data are needed to support the Five Year Review.

20. *Page 16, Assessment of GRAs Relative to Meeting the RAOs, Page 16, Soil Gas Bullet. Engineering Controls, not just Institutional Controls, must be considered for future land use scenarios. This would include engineered vapor intrusion mitigation systems to address soil gas from soil and groundwater sources from entering the future structures.*

Response: See Response to USEPA Specific Comment 2.

21. *Page 16, Screening of Technologies and Process Options, Paragraph 2. It is unconventional and inappropriate to eliminate a technology during screening based solely on cost.*

Response: This is a misunderstanding; elimination of a technology based solely on any one metric is not suggested.

22. *Page 33, Table 1, Groundwater. In general, anaerobic conditions are not favored for degradation of petroleum compounds as promoted in MNA rationale.*

Response: See Response to USEPA Specific Comment 5.

23. *Page 34, Table 1, Groundwater. The rationale stated for dismissal air sparging is weak; aerobic degradation of petroleum compounds and especially PAHs is the preferred pathway for biological-based processes. Air sparging as applied in a biobarrier is an effective and relatively inexpensive approach for increasing dissolved oxygen (DO) levels in situ. Please consider retaining this technology for use in alternative development.*

Response: Air sparging was retained as requested; however, project experience has shown poor performance of air sparging to remediate MGP residuals.

“Sparging has been shown to be effective at removing dissolved groundwater contaminants and is widely employed as a remediation technology for volatile contaminants, such as gasoline; however, its effectiveness against concentrated semivolatile contamination, such as undissolved coal tar, has not been demonstrated. Consequently, sparging is viewed as a polishing technology that could be effective in treating dissolved-phase contaminants, such as BTEX, and potentially in reducing the mobility of coal tar, but likely would be only marginally effective at remediating tar.” - NYSEG Oneonta MGP Site ROD, 2005; available online: http://www.dec.ny.gov/docs/remediation_hudson_pdf/rod439001.pdf

"For groundwater, the original remedy included three technologies which included groundwater/DNAPL extraction and treatment with on-site discharge of the treated groundwater, air sparging, and injection to nutrients to promote in-situ bio-degradation on the contaminants. Based on the findings a 2004 RSE, the air sparging and nutrient injection systems were shut down. Due to the extent of the DNAPL, the time-frame estimated in the Remedial Design to achieve the groundwater cleanup goals was underestimated. It will take significantly longer than eight years to achieve the groundwater cleanup goals." - Cape Fear Wood Preserving Site First 5-Year Review, 2006; available online: http://www.epa.gov/superfund/sites/fiveyear/f2006040001157.pdf

24. *Page 34, Table 1, Groundwater. Aerobic bioremediation nonaqueous phase liquid (NAPL) is feasible and demonstrated. Biological treatment of a source zone contaminated by petroleum hydrocarbons should be considered a feasible technology option. Suggest modifying rationale to remove (non-source) reference.*

Response: See response to USEPA Specific Comment 23.

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25. *Page 34, Table 1. Soil Gas. Mitigation is listed as an engineering control but is not retained given a rationale that "Existing buildings do not exceed vapor intrusion screening levels; therefore, institutional controls will be used to require this type of protective measure for future buildings." If mitigation will be required by institutional controls for future buildings, mitigation technologies should be carried forward for screening.*

Response: The remedy assesses current and future land use. There is no current vapor intrusion risk and inhalation of soil and groundwater is addressed with the soil and groundwater RAOs. Therefore, actual environmental conditions will be assessed when land use changes are proposed.

26. *Page 35, Table 1, Sediment. The rationale indicates that the RAOs for sediment were achieved as described in the Completion Report and the remedial investigation report; however, this information is not in the Completion Report or the remedial investigation report.*

Response: As described in the construction Final Report Revision 1 (NRT, 2013), the objective of the removal action was to mechanically excavate contaminated sediments in areas with elevated PAH concentrations and NAPL until post-dredge verification samples indicated that the remaining sediments contained Total (13) PAH concentrations less than 22.8 mg/kg and no visual NAPL remaining. A residual sand layer was placed in areas where sediment with Total (13) PAH concentrations greater than 22.8 mg/kg could not be fully removed due to the uneven bedrock surface. The sediment removal action was initiated in October 2012 and substantially completed in February 2013. Post-removal action sediment conditions were documented in the construction Final Report Revision 1 (NRT, 2013) which was approved by USEPA on October 25, 2013 along with a certification of completion. The Remedial Investigation Report Revision 2 (NRT, 2015) indicated that residual sand cover monitoring samples were collected in April 2013, October 2013, April 2014, and October 2014. Sampling results show the presence of greater than 10 inches of sand/sediment in the areas of the residual sand cover arear, and the top 6-inches of material has maintained concentrations below 22.8 mg/kg Total PAH(13) at all locations for all sampling events. Therefore, the objectives of the removal action were achieved.

27. *Page 35, Table 1, Sediment. Under the Rationale column, discuss the contingency measures described in the Long-term Monitoring Plan if monitoring results show the reactive core mat or sand cover have eroded, or contaminants are migrating upward through the containment layers. Should sand cap, sand cap amended with adsorptive media, and potentially multi-layer cap be carried forward for screening, instead of screened out at this time?*

Response: Note: the sand cover placed was a residual sand cover which typically does not have an expectation for permanence or monitoring and is placed when dredging has been completed to the extent practical (i.e., the bedrock surface). No monitoring was established for the reactive core mat, covered with 6 to 9 inches of sand, which was primarily placed to minimize potential upland MGP material migrating to the sediment, although RCM does cover two sample locations where the post dredge surface (0-6 inches below surface) was greater than the remedial action limit for the NTCRA. See response to USEPA Specific Comment 19.

28. *Page 35, Table 1. GRA (monitoring) was not included in alternative array text. Please update document text accordingly.*

Response: Section 3.1 text was updated.

29. *Page 35, Table 1. GRA (land use controls) was included in alternative array text. Please update text accordingly.*

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Response: Section 3.1 text was updated.

30. *Page 36, Table 2A, Containment Rationale. Would a fill layer as described in this context constitute an engineered barrier? Consider alternate wording for this approach.*

Response: The clean fill layer or backfill soil, while not specifically designed, acts as an engineered barrier providing a physical barrier, separating impacted soil from surface receptors.

31. *Page 38, Table 2A, Screening Result. Air sparging or biosparging is a highly effective treatment approach amenable to both saturated and unsaturated soil. This technology has been applied in the presence and absence of NAPL with good results at other sites where coal tar or MGP residuals are present. The presence of source materials does not preclude the application of biological-based treatment solutions. Consider retaining this technology for use in saturated soil and groundwater treatment.*

Response: See response to USEPA Specific Comment 23.

32. *Page 38, Table 2A, Effectiveness. The use of "reagent contact" for a biological treatment scenario is confusing. Is this in reference to electron donor /acceptor supply or some other treatment aspect?*

Response: In the context of this technology the term "reagent" refers to "amendments, such as nutrients and oxygen" and was reworded.

33. *Page 39, Table 2A, Chemical Oxidation Screening Result. Retention of this technology seems questionable given the presence of both free and residual product and the immense oxidant demand posed by MGP residuals when present in the subsurface. The presence of subsurface utilities and critical infrastructure also questions the implementability of this treatment approach.*

Response: Project experience indicates chemical oxidation may be a viable remedial option:

- Collins, J. *Coal Tar Contamination Remediation.* Pollution Engineering 44(5):26-30(2012) [a Pollution Engineering white paper]. Available online: http://digital.bnpmedia.com/publication/?i=108585&p=26
- *Revised Work Plan and Trial Management Plan: Surfactant Enhanced In Situ Chemical Oxidation (S-ISCO®) & Surfactant Enhanced Product Recovery (SEPR™)*, Block 5 and Hickson Road, Barangaroo, Pilot Trial New South Wales Office of Environment and Heritage, Australia. 355 pp, 2011. Available online: http://www.environment.nsw.gov.au/resources/barangaroo/BRRP46.pdf
- Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater Interstate Technology & Regulatory Council (ITRC). ISCO-1, 67 pp, 2001. Available online: http://www.itrcweb.org/Guidance/GetDocument?documentID=44
- *An Evaluation Of In Situ Chemical Oxidation (ISCO) For MGP Impacted Soils And Ground Water*. Marley, M.C.; B.L. Cliff; K.L. Sperry; J.M. Parikh, Xpert Design & Diagnostics, LLC, Stratham, NH. The 19th Annual International Conference on Contaminated Soils, Sediments and Water, 20-23 October 2003, University of Massachusetts at Amherst. Northeast Regional Environmental Health Center, Univ. of Massachusetts, Amherst.
- *Experiences On The Use Of In Situ Chemical Oxidation (ISCO) Technology For Remediation Of MGP Sites In The U.S.A.* Murarka, Ishwar P., Ish Inc., Raleigh, NC. The International Symposium & Exhibition on the Redevelopment of Manufactured Gas Plant Sites (MGP 2006), 4-6 April 2006, Reading, UK. International Society of Technical & Environmental Professionals, Inc. (INSTEP), Tallahassee, FL.

34. *Page 39, Table 2A, Chemical Oxidation Implementability. The presence of subsurface utilities can be very challenging for this technology, especially when the utilities are in the zone of treatment and subject to contact by injected oxidants.*

Response: Noted.

35. *Page 40, Table 2A, On-site treatment Implementability. A large footprint is not always required if small scale equipment is used for treatment. This is especially true for modular, portable, and smaller-scale thermal treatment systems that employ batch or bin based strategies.*

Response: On-site treatment and on-site disposal were retained as requested.

36. *Page 40, Table 2A, On-site treatment Screening Result. A number of small-scale modular thermal treatment units are commercial available for ex situ thermal treatment. These units are self-contained and include heating and treatment solutions in one package (including off gas treatment). The foot print of the operation is very small (ISO shipping containers are typically used to house the systems) and treatment cycles are operated in batch for high throughput and effective treatment of a wide range of hydrocarbons. If excavation is seriously considered for site restoration, onsite thermal desorption should be considered as it may provide a more financially attractive endpoint versus offsite disposal. Consider retaining for flexibility and cost efficiencies in an excavation based alternative.*

Response: See response to USEPA Specific Comment 35.

37. *Page 41, Table 2B, MNA Rationale. Consider prior comments provided on favorable geochemical conditions for MNA.*

Response: See response to USEPA Specific Comment 5.

38. *Page 42, Table 2B, Hydraulic Containment Implementability. Periodic replacement and maintenance of pump-and-treat system components is customary for any containment based remedy. This factor does not affect implementability of the technology.*

Response: Noted. Operation and maintenance requirements are implementability considerations for all technology types.

39. *Page 42, Table 2B, ISS Description. If a reactive component like powdered activated carbon addition to the reagent mixture is not considered, ISS application for groundwater treatment seems questionable. This technology is centered more on soil treatment and permeability reduction to mitigate contaminant flux and migration with groundwater. Consider evaluation of ISS as a soil treatment approach only.*

Response: Implementation of ISS as a groundwater remedy was not carried forward for additional screening because it is not appropriate for this Site. However, in our experience, ISS application does improve groundwater quality and does not require powdered activated carbon addition to do so.

40. *Page 44, Table 2B, Enhanced Bioremediation Rationale. Consider previous comments on MNA and favorable geochemical conditions.*

Response: See response to USEPA Specific Comment 5.

41. *Page 44, Table 2B, Enhanced Bioremediation Effectiveness. Use of reagent contact is unclear. Bioremediation is effective only when environmental conditions requisite for contaminant degradation are maintained in the subsurface.*

Response: See response to USEPA Specific Comment 32.

42. *Page 45, Table 2B, Chemical Oxidation Implementability. Integrate prior considerations for subsurface utilities, including preferential flow or potential (unintentional) damage to critical infrastructure by oxidant injection activities.*

Response: See response to USEPA Specific Comment 33.

43. *Page 45, Table 2B, Onsite reinjection Implementability. The statement of conductivity of less than 10^{-5} as rationale for technology exclusion is contradictory to prior statements provided in the screening table related to high formation permeability, and hydraulic connectivity to the adjacent river. Please correct text as needed to reflect the implementability challenges associated with the site-specific conditions.*

Response: The 'Implementability' column of the table is used to generally describe process option implementation considerations but is not used as rationale for retaining or excluding any process option. Rationale for screening process options is provided in the 'Rationale' column of the table.

44. *Page 46, Table 2B, On-site surface water Implementability. Modify implementability concerns to reflect prior comment provided on hydraulic conductivity constraints noted to be relevant for technology implementation at this site.*

Response: See response to USEPA Specific Comment 38 and 43.

45. *Page 46 Table 2B, On-site POTW Discharge Implementability. As in comment 38, above.*

Response: See response to USEPA Specific Comment 38 and 43.

46. *Page 4 7, Table 2B, Off-site Treatment Implementability. As in comment 38, above.*

Response: See response to USEPA Specific Comment 38 and 43.

47. *Page 48, Table 2C, Soil Gas. Mitigation as an engineering control should be included for the future land use scenario.*

Response: See USEPA Specific Comment 2.

48. *Page 49, Table 2D, Sediment. As the remaining area with sediment contamination is located at or near a public boat launch, is it feasible to use institutional controls to prohibit or restrict the use of the waterway in that location?*

Response: The general approach for implementation of institutional controls is presented as Alternative SED3 in Section 7.1.3.

49. *Page 50, Table 3. Update this table to include retained mitigation options for future land use scenarios.*

Response: Table 6 (previously Table 3) was updated.

Please contact Mr. Naren Prasad of WEC Business Services, LLC (WBS) at 312.240.4569 if you should have any questions regarding the content of this letter or the enclosed FS Report.

Sincerely,

NATURAL RESOURCE TECHNOLOGY, INC.

Jennifer M. Hagen, PE
Senior Engineer

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Encl: Feasibility Study Report Revision 0

cc: Ms. Cheryl Bougie, WDNR (3 hard copies, 1 CD, and electronic)
Ms. Kristen DuFresne, WDNR (1 hard copy, 1 CD, and electronic)
Ms. Jennifer Knoepfle, CH2MHill (electronic)
Mr. Naren Prasad, WBS (electronic)

Smarter Solutions

Exceptional Service

Value

Feasibility Study

Wisconsin Public Service Corporation
Former Marinette MGP Site
Marinette, Wisconsin
WIN000509952

Project No: 1549

Revision 0
July 10, 2015

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FEASIBILITY STUDY

WISCONSIN PUBLIC SERVICE CORPORATION
FORMER MARINETTE MANUFACTURED GAS PLANT SITE
MARINETTE, WISCONSIN
WIN000509952

Project No: 1549

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Revision 0
July 10, 2015

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FIGURES

TABLES

Imbedded within Text

APPENDICES

ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms Per Liter
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	Below Ground Surface
BLRA	Baseline Risk Assessment
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CERCLA (“Superfund")	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per Second
COPCs	Contaminants of Potential Concern
CWG	Carbureted Water Gas
CY	Cubic Yards
NAPL	Non-Aqueous Phase Liquid
ERP	Environmental Results Program
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ft^3	Cubic Feet
FVD	Foth & Van Dyke, Inc.
GIS	Geographic Information System
GRA	General Response Action
IBS	Integrys Business Support, LLC
IC	Institutional Control
ICIP	Institutional Controls Implementation Plan
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level
mg/kg	Milligrams Per Kilogram
MGP	Manufactured Gas Plant
MNA	Monitored Natural Attenuation
MTTD	Medium Temperature Thermal Desorption
msl	Mean Sea Level
NCP	National Contingency Plan
NRT	Natural Resource Technology, Inc.
NTCRA	Non-Time Critical Removal Action
O&M	Operation and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PID	Photoionization Detector
PQL	Practical Quantification Limit
PRAP	Proposed Remedial Action Plan
PRG	Preliminary Remediation Goal
PVOC	Petroleum Volatile Organic Compounds

RAF	Risk Assessment Framework
RAL	Remedial Action Level
RAO	Remedial Action Objective
RCM	Reactive Core Mat
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Level
SOW	Statement of Work
SSWP	Site-Specific Work Plan
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
TBC	To Be Considered
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WBS	WEC Business Services, LLC
WPSC	Wisconsin Public Service Corporation

1 INTRODUCTION AND SITE BACKGROUND

This Feasibility Study (FS) evaluates remedial alternatives to address MGP-affected media at the Wisconsin Public Service Corporation (WPSC), Former Marinette Manufactured Gas Plant (MGP) Site located in Marinette, Wisconsin (Figure 1). The Site is managed by WEC Business Services, LLC (WBS) (formerly Integrys Business Support, LLC) on behalf of WPSC. This FS was developed in accordance with the Administrative Order on Consent (AOC) and Statement of Work (SOW) between the United States Environmental Protection Agency (USEPA) and WPSC, identified as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") Docket No. V-W-06-C-847, dated May 5, 2006. The AOC/SOW addresses six former WPSC MGPs; however, this report focuses exclusively on the Former Marinette MGP. The extent of the Former Marinette MGP property is referred to herein as the “Former Marinette MGP” or “MGP” while the larger area where contamination has been detected is referred to herein as the “Site”. Under the AOC/SOW, a generic approach to address the six sites has been developed (the Multi-Site approach), which may be modified to account for Site-specific differences that may exist at a particular MGP site.

Substantial investigation and response actions were previously completed at the Site, as documented in the USEPA-approved *Remedial Investigation Report for WPSC’s Former Marinette MGP Site Marinette, Wisconsin, Revision 2* [referred to as the Remedial Investigation (RI) Report] [Natural Resource Technology, Inc. (NRT), February 2015]. In addition, an Alternatives Array Analysis was completed for the Site, as documented in the *Technical Memorandum No. 1, Site-Specific Alternatives Array Screening, WPSC, Former Marinette MGP, Marinette, Wisconsin* (referred to as the Alternatives Array) (NRT, March 2015). The USEPA provided comments on the Alternatives Array on May 15, 2015 (USEPA, May 2015). This FS Report addresses the USEPA comments on the Alternatives Array, as indicated in the transmittal letter for this report.

This FS Report is based on data and conclusions presented in the USEPA-approved Multi-Site Feasibility Study Support Document, (NRT, March 2010), USEPA-approved RI Report (NRT, February 2015), Alternatives Array (NRT, March 2015), and May 15, 2015 USEPA-provided comments (USEPA, May 2015). Further, this FS Report was completed in accordance with applicable federal regulations, including CERCLA, as amended by the Superfund Amendments and Reauthorization Act and the National Contingency Plan (NCP). Relevant guidance documents are referenced in Section 9.

1.1 Purpose and Organization of Report

The purpose of the FS is to develop, screen, and evaluate remedial alternatives to address unacceptable risks to human-health and ecological receptors resulting from former MGP operations. The evaluation of remedial alternatives includes comparison against the following criteria:

- Overall protection of human health and the environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume
- Short-term effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

To achieve this objective, this FS Report is organized into the following sections:

- Section 1 – Introduction and Site Background
- Section 2 – Development of Remedial Action Objectives
- Section 3 – Development and Screening of Technologies
- Section 4 – Detailed Analysis of Soil Remedial Alternatives
- Section 5 – Detailed Analysis of Groundwater Remedial Alternatives
- Section 6 – Detailed Analysis of Soil Gas Remedial Alternatives
- Section 7 – Detailed Analysis of Sediment Remedial Alternatives
- Section 8 – Comparative Analysis of Remedial Alternatives
- Section 9 – References

1.2 Background Information

Background information presented is based on the following USEPA-approved documents: RI Report Revision 2 (NRT, February 2015), Alternatives Array (NRT, March 2015), and May 15, 2015 USEPA provided comments (USEPA, May 2015).

Owner:	City of Marinette 1905 Hall Avenue Marinette, WI 54143
WEC Business Services Contact:	Mr. Naren M. Prasad (312-240-4569) 200 East Randolph Street, 24th Floor Chicago, IL 60601
Site Location:	T30N, R24E, Section 6, SE ¼, NE ¼, (Figure 1) 1603 Ely Street Marinette, Wisconsin Marinette County (Figures 1 & 2)
USEPA ID	WIN000509952
WDNR BRRTS #	02-38-000047

The former MGP property encompasses approximately four acres and is currently owned by the City of Marinette (City) and 1428 Main Street Holdings (Figure 2) and is primarily located within heavy manufacturing and park districts (Figure 3). The following definitions are used herein:

- Site: Refers to areas where contamination related to the former MGP has been discovered through Site investigation activities completed to-date.
- MGP residuals: oil-wetted or oil-coated soil or non-aqueous phase liquid (NAPL)
- MGP-affected soil: soil affected by the former MGP to the extent constituents of concern (COCs) exceed the preliminary remediation goals.

1.2.1 Site Description and Surrounding Land Use

The approximate extent of the upland Site illustrated on Figure 2 is approximately 15 acres and primarily located within heavy manufacturing and park districts (Figure 3); however, small portions of the Site also fall within community business and waterfront overlay districts. Most of the Site is covered with pavement, buildings, or manicured lawns. The Site includes properties owned by WPSC, Canadian National Railway Company (CN), Marinette Central Broadcasting, and the City of Marinette (Boom Landing, WWTP, fire station, and City right-of-way), as shown on Figure 2 and discussed below:

- **WPSC Property** – The triangle shaped property located on the west of the Site and north of Mann Street is owned by WPSC. The property is zoned community business and waterfront overlay district.

- **Canadian National Railway Company (CN)** – The railroad in the middle of the Site, parallel to Mann Street is owned by CN Railroad.

- **Marinette Central Broadcasting** – Marinette Central Broadcasting owns the property to the west of the Boom Landing, in the northern part of the Site. The property is zoned for community business and waterfront overlay district.

- **City of Marinette** – The City owns properties covering the majority of the Site, including Boom Landing on the north of the Site and along the Menominee River, the City WWTP covering the majority of the Site in the south, the fire station on the southwest corner of the Site, and Mann Street, Ely Street and Ludington Street bordering the WWTP to the north, southeast and southwest, respectively. The Boom Landing area is zoned either park district or community business district and waterfront overlay district. The WWTP is zoned heavy manufacturing district.

1.2.2 Site History

1.2.2.1 Former MGP Property

The former MGP facility was constructed between 1901 and 1910 and operated through 1960. Prior to 1903, the Marinette Lighting Company owned the former MGP property. In 1903, electric and gas utilities in Marinette, Wisconsin and Menominee, Michigan were merged to form the Menominee and Marinette Light and Traction Company. In 1922, WPSC acquired control of the Menominee and Marinette Light and Traction Company and operated it as a wholly owned subsidiary. In 1953, the subsidiary was merged with the parent company. In 1962, the former MGP property was sold to the City of Marinette under a land contract. The City subsequently used the property to expand the WWTP facilities.

The former MGP facility operated with two methods of coal gas production: heating and volatilizing coal in an airtight chamber (retort) from construction of the facility to 1928 and the carbureted water gas (CWG) process from 1928 to 1960.

Former MGP-related structures and pertinent historic Site features are shown on Figure 4. This figure was prepared based on historical Sanborn maps, a WPSC survey map dated December 10, 1923, and a STS Consultants, Ltd., (STS, 1991) drawing showing structures existing prior to the 1989 WWTP expansion. Former MGP-related structures at the Site in 1923 included the following:

- Main gas production and retort buildings, which likely contained purifiers, and a propane vaporizer room (later converted to a workshop)

- Coal storage area
- 300,000 cubic foot (ft^3) gas holder
- 50,000 ft^3 gas relief holder
- Two underground 12,000-gallon tar tanks west of the coal storage area and adjacent to the coal side track
- Two underground 12,000-gallon tar tanks/tar wells northwest of and adjacent to the gasification building
- Tar well approximately 6 feet by 60 feet located along the northeast wall of the water gas room
- Tar Seal Pot approximately 6 feet by 10 feet located along the same wall immediately southwest of the tar well

The 1935 Sanborn map indicates the four tanks and the tar well noted above had been removed. Additional features of interest on the 1935 map included the following:

- An additional tar tank adjacent to the gasification building, possibly for loading tar onto railroad cars
- Two 12,000-gallon tar wells east of the boiler building
- One tar tank immediately south of the 50,000 ft^3 gas holder
- Two large steel tar tanks south of the 50,000 ft^3 gas holder
- Two above ground propane tanks, added in 1948

Many of the MGP buildings and structures were present in 1962 when the City purchased the property from WPSC. All of the aboveground and most of the below ground structures associated with the MGP were removed and/or demolished by the City in the 1960s in preparation for the WWTP expansion.

1.2.2.2 City of Marinette Waste Water Treatment Plant Property

The City WWTP was originally constructed east of a former slough in 1938 and expanded in 1945 and 1952. Historic WWTP structures including the fuel oil underground storage tanks (UST) and an asphalt plant are shown on Figure 4. Following the purchase of the former MGP property by the City in 1962, the City WWTP was expanded in 1972 and 1989 to the current layout (Figure 2). A 10,000-gallon aboveground storage tank (AST) storing tar/oil, located northeast of the former MGP, across the slough in Figure 4, was replaced in 1985 due to failure of the tank's heating elements (NRT, 1994). From the early 1960s to 1990, the WWTP property was also used by the City to manufacture asphalt.

The WWTP property was also used as a service garage and had a gasoline tank. A release from the gasoline tank was reported to the Wisconsin Department of Natural Resources (WDNR) (NRT, 1994). According to the City Engineer, Mr. George Cowell, soil affected by the release from the gasoline tank was subsequently aerated and the case was closed by the WDNR.

1.2.2.3 Former Slough/Boom Landing

The history of the former slough was summarized below.

1800s	The slough was a meander of the Menominee River.
	Water flow direction of the slough was from north to south.
1945	Southern portion of the slough was filled with tarry material during the expansion of the WWTP.
	Water flow direction changed to south-to-north due to the fill placement.
1960	The slough/channel south of the MGP plant was completely filled by May 1960.
1970	The slough was gradually filled with silt.
1982	The slough was completely filled to the Menominee River and the boat landing was constructed.
1987	The area around Boom Landing was developed.
2004	The boat landing was reconstructed including the expansion of parking area and a wider boat landing complete with two floating piers.

1.2.2.4 Historical Releases and Dates

The former MGP operated until 1960. Fuels associated with the WWTP operation and asphalt production were stored on the property through 1990. MGP-affected soil and groundwater were identified on the property and reported during the 1989 WWTP expansion. Dewatering operations were necessary during expansion and, in some instances, dewatering extended into the bedrock aquifer (Simon Hydro-Search, Inc. [SHI], 1993). During the expansion, the City requested approval from the WDNR to divert the dewatering discharge from the WWTP headworks building (Figure 2) excavation to a storm sewer in order to reduce the hydraulic loading to the WWTP. Water quality data is limited; however, water quality samples collected from this excavation indicated the presence of benzene, toluene, ethylbenzene, total xylenes (BTEX), and naphthalene.

1.2.2.5 On-Site and Off-Site Non-MGP Sources

Potential on-site sources not related to the former MGP include:

- Contents of the former fuel oil USTs at the WWTP immediately east of the former MGP (Figure 4)

- Contents of the former 10,000-gallon fuel AST used by the City in the production of asphalt (Figure 4)
- Gasoline reportedly released from a UST at the WWTP service garage (Figure 2)
- Material used in filling the slough by the City beginning in 1945 (described above)

A search of the WDNR Bureau for Remediation and Redevelopment Tracking System (BRRTS) database also identified the following proximate sites (Figure 3) have the potential to affect Site media or release contaminants to co-mingle with MGP residuals:

Table A Summary of BRRTS search results of potential site media or release contaminants, August 2009/Updated in 2012

Site Name and Location	WDNR Program	Contaminants	Approximate Location Relative to the MGP Site	Current Status
Postorino Painting Co.(1) 501 Mann St.	LUST	Diesel, unleaded gasoline	North <500 ft, and east of Boom Landing	Open
Marinette Marine Corp, (1) 1600 Ely St.	ERP	Metals	Northeast, 1,000 ft	Closed
Marinette Marine Corp, (1) 1600 Ely St.	LUST	Diesel	Northeast, 1,000 ft	Closed
Marinette Marine Corp, (1) 1600 Ely St.	Spills (9 incidents)	Oils, fuel, paint, hydraulic fluid discharges to soil and surface water	Northeast, 1,000 ft	Closed
Phister SX (1) Golden Ct. and Pierce Ave.	LUST	Unknown fuel, free product	East, 1,000 ft	Open
St Vincent DePaul Store(1) 1619 Main St.	Spill	Unleaded gasoline	East. 1,000 ft	Historical
Nest Egg Marina (1) 300 Wells St.	Spill	Diesel discharge to surface water	Northwest, 1,000 ft	Closed
Lauerman Field (2) Stanton St.	Solid Waste	Unknown	Southeast, 1,000 ft	--
Village Pump II (1) 1368 Main St.	LUST	Leaded gasoline	South, 500 ft	Closed

Notes:
(1) WDNR, BRRTS on the Web
(2) WDNR, March 27, 2003. *Source Water Assessment, Marinette Water Utility*
< - Less than
BRRTS – Bureau for Remediation and Redevelopment Tracking System
ERP – Environmental Results Program
ft – Feet
LUST – Leaking underground storage tank

Sites judged to have potential for related contaminants to migrate onto the Site or co-mingle with known areas of MGP residuals include Postorino Painting Co (the Postorino site) and Village Pump II, due to their proximity and up-gradient location relative to the Site. Soil and groundwater data from the Postorino site were obtained from WDNR and incorporated into this document were applicable. Relevant materials were provided in Appendix L of the Site-Specific Work Plan Revision 3 (NRT, May 2012).

1.2.3 Site-Specific Logistical and Structural Constraints

MGP residuals in soil and groundwater affect properties adjacent to the former MGP constituting the broader area of the Site. The location of MGP residuals poses constraints to be considered both individually and as part of an overall strategy to effectively meet the remedial action objectives (RAOs). Consideration should be given to these Site constraints throughout the FS process so an effective and implementable remedial strategy is selected. Figure 2 presents the Site-related and surrounding surface and subsurface features; key considerations for the Site consist of the following:

- The former MGP property encompasses approximately four acres and is currently owned by the City. The City operates a WWTP at the property. The former MGP property is within 700 feet of the Menominee River. The WWTP property is bounded on the north by Mann Street and railroad tracks, on the southwest by Ludington Street and then Ely Street on the southeast. The WWTP consists of surface and subsurface structures joined by networks of above and below ground utilities.

- Boom Landing is owned by the City and encompasses approximately 2.31 acres and is located north of Mann Street and along the Menominee River, adjacent to the Marinette Marine property and the property where a former slough ran through it. The majority of Boom Landing is a parking lot serving the boat landing. There is also a fish-cleaning station. Subsurface stormwater and electric utilities are present, and sanitary discharge lines from the WWTP run through Boom Landing and discharge to the Menominee River.

- The aboveground and most of the below ground structures associated with the MGP were removed and/or demolished by the City in the 1960s in preparation for the WWTP expansion. In addition, during expansion of the WWTP, MGP-affected soil encountered during excavation was disposed of at a licensed landfill. Figure 4 shows the historic Site layout and areas of soil excavated by the City during the WWTP expansion.

- CN railroad and Mann Street separate Boom Landing and the WWTP. MGP residuals are present beneath the railroad and street.

- Subsurface conditions consist of up to 20 feet of unlithified deposits primarily comprised of fine and silty sand and occasional, discontinuous gravel and clay units.

- Bedrock occurs approximately 20 feet bgs and consists of competent dolomite.

- Most observations of MGP residuals are closely associated with the footprint of the former slough as shown on Figure 1.

- MGP residuals in the soil are generally not mobile - NAPL does not collect in monitoring wells.

- Groundwater flow is generally north to northeast toward the Menominee River.
- Depth to groundwater fluctuates and the average across the Site is approximately 4 to 10 feet bgs.

Existing underground utilities including storm water, sanitary, water, electric, and gas are shown on Figure 2. The majority of the Site is covered with pavement, buildings, or manicured grass. Site surface water runoff is collected in storm sewers located in the streets.

1.2.4 Topography and Drainage

Based on the United States Geologic Survey (USGS) Marinette West Quadrangle, relief within one mile of the Site is approximately 30 feet, ranging from approximately 575 feet mean sea level (msl) at the Menominee River to approximately 605 feet msl northeast of the Site in the City of Marinette. The ground surface elevation for the majority of existing groundwater monitoring wells ranges between 584 and 598 feet NAVD 88; the Site slopes towards the Menominee River. The elevation of the Menominee River is closely tied to the elevation of Lake Michigan (NRT, June 2004) and ranges between 575 and 578 feet NAVD 88 under normal conditions. Surface water readings collected during sediment sampling in April 2012 averaged 576.16 feet.

1.2.5 Site Geology/Hydrology

The regional geology of the Marinette area consists of Paleozoic bedrock units of sedimentary deposits overlain by unconsolidated Quaternary deposits. The regional bedrock strata are a sequence of Cambrian sandstone underlying Ordovician dolomite, sandstone, and shale units. Precambrian crystalline rock underlies the sedimentary units (Oakes and Hamilton, 1973). The bedrock units dip to the southeast. Due to the dip and erosion, the younger rocks are exposed at the surface in the southeast (including the Site) and the older, Precambrian crystalline rocks are exposed in the northern part of Marinette County.

The Galena-Platteville formation, which is predominantly dolomite, is the uppermost Ordovician unit present in the area. Due to erosion and the southeast dip, this unit is present as a narrow band, approximately 5 to 15 miles wide, trending southwest-northeast along the western shore of Green Bay. Regional information and reported experience in construction of WWTP structures suggests the dolomite bedrock at the Site is not highly fractured. Oakes and Hamilton (1973) indicate the Galena, Decorah and Platteville dolomite can be a confining layer for artesian conditions in the underlying St. Peter Sandstone. The Quaternary deposits overlying the Paleozoic sequence of bedrock units near the Site are unconsolidated lake deposits. Other Quaternary deposits found in Marinette County include glacial till, glacial outwash sediments and ground and end moraine deposits. Quaternary deposits are generally less than 100 feet thick.

Four aquifer systems have been identified in the Marinette area (Oakes and Hamilton, 1973). These aquifers are: 1) the sand-and-gravel aquifer of the unconsolidated glacial deposits; 2) the Galena-Platteville aquifer; 3) the sandstone aquifer of the Ordovician and Cambrian bedrock; and 4) the crystalline bedrock aquifer. The sand and gravel aquifer is very thin and produces less than 100 gallons per minute (gpm) in the southern portion of Marinette County. Generally, groundwater flow in the Quaternary sand and gravel is toward rivers and streams eventually discharging into Green Bay (Lake Michigan). Recharge is local from precipitation and surface water bodies.

1.2.6 Surface Water Flow

The Menominee River at Marinette forms the boundary between the southern tip of Michigan's Upper Peninsula and Wisconsin's northeast boarder. The river is approximately 118 miles long and flows into Green Bay (Lake Michigan). The drainage area for the Menominee River is 4,070 square miles according to the USGS.

The USGS had a stream monitoring station (USGS 04067651) in the mouth of the river until October 1995. The average monthly flow rate from November 1994 through October 1995 was 3,078 cubic feet per second (cfs) with the greatest average monthly flow rate of 5,585 cfs occurring in May 1995 and the lowest average monthly flow rate 1,920 cfs occurring in February 1995. The average daily flow rate from November 1994 through October 1995 was 3,088 cfs.

Currently, the closest USGS stream monitoring station (USGS 04067500) to the Site is 18 miles upstream. The average monthly flow at this station from October 1994 till September 1995 was 2,795 cfs with the greatest average monthly flowrate of 5,429 cfs (May 1995) and the lowest average monthly flowrate of 1,854 cfs (February 1995). The average daily flow during this period was 2,802 cfs. The average monthly flow from September 2007 till September 2008 (most recent data) was 2,536 cfs with the greatest average monthly flow rate of 7,786 cfs (April 2008) and the lowest average monthly flow rate of 968 cfs (September 2007). The average daily flow during this period was 2,532 cfs. The 1978 Federal Emergency Management Agency (FEMA) map indicates the 100-year floodplain is at elevation 585 msl.

1.2.7 Site Investigation Summary

The Completion Report (NRT, 2009) contains a bibliography of the early reports and summaries issued for the Site. Site investigation and historical soil excavation activities associated with WWTP construction were previously undertaken since the late-1980s through the present. Investigations have focused on determining the presence of former MGP structures, identifying source areas and an initial groundwater assessment. Investigations included soil borings, test pits, surface soil samples (defined in Section 1.2.9), sediment samples, and groundwater sampling from monitoring wells and piezometers. Upland sample locations are shown on RI Figure 5, included in Appendix A1. Investigations were completed for specific objectives, and those completed for the various media are summarized below.

1989	Foth and Van Dyke (FVD) conducted a Site investigation including a soil and groundwater sampling program to document conditions prior to and following excavation of the Site for WWTP expansion. This work is described in various correspondences between FVD and WDNR. Both clean and MGP-affected areas were documented based on visual and olfactory evidence.
1991	STS conducted an investigation on Site for the City of Marinette involving installation and sampling eight soil borings (B-1 through B-8) and five monitoring wells (B-1 through B-5) to determine the extent of MGP-affected soil and groundwater. An additional 13 boring logs (B-5 through B-18) were provided by Twin City Testing as part of a geotechnical exploration program for the expansion of the WWTP. A potable well search was also performed for the surrounding area; including an assessment of the municipal water sources (STS, 1991).
June 1992	Robert E. Lee & Associates, Inc. conducted a Site investigation.
1994	NRT implemented a work plan developed by Simon Hydro-Search, Inc. to evaluate the lateral and vertical extent of remaining MGP-affected soil and groundwater on-site. Nine test pits (TP-301 through TP-309) were created and the soil was sampled. In addition, 20 soil borings (B-301 through B-320), three monitoring wells (MW-301, MW-302, and P-301), and 52 soil gas points (SGPs) were installed and sampled; and two HydroPunch samples (HP-301 and HP-302) were collected and analyzed (NRT, September 1994).
1996	NRT conducted a Phase II addendum investigation. Work including installing and sampling soil borings (SB-321 through SB-343) and monitoring wells (MW-303 through MW-307 and P-302 through P-304) (NRT, March 1996).
2002	NRT conducted groundwater sampling at the Site and performed a potable well search of the area, including an assessment of the municipal water source (NRT, August 2003).
2004	NRT installed and sampled three environmental soil borings (SB-1 through SB-3) and five geotechnical soil borings (SB-4 through SB-8) to assess the proposed boat launch expansion area (NRT, February 2004).

NATURAL RESOURCE TECHNOLOGY

2004	NRT installed and sampled three shallow monitoring wells (MW-308, MW-310, and MW-311) and one piezometer (P-305). Locations MW-308, MW-310 and P-305 were installed to monitor down-gradient groundwater quality and location MW-311 was installed to monitor groundwater quality within the former slough (NRT, September 2005).
November 2011	Ambient sediment sampling, poling, surface water sampling, river bathymetry
April 2012	Implement remaining sediment sampling
July 2012	NRT conducted an Upland RI field work including installation of three hand auger borings soil borings (SB343, SB344, and SB345), six soil borings (MW313/SB349, SB346, SB347, SB348, SB350 and SB351), two groundwater monitoring wells (MW312 and MW313) and twenty three soil gas probes. .
August 2012 to April 2013	Upland RI quarterly groundwater monitoring
October 2013 to February 2015	Resumed semi-annual groundwater monitoring
August 2012 and May 2013	Upland RI seasonal vapor sampling (inclement winter weather delayed the 2013 sampling event)
April 2014 and August 2014	NRT conducted a supplemental upland RI field work. The field work included completing five soil vapor sampling points (SG17SS, SG17D, SG18SS, SG18D, and SG19SS) in April 2014 and thirteen hand auger soil borings (SB358 through SB370) and five Geoprobe™ soil borings (SB352 through SB355, and SB357) in August 2014.
Semi-annually April 2013 through April 2015	Residual Sand Layer Monitoring

1.2.8 Previous Remedial Actions Performed

1.2.8.1 Historical Soil Excavation

MGP-affected soils were encountered during excavations for expansion of the WWTP in 1989. During construction activities, MGP-affected soil and groundwater were reported by the City to the WDNR. The City mandated no MGP-affected soil was to be left in place underneath the proposed WWTP structures (SHI, 1993). Thus, approximately 9,700 tons of MGP-affected soil encountered during construction activities were excavated and stockpiled on a lined holding pad until transported to and disposed of at the licensed Michigan Environs Landfill.

The approximate extent of MGP-affected and non-affected soil as delineated by Foth & Van Dyke, Inc. (FVD), during excavation for the WWTP expansion as shown on Figures 4 and 5 to illustrate spatial relationships to both past and present features. MGP-affected soil was determined based on visual and olfactory evidence only. Soil samples were not collected in affected areas and the extent of MGP-affected soil outside the limits of excavation were not defined at the time. MGP-affected soils were found in the five different areas identified on Figures 4 and 5 as discussed below.

Area 1: To install the WWTP effluent piping to the Menominee River to the north, the northwest portion of the property near Mann Street was excavated. The asphalt production plant on the north side and a large gravel pile on the south side confined this excavation to a relatively small area. The excavation crossed the north property line of the MGP and also crossed the former slough, which historically separated the former WWTP and the MGP property (Figure 4). According to FVD, the excavated soils were heavily MGP-affected; the excavated areas included the location of the 10,000-gallon tar/oil tank used in asphalt production located east of the former slough, and the former tar wells at the MGP located west of the former slough.

Area 2: According to FVD, the area extending from beneath the railroad tracks north toward the river was found to contain non-affected general debris. However, just south of the outfall headwall at the Menominee River, highly MGP-affected soils were present (Figure 4). Note the shoreline illustrated on the historical Site layout has changed over time; Figure 5 illustrates how Area 2 relates to the shoreline. According to construction maps, the effluent line was constructed west of the slough for most of the effluent line length (SHI, 1993). The shoreline was further excavated and capped with a reactive core mat (RCM) during the Non-Time Critical Removal Action (NTCRA) discussed in Section 1.2.8.2.

Area 3: Soil at the site of the former 50,000 ft^3 gas holder, now located partially under one of the primary clarifiers (Figure 5). The former gas holder, including its foundation, was completely removed during expansion of the WWTP. Excavation north of the structure was apparently constrained by the City's asphalt plant gravel pile.

Area 4: MGP-affected soil found in the eastern part of the former MGP property was identified in the area between the WWTP headworks and aeration basins (Figure 5). This area lies southeast of the former gas production building and intersects the slough. The east portion of this area was the site of fuel oil tanks used for the pumps at the City's former WWTP and the west portion of this area was in the vicinity of former MGP tar tanks shown on a 1935 Sanborn map (Figure 4).

Area 5: MGP-affected soil was identified south of the aeration basins and extending beneath one of the final clarifiers. Wood chips were also observed in this area. Soils affected by organic compounds do not likely extend under the aeration basins due to the extent of the excavation necessary to construct the aeration basins. However, residuals did extend south toward Ludington Street. Non-affected fill (e.g. debris, glass, and brick) was found southeast of this area under the adjacent final clarifiers. This area coincides with the former slough (former log run) south of the former MGP structures and the type of fill identified here indicates the City formerly used the area as a landfill.

Some of the WWTP construction excavations extended into bedrock. Reportedly, a clay layer was installed prior to construction above the bedrock. However, the conditions of the excavation base grades were not documented.

As previously noted, all of the aboveground and most of the below ground structures associated with the MGP were removed and/or destroyed by the City in the 1960s in preparation for the WWTP expansion. Below ground structures which may not have been removed/destroyed by later construction include the foundation of the former 300,000 ft^3 gas holder, which is located at the west edge of the property, partially under Ludington Street; the tar tank located on the north side of the gasification building; and the foundation of the gasification building. The soil boring for soil gas probe SG09 was completed in 2012 within the footprint of the former gas holder partially located under Ludington Street and did not encounter buried foundation or evidence of MGP residuals. A gravel pile for the City's asphalt plant covered the area of the oil tanks and gasification building at the time of the WWTP expansion in 1989.

In June 2004, the City began another sewer expansion project requiring excavation of additional soils on the former MGP property. Prior to the expansion, Ayres Associates, Inc. hired STS to conduct borings on the proposed alignment on behalf of the City. STS installed 12 borings (NRT, May 2009). Strong petroleum odor and areas of tar were noted in logs for boring B-28 through B-35. Typically, petroleum odors were noted below 14 feet below ground surface (bgs); however, B-29 had a strong odor starting at 3 feet bgs and B-30 at 6 feet bgs. During excavation activities for the sewer expansion, NRT assisted the excavation contractor with visually identifying MGP-affected soil. Excavation along the proposed sewer line extended from 3 to 7 feet bgs. Approximately 1,030 tons of MGP-affected soil were excavated during the sewer expansion project and disposed of at the Waste Management landfill in Menominee, Michigan.

In 2003, Ayers Associates, Inc. installed a boring in the excavation area for the new ramp at the boat launch and found no evidence of MGP residuals. However, NRT conducted a subsequent near-shore upland survey of the Boom Landing area (including three borings in the ramp excavation area and four geotechnical borings upstream along the shore) and found traces of MGP residuals in one boring in the excavation area. Because trace amounts of MGP residuals were discovered in the ramp excavation area, NRT provided a field person to assist the contractor, Phenco, Incorporated, in managing excavated soils with MGP residuals during ramp excavation and construction. A small amount of MGP residuals were encountered in an excavation for electrical lines. This material was drummed and disposed of at the Waste Management Landfill in Menominee, Michigan.

In October 2013, the City of Marinette completed utility maintenance and road improvements on Mann Street between the WWTP and Boom Landing. During these activities, approximately 187 tons of fill material with visual observations of MGP residuals was excavated from water and sewer lines crossing the former slough. This material was transported to the Waste Management Landfill in Menominee, Michigan for disposal.

1.2.8.2 Non-Time Critical Removal Action

Focused NAPL removal activities were performed during the NTCRA to remediate a portion of the Menominee River known to have historical impacts from the Former Marinette MGP. Activities were initiated on October 15, 2012 and substantially completed by March 25, 2013 (NRT, October 2013). During the NTCRA a total of 14,799 cubic yards (CY) of sediment were removed from the Menominee River in areas near the former MGP and offshore of the City of Marinette's Boom Landing Boat Launch. An additional 422 CY were removed for navigational purposes as part of an access agreement established between WPSC and an adjacent property owner, Nestegg Marine. The objective of the NTCRA was to mechanically excavate contaminated sediments in areas with elevated polynuclear aromatic hydrocarbon (PAH) concentrations and NAPL until post-dredge verification samples indicated the remaining sediments contained Total PAH(13) concentrations less than the remedial action level (RAL) of 22.8 milligrams per kilogram (mg/kg) and no visual NAPL remaining.

Despite multiple attempts by the dredging contractor, there were a few areas where sediment on the uneven bedrock surface could not be fully removed. This was due to multiple factors, including: irregularity of the bedrock surface, and the size and type of equipment used. Consequently, a total of approximately 12,250 square feet of sand (residual sand layer) with a minimum thickness of 10 inches was placed in areas where post-dredge verification samples showed residual Total PAH(13) concentrations greater than 22.8 mg/kg. Monitoring of the residual sand layer is discussed below with other sediment sample collection and results.

Dredging progressed upland into the shoreline in areas where NAPL was observed to be present. Due to upland land use and associated space constraints, not all upland NAPL was able to be removed. Consequently, RCM was placed along the shoreline in these areas to prevent future migration of upland NAPL into the river. This RCM extends out onto the river bed from the shoreline and covers some of the residual sediments on the irregular bedrock surface with concentrations of Total PAH(13) greater than 22.8 mg/kg. Upland excavation required removal and replacement of an existing sewer outfall structure on the shoreline. In this area, RCM was placed on the side slope of the upland excavation prior to backfill to prevent contamination of clean backfill adjacent to the replacement outfall structure.

Sediment removed from the river was mixed with stabilization additives on a geomembrane-lined, asphalt pad before being transported to the Waste Management Menominee, Michigan Landfill for disposal. Debris encountered during dredging activities and from removal of the former outfall structure was also disposed of at the aforementioned landfill under a separate waste profile. Sediment contact water collected at the stabilization pad was treated on a batch basis with an on-site treatment system in accordance with the substantive requirements of the Wisconsin Pollution Discharge Elimination System (WPDES).

1.2.9 Nature and Extent of Contamination

The Baseline Risk Assessment (BLRA) for the Former Marinette MGP Site was performed by Exponent in conformance with the RAF. The RAF addresses both human health and ecological risk assessment and was approved by USEPA in December 2007 (Exponent, September 2007). RAF addenda were prepared in 2011 and 2014 (Exponent, April 2011 & February 2014) to address changes to human health screening levels and vapor intrusion assessment guidelines since the RAF was developed in 2007. RAF Addendum 3 (Exponent, July 2014) continues to provide appropriate screening levels, as the November 2014 screening level update did not adjust screening levels for MGP COPCs.

A description of the nature and extent of contamination within each upland media of concern and associated constituents of concern are summarized in the following subsections. Unless otherwise noted, the nature and extent evaluation was performed through evaluation of media and locations exceeding the risk management range for the residential exposure scenario.

1.2.9.1 Soil

Soil data were used to perform evaluations related to human health only, because the lack of ecological habitat in the upland area made an evaluation of wildlife receptors unnecessary. The soil data were segregated into surface soils and subsurface soils. Soils collected from the top 2 feet of soil are referred to as surface soils. Subsurface soils were sampled at depths greater than 2 feet bgs. Additionally, samples collected beneath pavement, concrete, or gravel were also categorized as subsurface soil because of the presence of a barrier preventing human exposure. Soil data were also segregated into two areas based on current and potential future land use. The first area consists of samples in the Park District property north of Mann Street, including the parking lot and Boom Landing boat launch (labeled on the figures as “Boom Landing”). The second area consisted of all other samples taken on the WWTP and former MGP property (labeled on the figures as “WWTP”). BLRA conclusions with respect to soil include:

- Surface soils in Boom Landing and the WWTP were estimated to be associated with risks within the risk management range for an industrial worker, a construction worker, or for the limited exposure of a recreational visitor. Estimated risks will be above the risk management range under a hypothetical future residential scenario.

- Subsurface soils on the Boom Landing and WWTP properties do not currently pose a risk to human receptors, because they are not available for contact, but under the assumption of potential future exposure to these soils, estimated risks are above the risk management range for all receptors.

MGP residuals in soil occur at depths greater than 4 feet below ground surface and most observations of MGP residuals are closely associated with the footprint of the former slough (or former log run as indicated on Figure 4). Soil samples exceeding the risk based screening levels are often associated with the footprint of the former slough, observations of MGP residuals, and former MGP structures (Figures 6-1, 6-2, and 6-3).

Non-source areas identified on Figures 6-1, 6-2, and 6-3 were delineated based on exceedances of the specified cumulative risk target for each of the three evaluated cancer risks as tabulated in Appendix C1.

As discussed in the RI Report, one of the 2012 upland RI boring locations (SB347) encountered a 1.5-foot thick interval of black fill material exceeding soil screening levels (note: there was no oil coated or oil wetted material observed). Soil boring locations SB352, SB353, and SB354 were selected to refine the extent of soil contamination south of SB347. SB353 (located closest to SB347) was the only soil boring of the three borings (SB352, SB353, and SB354) to observe discolored fill material. The fill material was 0.2 feet thick and located at a similar depth as the discolored material from SB347. There were no elevated photoionization detector (PID) readings and the analytical results were much lower than those of SB347. Sample SB353 (3-5 feet) was collected from the same interval as the neighboring boring SB347 containing soil impacts and the results indicated a mixture of PAH ratios that do not match tar-like material; therefore, the soil impacts are from an unknown source. Sample SB353 (5-7 feet) collected just below the SB347 interval with impacts had PAH ratios more petrogenic, suggesting a heavy distillate fuel as a possible source. Supplemental investigation activities (soil borings and forensic analysis) suggest the black fill material observed at SB347 and the discolored material at SB353 is limited in extent and not derived from MGP operations.

1.2.9.2 Groundwater

Groundwater data from 2012 through 2013 were included for evaluation in the risk assessment. The groundwater data from Site wells were used to evaluate groundwater quality at the Site. The BLRA conclusions with respect to groundwater include:

- Groundwater at the Site is not a drinking water source. Groundwater is not usable as a drinking-water source as a result of numerous exceedances of the drinking-water standards. Potable water for the City of Marinette is obtained from the bay of Green Bay (Lake Michigan); therefore, it is unlikely Site groundwater will be considered a potential future source of drinking water. If future construction in the area entails workers having direct physical contact with groundwater or associated vapors in excavations at or below the water table, there will be some potential for risks above the risk management range where MGP residuals exist.

Groundwater plumes containing organic compounds as indicated by benzene, naphthalene, and benzo(a)pyrene have been delineated at the Site as presented in Figure 7. Concentration trends are stable (flat) or decreasing, except benzo(a)pyrene at MW311 and MW306. RI Figures 18 and 22 provided in Appendix A1 present the benzene and naphthalene plumes. The benzo(a)pyrene plume developed for Figure 7 was prepared using averaged concentrations for January 2013 through April 2014 (RI Table 8 included in Appendix A2).

The RI concluded conditions are favorable for monitored natural attenuation (MNA) as supported by a reducing environment with anaerobic degradation occurring through methanogenesis within the groundwater contaminant plume.

Sample analysis of bedrock groundwater has not indicated exceedances of constituents of concern (COCs). Manganese, which is monitored for MNA, is the only compound detected in bedrock groundwater above a screening level. The relatively low concentrations of COCs in bedrock wells and observations of low groundwater recovery in the deeper piezometers support observations discussed in the RI Report, indicating bedrock at depth behaves like an aquitard at the Site.

1.2.9.3 Sediment

As discussed in BLRA Section 2.3.4, no sediment data were evaluated for the human health risk assessment because all areas of potential exposure were remediated between October 2012 to March 2013. Specifically, the NTCRA included removal of MGP-affected sediments with Total PAH(13) concentration higher than the RAL of 22.8 mg/kg. A residual sand layer with a minimum thickness of 10 inches was placed in areas where post-dredge verification samples showed residual Total PAH(13) concentrations greater than the RAL of 22.8 mg/kg. RCM was placed along the shoreline in areas where NAPL was not accessible in order to prevent future migration of upland NAPL into the river. BLRA conclusions with respect to sediment are:

- Prior to the NTCRA, there were localized areas of surface sediments estimated to pose a risk to sensitive ecological receptors. In these areas, water depth will generally minimize the potential for human exposure to the sediments. These sediments have been removed to the extent practical. A small area where bedrock prevented further dredging has been covered with a minimum of 10 inches of sand. Because of the NTCRA and the placement of the residual sand layer, human and ecological receptors under current conditions do not have the potential for exposure to MGP-affected sediments. Following 2 years of monitoring, results of sand layer sampling meet the conditions for monitoring to cease until the Five-Year Review as described in the approved Residual Sand Cover Monitoring Plan (NRT, 2013).

As a result of the NTCRA, sediment is not a media of concern.

1.2.9.4 Surface Water

Surface water samples were collected from the Menominee River prior to the NTCRA in 2012. BLRA conclusions with respect to surface water are:

- Prior to the NTCRA, surface water samples were collected to evaluate if contaminated sediments were impacting the water quality. The surface water quality was not found to pose a health concern to either human or ecological receptors based on screening assessments performed on these data; further, the NTCRA would have improved the current water quality.

Therefore, surface water is not a media of concern.

1.2.9.5 Soil Gas

Soil gas data were collected in August 2012, May 2013, April 2014, and August 2014; the BLRA conclusions with respect to soil gas include:

- For soil gas underneath the WWTP Vehicle Storage building, estimated risks were within the risk management range under a residential scenario, and no COCs were identified under the current industrial scenario.
- For soil gas samples collected directly beneath or near the Service Building, all results were within or below the risk management range under the current industrial scenario. Under a hypothetical residential scenario, one sample (SG18SS, sub-slab) had a noncancer hazard above the risk management criterion during the first sampling event (4/3/2014), driven by 1,2,4-trimethylbenzene.
- For soil gas samples collected in Boom Landing or the WWTP in areas where no buildings currently are present, estimated risks for either a hypothetical future industrial building or residence were within the risk management range except for a single location in the WWTP (SG05).
- Construction workers exposed to soil gases in excavations are not expected to be exposed to chemical concentrations in air above the risk management range unless MGP residuals are encountered.

Collectively considering the results of the soil gas sampling performed on-site, if construction workers performed maintenance or redevelopment activities involving excavations, the air quality in the excavation is not be expected to pose a health concern due to chemical concentrations in air. Based on the low concentrations of COCs in soil gas, other than in an isolated location (SG05) in the WWTP area, the concentrations of chemicals in air inside an excavation are expected to be low as well, considering the amount of dilution occuring when soil gas is mixed with ambient air.

1.2.10 Summary of Media-Specific Constituents of Concern

Based on the conclusions of the RI and BLRA, soil, groundwater, and soil gas were retained as media of concern. Additionally, the media-specific COCs for the Site are summarized in Table B.

Table B Summary of COCs in Soil, Groundwater, and Soil Gas

Risk Level / Constituents of Concern (COCs)	Soil [3]		Groundwater [4]	Soil Gas [5]
	$CR>1\times10^{-4}$ HQ>1	$CR>1\times10^{-5}$; HQ>1 $CR>1\times10^{-6}$; HQ>1		$CR>1\times10^{-4}$; HQ>1 $CR>1\times10^{-5}$; HQ>1 $CR>1\times10^{-6}$; HQ>1
Benzene	---	x	x	x
Ethylbenzene	x	x	x	x
Xylenes, total	x	x	x	x
Benz[a]anthracene	x	x	---	---
Benzo[a]pyrene	x	x	x	---
Benzo[b]fluoranthene	x	x	x	---
Benzo[k]fluoranthene	x	x	---	---
Dibenz[a,h]anthracene	x	x	---	---
Indeno[1,2,3-cd]pyrene	x	x	---	---
1-Methylnaphthalene	---	x	---	---
2-Methylnaphthalene	x	x	---	---
Chrysene	---	x	x	---
Naphthalene	x	x	x	x
1,2,4-Trimethylbenzene	---	---	---	x

Notes:

1) CR = Cancer Risk
2) HQ = hazard quotient
3) Soil COCs are the same for cancer risks of 1×10^{-5} and of 1×10^{-6}
4) Groundwater risks were not calculated and so the list herein reflects analytes exceeding a screening criteria. No COCs were identified based on human health risk assessment in surface water or sediment of the Menominee River considering the completed sediment remediation.
5) COCs in soil gas are the same for cancer risks of 1×10^{-4}, $1\times10^{-5,}$ and of 1×10^{-6}

In addition to the COCs for soil media with a cancer risk level of 1×10^{-4}, the following COCs apply to cancer risks level of 1×10^{-5} and 1×10^{-6}: benzene, chrysene, 1-Methylnaphthalene, and 1,2,4-Trimethylbenzene. The COCs for soil gas are the same for cancer risks levels of 1×10^{-4}, 1×10^{-5}, and 1×10^{-6}.

2 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The remedial action objectives were developed to address the potential Site risk to human health and the environment as noted in the BLRA.

2.1 Summary of Baseline Risk Assessment

The BLRA evaluated soil, groundwater, sediment, surface water, and soil gas data against appropriate screening levels identified in the Multi-Site Risk Assessment Framework (RAF, Exponent, 2007) and the RAF Addenda. The BLRA was included in Appendix L of the RI Report. The potential human receptors and the associated exposure pathways are graphically presented in the Conceptual Site Model (RI Figure 30, included in Appendix A1) and summarized below:

2.1.1 Human Health Receptors

The BLRA evaluated the current and potential future land uses at the Site. Under current and potential future land-use conditions at the Site, the potential human receptors and the associated exposure pathways include:

- **Industrial or commercial workers:**
    - Incidental ingestion of soil (surface and subsurface)
    - Dermal contact with soil (surface and subsurface) as a result of soil disturbance
    - Inhalation of vapors and dusts as a result of soil disturbance
    - Inhalation of vapors as a result of vapor intrusion from visual observations of MGP residuals and groundwater into commercial/industrial buildings on the Site
    - Ingestion of groundwater
    - Dermal contact with groundwater
- **Construction workers:**
    - Incidental ingestion of soil (surface and total) and groundwater associated with excavation activities
    - Dermal contact with soil and groundwater associated with excavation activities

    - Inhalation of vapors and dust derived from soil and groundwater associated with excavation activities

- **Recreational visitors:**
    - Incidental ingestion of surface soil
    - Dermal contact with surface soil

- **Residents** (under a hypothetical future land-use scenario, including the unlikely possibility of significant disturbance of subsurface soils):
    - Incidental ingestion of soil (surface and subsurface)
    - Dermal contact with soil (surface and subsurface) as a result of soil disturbance
    - Inhalation of vapors and dust as a result of soil disturbance
    - Inhalation of vapors as a result of vapor intrusion from subsurface soils and groundwater into a future residential building constructed on the Site
    - Ingestion of groundwater
    - Dermal contact with groundwater

The applicability of each of these receptors is addressed in the following subsections by medium. The preamble to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states: “EPA’s risk range of 10^{-4} to 10^{-6} represents EPA’s opinion on what are generally acceptable levels” (55 Federal Register 8665-8865, March 8, 1990). As a result, cancer risks in the range of 10^{-4} to 10^{-6} are labeled as being within the risk management range. Similarly, a USEPA memorandum titled *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* states: “Records of Decision for remedial actions taken at sites posing risks within the 10^{-4} to 10^{-6} risk range must explain why remedial action is warranted” (USEPA, 1991). The USEPA memorandum also indicates non-carcinogenic hazard quotients less than one represent generally acceptable levels. Ultimately, USEPA will select the most appropriate carcinogenic and non-carcinogenic risks for the Site as part of the FS process.

2.1.2 Potential Human Health Risks

Results of the BLRA are summarized below:

- **Soil:** The calculations of cancer risks and hazard quotients used to develop cumulative risks are based solely on COC concentrations. These calculations do not account for potential reductions in risk resulting from sufficient thickness of unimpacted overburden soil, presence of an existing barrier (concrete floor slabs/pavement), or other controls which successfully remove the exposure pathway and reduce risk. The following bullets provide a qualitative discussion of the reduction of risks based on the current Site conditions:

- Surface soils in Boom Landing and the WWTP were estimated to be associated with risks within the risk management range for an industrial worker, a construction worker, or for the limited exposure of a recreational visitor. Estimated risks will be above the risk management range under a hypothetical future residential scenario.
- Subsurface soils on the Boom Landing and WWTP properties do not currently pose a risk to human receptors, because they are not available for contact, but under the assumption of potential future exposure to these soils, estimated risks are above the risk management range for all receptors.

- **Groundwater:**
  - Groundwater at the Site is not usable as a drinking water source as a result of numerous exceedances of the drinking water standards. Potable water for the City of Marinette is obtained from the bay of Green Bay (Lake Michigan); therefore, it is unlikely Site groundwater will be considered a potential future source of drinking water. If future construction in the area will result in workers having direct physical contact with groundwater or associated vapors in excavations at or below the water table, there will be some potential for risks above the risk management range due to the presence of MGP residuals.
  - Groundwater results indicate benzene and naphthalene plumes are stable or decreasing in all Site monitoring wells; and, natural attenuation indicator parameters indicate favorable conditions for MNA.

- **Sediment and Surface Water:**
  - There is no risk associated with sediment and surface water as discussed in BLRA because remedies including dredging and covering have been installed to address the contamination in sediments.

- **Soil Gas:**
  - For soil gas samples collected directly beneath or near the Service Building, all results were within or below the risk management range under the current industrial scenario. Under a hypothetical residential scenario, one sample (SG18SS, sub-slab) had a non-cancer hazard above the risk management criterion during the first sampling event (April 2014), driven by 1,2,4-trimethylbenzene (the second sampling event (August 2014) was below the risk management criterion).
  - For soil gas samples collected in Boom Landing or the WWTP in areas where no buildings currently are present, estimated risks for either a hypothetical future industrial building or residence were within the respective risk management ranges except for a single location in the WWTP (SG05).

2.1.3 Ecological Receptors and Risk

- **Upland:**
  - The BLRA evaluated the ecological risks at the Site and concluded the upland area of the Site does not support habitat for ecological receptors due to the developed nature of the properties, consistent with the commercial/industrial zoning of the land. Therefore, the upland portion of the Site did not require further ecological evaluation.

- **Sediment:**
  - Prior to the NTCRA, there were localized areas of surface sediments estimated to pose a risk to sensitive ecological receptors. These sediments have been removed to the extent practical. A small area where bedrock prevented further dredging has been covered with 10 inches of sand. Because of the NTCRA and the placement of the residual sand layer, ecological receptors under current conditions do not have the potential for exposure to MGP-affected sediments. Following 2 years of monitoring, results of sand layer sampling meet the conditions for monitoring to cease until the 5-year review, as described in the approved Residual Sand Cover Monitoring Plan (NRT, September 2013).

2.2 Applicable or Relevant and Appropriate Requirements

Section 121 of CERCLA requires, subject to specified exceptions, remedial actions be protective of human health and the environment. In addition, remedial actions performed under the Superfund program must be undertaken in compliance both state and federal Applicable or Relevant and Appropriate Requirements (ARAR). The NCP defines applicable requirements as:

> "…those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

The NCP defines relevant and appropriate requirements as:

> "…those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate."

In addition to ARARs, the USEPA may identify other relevant information, criteria, or guidance to be considered (TBC). TBCs may not be legally binding or enforceable but may be useful for consideration when developing remedial alternatives. Both ARARs and TBCs may be chemical-specific, location-specific, or action-specific. Table 1 summarizes preliminary federal and state ARARs and TBCs. The ARARs and TBCs may be modified until a Record of Decision (ROD) is issued and may be reexamined during the five-year review process.

2.2.1 Chemical-specific ARARs

Chemical-specific ARARs are generally health or risk based standards defining concentration limits for environmental media or discharges. These requirements may be used to set cleanup levels for constituents of concern in environmental media.

2.2.2 Location-specific ARARs

Location-specific ARARs are based on the Site's characteristics or location including natural Site features such as wetlands, floodplains, and endangered or threatened species and habitats. Location-specific ARARs may also apply to man-made features such as cultural resource areas.

2.2.3 Action-specific ARARs

Action-specific ARARs are technology-based or activity-based limits used to guide implementation of the remedial action or how remedial waste may be handled.

2.2.4 ARARs Waiver

CERCLA Section 121(d) allows the selection of an alternative not attaining ARAR status if any of five conditions for an ARAR waiver exist. The selected alternative must be protective of human and ecological health even if an ARAR is waived. These conditions are summarized below:

- **Interim Measure** – A waiver may be obtained for interim measures not fully meeting ARARs, as long as the interim measures are followed by more comprehensive remedial measures that will attain the ARARs.
- **Greater Risk to Human Health and the Environment** – remedial action meeting an ARAR but resulting in greater risk than an alternative not meeting that ARAR.
- **Technical Impracticability -** This waiver may be obtained if achieving the specified ARARs within a reasonable time period is not feasible or reliable from an engineering perspective.
- **Equivalent Standard of Performance -** The action selected will result in a standard of performance equivalent to an applicable requirement through the use of another method or approach.
- **Inconsistent Application of State Requirements -** A state requirement has not been equitably applied in similar circumstances on other clearance actions with the state.

2.3 Preliminary Remediation Goals

Preliminary remediation goals (PRGs) are long-term target goals used during analysis, evaluation, and implementation of remedial alternatives. Achieving the PRGs through remedial action will result in protection of human health and the environment. The PRGs for soil, groundwater and soil gas, and sediment are provided below. It is USEPA's discretion to choose the cancer risk USEPA deems appropriate at a given site within the cancer risks of 10^{-4}, 10^{-5}, and 10^{-6}.

2.3.1 Soil PRGs

The proposed PRGs for soil are generally based on USEPA default exposure parameters and factors representing reasonable maximum exposure conditions for long-term/chronic exposures for cancer risks of 10^{-4}, 10^{-5}, and 10^{-6} with a corresponding hazard quotient of 1 under a hypothetical residential exposure scenario. As specified by the WDNR's *Update to RR-890 and RCL Spreadsheet* (WDNR, June 2014) certain USEPA default exposure parameters were modified to match current WDNR requirements. The PRGs were developed based on the most recent toxicity values included in the USEPA November 2014 Regional Screening Level web calculator. A summary of the calculator inputs and results are included in Appendix C2. As noted in the below table, where the laboratory practical quantification limit (PQL) was higher than the risk based level, the PRG selection defaulted to the PQL value. A summary of the petroleum volatile organic compound (PVOC) and PAH COCs, and the proposed PRGs for the varying risk values are presented in Table C.

Table C Proposed PRGs for Soil

Constituents of Concern	CR>1×10^{-4}; HQ>1	CR>1×10^{-5}; HQ>1	CR>1×10^{-6}; HQ>1
PVOCs (mg/kg)			
Benzene	---	14.9 ^{ca}	1.49 ^{ca}
Ethylbenzene	747 ^{ca}	74.7 ^{ca}	7.47 ^{ca}
Xylenes, total	983 ^{nc}	983 ^{nc}	983 ^{nc}
PAHs (mg/kg)			
Benz[a]anthracene	14.8 ^{ca}	1.48 ^{ca}	0.148 ^{ca}
Benzo[a]pyrene	1.48 ^{ca}	0.148 ^{ca}	0.017 ^{pql}
Benzo[b]fluoranthene	14.8 ^{ca}	1.48 ^{ca}	0.148 ^{ca}
Benzo[k]fluoranthene	148 ^{ca}	14.8 ^{ca}	1.48 ^{ca}
Chrysene	---	148 ^{ca}	14.8 ^{ca}
Dibenz[a,h]anthracene	1.48 ^{ca}	0.148 ^{ca}	0.017 ^{pql}
Indeno[1,2,3-cd]pyrene	14.8 ^{ca}	1.48 ^{ca}	0.148 ^{ca}
1-Methylnaphthalene	---	156 ^{ca}	15.6 ^{ca}

Constituents of Concern	CR>1×10^{-4}; HQ>1	CR>1×10^{-5}; HQ>1	CR>1×10^{-6}; HQ>1
2-Methylnaphthalene	229 ^{nc}	229 ^{nc}	229 ^{nc}
Naphthalene	188 ^{nc}	51.5 ^{ca}	5.15 ^{ca}

Notes:
CR - Carcinogenic Risk
HQ - Hazard Quotient Risk
ca - Carcinogenic Risk Based
nc - Noncarcinogenic Risk Based
pql - Practical Quantification Limit Based

During implementation of a remedy, flexibility will be provided to modify the above PRGs by conducting a post remedy risk assessment following the RAF Framework. If the post remedy risk assessment concludes cumulative Site risk is below the target cancer risk and noncancer hazard index for the targeted exposure scenario, no additional remedial action will be required.

2.3.2 Groundwater PRGs

USEPA Tap-Water regional screening levels (RSLs) are a screening tool and are not appropriate or enforceable cleanup levels. As a result, the selected groundwater PRGs will be based on enforceable federal or state groundwater standards. For groundwater at the Site, the PRGs will be the more conservative of Wisconsin NR 140 Groundwater Enforcement Standard (NR 140) or the National Primary Drinking Water Regulations Maximum Contaminant Level (MCL) as presented in the Multi-Site Risk Assessment Framework Addendum Revision 3 (Exponent, July 2014). A summary of the COCs and the associated PRGs for groundwater is presented in the below Table D.

Table D Proposed PRGs for Groundwater

Constituents of Concern	PRG (µg/L)	Basis of PRG
PVOCs		
Benzene	5	MCL and NR 140
Ethylbenzene	700	MCL and NR 140
Total Xylenes	2,000	NR 140
PAHs		
Benzo[a]pyrene	0.2	MCL and NR 140
Benzo[b]fluoranthene	0.2	NR 140
Chrysene	0.2	NR 140
Naphthalene	100	NR 140

The extent of MGP-affected groundwater is defined on Figure 7.

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2.3.3 Sediment and Surface Water

As a result of the NTCRA, sediment is not a media of concern. Therefore, the post-dredge surface concentrations are currently monitored, as defined in the Residual Sand Cover Monitoring Plan (NRT, September 2013).

2.3.4 Soil Gas

PRGs were not developed for soil gas or indoor because the BLRA concluded the vapor intrusion pathway is incomplete for the current industrial/commercial land use (Exponent, 2015). If the integrity or configuration of existing structures is modified, or if new structures are constructed over visual observations of MGP residuals in soil or MGP-affected groundwater, then a revised risk evaluation will be required.

2.4 Remedial Action Objectives

RAOs describe goal(s) the proposed remedial action is expected to accomplish. RAOs for the Site were developed to protect human health and environmental receptors from unacceptable risk resulting from former MGP operations at the Site. An RAO provides a basis to evaluate the process options discussed in Section 3 and the remedial alternatives evaluated in Sections 4 through 7. RAOs for the Site were developed to protect human health receptors from unacceptable risk resulting from former MGP operations at the Site. The RAOs address current and reasonably anticipated future land use.

- **Soil/Soil Vapor**
  - **RAO-1 -** Prevent human exposure (dermal, incidental ingestion of particulates, and vapor) to subsurface soil containing MGP-related contaminants presenting unacceptable carcinogenic risks ranges as defined by the PRGs.
- **Groundwater**
  - **RAO-2** - Prevent human exposure, including dermal contact, ingestion, and inhalation (as a result of vapor intrusion) of groundwater containing MGP residuals exceeding the PRGs.
  - **RAO-3** - Restore groundwater to PRGs for MGP-related constituents within a reasonable timeframe.
  - **RAO-4 -** Minimize, to the extent practicable, the potential for migration of groundwater with MGP-related constituents above the PRGs to surface water.
- **Sediment**
  - **RAO-5 -** Demonstrate post-dredge sand layer is present in accordance with the Residual Sand Cover Monitoring Plan dated September 27, 2013.

2.5 Areas and Volumes of Contaminated Media

Areas and volumes of contaminated media likely requiring remedial action were estimated based on the areas of the Site containing COCs which exceed of the cumulative risk threshold at the Site. The areas and volumes of contaminated media presented in this subsection were based on the analytical sampling results of the RI, and should be considered approximations for planning level purposes. Depending on the selected remedy, pre-design investigations may be beneficial to further refine the areas and volumes of known contamination prior to final design and subsequent implementation of remedial measures.

2.5.1 Soil

FS-level analysis of sites with a relatively uniform depth and/or concentration of MGP-affected soil are typically evaluated using a site-wide approach. This approach results in evaluation of one remedial alternative to address all MGP-affected soil at the Site. MGP-affected soil at Marinette with observations of MGP residuals is not spatially continuous and remediation of soil at the Site is complicated further by physical and administrative access constraints.

To allow for a selection of the most appropriate comprehensive soil remedy, MGP-affected soil at the Site has been divided into two zones: Boom Landing Zone and WWTP Zone, separated by the railroad as shown on Figures 6-1 through 6-3. These zones were developed in order to combine areas with shared land ownership and/or similar physical access limitations. MGP-affected soil within each remediation zone is categorized as source areas and non-sources areas. MGP residuals are more frequently observed in the source area in Boom Landing zone than in WWTP zone. Non-source areas were delineated based on exceedances of the specified cumulative risk target for each of the three evaluated cancer risks (Appendix C1).

The soil remedial area and quantity estimates were based on locations of visual MGP residuals in soil (source material) and analytical exceedances (non-source material). Figures 6-1 through Figure 6-3 respectively present the approximate extent of MGP residuals in soil and distribution of soils with residential cancer risks exceeding $1{\times}10^{-4}$, $1{\times}10^{-5}$, and $1{\times}10^{-6}$ or a hazard quotient exceeding 1.0. The horizontal delineation of soil exceeding the target cancer risk was estimated by evaluating the location of adjacent borings with no risk-based exceedances or visual observations of MGP residuals as well as by the location of previously excavated soil. The vertical delineation of soil within the horizontally delineated area was estimated by evaluating the top and bottom of risk-based exceedances, top and bottom of source material within a delineated area, and/or the location other confining features (former MGP structure floors, confining clay, etc.). The horizontal and vertical delineation within each Area and the estimated resulting volumes are presented in Table 2.

Remedy alternatives assume the following for soil volumes:

- Excavation volumes for removing soil to a certain cancer risk level or hazard quotient include the full depth of soil for source and non-source areas. The excavated material is either disposed off-site or thermally treated and disposed on-site. Excavation within the railroad right-of-way was not considered due to the complexity of obtaining access agreements.

- Volume estimates for in-situ chemical treatment include soil with the targeted cancer risk level or hazard quotient from 5 feet bgs and deeper, followed by excavation and disposal of the upper five feet of soil (0 to 5 feet bgs). In-situ chemical treatment was considered for the source areas in Boom Landing and WWTP zones and the non-source area in Boom Landing zone.

- Volume estimates for air sparging/soil vapor extraction (SVE) include full-depth treatment of soil with the targeted cancer risk level or hazard quotient. Although air sparging has limited effectiveness for treating MGP residuals, treatment was considered as requested by USEPA Specific Comment 31 on the Alternatives Array (provided in the transmittal letter for this FS).

Preliminary volume estimates are only approximations of the volume of impacted material based on the samples results presented in the RI Report. Refinement and/or modification of the preliminary estimate approach will be required based on the scope and purpose of each of the alternatives. For example, in areas where the top of the cumulative risk exceedance is several feet below grade, removal or treatment of the overburden material may be required to implement a particular remedial technology. Section 4, Table 2, and the cost estimates included in Appendix B1 were developed to account for removal or treatment of overburden material, as necessary, based on the methods available to implement each alternative.

2.5.2 Groundwater

In shallow groundwater, PAH compounds detected above the PRGs, ranked by number of exceedances, are: chrysene, benzo[a]pyrene, benzo[b]fluoranthene and naphthalene. MGP-affected groundwater at the Site generally consists of a smaller naphthalene plume (primarily driven by MW311), which is encompassed by a larger benzene plume (primarily driven by MW302, MW304, and MW311) and benzo(a)pyrene plume (primarily driven by MW307R, MW310, MW302, MW305, and MW306).

Naphthalene has been detected at very low levels at the Site monitoring locations, but has only been observed above the PRG in two wells (MW311 and MW306). The naphthalene PRG has not been exceeded in MW306 since 2009.

As indicated in the RI, benzene and ethylbenzene are the only (PVOCs) exhibiting exceedances in shallow or bedrock groundwater since 2004. Benzene was selected as the representative COC because it was detected more frequently than ethylbenzene (32 to 3 respectively) and is commonly considered an indicator parameter representative of PVOC exceedances in groundwater. Analytical results are summarized on RI Table 10, provided in Appendix A2.

The PAH COCs include benzo(a)pyrene, benz(b)fluoranthene, and chrysene. Benzo(a)pyrene, was selected as the representative COC because it was detected as frequently than the other COCs and was detected in the same number of wells as other PAH COCs.

For purposes of this analysis, the surface area of MGP-affected groundwater requiring remedial action is defined by the composite plume of the benzene and naphthalene plume from April 2014 and benzo(a)pyrene plume from January 2013 through April 2014, as shown on Figure 7.

In bedrock groundwater, no PAH compounds were detected above the groundwater PRGs. The relatively low concentrations of COCs in bedrock wells and observations of low groundwater recovery in the deeper piezometers support the observations discussed in the RI, indicating bedrock at depth behaves like an aquatard at the Site.

2.5.3 Soil Gas

The BLRA concluded the vapor intrusion pathway is currently incomplete based on the current industrial/commercial land use (Exponent, 2015). Current land use (WWTP and boat landing) is anticipated to remain the same in the foreseeable future. As a result, determination of a surface area and volume of vapor requiring remedial action is not necessary.

2.5.4 Sediment and Surface Water

As a result of the NTCRA, sediment and surface water are not media of concern. The residual sand layer surface concentrations are currently monitored, as defined in the Residual Sand Cover Monitoring Plan dated September 27, 2013 (NRT, September 2013).

3 DEVELOPMENT AND SCREENING OF TECHNOLOGIES

3.1 General Response Actions (GRAs)

General Response Actions (GRAs) identified in the Multi-Site FS Support Document describe those actions satisfying the RAOs. In developing alternatives, combinations of GRAs may be identified. GRAs and associated technology types include:

- **Soil:**
  - **No-Further Action** - Provides a baseline for comparison with other alternatives and is required by the NCP.
  - **Institutional Controls** - Minimizes human exposure to MGP-affected soil through administrative controls, but does not address reducing toxicity, mobility, or volume.
  - **Containment (engineered barriers)** - Engineered barriers to limit or control the migration/mobility of MGP-affected soil beyond the present boundary into adjacent areas but does not contribute to reducing toxicity or volume.
  - **In-Situ Approaches (chemical and enhanced biological)** - Use processes implemented while the MGP-affected soil remains in place (in-situ) to reduce the toxicity, mobility, or volume.
  - **Ex-Situ Approaches (excavation/off-site disposal and excavation/on-site treatment/on-site disposal)** - Use processes implemented while the MGP-affected soil is removed (ex-situ) to reduce the toxicity, mobility, or volume.
- **Groundwater:**
  - **No-Further Action** - Provides a baseline for comparison with other alternatives and is required by the NCP.
  - **Institutional Controls** - Minimizes human exposure to MGP-affected media but does not address reducing toxicity, mobility, or volume of MGP-affected groundwater.
  - **Monitored Recovery** - Use and monitoring of natural degradation processes to reduce toxicity, mobility, or volume of MGP-affected groundwater.
  - **Containment (physical or gradient control)** - Limits or controls the migration/mobility of MGP-affected groundwater beyond the present boundary into adjacent areas but does not contribute to reducing toxicity or volume.
  - **In-Situ Approaches (chemical and enhanced biological)** – Use processes implemented while the MGP-affected groundwater remains in place (in-situ) to reduce the toxicity, mobility, or volume

- **Soil Gas:**
  - **No-Further Action** - Provides a baseline for comparison with other alternatives and is required by the NCP
  - **Institutional Controls** - Minimizes human exposure through administrative controls, but does not address reducing toxicity, mobility, or volume.
- **Sediment:**
  - **No-Further Action** - Provides a baseline for comparison with other alternatives and is required by the NCP.
  - **Institutional Controls** - Minimizes human exposure to MGP-affected sediment through administrative controls, but does not address reducing toxicity, mobility, or volume.
  - **Monitoring** - Monitoring the existing remedies to demonstrate the effectiveness of the remedy to reduce toxicity, mobility, or volume MGP-affected sediment

Each of these alternatives were compared with the RAOs. GRAs presented in the support document are considered generally acceptable for most MGP scenarios but may not always be applicable based on site-specific assessments. Table 3 includes the rationale for eliminating or carrying forward remedial options based on the potential capability to meet the RAOs, either individually or in combination with other remedial options.

3.2 Identification and Screening of Technology Types and Process Options

The media-specific remedial options associated with the GRAs retained after initial screening were further evaluated against following criteria (in order):

- **Implementability**: This criterion addresses the technical and administrative feasibility of implementing the technology as well as the availability of contractors and materials, the potential Site constraints (on- and off-site), the difficulties monitoring the effectiveness of the process option, and agency coordination or permits.
- **Effectiveness**: This criterion evaluated the ability of a technology to achieve the RAOs and to provide long-term protection of human health and the environment. Potential short-term impacts to human health and the environment, and the reliability of the technology are also evaluated.
- **Cost**: This criterion utilizes engineering judgment to develop relative estimated costs of each technology for a given RAO.

Technically implementable remedial options were retained for further evaluation. Cost alone is not considered a primary criterion for eliminating a technology type or process option unless the cost

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ramifications deviate significantly from cost considerations for other options. The results of the technology type and process option screening are presented in Table 4-1 through 4-4.

3.3 Remedial Alternatives Retained for Detailed Analysis

As discussed in Section 2.5.1, MGP-affected soil in the Boom Landing and WWTP zones was further delineated into source areas or non-source areas. This approach was selected to evaluate remedial alternatives based on the unique surface features and extent of contamination present in each zone. The process options screening presented in Section 3.2 was performed to screen out technologies not applicable or appropriate for addressing MGP-affected soil. Additional screening of the soil process options presented in Table 5 accounts for the unique effectiveness and implementability considerations for each area of MGP-affected soil at the Site.

The array of media-specific technology types and process options meeting the screening criteria are provided in Table 6. Detailed descriptions and analysis of the retained remedial alternatives for soil, groundwater, soil gas, and sediment are presented in Sections 4 through 7. The objective of the detailed analysis is to present sufficient remedial alternative descriptions and evaluations to allow for adequate comparison and selection of the most appropriate remedy. In addition, the detailed descriptions of the alternatives discuss the various cost estimate assumptions for each alternative. The details of the selected remedy will be refined through the remedial design phase.

In accordance with CERCLA Section 121, the NCP, and USEPA Remedial Investigation and Feasibility Study (RI/FS) guidance, remedial alternatives are assessed against seven evaluation criteria. These criteria include the following two threshold criteria and five balancing criteria:

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 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 (O&M) costs of each alternative. Present worth costs, using a 7% 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, will be sufficient to cover all costs associated with remedial action over its planned life. 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 alternative are in Appendix B 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 O&M costs, if applicable.

  - A 10% bid contingency and 15% scope contingency on construction capital costs to account for unforeseen project complexities such as adverse weather, unexpected subsurface conditions increased standby times, etc.

  Consistent with USEPA’s request for the North Shore Gas Former South Plant MGP, present worth costs were calculated using a real discount rate of 7%. This discount rate is the static non-federally funded site discount rate prescribed in USEPA's July 2000 A Guide for Developing and Documenting Cost Estimates During the Feasibility Study for sites. Federally-funded sites are allowed to use discount rates developed by the Office of Management and Budget, which are updated annually to reflect current economic conditions. The real discount rate for federally funded-sites in 2000, when the guidance document was published, was 4.2% for a 30-year analysis. Based on current (2015) economic conditions, the Office of Management and Budget suggests 1.4% is the appropriate real discount rate for 30-year present worth analysis.

  Due to the fixed discount rate (7%) approach, required for non-federally funded sites, the present worth estimates in this FS Report may underestimate the actual total O&M costs for remedial alternatives. The magnitude of the underestimation in total O&M costs will vary based on the magnitude of annual O&M costs and the projected duration of the remedial alternative.

In accordance with USEPA direction provided during a February 27, 2015 meeting on the Former Manitowoc MGP FS, alternatives presented in this FS are individually selectable by media. In addition, areas of soil requiring remedial action were segregated into zones and evaluated independently to allow USEPA to select the most appropriate soil remedy. Costs do not account for other compatible remedial actions occurring in other areas or zones on-site. As a result, there is potential for duplication of costs when assembling alternatives into a comprehensive Site-wide alternative. For example, if chemical treatment was selected for the Boom Landing and WWTP Zones, the cost for mobilizing equipment will be shared between zones. Further, costs for bench-scale and pilot-scale work will be shared between zones.

The degree to which duplicating costs will result in overestimation of the total cost for a Site-wide alternative cannot be accurately estimated in this FS Report. If the comprehensive Site-wide alternative selected by USEPA involves similar or complementary media-specific alternatives, the magnitude of the overestimation of cost could be significant. Conversely, if the comprehensive Site-wide alternative selected by USEPA involves alternatives requiring multiple specialty contractors, the overestimation of costs will likely be minimal.

Modifying Criteria

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 the 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.

The detailed descriptions of retained alternatives for each evaluated media are presented in the following sections.

4 DETAILED ANALYSIS OF SOIL REMEDIAL ALTERNATIVES

The objective of the detailed analysis is to present sufficient information to adequately compare the remedial alternatives so an appropriate remedy may be selected in order to prevent human exposure to soil containing MGP-related contaminants above PRGs, thereby addressing RAO-1.

The selection of a PRGs based on cancer risks of 10^{-4}, 10^{-5}, or 10^{-6} does not have a significant effect on the overall remedial approach for each alternative, but does have an effect on the surface area and volume of soil requiring remedial action. Modification of surface area and volume of MGP-affected soil associated with the varying cancer risks does not have a significant effect on the evaluation of an alternative against the Overall Protection of Human Health and the Environment, Compliance with ARARs, Long-Term Effectiveness and Permanence, Reduction of Toxicity, Mobility, or Volume through Treatment, Short-Term Effectiveness, or Implementability criteria. Accordingly, the comparison of each alternative against the preceding criteria is reflective of the three cancer risks being evaluated in this FS. The modification of surface area and volume of soil requiring remedial action does have an effect on the cost of each remedial alternative. As a result, the cost criterion presents costs associated with achieving a cancer risks of 10^{-4}, 10^{-5}, and 10^{-6}.

4.1 Soil Remedial Alternatives

This section presents detailed descriptions and analysis of the soil remedial alternatives developed and retained in Section 3, which include:

- S1 - No-Further Action
- S2 - Institutional Controls
- S3 - Horizontal Engineered Surface Barriers
- S4 - In-Situ Chemical Treatment
- S5a - Excavation and Off-Site Disposal
- S5b - Excavation and On-Site Treatment/On-Site Disposal
- S6 - Air Sparging/SVE

4.1.1 S1 – No-Further Action

Consistent with NCP requirements, a No-Further Action alternative is considered. This alternative does not include remediation or monitoring to minimize potential exposures to source and non-source material at the Site. The No-Further Action alternative will be used as a baseline for comparisons of other remedial alternatives. In accordance with CERCLA, Site reviews will be performed every five years for Alternative S1.

4.1.2 S2 – Institutional Controls

Alternative S2 will rely on non-engineered administrative and legal controls to minimize human exposure to source material and soil containing COCs above the PRGs. WDNR's Geographic Information System (GIS) Registry will be the mechanism for restricting soil disturbance. Requirements, limitations, or conditions relating to soil disturbance for sites listed on the WDNR GIS database are required to be met by all property owners [Wisconsin Statutes Section 292.12(5)]. In effect, the statute makes the GIS database conditions be maintained for a property, regardless of changes in ownership. A violation of Section 292.12 is enforceable under Wisconsin Statutes Sections 292.93 and 292.99.

The areas subject to institutional controls are summarized in Table 2 and indicated in Figure 6-1 to 6-3. Area of source material is based on visual observations of oil-coated and oil-wetted material within the remedial investigation soil borings. Non-source material areas are based on exceedances of the PRGs presented in Section 2.3.1.

A Soil Management Plan will be required to describe proper management of subsurface soil disturbed in the event of future Site development, utility repairs, or other intrusive activities. The WDNR GIS Registry may restrict future building construction or require specific construction methods to limit potential exposure. Further, the WDNR GIS Registry may be used to require future buildings be constructed with vapor intrusion mitigation barriers. Institutional controls combine land use restrictions and intrusive activity restrictions to minimize the potential for human exposure to source material and COCs above PRGs, thereby addressing remedial action objective RAO-1.

An Institutional Controls Implementation Plan (ICIP) will be developed to detail land-use restrictions and document procedures for effectively implementing institutional controls. For cost estimating purposes, institutional controls will be assessed during the Five-Year Reviews for a duration of 30 years.

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4.1.3 S3 – Horizontal Engineered Surface Barriers

Alternative S3 will involve maintenance of existing surface barriers, which are currently successful at limiting human exposure to source material and soil containing COCs above the PRGs. In addition, a barrier will be constructed over Site locations where MGP-affected soil containing COCs above the PRGs and is not covered by an existing surface barrier of sufficient thickness or unaffected overburden soil. For the purposes of this FS evaluation, it is assumed the newly constructed barriers will require excavation of up to two feet of surface soil, which will be replaced with clean material to provide a sufficient barrier to human exposure. Additional barrier approaches, including barriers constructed using asphalt or concrete, will be evaluated in the remedial design phase of the project. The areas requiring installation and maintenance of a surface barrier are summarized in Table 2 and indicated on Figure 6-1 to 6-3. Presumptive elements of Alternative S3 include:

- Maintaining the existing concrete, asphalt pavement, or soil barriers.
- Maintaining existing building slabs.
- Excavating the top two feet of surface soil with COCs above PRGs, excluding the existing structures and pavement. Excavated material will be disposed off-site and replaced with clean backfill. Backfilled material will be graded to match to the surrounding elevations and vegetated.
- Implementing institutional controls (Alternative S2).

Implementation of Alternative S3 will minimize the potential for human expose to source material and COCs above PRGs, thereby addressing remedial action objective RAO-1.

4.1.4 S4 – In-Situ Chemical Treatment

Alternative S4 involves introduction of chemical oxidants into the subsurface to degrade COCs in MGP-affected soil to less toxic or inert compounds. In-situ chemical treatment of MGP-affected soil can be achieved through chemical injection or soil mixing. Due to the difficulty of accessing soil and source material beneath the existing structures, utilities, and other improvements, chemical injection is considered the only viable option for in-situ chemical treatment.

The most common chemical oxidants include ozone, hydrogen peroxide, sodium persulfate, and permanganate. For FS-level analysis and cost estimation purposes, a hydrogen peroxide-based oxidant was selected. This selection was made based on the proven ability of hydrogen peroxide to address MGP related source material. It is assumed hydrogen peroxide will be catalyzed by the simultaneous injection of ferrous iron to improve the oxidation potential, thereby improving the performance of the in-situ chemical treatment system. Due to the aggressive nature of the catalyzed hydrogen peroxide reaction, reaction byproducts often will transition to the vapor phase. These byproducts are typically captured using vent wells and vapor recovery systems installed throughout treatment zone. Other oxidants, such as ozone, sodium persulfate, or permanganate, may be considered during the design phase.

In-situ chemical treatment is only effective when oxidant is in direct contact with MGP-affected soil. Achieving sufficient distribution of oxidant in the zero to five foot below ground surface interval cannot be implemented with a reasonable degree of certainty, as the injected oxidant typically surfaces rather than laterally dispersing. As a result, if there is MGP-affected soil in the top five feet of a treatment zone, the soil is typically excavated following conclusion of injection activities. It is not possible to excavate or treat the MGP-affected soil directly beneath the current structures in WWTP zone. As a result, in-situ chemical treatment is only being evaluated as to address source and non-source areas in Boom Landing zone and the source areas in WWTP zone. In-situ chemical treatment will not be evaluated to address non-source areas in WWTP zone. Institutional controls similar to those described for Alternative S2 in Section 4.1.2, will be required for soil beneath buildings that cannot be addressed by in-situ chemical treatment.

In-situ chemical treatment using injection typically involves overlapping injection points spaced at approximately 15-feet. These overlapping injections will target the treatment intervals for each zone, as presented in Table 2 and on Figures 6-1 through Figure 6-3.

Presumptive elements of Alternative S4 are summarized below and have been used successfully at similar former MGP sites. Future refinement of injection locations, chemical oxidants, and vapor mitigation systems will be analyzed during the remedial design phase.

Presumptive elements of Alternative S4 include the following elements:

- Performing a predesign investigation to further define horizontal and vertical extent of contamination and collecting samples for bench-scale testing.
- Performing bench-scale testing of Site soils with varying types and percentages of reagents to determine the most effective oxidant for the Site.
- Performing a small-scale pilot study to verify injection assumptions and develop solutions to potential operational issues associated with full-scale implementation.
- Installation of injection wells using direct push technology. Wells will be installed in an approximate 15-foot grid over the target treatment area.

- Installation of vapor mitigation wells using direct push technology. Vapor mitigation wells are anticipated to be constructed at a ratio of approximately one vapor mitigation well for every four injection wells.

- Injection of catalyzed hydrogen peroxide, matching the target concentration determined during the bench- and pilot-scale tasks. For FS-level cost estimating purposes, an estimated 20 pounds of 34% hydrogen peroxide solution will be required for every pound of contaminant mass being remediated. The 34% hydrogen peroxide solution will be diluted with water to approximately a 9% solution prior to subsurface injections.

- Frequent monitoring of subsurface soil, groundwater, and vapor to assess oxidant performance and provide information to guide modifications to injection procedures.

- Implementation of institutional controls (Alternative S2) for soil beneath buildings or other surface or subsurface improvements that cannot be addressed.

Injection activities are anticipated to occur continuously until source material and affected soil is remediated. Confirmation samples will be collected throughout the horizontal and vertical extent of the treatment zone to verify the success of the chemical treatment activities. The laboratory results from confirmation sampling will be analyzed using the most recent version of USEPA's ProUCL statistical software package to determine the 95th Percent Upper Confidence Limit (UCL) of the mean for each analyte. Additional remedial action will be performed until the 95th Percent UCL value for each COC meets its respective PRG. Additional details related to development of a statistically valid sampling approach and details related to the 95th Percent UCL statistical model will be provided in the remedial design phase of the project.

Implementation of Alternative S4 will minimize the potential for human expose to source material and COCs above PRGs, thereby addressing remedial action objective RAO-1.

4.1.5 S5a – Excavation and Off-Site Disposal

Alternative S5a will involve excavation and off-site disposal of source material and soil containing COCs above PRGs. Excavation extent and depth will vary with the varying cancer risks being evaluated in this FS, as presented on Table 2 and Figures 6-1 through 6-3.

Presumptive major elements of Alternative S5a include:

- Predesign investigation to further define horizontal and vertical extent of excavation and provide waste characterization sampling.

- Access agreements and demolition/removal of the parking lot, fish house, utilities and existing concrete and asphalt pavements in Boom Landing zone.

- Temporary utility relocating and clearing and grubbing source areas in the WWTP zone. Full-depth excavation of non-source areas in the WWTP zone will not be practical due to the presence of WWTP process units and will not be evaluated.
- Temporary shoring, as necessary to support deeper excavations associated with cancer risks of 10^{-4}, 10^{-5},or 10^{-6}.
- Temporary dewatering to lower the water table within the excavation footprint.
- Excavate MGP-affected soil and transport to a Subtitle D Landfill.
- Backfill of excavation to surrounding grades and Site restoration
- Implementation of institutional controls (Alternative S2), if excavation activities do not achieve soil PRGs.

Implementation of Alternative S5a will minimize the potential for human expose to source material and COCs above PRGs, thereby addressing remedial action objective RAO-1.

4.1.6 S5b – Excavation and On-Site Treatment/On-Site Disposal

Alternative S5b will involve excavation of source material and soil containing COCs above PRGs. The soil will be treated on-site via a mobile thermal desorption treatment unit. Before thermal treatment, debris greater than 2 inches in diameter must be crushed or separated from material to be treated. Debris may include concrete, wood waste, or other material excavated from the Boom Landing and WWTP zones. Medium Temperature Thermal Desorption (MTTD) mobile thermal treatment is commonly implemented at MGP sites in the Midwest. MTTD is effective at addressing volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and other COCs. MTTD will be the presumptive method of treatment for Alternative S5b. Thermal desorption used to MGP-affected soil from source and non-source areas in the Boom Landing zone and the source area in the WWTP zone. The treated soil will be reused on-site to backfill excavations.

Excavation extent and depth will vary with the varying cancer risks being evaluated in this FS, as presented on Figures 6-1 through 6-3 and Table 7-1 to 7-3.

Presumptive major elements of Alternative S5b include:

- Perform predesign investigation to further define horizontal and vertical extent of excavation and provide waste characterization sampling.
- Access agreements and demolition/removal of the parking lot, fish house, utilities, and existing concrete and asphalt pavements in Boom Landing zone.

- Temporary utility relocating and clearing and grubbing source areas in WWTP zone. Excavation will not be practical and will not be evaluated for the non-source area in WWTP zone.
- A mobile unit and ancillary equipment will be set up at Marinette Central Broadcasting's property within Boom Landing Zone because inadequate space is available in WWTP zone.
- Staging areas for excavated soil will be sequenced in the Boom Landing zone to accommodate remedial activities.
- Temporary shoring, as necessary to support deeper excavations associated with cancer risks of 10^{-4}, 10^{-5}, or 10^{-6}.
- Temporary dewatering to lower the water table within the excavation footprint.
- Backfill of excavation with thermally treated soil to surrounding grades and Site restoration.
- Implementation of institutional controls (Alternative S2), if excavation activities do not achieve soil PRGs.

Implementation of Alternative S5b will minimize the potential for human expose to source material and COCs above PRGs, thereby addressing remedial action objective RAO-1.

4.1.7 S6 – Air Sparing/Soil Vapor Extraction

Alternative S6 involves injection of air into the saturated zone to remediate volatile or biodegradable containments. Volatilized contaminants will be removed from the subsurface using a soil vapor recovery system. This soil vapor recovery system is also effective at removing volatile constituents from the vadose zone. Major components typical to air sparing include a compressor which supplies air through a manifold distribution system into air sparge/injection wells within the saturated interval. Major components typical to SVE system include vadose zone recovery wells, which are connected to a water/air separator (knock-out pot), a blower to pull a vacuum, and associated carbon or oxidizer to recover contaminants from vapor stream prior to discharge.

Remediation extent and depth will vary with different cancer risks being evaluated in this FS, as shown on Table 2 and Figures 6-1 to 6-3

Presumptive major elements of Alternative S6 include:

- Predesign investigation to further define the permeability and structure of the soil for placement and spacing of air sparging/SVE points.
- Installation of air sparging/SVE wells. Wells will be installed in an approximate 15-foot grid over the target treatment area.
- Construction of an air sparging/SVE system, generally consisting of compressors, blowers, condensate knock-out pots, and vapor treatment systems.

- Frequent monitoring of subsurface soil, groundwater, and vapor to assess system performance and provide information to guide modifications to procedures, as necessary.
- Extraction and sparging well abandonment and restoration of Site to surrounding grades.
- Implementation of institutional controls (Alternative S2) if soil PRGs are not achieved and for soil beneath buildings or other surface or subsurface improvements that cannot be addressed.

Remedial action objective RAO-1 will be achieved in non-source areas in 7 years or operation of the air sparging/SVE will cease because it may no longer influence COC degradation. Source areas will present challenges to meeting RAO-1 due to the low volatility of MGP residuals.

4.2 Soil Detailed Analysis of Remedial Alternatives

Potential remedial alternatives for soil were evaluated in this section in accordance with the threshold criteria, primary balancing criteria, and modifying criteria.

4.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is applied to evaluate if the alternatives adequately protect human health and the environment. Table E presents an evaluation of the overall protection of human health and the environment for each soil remedial alternative.

Table E Soil Remedial Alternatives Evaluation of Overall Protection of Human Health and the Environment

Remedial Technology	Overall Protection of Human Health and the Environment
S1 No-Further Action	Does not include remediation or monitoring to minimize potential exposures to source or non-source material. Therefore, it will not protect human health and the environment for the Site.
S2 Institutional Controls	Partially protective of human health in the short-term and long-term in Boom Landing and WWTP zones because most of the MGP-affected soil is currently restricted by the presence of pavement or building floor slabs. ICs will restrict or limit land use and prevent intrusive activities without necessary controls, thereby reducing exposure and addressing RAO-1. However, Alternative S2 does not involve removal or construction of a barrier to protect against exposure to affected surface soil in locations where barrier does not currently exist. Therefore, Alternative S2 is partially protective of the human health and the environment.

Remedial Technology	Overall Protection of Human Health and the Environment
S3 Horizontal Engineered Surface Barriers	Protective of human health in the short-term and long-term under either the current Site conditions and anticipated future Site conditions in Boom Landing and WWTP zones. Preventing direct contact, ingestion, and inhalation of source material and soil with COCs above PRGs through maintenance of existing asphalt, concrete, and soil barriers, coupled with implementation of soil institutional controls will be protective of human health and the environment.
S4 In-Situ Chemical Treatment	Protective of human health and environment by chemically oxidizing source material to inert or less harmful compounds, resulting in remediation of soil to PRGs, thereby achieving RAO-1. Treatment of source material will also reduce the potential risk to future construction workers performing excavations at the Site.
S5a Excavation an Off-Site Disposal	Protective of human health and the environment in the long-term under current Site conditions or hypothetical future residential use in Boom Landing and WWTP zones. Source and non-source material will be removed from the Boom Landing and source material will be removed from WWTP, thereby fully addressing RAO-1.
S5b Excavation and On-Site Thermal Treatment/On-Site Disposal	Alternative S5b will be protective of human health and the environment in the long-term under either the current Site conditions or anticipated future Site conditions in both Boom Landing Zone and WWTP zone. Source material and soil containing COCs above PRGs will be excavated from Boom Landing and source material will be removed from WWTP. Excavated material will be thermally treated and backfilled, thereby addressing fully addressing RAO-1.
S6 Air Sparging/SVE	Alternative S6 will be protective of human health and environment by addressing volatile COCs in soil, thereby making progress toward achieving RAO-1. Treatment of source material may reduce the potential risk to future construction workers performing excavations at the Site. Fully meeting RAO-1 in source areas will likely require a technology better at addressing MGP residuals.

4.2.2 Compliance with ARARs

Alternative S1 (no-further action) will not comply with or attain compliance with soil ARARs identified in Table 1. Alternative S2 (institutional controls) will partially comply with soil ARARs. Most of the surface soils (as defined in Section 1.2.9) exceed residential cancer risk of 10^{-4}. Therefore, institutional controls for soil will require implementation of a compatible remedy, such as a horizontal engineered surface barrier, to attain compliance with the soil ARARs. Alternatives S3 through S6 (horizontal engineered surface barriers, in-situ chemical treatment, excavation and off-site disposal, excavation and treatment/on-site disposal, and air sparging/SVE) fully comply with and attain soil ARARs.

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4.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence focuses on the evaluation of the extent and effectiveness of each alternative. This criterion consists of two components: evaluation of magnitude or residual risk and adequacy and reliability of controls. Table F presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table F Soil Remedial Alternatives Evaluation of Long-term Effectiveness and Permanence

Remedial Technology	Long-term Effectiveness and Permanence	
	Magnitude of Residual Risk	**Adequacy and Reliability of Controls**
S1 No-Further Action	• Does not reduce potential risk to human health or the environment.	• No remedial action will be taken.
S2 Institutional Controls	• Source material and MGP-affected soil will remain in-place; however, ICs will reduce the potential risk to human health or the environment by restricting land use and intrusive activities. • Does not involve removal or construction of a barrier to protect against exposure to affected surface soil in locations where barrier does not currently exist.	• Provides long-term effectiveness and prevents exposure to source and non-source material by restricting land use and intrusive activities. • The conditions of the GIS Registry are maintained for a property, regardless of future changes in ownership.
S3 Horizontal Engineered Surface Barriers	• Source and non-source material will remain in-place; however, surface barriers will prevent human and ecological exposure, thereby reducing risk. • Alternative S3 will have long-term effectiveness and permanence when combined with the institutional controls presented in Alternative S2.	• Barriers and institutional controls will minimize human exposure to MGP-affected soil. • Ongoing monitoring and maintenance of barriers is easily implemented and will promote remedy reliability.
S4 In-Situ Chemical Treatment	• Alternative S4 will oxidize and treat source material and MGP-affected soil into inert or less toxic compounds, thereby reducing risk. Chemical treatment is capable of addressing COCs present in the soil. • Addressing source material and MGP-affected soil will remove the source of groundwater impacts, thereby improving future groundwater conditions.	• The oxidation reaction is permanent; however, there is potential for source material to rebound following initial oxidant injection activities, as the subsurface attenuates to natural conditions. As a result, there is a potential long-term risk and the associated potential for rebounding source material.

Remedial Technology	Long-term Effectiveness and Permanence	
	Magnitude of Residual Risk	Adequacy and Reliability of Controls
S5a Excavation and Off-Site Disposal	• Removal of source material and soil containing COCs above PRGs will eliminate direct contact, ingestion, and inhalation pathways. • Will fully remove risk where excavation is implementable. Some residual risk remaining in locations where source material and MGP-affected soil cannot be removed, such as the WWTP non-source areas.	• Alternative S5 is adequate and reliable because source material and soil containing COCs above PRGs will be removed. • Long-term management of the zones which can be fully excavated will not be necessary. ICs will be required for areas of the Site that cannot be fully excavated, such as the WWTP non-source areas.
S5b Excavation and On-Site Thermal Treatment/On-Site Disposal	• MTTD systems are highly effective at addressing PAHs, SVOCs, and VOCs. • Will fully remove risk where excavation and treatment is implementable. Some residual risk remaining in locations where source material and MGP-affected soil cannot be removed , such as the WWTP non-source areas.	• Alternative S5b is adequate and reliable because source material and soil containing COCs above PRGs will be removed. • Long-term management of the zones will not be necessary. Institutional controls will be required for areas of the Site that cannot be fully excavated, such as the WWTP non-source areas.
S6 Air Sparging/SVE	• Highly effective at addressing volatile COCs. Moderately effective at addressing naphthalene, and minimally effective at addressing remaining PAHs. • Remaining risk will be moderate and related to PAHs in source areas, which are unlikely to be fully addressed by Alternative S6.	• Air Sparing/SVE permanently removes volatile/strippable COCs from the subsurface. • The remaining PAHs may experience some biodegradation resulting from increased dissolved oxygen, however, this biodegradation is not expected to be significant enough to achieve the PRGs in source areas.

4.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment is applied to evaluate if the alternative can successfully reduce the principal threat wastes at the Site through destruction of contaminants, reduction of the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The analysis factors of this criterion are: treatment process used and materials treated, amount of material destroyed or treated, degree of expected reductions and treatment irreversibility, and type and quantity of residuals remaining. Table G presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table G Soil Remedial Alternatives Evaluation of Reduction of Toxicity, Mobility, or Volume Through Treatment

Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used	**Amount of Material Destroyed or Treated and Degree of Expected Reductions**	**Treatment Irreversibility**	**Type and Quantity of Residuals Remaining**
S1 No-Further Action	• None	• None	• None	• None
S2 Institutional Controls	• Relies on non-engineering controls. No active remediation is implemented. • No special requirements for the treatment process.	• None	• None	• None
S3 Horizontal Engineered Surface Barriers	• Relies on existing surface barriers and constructed surface barriers. • No special requirements for the treatment process (excavated soils will be disposed at an off-site landfill).	• Where there is no existing pavement or buildings, the top two feet of MGP-affected surface soil will be removed, reducing the volume of COCs above PRGs in surface soil.	• The existing and constructed surface barriers are removable; however, ICs will require maintenance and restrict modification of barriers.	• Contaminated material remains in place, except the surface soil excavated and replaced with clean backfill.
S4 In-Situ Chemical Treatment	• Involves chemically oxidizing source material and MGP-affected soil in Boom Landing zone, and source material in WWTP zone.	• Treating soil will result in reduction of contaminant mass, toxicity, mobility and volume.	• Although the oxidation of the contaminants is considered irreversible, there is potential for rebounding source material.	• There will be little to no source and non-source material remaining in the Boom Landing zone and little to no source material in the WWTP zone. Non-source material is not targeted in the WWTP zone.

Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used	Amount of Material Destroyed or Treated and Degree of Expected Reductions	Treatment Irreversibility	Type and Quantity of Residuals Remaining
S5a Excavation and Off-Site Disposal	• Source material and MGP-affected soil in Boom Landing zone and source material in WWTP zone will be excavated and hauled off-site for disposal at an approved landfill.	• Areas of soil removal result in full reduction of contaminant mass, toxicity, mobility, and volume.	• Excavation and off-site disposal will irreversibly reduce the volume of MGP-affected media at the Site.	• Excavation will fully remove MGP-affected soil. • Non-source material in the WWTP will require another remedial alternative.
S5b Excavation and On-Site Thermal Treatment/ On-Site Disposal	• Source material and MGP-affected soil in Boom Landing zone and source material in WWTP zone will be excavated and thermally treated. • Relies on thermal desorption process. • Requires a vapor treatment system. • Treated soil will be reused on-site in excavation areas.	• Thermal treatment systems are highly effective at addressing PAHs, VOCs, and SVOCs.	• Irreversible.	• Excavation will fully remove MGP-affected soil. • Non-source material in the WWTP will require another remedial technology.
S6 Air Sparging/ SVE	• A vacuum is applied to extraction wells to remove volatile contaminants from the vadose (unsaturated) zone. • May need a groundwater extraction system to prevent groundwater from raising and getting drawn into the vacuum extraction system.	• Will effectively remediate PVOCs. • Limited effectiveness at remediating PAHs.	• PVOC removal will be irreversible.	• The majority of PAHs are expected to remain within source areas.

4.2.5 Short-Term Effectiveness

Under short-term effectiveness criterion, each alternative is evaluated based on their effects on human health and the environment during implementation of the remedial action. The analysis factors of this criterion are: protection of community and workers during remediation, environmental impacts, and time until RAOs are achieved. Table H presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table H Soil Remedial Alternatives Evaluation of Short-term Effectiveness

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
S1 No-Further Action	• Does not present short-term risks to the community or workers during implementation because no remedial action is taken.	• No short-term impacts to the environment as the result of implementing this remedy.	• RAOs will not be achieved.
S2 Institutional Controls	• Will not present short-term risks to the community or workers because no intrusive remedial action will be taken.	• No short-term impacts to the environment.	• In combination with other remedial alternatives, ICs will achieve RAO-1. • Relies on the WDNR GIS Registry. Listing the property on the WDNR GIS Registry is estimated to take up to six months.
S3 Horizontal Engineered Surface Barriers	• The potential for community and construction worker exposure to MGP-affected soil under this alternative is moderate and can be control through best management practices (e.g., dust control) and adhering to task-specific health and safety procedures (e.g., personal protective equipment and observing appropriate practices for designated safety zones).	• During the intrusive activities associated with Alternative S3 dust and VOCs will be emitted from MGP-affected soil and will have a negative impact on the environment. However, the emissions can be controlled through best management practices (e.g., dust control).	• RAO-1 is achieved with existing barriers, installation of additional surface barriers, and institutional controls (Alternative S2). • For cost estimating and comparison purposes, implementation is assumed to take approximately 6 months.

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Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	**Environmental Impacts**	**Time Until RAOs Are Achieved**
S4 In-Situ Chemical Treatment	• Will potentially generate fugitive emissions and release vapors to the atmosphere during chemical treatment. As a result, construction workers and nearby building occupants will potentially be exposed to airborne contaminants. These exposures can be controlled through best management practices, engineering controls, and adhering to task-specific health and safety procedures (e.g., personal protective equipment and observing appropriate practices for designated safety zones). • Alternative S4 will involve handling large quantities of hazardous oxidizing chemicals, but hazards can be eliminated through safety procedures.	• During the intrusive activities, dust and VOCs will emitted from MGP-affected soil and will have a negative impact on the environment. However the emissions can be controlled through best management practices (e.g., dust control).	• For cost estimating and comparison purposes, it is assumed implementation will be approximately 18 to 30 months.

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	**Environmental Impacts**	**Time Until RAOs Are Achieved**
S5a Excavation and Off-Site Disposal	• Soil excavation will potentially create direct contact exposure to fugitive volatile organic emissions and nuisance odors. • Transporting MGP-affected soil to a landfill creates a short-term impact on the communities due to increased truck traffic, noise, and the potential for increased traffic accidents. • Risks can be minimized through best management practices (e.g., misting to minimize dust and odors) and covering trucks when transporting soil to the landfill. • Depending on the selected cancer risk, excavation could require shoring to reach approximately 15 feet bgs. As a result, there are increased risks associated with damage to surround infrastructure and increased risks to construction workers involved installation of shoring and entering a deep excavation.	• During the intrusive activities, dust and VOCs will emitted from MGP-affected soil and will have a negative impact on the environment. However the emissions can be controlled through best management practices (e.g., dust control).	• For cost estimating and comparison purposes, it is assumed implementation will occur over 12 to 18 months, depending on volume and complexity of the treatment zone.

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
S5b Excavation and On-Site Thermal Treatment/ On-Site Disposal	• Soil excavation will create the potential for direct contact exposure to fugitive volatile organic emissions and nuisance odors. • Risks can be minimized through best management practices (e.g., misting to minimize dust and odors) • Depending on the selected cancer risk, excavation could require shoring to reach approximately 15 feet bgs. As a result, there are increased risks associated with damage to surround infrastructure and increased risks to construction workers involved installation of shoring and entering a deep excavation.	• During the intrusive activities, dust and VOCs emitted from MGP-affected soil and will have a negative impact on the environment. However the emissions can be controlled through best management practices (e.g., dust control).	• For cost estimating and comparison purposes, it is assumed implementation will range between 18 and 24 months, depending on volume and complexity of the treatment area.

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Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	**Environmental Impacts**	**Time Until RAOs Are Achieved**
S6 Air Sparging/ SVE	• Will potentially generate fugitive emissions and release vapors to the atmosphere during air sparging/SVE operations. As a result, construction workers and nearby building occupants will have the potential exposure to airborne contaminants. • Potential worker hazards related to operations of a thermal oxidizer, which is typically used to treat the recovered vapors. • These exposures can be controlled through best management practices, engineering controls, and adhering to task-specific health and safety procedures (e.g., personal protective equipment and observing appropriate practices for designated safety zones). • Vapor treatment typically involves use of a thermal oxidizer to destroy removed COCs.	• During the intrusive activities and operations, dust and VOCs emitted from MGP-affected soil and will have a negative impact on the environment. However the emissions can be controlled through best management practices (e.g., dust control).	• For cost estimating and comparison purposes, it is assumed progress will be assessed after seven years. Source material and PAHs are expected to exceed PRGs and will likely need to be addressed with an alternate technology.

4.2.6 Implementability

Implementability criterion focuses on the technical and administrative feasibility and the availability of various services and materials during the implementation of each remedial action. The analysis factors of this criterion are: ability to construct and operate technology and reliability of technology and ability to monitor effectiveness of remedy, availability of services and materials, ease of undertaking additional remedial actions if necessary, and ability to coordinate and obtain approvals from other agencies. Table I presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table I Soil Remedial Alternatives Evaluation of Implementability

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
S1 No-Further Action	• Easily implemented because there are no activities to perform.	• There is no remedial action.	• There is no remedial action.	• Agency approval is achievable where risk is within the risk management range.
S2 Institutional Controls	• Technically and administratively implementable.	• WDNR GIS Registry	• Footprint of land controlled through ICs is easily expanded and can be easily supplemented with other remedial alternatives.	• Mechanisms for land-use controls and restrictive measures are established through WDNR GIS Registry.
S3 Horizontal Engineered Surface Barriers	• Technically implementable. Extent of the engineered barrier is easily adjustable, should the location of remedial action be modified through additional sampling and final design. • Effectiveness of the barrier will be monitored using visual inspection methods.	• Qualified contractors and materials are readily available.	• Footprint of barriers is easily expanded and can be supplemented with other remedial alternatives.	• Barriers have been included as part of remedial action at many former MGP sites throughout Wisconsin and are a proven and reliable approach.

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
S4 In-Situ Chemical Treatment	• Technically implementable. Oxidant delivery method is an important factor. Debris could be a potential obstacle to effective treatment because preferential pathways or barriers may be present within the subsurface resulting in uneven oxidant distribution. Contaminant concentrations may rebound after initial injection activities, and additional oxidant applications may be required to meet the treatment objectives. • Requires coordination of injection and vapor recovery infrastructure. Typically, injection points are located on a 15-foot grid, so there is limited flexibility to accommodate access restrictions within a desired treatment zone. Limited flexibility to adjust injection points is not a concern in Boom Landing zone but will be a challenge on the WWTP property. • Treatment effectiveness can be monitored in a number of ways and through multiple media sampling such as: groundwater sampling from monitoring wells; soil sampling; and soil vapor sampling from monitoring wells and vapor mitigation wells.	• Multiple vendors and contractors provide in-situ chemical treatment products, design, construction, and operation, allowing for an array of options and competitive pricing.	• Footprint of treatment can be expanded, so long as Site improvements do not restrict injections. • Typically applied alone and sometimes used to partially degrade some organics as an aid to subsequent biodegradation.	• Approved for implementation at many MGP sites with varying degree of success. Adequacy and reliability to treat COCs will depend on the degree to which the oxidant is dispersed in the subsurface and debris encountered. • Typically requires obtaining a Underground Injection Control Permit.

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
S5a Excavation and Off-Site Disposal	• Technically implementable. Previous excavations have been performed on-site during the expansion of the City WWTP. • Construction of temporary shoring and operation of a dewatering system will be required under the 10^{-5} and 10^{-6} cancer risk scenario due to the depth of excavation • Effectiveness of excavation activities can be determined through confirmation sampling and landfill scale tickets documenting the mass of impacted soil transported off-site. No long-term effectiveness monitoring is required for excavation activities.	• Qualified contractors and materials are readily available	• Horizontal and vertical extent of excavation is easily adjusted to accommodate field conditions encountered during implementation in Boom Landing zone but will be a potential concern to excavate the source area in WWTP zone. • Can be easily combined with other remedial alternatives.	• Approved by regulatory agencies as the primary remedy at several MGP sites and is a proven and reliable approach.
S5b Excavation and On-Site Thermal Treatment/ On-Site Disposal	• Same as Alternative S5a in addition to the following: • Potential concern for assigning enough room for a thermal treatment plant and temporary area for excavated soil. • Potential concern with regard to the limited production rate of MTTD treatment, estimated at 350 cubic yards per day. • Requires separation and off-site disposal of large debris that cannot be treated by thermal desorption plant. • The effectiveness of the Alternative S5b can be determined through confirmation sampling of treated soil.	• Qualified contractors and equipment are readily available. • Multiple vendors and contractors provide on-site thermal desorption system.	• It will not be difficult to adjust the horizontal and vertical extent of excavation to accommodate differing field conditions during implementation in Boom Landing zone but will be a potential concern to excavate the source area in WWTP property. • Typically applied alone and may be used to partially degrade some organics as an aid to subsequent biodegradation.	Approved by regulatory agencies as the primary remedy at several MGP sites and is a proven and reliable approach.

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
S6 Air Sparging/ SVE	• Technically implementable for addressing volatile COCs • Requires coordination of injection and vapor recovery infrastructure. Typically, injection points are located on a 15-foot grid, so there is limited flexibility to accommodate access restrictions within a desired treatment zone. Limited flexibility to adjust injection points is not a concern in Boom Landing zone but will be a challenge on the WWTP property. • Treatment effectiveness can be monitored in a number of ways and through multiple media sampling such as: groundwater sampling from monitoring wells; soil sampling; and soil vapor sampling from monitoring wells and vapor mitigation wells.	• Multiple vendors and contractors provide air sparing/SVE system, design, construction, and operation, allowing for an array of options and competitive pricing during the procurement process.	• Usually applied as an exclusive remedy, however, biodegradation of COCs can be promoted by reducing the flow rate of air into the subsurface to promote biodegradation of COCs.	• Air sparging/SVE is a well-accepted remedy for addressing volatile contaminants. • There has been limited agency approval or documented success in address MGP-related PAHs.

4.2.7 Cost

Feasibility-level cost estimates for soil remedial alternatives were prepared for source and non-source areas in the Boom Landing and WWTP zones. Non-source area costs were developed to address cancer risks of 10^{-4}, 10^{-5}, and 10^{-6} or a hazard quotient of 1. Present value costs were developed using a discount rate of 7% as required for non-federally funded sites as discussed in Section 3.3. For comparative purposes, the alternatives were generally ranked in order of increasing cost (lowest to highest) based on present value estimates, as summarized in Tables 7-1, 7-2, and 7-3.

- **Alternative S1 (No-Further Action)** is the lowest cost alternative but does not achieve RAO-1.
- **Alternative S2 (Institutional Controls)** has relatively low cost but must be used in conjunction with one or more compatible alternatives to achieve RAO-1.

- **Alternative S3 (Horizontal Engineered Surface Barriers)** is the lowest cost alternative achieving RAO-1 for source and non-source areas when implemented in conjunction with Alternative S2 (ICs). Overall, Alternative S3 is about one-third of the cost compared to implementing Alternative S6 (Air Sparging/SVE) and about one-eighth to one-fourth of the cost compared to implementing Alternative S5a (Excavation and Off-Site Disposal).

- **Alternative S6 (Air Sparging/SVE)** in the highest cost alternative for the WWTP zone non-source area and the 4th highest cost for other areas. Alternative S6 is unlikely to achieve RAO-1 as a sole remedy in non-source areas and is not recommended for MGP-affected soil in source areas.

- **Alternative S5a (Excavation and Off-Site Disposal)** is about two to three times more costly than Alternative S6 (Air Sparging/SVE) within the Boom Landing zone and about the same cost as Alternative S6 (Air Sparging/SVE) for the WWTP source area. Alternative S5a is about half to one-third of the cost compared to implementing Alternative S4 (In-Situ Chemical Treatment) in the Boom Landing non-source area. Alternative S5a was not considered for the WWTP non-source area due to existing infrastructure. Alternative S5a potentially achieves RAO-1 in the Boom Landing zone as a sole remedy. WWTP zone non-source area requires implementation of another alternative and/or Alternative S2 (ICs) to achieve RAO-1.

- **Alternative S5b (Excavation and On-Site Treatment/On-Site Disposal)** is the most expensive alternative for the non-source area in Boom Landing (not considered for non-source areas in WWTP zone) and the 2nd most expensive for source areas. Overall, Alternative S5b is 30 to 40 percent more costly than Alternative S5a (Excavation and Off-Site Disposal). Alternative S5b potentially achieves RAO-1 in Boom Landing zone as a sole remedy. WWTP zone non-source area requires implementation of another alternative and/or Alternative S2 (ICs) to achieve RAO-1.

- **Alternative S4 (In-Situ Chemical Treatment)** is the highest cost alternative for the Boom Landing and WWTP zone source areas. Alternative S4 is less costly than excavation alternatives S5a and S5b for the Boom Landing non-source area. Alternative S4 was not considered for the WWTP non-source area due to implementation challenges related to existing WWTP process units. Alternative S4 potentially achieves RAO-1 as a sole remedy.

Tables 7-1, 7-2, and 7-3 summarize costs for soil remedial alternatives for cancer risks of 10^{-4}, 10^{-5}, and 10^{-6}, respectively. Appendix B1 provides detailed cost estimates for each of the alternatives. Section 8 provides a comparative analysis of remedial alternatives to the NCP evaluation criteria to assist in remedy selection.

5 DETAILED ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

The objective of the detailed analysis is to present sufficient information to adequately compare the remedial alternatives so an appropriate remedy may be selected in order to: prevent human exposure to groundwater containing MGP residuals exceeding the PRGs, thereby addressing RAO-2; restore groundwater to PRGs for MGP-related constituents within a reasonable timeframe, thereby addressing RAO-3; and minimize, to the extent practicable, the potential for migration of groundwater with MGP-related contaminants above the PRGs to surface water, thereby addressing RAO-4. The detailed analysis of groundwater remedial alternatives assumes the source material is treated or removed, so the source material no longer contributes additional dissolved phase mass to the groundwater plume.

5.1 Groundwater Remedial Alternatives

This section presents detailed descriptions of the groundwater remedial alternatives developed and retained in Section 3, which include: G1 - No-Further Action, G2 - Institutional Controls, G3 - Monitored Natural Attenuation, G4 - Air Sparing/SVE, and G5 – In-Situ Chemical Treatment. The detail analysis for these alternatives is presented in Section 5.2.

5.1.1 G1 – No-Further Action

Consistent with NCP requirements, a No-Further Action alternative is considered. This alternative will not include remediation or monitoring to minimize potential exposures related to groundwater at the Site. The No-Further Action alternative will be used as a baseline for comparisons of other remedial alternatives. In accordance with CERCLA, Site reviews will be performed every five years for a duration of 30 years for Alternative G1.

5.1.2 G2 – Institutional Controls

The primary goal of Alternative G2 is to limit exposure to MGP-affected groundwater through non-engineered administrative and legal controls. Alternative G2 will place restrictions on the use of groundwater within a defined zone. Institutional controls for groundwater will be implemented within the extent of groundwater requiring remedial action, as shown on Figure 7. The WDNR GIS Registry will be the mechanism for restricting the use of groundwater.

An ICIP will be developed to detail groundwater use restrictions and document procedures for effective implementation. For cost estimating purposes, institutional controls are assumed to be assessed in the Five-Year Reviews for a duration of 30 years.

5.1.3 G3 – Monitored Natural Attenuation

Monitored natural attenuation involves documentation of the naturally occurring biological degradation of COCs in groundwater. A key component to determine the suitability of an MNA remedy is evaluation of the plume stability. The groundwater plume maps in the RI Report show the overall extent of the plume is relatively stable, despite concentrations varying from sampling event to sampling event. Groundwater trends supporting MNA are presented in Appendix I3 of the RI Report (NRT, 2015). A summary of groundwater quality and trends indicate the following:

- MGP-affected groundwater is well defined by the well network.
- The regression plots indicate generally stable or decreasing trends.
- The MNA geochemical indicator parameters suggest biological degradation is occurring within the plume.

Plume stability may be further enhanced if one or more of the source remedial activities presented in Section 4.1 is implemented. Implementation of MNA at the Site will likely consist of monitoring for COCs and MNA parameters during semi-annual sampling events. Monitoring will verify the groundwater plume is stable or decreasing and will also provide field data to further refine Alternative G3 (MNA) remedial duration estimates. Groundwater monitoring wells to be considered for inclusion in the MNA monitoring well network include: MW01R, MW312, MW307R, MW310, MW308, MW311, MW306, MW03R, MW303, MW313, MW304, MW302, and MW05. As MNA monitoring continues, consideration could be given to reducing the number of wells in the MNA network and/or reducing the frequency of monitoring. Concurrent implementation of Alternatives G3 and G2 (Institutional Controls), as described in Section 5.1.2, is assumed to restrict groundwater use until PRGs are achieved.

The duration for MNA processes to achieve groundwater PRGs, assuming source removal, was estimated using WDNR and USEPA natural attenuation guidance documents. The calculations are included in Appendix C3, and use benzene, naphthalene, and benzo(a)pyrene as the representative groundwater COCs. The analysis indicates benzene is the controlling COC and it will take approximately 30 years for COCs to meet the PRGs. The duration for MNA processes to achieve groundwater PRGs without source removal has not been estimated.

5.1.4 G4 – Air Sparging/Soil Vapor Extraction

Air sparging/SVE involves injection of air into the groundwater to remediate volatile or biodegradable containments. Volatilized contaminants will be removed from the subsurface using a soil vapor recovery system. Major components typical to air sparing include a compressor, which supplies air through a manifold distribution system into air sparge/injection wells within the groundwater. Major components typical to SVE system include vadose zone recovery wells, which are connected to a water/air separator (knock-out pot), a blower to generate vacuum, and associated carbon or oxidizer to recover contaminants from the vapor stream prior to discharge.

Presumptive major elements of Alternative G4 include:

- Predesign investigation to further define the permeability and structure of the soil for placement and spacing of air sparge/SVE points.
- Installation of air sparge/SVE wells. Wells will be installed in an approximate 15-foot grid over the target treatment area. The target treatment area will be based on the size and concentration of the plume remaining following implementation of the selected source area remedies described in Section 4. Alternative G4 may target highly-affected groundwater and rely on monitored natural attenuation to remediate less-affected groundwater.
- Construction of an air sparge/SVE system, generally consisting of compressors, blowers, condensate knock-out pots, and vapor treatment systems.
- Frequent monitoring of groundwater and vapor to assess system performance and provide information to guide modifications to procedures, as necessary.
- Well abandonment and restoration of Site to post-remedy grades.
- Implementation of institutional controls (Alternative G2).

Remedial action objectives RAO-2, RAO-3, and RAO-4 will be achieved through implementation of Alternative G4. Analysis of Alternative G4 assumes the PRGs will be achieved in approximately 7 years or operation of the air sparging/SVE will cease because it may no longer influence COC degradation.

5.1.5 G5 – In-Situ Chemical Treatment

In-situ chemical treatment involves introduction of chemical oxidants into the subsurface to degrade contaminant compounds. In-situ chemical treatment for remediation of groundwater is typically performed by overlapping the zone of influence from pressurized injection wells within the delineated plume. The most common chemical oxidants include ozone, hydrogen peroxide, sodium persulfate, and permanganate. For cost estimation purposes, a hydrogen peroxide-based oxidant was selected to treat subsurface contamination. This selection was made based on the proven ability of hydrogen peroxide to address COCs present in Site groundwater. It is assumed hydrogen peroxide will be catalyzed by the simultaneous injection of ferrous iron to improve the oxidation potential, thereby improving the performance of the in-situ chemical treatment system.

In-situ chemical treatment will target the desired treatment interval, however in-situ chemical treatment reactions can result in generation of off-gases, primarily carbon dioxide, so a passive or active ventilation system will mitigate vapor emissions.

Presumptive elements of Alternative G5 include:

- Performing a predesign investigation to further define horizontal and extent of MGP-affected groundwater and collecting samples for bench-scale testing.
- Performing bench-scale testing of Site soils and groundwater with varying types and percentages of reagents to determine the most effective oxidant to address COCs in groundwater and overcome the natural oxidant demand.
- Performing a small-scale pilot study to verify injection assumptions and develop solutions to potential operational issues associated with full-scale implementation.
- Installation of permanent injection wells using direct push technology. Wells will be installed in a 15-foot grid over the target treatment area, resulting in approximately 2,000 injection points. The treatment area will be based on the size and concentration of the plume remaining following successful implementation of one or more source area remedies described in Section 4. Alternative G5 may target highly-affected groundwater and rely on monitored natural attenuation to remediate less-affected groundwater.
- Installation of permanent vapor mitigation wells using direct push technology.
- Injection of catalyzed hydrogen peroxide solution, matching the target concentration determined during the bench and pilot scale tasks. For FS-level cost estimating purposes, approximately 13,000,000 pounds of 34% hydrogen peroxide solution will be required to fully remediate the groundwater plume. Approximately 34% hydrogen peroxide solution will be diluted with Site water to approximately a 10% solution prior to subsurface injections.
- Frequent monitoring of subsurface groundwater and vapor to assess oxidant performance and provide information to guide potential modifications to injection procedures.
- Well abandonment and restoration of Site to surrounding grades.

Injection activities are anticipated to occur continuously for approximately two years to reduce COCs to the selected PRGs and achieve remedial action objectives RAO-2, RAO-3, and RAO-4.

5.2 Groundwater Detailed Analysis of Remedial Alternatives

Potential remedial alternatives for groundwater were evaluated in this section in accordance with the threshold criteria, primary balancing criteria, and modifying criteria.

5.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is applied to evaluate if the alternatives adequately protect human health and the environment. Table J presents an evaluation of the overall protection of human health and the environment for each groundwater remedial alternative.

Table J Groundwater Remedial Alternatives Evaluation of Overall Protection of Human Health and the Environment

Remedial Technology	Overall Protection of Human Health and the Environment
G1 No-Further Action	Does not include remediation or monitoring to minimize potential exposures to will not achieve overall protection of human health and the environment.
G2 Institutional Controls	Will be protective of human health by implementing controls to prevent the use of Site groundwater within a defined zone. However, ICs will not prevent or monitor for impacted groundwater potentially migrating to adjacent surface water resources (Menominee River and Lake Michigan) or remove contaminants from groundwater. Therefore, G2 is not environmentally protective as a sole remedy.
G3 Monitored Natural Attenuation	Protective of human health in the short-term and long-term in conjunction with Alternative G2 (Institutional Controls) and implementation of Alternative G3 (Monitored Natural Attenuation). The duration required for MNA is estimated as 30 years. Incorporates monitoring of sentry wells to verify MGP-affected groundwater does not migrate to surface water resources. If monitoring indicates unacceptable migration of MGP-affected groundwater, additional remedial action will be performed. Therefore, MNA is protective the environment.
G4 Air Sparging/SVE	Protective of human health and the environment by implementing active remediation to degrade COCs in groundwater to the PRGs, addressing RAO-2, RAO-3, and RAO-4 in approximately 7 years.
G5 In-Situ Chemical Treatment	Protective of human health and the environment by implementing active remediation to degrade COCs in groundwater to the PRGs, addressing RAO-2, RAO-3, and RAO-4 in approximately 2 years.

5.2.2 Compliance with ARARs

Alternative G1 (No-Further Action) will not comply with or attain compliance with groundwater ARARs identified in Table 1. Alternative G2 through G5 (Institutional Controls, Monitored Natural Attenuation, Air Sparging/SVE, and In-Situ Chemical Treatment) fully comply with and attain groundwater ARARs.

5.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence criterion consists of two components: magnitude of residual risk, and adequacy and reliability of controls. Table K presents an evaluation of the long-term effectiveness and permanence of each groundwater remedial alternative.

Table K Groundwater Remedial Alternatives Evaluation of Long-term Effectiveness and Permanence

Remedial Technology	Long-term Effectiveness and Permanence	
	Magnitude of Residual Risk	Adequacy and Reliability of Controls
G1 No-Further Action	• Does not reduce potential risk to human health or the environment.	• No remedial action or administrative controls.
G2 Institutional Controls	• Groundwater contamination will remain in-place; however, ICs will provide long-term effectiveness and prevent potential human health risk by restricting groundwater use.	• Conditions of the WDNR GIS Registry are maintained for a property, regardless of future changes in ownership.
G3 Monitored Natural Attenuation	• Will achieve the PRGs in approximately 30 years (assuming the source area is remediated or removed). Duration to achieve RAOs without source removal has not been estimated. • There will be no residual risk once the PRGs are achieved.	• Provides long-term effectiveness and permanent control of potential risk when implemented with intuitional controls described in Alternative G2 until PRGs are achieved.
G4 Air Sparging/SVE	• Highly effective at addressing volatile COCs. Moderately effective at addressing naphthalene, and minimally effective at addressing remaining PAHs. Remaining PAHs will be addressed through natural biological attenuation.	• Permanently removes volatile/strippable COCs from the subsurface. • PAHs may experience some biodegradation resulting from increased dissolved oxygen. Monitoring of biodegradation/attenuation will be required to document PRGs are achieved.
G5 In-Situ Chemical Treatment	• The effectiveness of the chemical oxidation is often limited as concentrations of COCs approach the PRGs. • Many chemical oxidation systems will initially achieve the PRG following treatment and concentrations of COCs rebound once the oxidant has been fully utilized.	• Adequacy and reliability of in-situ chemical treatment to treat COCs will depend on the degree to which the oxidant is dispersed in the subsurface and debris encountered. Debris could be a potential obstacle to effective treatment because it can create preferential pathways within the subsurface resulting in uneven oxidant distribution. • Highly effective at reducing the concentration of the plume. Monitoring of biodegradation/attenuation will be required to document PRGs are achieved.

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5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment is evaluated to determine if remedial alternatives can successfully reduce the principal threat wastes at a site through destruction of contaminants, reduction of the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The analysis factors of this criterion are: treatment process used and materials treated, amount of contaminant destroyed or treated, degree of expected reductions and treatment irreversibility, and type and quantity of residuals remaining. Table L presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table L Groundwater Remedial Alternatives Evaluation of Reduction of Toxicity, Mobility, or Volume Through Treatment

Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used and Special Requirements for the Treatment Process	Amount of Material Destroyed or Treated and Degree of Expected Reductions	Treatment Irreversibility	Type and Quantity of Residuals Remaining
G1 No-Further Action	• None	• No contaminated material is destroyed and treated.	• None	• All contaminated material remains
G2 Institutional Controls	• Relies on non-engineering controls. No active remediation is implemented. • No special requirements.	• No contaminated material is destroyed and treated and natural biodegradation is not monitored or confirmed.	• None	• All contaminated material remains
G3 Monitored Natural Attenuation	• Relies on natural attention processes to treat the groundwater. • Documentation, assessment, and reporting of natural attenuation.	• Will reduce the concentration and volume of MGP-affected groundwater.	• Assuming the source material is treated or removed, the natural attenuation of groundwater is irreversible.	• None

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Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used and Special Requirements for the Treatment Process	Amount of Material Destroyed or Treated and Degree of Expected Reductions	Treatment Irreversibility	Type and Quantity of Residuals Remaining
G4 Air Sparging/SVE	• Directly injects air into the groundwater. Injected air reduces dissolved contaminant mass through volatilization and biodegradation.	• Will effectively remediate PVOCs. • Limited effectiveness at remediating PAHs and may require reliance on natural attenuation.	• Assuming the source material is treated or removed, PVOC removal is irreversible.	• It is anticipated PVOCs will be rapidly reduced and degradation of PAHs will be predominantly performed through natural attenuation.
G5 In-Situ Chemical Treatment	• Involves injection of chemical oxidants to degrade COCs.	• Will reduce the concentration and volume of MGP-affected groundwater.	• Contaminant concentrations may rebound after treatment.	• None

5.2.5 Short-Term Effectiveness

Under short-term effectiveness criterion, remedial alternatives are evaluated based on their effects on human health and the environment during implementation of the remedial action. The analysis criterion are: protection of community and workers during remediation, environmental impacts, and time to achieve RAOs. Table M presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table M Groundwater Remedial Alternatives Evaluation of Short-term Effectiveness

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
G1 No-Further Action	• Will not present short-term risks to the community or workers during implementation because no remedial action is taken.	• None.	• RAOs will not be achieved.

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Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
G2 Institutional Controls	• Will not present short-term risks to the community or workers during implementation because no intrusive remedial action is taken.	• There will be no short-term impacts to the environment.	• Will be protective of human health by restricting the use of Site groundwater within a defined zone, thereby addressing RAO-2. • Not able to achieve RAO-3 or RAO-4 as a sole remedy.
G3 Monitored Natural Attenuation	• Will not present short-term risks to the community or workers during implementation because no intrusive remedial action is taken.	• There will be no short-term impacts to the environment.	• The time until RAOs are achieved is estimated at 30 years (assuming source removal). Duration to achieve RAOs without source removal has not been estimated.
G4 Air Sparing/SVE	• Has the potential to generate fugitive emissions and release vapors to the atmosphere during air sparging/SVE operations. As a result, construction workers and nearby building occupants will potentially be exposed to airborne contaminants. • Potential thermal hazards related to operating an oxidizer, which is typically used to treat recovered vapors. • Thermal exposure risks can be controlled through best management practices, engineering controls, and adhering to task-specific health and safety procedures (e.g., personal protective equipment and observing appropriate practices for designated safety zones).	• During intrusive activities and operations, dust and VOCs will emitted and will have a negative impact on the environment. However, the emissions can be controlled through best management practices (e.g., dust control).	• For cost estimating and comparison purposes, implementation is assumed to occur over approximately 7 years.

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
G5 In-Situ Chemical Treatment	• Has the potential to generate fugitive emissions and release vapors to the atmosphere during chemical treatment. As a result, construction workers and nearby building occupants will potentially be exposed to airborne contaminants. These exposures can be controlled through best management practices, engineering controls, and adhering to task-specific health and safety procedures (e.g., personal protective equipment and observing appropriate practices for designated safety zones). • Large quantities of oxidants will be required for in-situ chemical treatment. The oxidants are reactive and concentrated chemicals could pose a risk to construction workers and surrounding parties during transportation, handling, storage, and treatment application. Several approaches could be used to minimize risk, including administrative requirements and procedures during oxidant shipping and storage; selection of experienced contractors to administer the oxidant; selection of a slower-reacting and safer oxidant; and engineering controls.	• During implementation emission will be generated. However, the emissions can be controlled through best management practices. • Improper pressurized injection of oxidants may cause unexpected spread of groundwater contamination. However, this can be eliminated by controlling the injection pressure and other containment methods. • Groundwater geochemistry may also change.	• The time until RAOs are achieved is estimated as 2 years.

5.2.6 Implementability

Implementability criterion focuses on the technical and administrative feasibility and the availability of various services and materials required for implementation. The analysis criterion are: ability to construct and operate technology, reliability of technology, ability to monitor effectiveness of remedy, availability of services and materials, ease of undertaking additional remedial action if necessary, and ability to coordinate and obtain approvals from other agencies. Table N presents an evaluation of the long-term effectiveness and permanence of the remedial alternatives.

Table N Groundwater Remedial Alternatives Evaluation of Implementability

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	Availability of Services and Materials	Ease of Undertaking Additional Remedial Action if Necessary	Ability to Coordinate and Obtain Approvals from Other Agencies
G1 No-Further Action	• Easily implemented because there are no activities to perform.	• There is no remedial action.	• Easy to be combined with other remedial alternatives	• Agency approval achievable in areas where risk is within a the risk management range.
G2 Institutional Controls	• Technically and administratively implementable.	• WDNR GIS Registry is commonly used.	• Easily combined with other remedial alternatives and the footprint of institutional controls can be easily expanded.	• GIS Registry coordination through the WDNR and is commonly implemented.
G3 Monitored Natural Attenuation	• Technically and administratively implementable. • The effectiveness of this alternative can be evaluated through standard groundwater monitoring techniques.	• Relies on natural attention processes.	• Easily combined with other remedial alternatives and the footprint of monitoring activities can be easily expanded	• Agency approval achievable in areas where MGP-affected groundwater does not present a short-term risk to human health.

Natural Resource Technology

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
G4 Air Sparging/SVE	• Technically implementable for addressing volatile COCs. • Requires coordination of sparging/SVE infrastructure to be installed and operated on the property. Typically, injection points need to be located on spacing ranging between 10 and 30 feet, so there is limited flexibility to accommodate access restrictions within a desired treatment zone. • Effectiveness of the treatment can be monitored in a number of ways and through multiple media sampling such as: groundwater sampling from monitoring wells; soil sampling; and soil vapor sampling from monitoring wells and vapor mitigation wells located in and around the treatment area.	• Multiple vendors and contractors provide air sparing/SVE system, design, construction, and operation, allowing for an array of options and competitive pricing during the procurement process.	• Usually applied as an exclusive remedy, however, the flow rate of air into the subsurface can be reduced to promote biodegradation of PAHs.	• Air sparging/SVE is a well-accepted remedy for addressing volatile contaminants.

Natural Resource Technology

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	Availability of Services and Materials	Ease of Undertaking Additional Remedial Action if Necessary	Ability to Coordinate and Obtain Approvals from Other Agencies
G5 In-Situ Chemical Treatment	• Technically implementable. • Several conventional delivery systems, including vertical wells and horizontal or inclined wells are available and capable of injecting chemicals into the subsurface. • Requires coordination of injection and vapor recovery infrastructure to be installed and operated on the property. Typically, injection points need to be located on a 15-foot spacing, so there is limited flexibility to accommodate access restrictions within a desired treatment zone, especially for groundwater plume in WWTP zone. • Effectiveness of the treatment can be monitored in a number of ways and through multiple media sampling such as groundwater sampling from monitoring wells located in and around the treatment area. • Adequacy and reliability to treat COCs depends on the degree to which the stimulants are dispersed in the subsurface and debris encountered. Debris could be a potential obstacle to effective treatment because it can create preferential pathways within the subsurface resulting in uneven stimulant distribution. Contaminant concentrations may rebound after treatment, and multiple applications will likely be required to meet the treatment objectives.	• Multiple vendors and contractors provide in-situ chemical treatment products, design, construction, and operation, allowing for an array of options and competitive pricing during the procurement process.	• Additional injection points can be installed if plume is larger than anticipated; however, presences of utilities, buildings, or other surface improvements can complicate expanding the injection system	• In-situ chemical treatment has been approved for implementation at many MGP sites with varying degrees of success.

5.2.7 Cost

Feasibility level cost estimates for groundwater remedial alternatives were prepared assuming the source material was addressed through implementation of one or more soil remedial alternatives described in Section 4.1. Present value costs were developed using a discount rate of 7% as required for non-federally funded sites as discussed in Section 3.3. For comparative purposes, the alternatives were ranked in order of increasing cost (lowest to highest) based on present value estimates, as summarized in Table 8.

- **Alternative G1 (No-Further Action)** is the lowest cost alternative but does not achieve groundwater RAOs.
- **Alternative G2 (Institutional Controls)** has relatively low cost but must be used in conjunction with one or more compatible alternatives to achieve groundwater RAOs.
- **Alternative G3 (Monitored Natural Attenuation)** is the lowest cost alternative achieving groundwater RAOs when implemented in conjunction with Alternative G2 (ICs). Overall, Alternative G3 is about one-tenth of the cost to implement Alternative G4 (Air Sparging/SVE) and about 26 times less costly than implementation of Alternative G5 (In-Situ Chemical Treatment).
- **Alternative G4 (Air Sparging/SVE)** is approximately 10 times the cost of implementing Alternative G3 (Monitored Natural Attenuation). Alternative G4 is less than half the cost to implement Alternative G5 (In-Situ Chemical Treatment). Alternative G4 potentially achieves groundwater RAOs as a sole remedy.
- **Alternative G5 (In-Situ Chemical Treatment)** is the highest cost alternative achieving groundwater RAOs.

Table 8 summarizes the costs for groundwater remedial alternatives. Appendix B2 provides detailed cost estimates for each of the alternatives. Section 8 provides a comparative analysis of remedial alternatives to the NCP evaluation criteria to assist in remedy selection.

6 DETAILED ANALYSIS OF SOIL GAS REMEDIAL ALTERNATIVES

Presently there is no indoor air cancer risk for the current Site conditions and land use. Current land use (WWTP and public boat launch) is anticipated to remain in the foreseeable future. Achieving unrestricted and unlimited use of the Site for future construction and development will require evaluation of the potential soil gas risk. Implementation of one or more soil and groundwater remedial alternatives is expected to achieve RAO-1 and RAO-2 with respect to mitigating potentially unacceptable vapor risks. The objective of the detailed analysis is to present sufficient information to adequately compare the alternatives so an appropriate remedy may be selected.

6.1 Soil Gas Remedial Alternatives

6.1.1 SG1 – No-Further Action

Consistent with NCP requirements, a No-Further Action alternative is considered. This alternative will not include remediation or monitoring to minimize potential exposures related to soil gas at the Site. The No-Further Action alternative will be used as a baseline for comparisons of other remedial alternatives. In accordance with CERCLA, Site reviews will be performed every five years for a duration of 30 years.

6.1.2 SG2 – Institutional Controls

Alternative SG2 will rely on institutional controls to minimize human exposure to soil gas containing MGP related COCs through non-engineered administrative and legal controls. SG2 will rely on WDNR GIS Registry, building codes, state, county, municipal legislation, and/or an ordinance to restrict land use to non-residential and prohibit or restrict occupancy in buildings or specify conditions of occupancy.

An ICIP will be developed to detail land use restrictions and document procedures for effective implementation. For cost estimating purposes, institutional controls will be assessed in the Five-Year Reviews for a duration of 30 years.

6.2 Soil Gas Detailed Analysis of Remedial Alternatives

6.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is applied to evaluate if the alternatives adequately protect human health and the environment. Table O presents an evaluation of the overall protection of human health and the environment for each alternative.

Table O Soil Gas Remedial Alternatives Evaluation of Overall Protection of Human Health and the Environment

Remedial Technology	Overall Protection of Human Health and the Environment
SG1 No-Further Action	• Although there is no indoor air cancer risk for the current Site conditions and land use, SG1 may not provide overall protection of human health and the environment in the event of future modification to land use. Bear in mind soil and groundwater remedial actions will likely reduce or eliminate risks related to soil gas.
SG2 Institutional Controls	• Protective of human health and environment by restricting current and future land use. Implementation of use restrictions sufficiently addresses RAO-1 and RAO-2.

6.2.2 Compliance with ARARs

Alternative SG1 (No-Further Action) will not comply with or attain compliance with ARARs identified in Table 1. Alternative SG2 (Institutional Controls) fully complies with and attains soil gas and vapor intrusion ARARs.

6.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence criterion consists of two components: magnitude of residual risk, and adequacy and reliability of controls. Table P presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table P Soil Gas Remedial Alternatives Evaluation of Long-term Effectiveness and Permanence

Remedial Technology	Long-term Effectiveness and Permanence	
	Magnitude of Residual Risk	Adequacy and Reliability of Controls
SG1 No-Further Action	• Does not reduce potential risk to human health or the environment.	• No remedial action.
SG2 Institutional Controls	• Provides long-term effectiveness control of potential human health risk by restricting land use, thereby addressing RAO-1 and RAO-2.	• Provides permanent and adequate control because the conditions of the WDNR GIS Registry are maintained for a property, regardless of future changes in ownership.

6.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment is evaluated to determine if remedial alternatives can successfully reduce the principal threat wastes at a site through destruction of contaminants, reduction of the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The analysis factors of this criterion are: treatment process used and materials treated, amount of contaminant destroyed or treated, degree of expected reductions and treatment irreversibility, and type and quantity of residuals remaining. Table Q presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table Q Soil Gas Remedial Alternatives Evaluation of Reduction of Toxicity, Mobility, or Volume Through Treatment

Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used and Special Requirements for the Treatment Process	Amount of Material Destroyed or Treated and Degree of Expected Reductions	Treatment Irreversibility	Type and Quantity of Residuals Remaining
SG1 No-Further Action	• None	• No contaminated material is destroyed or treated.	• None	• All contaminated material remains in place.
SG2 Institutional Controls	• Involves WDNR GIS Registry, building codes, county municipal legislation, and/or an ordinance to prohibit or restrict conditions of occupancy.	• No contaminated material is destroyed and treated.	• None	• All contaminated material remains. However, ICs will reduce potential for exposure to soil gas.

6.2.5 Short-Term Effectiveness

Under short-term effectiveness criterion, remedial alternatives are evaluated based on their effects on human health and the environment during implementation of the remedial action. The analysis criterion are: protection of community and workers during remediation, environmental impacts, and time to achieve RAOs. Table R presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table R Soil Gas Remedial Alternatives Evaluation of Short-term Effectiveness

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	Environmental Impacts	Time Until RAOs Are Achieved
SG1 No-Further Action	• No remedial action is taken.	• None.	• RAOs will not be achieved.
SG2 Institutional Controls	• Does not present short-term risks because no active remedial action is taken.	• None.	• RAO-1 and RAO-2 will be achieved. • Relies on the WDNR GIS Registry. Listing the property on the WDNR GIS Registry is estimated to take up to six months.

6.2.6 Implementability

Implementability criterion focuses on the technical and administrative feasibility and the availability of various services and materials required for implementation. The analysis criterion are: ability to construct and operate technology, reliability of technology, ability to monitor effectiveness of remedy, availability of services and materials, ease of undertaking additional remedial action if necessary, and ability to coordinate and obtain approvals from other agencies. Table S presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table S Soil Gas Remedial Alternatives Evaluation of Implementability

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
SG1 No-Further Action	• No action.	• None.	• Easily combined with other remedial alternatives	• Agency approval achievable in areas where risk is within a the risk management range
SG2 Institutional Controls	• Technically and administratively implementable.	• WDNR GIS Registry is reliably available.	• Easily combined with other remedial alternatives	• Mechanisms for land-use controls and restrictive measures established through the WDNR GIS Registry.

6.2.7 Cost

Feasibility level cost estimates for soil gas remedial alternatives were prepared to address potentially unacceptable cancer risk associated with exposure to soil gas at the Site. Present value costs were developed using a discount rate of 7% as required for non-federally funded sites as discussed in Section 3.3. For comparative purposes, the alternatives were ranked in order of increasing cost (lowest to highest) based on present value estimates, as summarized in Table 9.

- **Alternative SG1 (No-Further Action)** is the lowest cost alternative but does not achieve applicable RAOs.
- **Alternative SG2 (Institutional Controls)** has relatively low cost and achieves applicable RAOs.

Table 9 summarizes the costs for soil gas remedial alternatives. Appendix B3 provides detailed cost estimates for each of the alternatives. Section 8 provides a comparative analysis of remedial alternatives to the NCP evaluation criteria to assist in remedy selection.

7 DETAILED ANALYSIS OF SEDIMENT REMEDIAL ALTERNATIVES

As discussed in Section 1.2.8.2, a NTCRA was performed to remediate a portion of the Menominee River known to have historical impacts from the Former Marinette MGP. The NTCRA included dredging MGP-affected sediment and placement of a residual sand layer over a portion of the dredge area where uneven bedrock prevented dredging of a limited quantity of sediment exceeding the RAL of 22.8 mg/kg Total PAH(13).

As a result of the NTCRA, MGP-affected sediment has been fully remediated and sediment is no longer a media of concern. The concentration of Total PAH(13) within the surface of the residual sand layer is currently monitored, as defined in the Residual Sand Cover Monitoring Plan dated September 27, 2013. Monitoring is performed to verify the limited quantity of MGP-affected sediment beneath the residual sand layer remains inaccessible for human and ecological exposure. The objective of this detailed analysis for sediment is to present sufficient information to adequately compare alternatives for maintaining the integrity of the residual and layer, thereby addressing RAO-5.

7.1 Sediment Remedial Alternatives

This section presents detailed descriptions and analysis of the soil remedial alternatives developed and retained in Section 3, which include: SED1 – No-Further Action, SED2 – Monitoring, and SED3 – Institutional Controls.

7.1.1 SED1 – No-Further Action

Consistent with NCP requirements, a No-Further Action alternative is considered. This alternative will not include further remediation or monitoring to minimize potential exposures related to sediment at the Site. The No-Further Action alternative is viable for sediment because of the previously completed remedial action conducted in years 2012 and 2013. In accordance with CERCLA, Site reviews will be performed every five years for a duration of 30 years.

NATURAL RESOURCE TECHNOLOGY

7.1.2 SED2 – Monitoring

Alternative SED2 will continue the current monitoring program implemented since conclusion of the NTCRA completed in 2013. The presence of the residual sand layer will be demonstrated as defined in the Residual Sand Cover Monitoring Plan, dated September 27, 2013. This process will be used to monitor concentrations of total PAH(13) in the surface of the residual sand layer. Should monitoring indicate unacceptable levels of Total PAH(13) are accessible for human and/or ecological exposure, contingency actions, such as supplemental residual sand layer installation may be considered.

7.1.3 SED3 – Institutional Controls

The NTCRA completed in 2013 included installation of a residual sand layer. The residual sand layer falls within the boundaries of a no-wake zone established by the City of Marinette and enforced by the Marinette Police Department. Additional waterway restrictions will be similar to the downstream Ansul Superfund Site (EPA ID# WID006125215), such as no digging, no trenching, and no anchoring at locations in and around the residual sand layer area (USEPA, 2008). As with the institutional controls for the Ansul Site, restrictions are anticipated to be incorporated into the City of Marinette Code of Ordinances and enforced by the Marinette Police Department.

7.2 Sediment Detailed Analysis of Remedial Alternatives

7.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is applied to evaluate if the alternatives adequately protect human health and the environment. Table T presents an evaluation of the overall protection of human health and the environment of each alternative.

Table T Sediment Remedial Alternatives Evaluation of Overall Protection of Human Health and the Environment

Remedial Technology		Overall Protection of Human Health and the Environment
SED1	No-Further Action	• Will be protective of human health and the environment because RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED2	Monitoring	• Will be protective of human health and the environment because RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED3	Institutional Controls	• Will be protective of human health and the environment because RAOs have been achieved through the early action remedy completed in years 2012 and 2013.

7.2.2 Compliance with ARARs

Alternatives SED1 through SED3 fully comply with and attain sediment ARARs.

7.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence focuses on the evaluation of the extent and effectiveness of each remedial alternative. This criterion consists of two components: evaluation of magnitude or residual risk and adequacy and reliability of controls. Table U presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table U Sediment Remedial Alternatives Evaluation of Long-term Effectiveness and Permanence

Remedial Technology		Long-term Effectiveness and Permanence	
		Magnitude of Residual Risk	Adequacy and Reliability of Controls
SED1	No-Further Action	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• No remedial action will be taken associated with this alternative.
SED2	Monitoring	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• The presence of the residual sand layer will be demonstrated as defined in the Residual Sand Cover Monitoring Plan dated September, 2013.
SED3	Institutional Controls	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• City ordinance will remain in effect regardless of future changes in ownership.

7.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment is evaluated to determine if remedial alternatives can successfully reduce the principal threat wastes at a site through destruction of contaminants, reduction of the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The analysis factors of this criterion are: treatment process used and materials treated, amount of contaminant destroyed or treated, degree of expected reductions and treatment irreversibility, and type and quantity of residuals remaining. Table V presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table V Sediment Remedial Alternatives Evaluation of Reduction of Toxicity, Mobility, or Volume Through Treatment

Remedial Technology	Reduction of Toxicity, Mobility, or Volume Through Treatment			
	Treatment Process Used and Materials Treated	Amount of Material Destroyed or Treated	Degree of Expected Reductions and Treatment Irreversibility	Type and Quantity of Residuals Remaining
SED1 No-Further Action	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• None	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED2 Monitoring	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• None	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED3 Institutional Controls	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.	• None	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.

7.2.5 Short-Term Effectiveness

Under short-term effectiveness criterion, each remedial alternative is evaluated based on their effects on human health and the environment during implementation of the remedial action. The analysis factors of this criterion are: protection of community and workers during remediation, environmental impacts, and time until RAOs are achieved. Table W presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table W Sediment Remedial Alternatives Evaluation of Short-term Effectiveness

Remedial Technology	Short-term Effectiveness		
	Protection of Community and Workers During Remediation	**Environmental Impacts**	**Time Until RAOs Are Achieved**
SED1 No-Further Action	• Does not present short-term risks to the community or workers during implementation because no remedial action is taken.	• Does not present short-term risks to the environment during implementation because no remedial action is taken.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED2 Monitoring	• Does not present short-term risks to the community or workers during implementation because no active remedial action is taken.	• Does not present short-term risks to the environment during implementation because no active remedial action is taken.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.
SED3 Institutional Controls	• Does not present short-term risks to the community or workers during implementation because no remedial action is taken.	• Does not present short-term risks to the environment during implementation because no active remedial action is taken.	• RAOs have been achieved through the early action remedy completed in years 2012 and 2013.

7.2.6 Implementability

Implementability criterion focuses on the technical and administrative feasibility and the availability of various required services and materials during the implementation of each remedial alternative. The analysis factors of this criterion are: ability to construct and operate technology and reliability of technology and ability to monitor effectiveness of remedy, availability of services and materials, ease of undertaking additional remedial action if necessary, and ability to coordinate and obtain approvals from other agencies. Table X presents an evaluation of the long-term effectiveness and permanence of each alternative.

Table X Sediment Remedial Alternatives Evaluation of Implementability

Remedial Technology	Implementability			
	Ability to Construct and Operate Technology and Reliability of Technology and Ability to Monitor Effectiveness of Remedy	**Availability of Services and Materials**	**Ease of Undertaking Additional Remedial Action if Necessary**	**Ability to Coordinate and Obtain Approvals from Other Agencies**
SED1 No-Further Action	• Alternative S1 will be easily implemented because there are no activities to perform. • Monitoring is not needed.	• There is no remedial action.	• Easily combined with other remedial alternatives	• Not Applicable.
SED2 Monitoring	• Technically and administratively implementable.	• Availability	• Easily combined with other remedial alternatives	• Monitoring is currently approved by the agencies for the post NTCRA.
SED3 Institutional Controls	• Technically and administratively implementable.	• The institutional controls will rely on City ordinance.	• Easily combined with other remedial alternatives	• Intuitional Controls are currently accepted by agencies for the adjacent Ansul Inc. Stanton St. Facility Sediment Site.

7.2.7 Cost

Feasibility level cost estimates for sediment remedial alternatives were prepared to address potentially unacceptable cancer risk associated with exposure to soil gas at the Site. Present value costs were developed using a discount rate of 7% as required for non-federally funded sites as discussed in Section 3.3. For comparative purposes, the alternatives were ranked in order of increasing cost (lowest to highest) based on present value estimates, as summarized in Table 10.

- **Alternative SED1 (No-Further Action)** is the lowest cost alternative and achieves applicable RAOs.
- **Alternative SED2 (Institutional Controls)** has relatively low cost and achieves applicable RAOs.
- **Alternative SED3 (Monitoring)** is the highest cost alternative and achieves applicable RAOs.

Table 10 summarizes the costs for sediment remedial alternatives. Appendix B4 provides detailed cost estimates for each of the alternatives. Section 8 provides a comparative analysis of remedial alternatives to the NCP evaluation criteria to assist in remedy selection.

8 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The comparative analysis evaluates the performance of media-specific alternatives presented in Sections 4 through 7 against seven of the nine specific evaluation criteria. This analysis highlights advantages, disadvantages, and key differences of the various media specific alternatives, thereby providing a framework for USEPA to select an appropriate remedy. The comparative analysis is tabulated as follows:

- Table 11 Soil Remedial Alternatives Comparative Analysis
- Table 12 Groundwater Remedial Alternatives Comparative Analysis
- Table 13 Soil Gas Remedial Alternatives Comparative Analysis
- Table 14 Sediment Remedial Alternatives Comparative Analysis

The following highlight the ability of remedial alternatives to achieve threshold and balancing criteria.

Soil remedial alternatives fully meeting threshold and balancing criteria are Alternatives S4 (In-Situ Chemical Treatment) and S5a (Excavation and Off-Site Disposal). Alternative S5a (Excavation and Off-Site Disposal) is approximately half of the present worth cost of implementing Alternative S4 (In-Situ Chemical Treatment) and can remediate soil source areas in about half of the time. Alternatives S4 and S5a were not assessed for the non-source area in the WWTP zone.

Alternative S3 (Horizontal Engineered Surface Barriers) could fully meet threshold and balancing criteria in combination with Alternative S2 (Institutional Controls) for a relatively low cost. However, remediation of MGP source material may be necessary for successful implementation of groundwater remedial alternatives.

Alternative S5b (Excavation and On-Site Treatment/On-Site Disposal) is similar to Alternative S5a (Excavation and Off-Site Disposal) but consists of additional challenges associated with sequencing, staging, and land area requirements. Implementation of Alternative S5b (Excavation and On-Site Treatment/On-Site Disposal) is anticipated to take longer and cost more than Alternative S5a (Excavation and Off-Site Disposal).

Alternative S6 (Air Sparging/SVE) is not recommended due to the low volatility of MGP residuals, likely resulting in the majority of PAHs remaining after seven years of system operation. Cost estimates prepared for Alternative S6 assumes running the air sparging/SVE system for seven years, at which time progress toward achieving RAOs will be assessed.

Assuming the soil source areas are remediated, the groundwater remedial alternatives fully meeting the threshold and balancing criteria include Alternatives G3 (Monitored Natural Attenuation), G4 (Air Sparging/SVE), and G5 (In-Situ Chemical Treatment). Alternatives G3 through G5 will require implementation of Alternative G2 (Institutional Controls) until groundwater RAOs are achieved.

Alternative G3 (Monitored Natural Attenuation) is the most economical alternative but requires an estimated 30 years to achieve RAOs. Alternative G4 (Air Sparging/SVE) is approximately 10 times the cost of implementing Alternative G3 (Monitored Natural Attenuation) and is expected to require 7 years to achieve RAOs or no longer be effective at degrading groundwater COCs. Alternative G5 (In-Situ Chemical Treatment) is the highest cost groundwater alternative and is expected to require 2.5 years to achieve RAOs. As indicated in Section 1.2.9.2, groundwater is not a drinking water source (and is never expected to be); therefore, remedial duration may not be a primary factor for remedy selection.

As discussed in Section 2.3.4, the vapor intrusion pathway is currently incomplete based on the current industrial/commercial land use (Exponent, 2015). Current land use (WWTP and boat landing) is anticipated to remain the same in the foreseeable future. In the event of future building construction at the Site, one alternative, Alternative SG2 (Institutional Controls) fully meets the threshold and balancing criteria.

Sediment Alternative SED1 (No-Further Action) fully meets the threshold and balancing criteria because the sediment was remediated during years 2012 and 2013 as part of a NTCRA, described in Section 1.2.8.2. Two years of residual sand cover monitoring is documented in the Residual Sand Cover Monitoring Results letter (NRT, July 2015). The need for and scope of continued sand cover monitoring is to be determined.

8.1 Modifying Criteria

The last of the specific evaluation criteria (modifying criteria), state acceptance and community acceptance, are evaluated by USEPA through review of formal comments on the FS Report and PRAP. More specifically, USEPA will develop and select a combination of remedial alternatives, highlighting key factors for identifying the preferred alternatives in a PRAP. The PRAP, RI/FS, and other information forming the basis for the lead agency’s response selection, is made available for public comment in the Administrative Record file.

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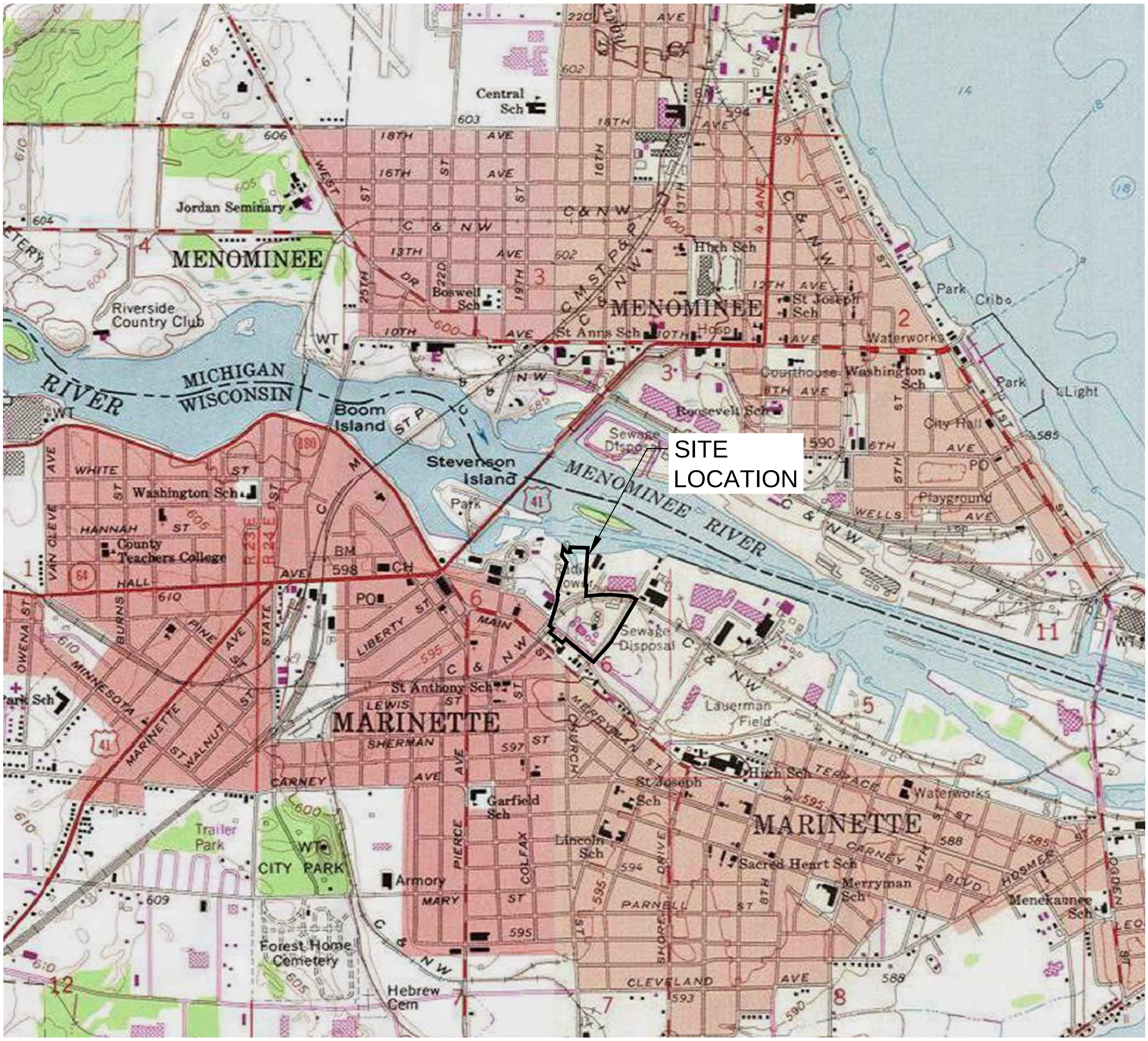
FIGURES



SOURCE NOTES:

1. NATIONAL GEOGRAPHIC TOPO. 1:24,000-SCALE MAPS FOR THE UNITED STATES. THE TOPO! MAPS ARE SEAMLESS, SCANNED IMAGES OF UNITED STATES GEOLOGICAL SURVEY (USGS) PAPER TOPOGRAPHIC MAPS. FOR MORE INFORMATION ON THIS MAP, VISIT US ONLINE AT HTTP://GOTO.ARCGISONLINE.COM/MAPS/USA_TOPO_MAPS COPYRIGHT:© 2011 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED
2. COORDINATE SYSTEM IS WISCONSIN COUNTY COORDINATE SYSTEM, MARINETTE COUNTY, US FOOT.

QUADRANGLE LOCATION

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CONTOUR INTERVAL 10 FEET

SITE LOCATION MAP

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

DRAWING NO.
1549-200-A01

FIGURE NO.
1

DRAWN: AGC DATE: 06/15/15 CHK'D: Y_Z DATE: 06/23/15 APP'D: RJB DATE: 07/06/15

Jul 06, 2015 10:39am PLOTTED BY: acawrse SAVED BY: acawrse
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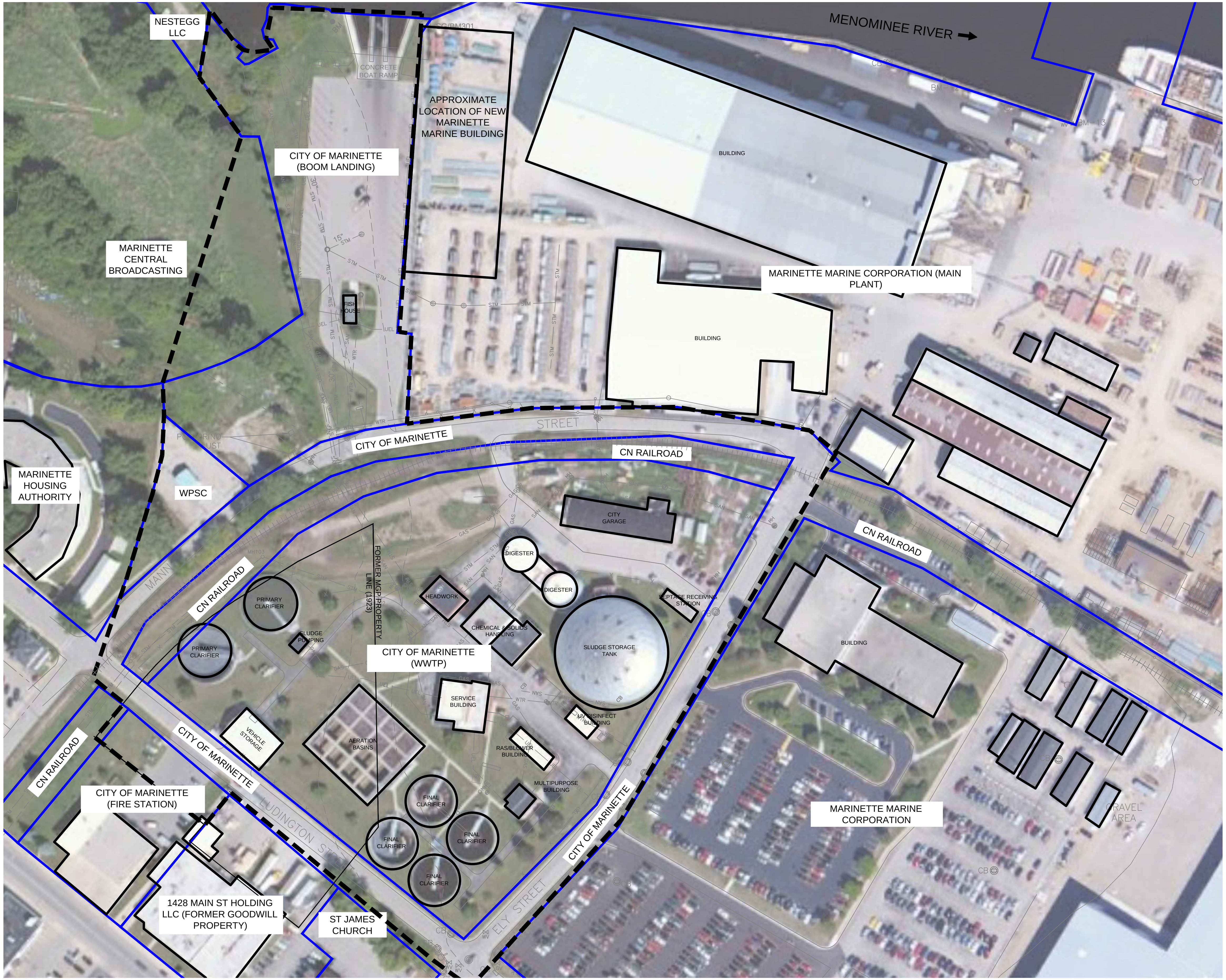

PROPERTY BOUNDARIES
EXISTING BUILDING
FORMER MGP PROPERTY LINE (1923)
APPROXIMATE EXTENT OF UPLAND SITE
FORMER SLOUGH
GAS LINE
STORM SEWER LINE
SANITARY SEWER LINE
WATER LINE
UNDERGROUND ELECTRIC LINE
SANITARY MANHOLE
STORM MANHOLE
CATCH BASIN
HYDRANT

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0 75 150
SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. DATA WAS OBTAINED FROM THE MARINETTE COUNTY LAND RECORDS SYSTEM (GIS): (http://webgis.marinettecounty.com)
3. A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001.
4. VERTICAL CONTROL IS NAVD88 DATUM.
5. BUILDING LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
6. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
7. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
8. AERIAL IMAGE SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY.

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DRAWING NO: 1549-200-B02
REFERENCE: .

SITE LAYOUT AND EXISTING STRUCTURES

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1549/20.0

FIGURE NO. 2

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REVIEWED BY/DATE: Y_Z 6/23/15
APPROVED BY/DATE: RJB 6/29/15

ZONING AND POTENTIAL NON-MGP SOURCES

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WI

PROJECT NO: 1549

FIGURE NO: 3

NATURAL RESOURCE TECHNOLOGY

Y:\GIS\Projects\15\1549\MXD\FS\Figure 3_Site Layout.mxd Author: mmejac; Date/Time: 6/26/2015, 2:57:12 PM

APPROXIMATE EXTENT OF UPLAND SITE

FORMER SLOUGH/ LOGRUN

FORMER LUMBER STORAGE AREA

FORMER MGP PROPERTY BOUNDARY

RAILROAD

AREAS OF AFFECTED SOIL WERE NUMBERED FOR DISCUSSION IN THE TEXT

AREAS EXCAVATED BY CITY OF MARINETTE EXHIBITING NO EVIDENCE OF MGP RESIDUALS IN SOIL

AREAS EXHIBITING EVIDENCE OF MGP RESIDUALS IN SOIL EXCAVATED AND BACKFILLED WITH CLEAN MATERIAL, BY CITY OF MARINETTE

NOTE: ALL OF THE ABOVE GROUND AND MOST OF THE BELOW GROUND STRUCTURES ASSOCIATED WITH THE MGP WERE REMOVED AND/OR DEMOLISHED BY THE CITY OF MARINETTE IN THE 1960s IN PREPARATION FOR THE WTTP EXPANSION.

N

0 80 160

SCALE IN FEET

NOTES:
1. FORMER MGP AND WWTP STRUCTURES FROM 1993.
2. MANN ST., LUDINGTON ST., ELY ST., AND BOOM LANDING PARK ARE SHOWN AS THEY EXISTED IN 1994.

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APPROVED BY: RJB DATE: 07/06/15
DRAWING NO: 1549-200-B04
REFERENCE: .

HISTORIC SITE LAYOUT

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1549/20.0

FIGURE NO. 4

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APPROXIMATE EXTENT OF UPLAND SITE

PROPERTY BOUNDARY

FORMER SLOUGH

FORMER MGP PROPERTY LINE (1923)

RAILROAD

FORMER MGP STRUCTURE

EXISTING STRUCTURE

AREAS EXCAVATED BY CITY OF MARINETTE EXHIBITING NO EVIDENCE OF MGP RESIDUALS IN SOIL

AREAS EXHIBITING EVIDENCE OF MGP RESIDUALS IN SOIL EXCAVATED AND BACKFILLED WITH CLEAN MATERIAL, BY CITY OF MARINETTE

1 AREAS OF AFFECTED SOIL WERE NUMBERED FOR DISCUSSION IN THE TEXT

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001. VERTICAL CONTROL IS U.S.G.S. DATUM. BUILDING AND STREET LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
3. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
4. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
5. VERTICAL CONTROL IS NAVD88 DATUM
6. WELL LOCATIONS FROM A SURVEY BY WPSC DATED OCTOBER 8, 2003, REVISED OCTOBER 31, 2003.
7. BRICK INTERCEPTOR SEWER REPLACEMENT TAKEN FROM DRAWING BY AYRES ASSOCIATES, GREEN BAY, WISCONSIN, JOB NO. 16-0189.10, DRAWING NO. P101, SHEET NO. 7, DATED 3/14/03.

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APPROVED BY:	RJB	DATE:	07/06/15
DRAWING NO:	1549-200-B05		
REFERENCE:			

FORMER MGP STRUCTURES

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

FIGURE NO.
5

Jul 06, 2015 10:51am PLOTTED BY: acowse SAVED BY: kmiks
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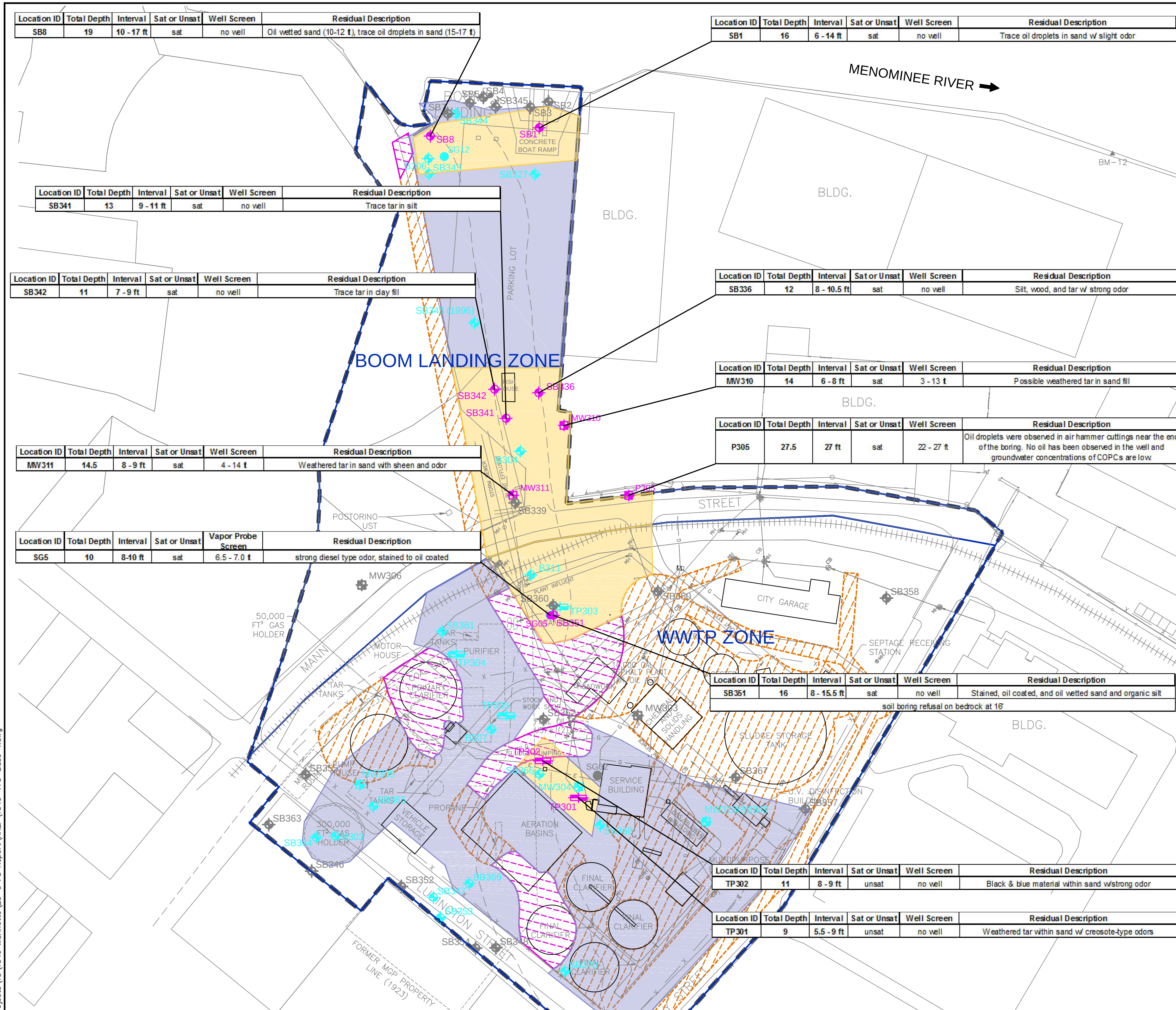


Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB8	19	10 - 17 ft	sat	no well	Oil wetted sand (10-12 ft), trace oil droplets in sand (15-17 ft)

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB1	16	6 - 14 ft	sat	no well	Trace oil droplets in sand w/ slight odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB341	13	9 - 11 ft	sat	no well	Trace tar in silt

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB342	11	7 - 9 ft	sat	no well	Trace tar in clay fill

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB336	12	8 - 10.5 ft	sat	no well	Silt, wood, and tar w/ strong odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
MW310	14	6 - 8 ft	sat	3 - 13 ft	Possible weathered tar in sand fill

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
P305	27.5	27 ft	sat	22 - 27 ft	Oil droplets were observed in air hammer cuttings near the end of the boring. No oil has been observed in the well and groundwater concentrations of COPCs are low.

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
MW311	14.5	8 - 9 ft	sat	4 - 14 ft	Weathered tar in sand with sheen and odor

Location ID	Total Depth	Interval	Sat or Unsat	Vapor Probe Screen	Residual Description
SG5	10	8-10 ft	sat	6.5 - 7.0 ft	strong diesel type odor, stained to oil coated

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB351	16	8 - 15.5 ft	sat	no well	Stained, oil coated, and oil wetted sand and organic silt
soil boring refusal on bedrock at 16'					

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
TP302	11	8 - 9 ft	unsat	no well	Black & blue material within sand w/strong odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
TP301	9	5.5 - 9 ft	unsat	no well	Weathered tar within sand w/ creosote-type odors

MW310 LOCATIONS WITH OBSERVATIONS OF MGP RESIDUALS

MW305 LOCATIONS WITH CUMULATIVE CANCER RISK EXCEEDANCE

MW306 LOCATIONS WITH CUMULATIVE CANCER RISK LESS THAN 10^{-4} AND A HAZARD QUOTIENT <1.0.

APPROXIMATE EXTENT OF UPLAND SITE

PROPERTY BOUNDARY

FORMER SLOUGH

RAILROAD

FORMER MGP STRUCTURE

EXISTING STRUCTURE

AREAS EXCAVATED BY CITY OF MARINETTE EXHIBITING NO EVIDENCE OF MGP RESIDUALS IN SOIL

AREAS EXHIBITING EVIDENCE OF MGP RESIDUALS IN SOIL EXCAVATED AND BACKFILLED WITH CLEAN MATERIAL, BY CITY OF MARINETTE

NON-SOURCE AREA

SOURCE AREA

REMEDIATION ZONE

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
Location ID	Total Depth (ft bgs)	Sample Interval (ft bgs)	Saturated or Unsaturated	Well Screen Interval (ft bgs)	Residual Description
ft: feet					
bgs: below ground surface					
sat: saturated					
unsat: unsaturated					

N

0 80 160
SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001.
3. VERTICAL CONTROL IS NAVD 88 DATUM
4. BUILDING LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
5. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
6. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
7. WELL LOCATIONS FROM A SURVEY BY WPSC DATED OCTOBER 8, 2003, REVISED OCTOBER 31, 2003.
8. BRICK INTERCEPTOR SEWER REPLACEMENT TAKEN FROM DRAWING BY AYRES ASSOCIATES, GREEN BAY, WISCONSIN, JOB NO. 16-0189.10, DRAWING NO. P101, SHEET NO. 7, DATED 3/14/03.
9. MONITORING WELLS MW2R, MW3R, MW307R INSTALLED OCTOBER 2004 AND MW308, MW310, P305 INSTALLED JUNE 2004. SURVEYED BY WPSC IN JANUARY 2005. (NAVD88, MARINETTE COUNTY COORDINATES).
10. MONITORING WELLS MW312 AND MW313 WERE SURVEYED BY WPSC IN AUGUST 2012.

NOTES:

1. THE FOLLOWING SAMPLE LOCATIONS INDICATED ELEVATED CANCER RISK BUT WERE NOT DERIVED FROM MGP OPERATIONS; THEREFORE, THESE LOCATIONS WERE NOT INCLUDED IN THE DELINEATION OF MGP-RELATED SOIL IMPACTS:
   - SAMPLE SB347 (3-5 FEET) WITH CANCER RISK OF 1.3E-03.
   - SAMPLE SB353 (3-5 FEET) AND (5-7 FEET) WITH CANCER RISKS OF 5.1E-04 AND 1.3E-04, RESPECTIVELY.

DRAWN BY: AGC DATE: 06/16/15
CHECKED BY: Y_Z DATE: 06/23/15
APPROVED BY: RJB DATE: 07/06/15
DRAWING NO: 1549-200-B06-1
REFERENCE: .

ESTIMATED EXTENT OF SOIL REQUIRING REMEDIAL ACTION - CR>10^{-4} OR HQ>1

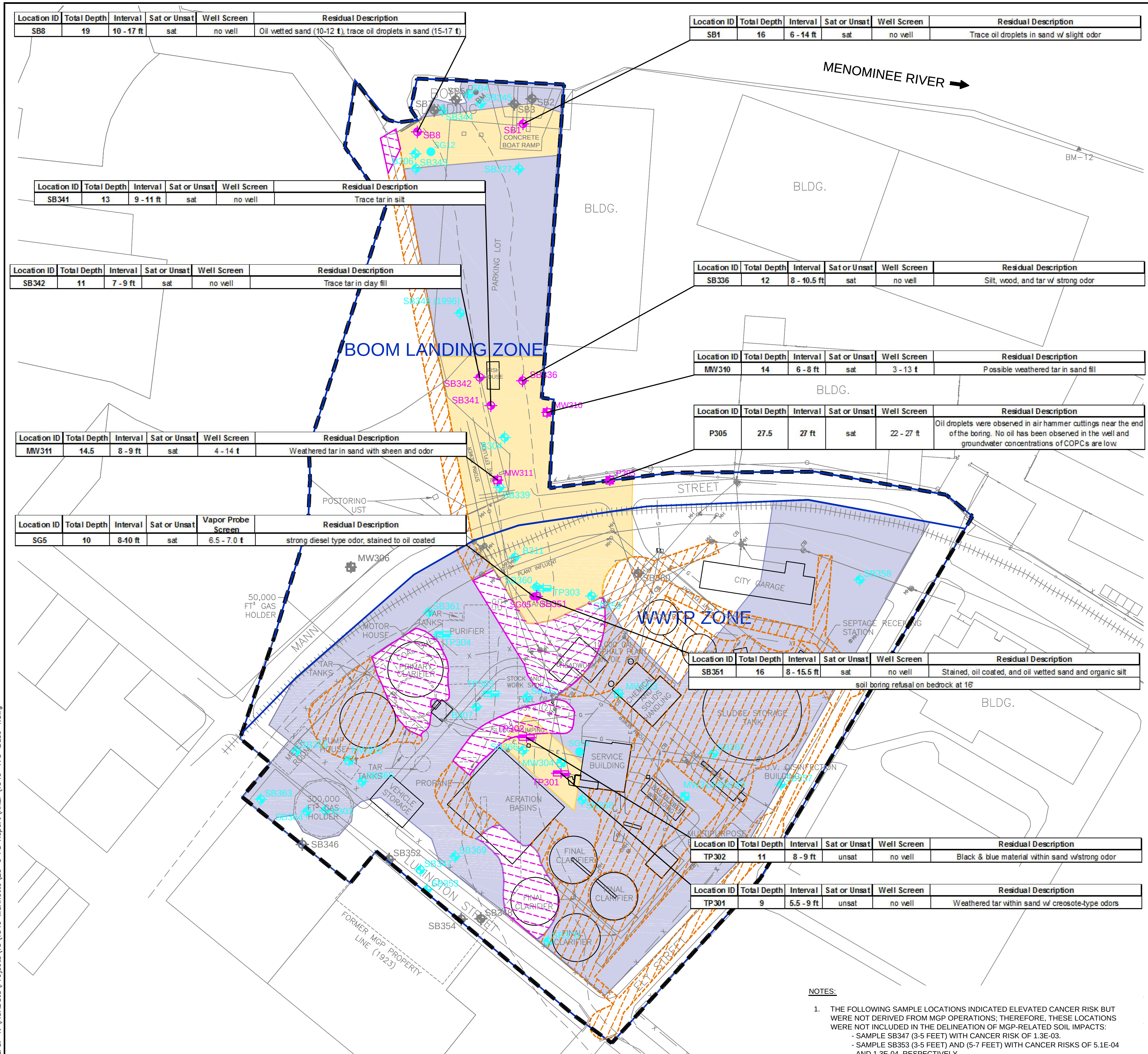
FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

FIGURE NO.
6-1

Jul 06, 2015 11:26am PLOTTED BY: ddudo SAVED BY: ddudo
Y:\ACAData\Projects\15\1549 Marinette\20-0 FS Report\1549-200-B06-1.dwg Layout1
IMAGES:
XREFS: Y:\ACAData\Projects\15\1549 Marinette\20-0 FS Report\XREF\1549-175-Base 4.dwg



Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB8	19	10 - 17 ft	sat	no well	Oil wetted sand (10-12 t), trace oil droplets in sand (15-17 t)

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB1	16	6 - 14 ft	sat	no well	Trace oil droplets in sand w/ slight odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB341	13	9 - 11 ft	sat	no well	Trace tar in silt

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB342	11	7 - 9 ft	sat	no well	Trace tar in clay fill

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB336	12	8 - 10.5 ft	sat	no well	Silt, wood, and tar w/ strong odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
MW310	14	6 - 8 ft	sat	3 - 13 t	Possible weathered tar in sand fill

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
P305	27.5	27 ft	sat	22 - 27 ft	Oil droplets were observed in air hammer cuttings near the end of the boring. No oil has been observed in the well and groundwater concentrations of COPCs are low.

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
MW311	14.5	8 - 9 ft	sat	4 - 14 t	Weathered tar in sand with sheen and odor

Location ID	Total Depth	Interval	Sat or Unsat	Vapor Probe Screen	Residual Description
SG5	10	8-10 ft	sat	6.5 - 7.0 t	strong diesel type odor, stained to oil coated

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
SB351	16	8 - 15.5 ft	sat	no well	Stained, oil coated, and oil wetted sand and organic silt
soil boring refusal on bedrock at 16'					

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
TP302	11	8 - 9 ft	unsat	no well	Black & blue material within sand w/strong odor

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
TP301	9	5.5 - 9 ft	unsat	no well	Weathered tar within sand w/ creosote-type odors

MW310 LOCATIONS WITH OBSERVATIONS OF MGP RESIDUALS

MW305 LOCATIONS WITH CUMULATIVE CANCER RISK EXCEEDANCE

MW306 LOCATIONS WITH CUMULATIVE CANCER RISK LESS THAN 10^{-4} AND A HAZARD QUOTIENT <1.0.

APPROXIMATE EXTENT OF UPLAND SITE

PROPERTY BOUNDARY

FORMER SLOUGH

RAILROAD

FORMER MGP STRUCTURE

EXISTING STRUCTURE

AREAS EXCAVATED BY CITY OF MARINETTE EXHIBITING NO EVIDENCE OF MGP RESIDUALS IN SOIL

AREAS EXHIBITING EVIDENCE OF MGP RESIDUALS IN SOIL EXCAVATED AND BACKFILLED WITH CLEAN MATERIAL, BY CITY OF MARINETTE

NON-SOURCE AREA

SOURCE AREA

REMEDIATION ZONE

Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
Location ID	Total Depth (ft bgs)	Sample Interval (t bgs)	Saturated or Unsaturated	Well Screen Interval (t bgs)	Residual Description
t: feet					
bgs: below ground surface					
sat: saturated					
unsat: unsaturated					

N

0 80 160

SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001.
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6. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
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NOTES:

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DRAWN BY: AGC DATE: 06/18/15
CHECKED BY: Y_Z DATE: 06/23/15
APPROVED BY: RJB DATE: 07/06/15
DRAWING NO: 1549-200-B06-2
REFERENCE: .

ESTIMATED EXTENT OF SOIL REQUIRING REMEDIAL ACTION - CR>10^{-5} OR HQ>1

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

FIGURE NO.
6-2

Jul 06, 2015 11:28am PLOTTED BY: ddudo SAVED BY: ccowree
Y:\ACAData\Projects\15\1549 Marinette\20-0 FS Report\1549-200-B06-2.dwg Layout1
IMAGES:
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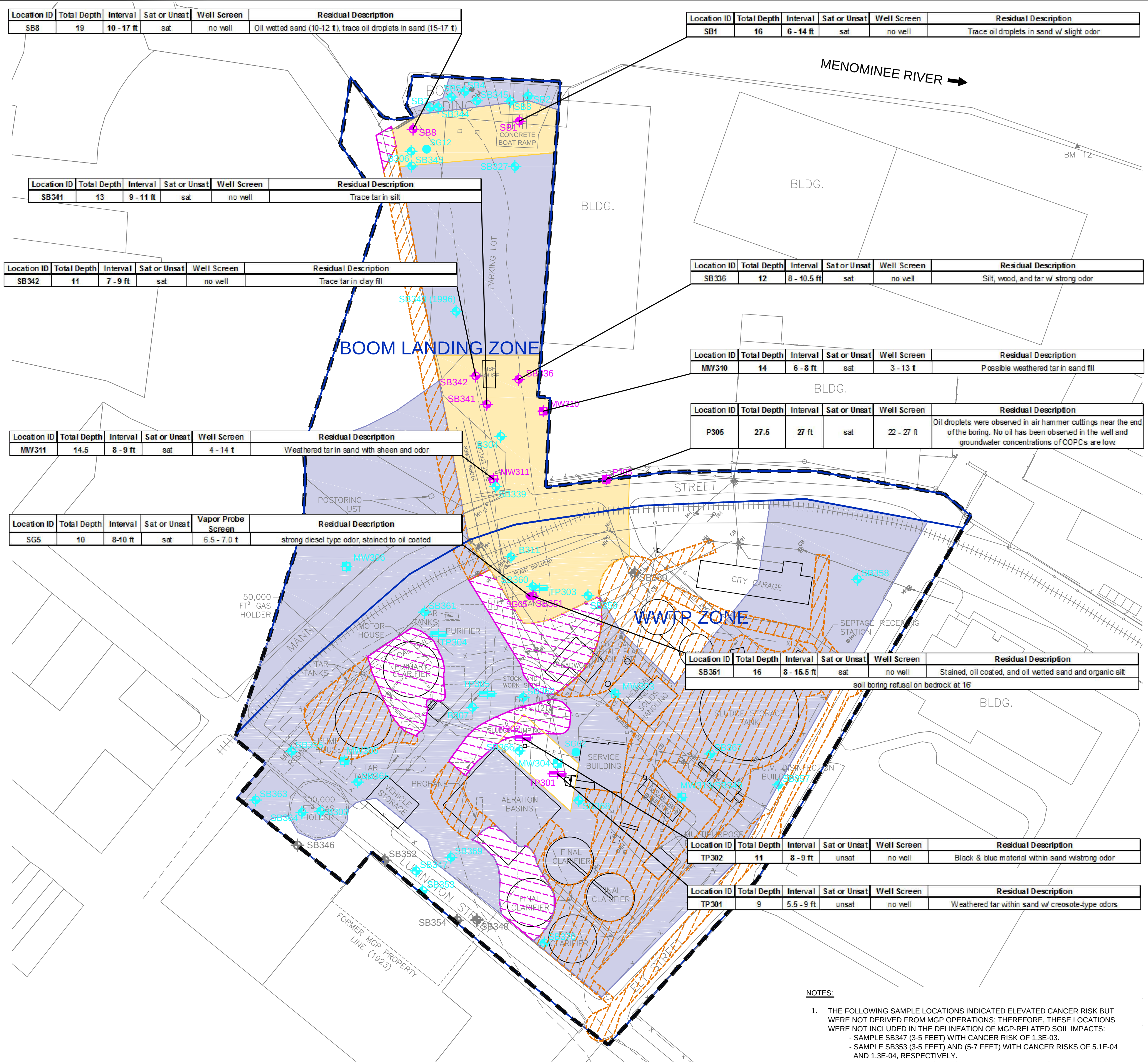

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Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
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Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
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Location ID	Total Depth	Interval	Sat or Unsat	Well Screen	Residual Description
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APPROXIMATE EXTENT OF UPLAND SITE

PROPERTY BOUNDARY

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RAILROAD

FORMER MGP STRUCTURE

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SOURCE AREA

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ft: feet					
bgs: below ground surface					
sat: saturated					
unsat: unsaturated					

N

0 80 160

SCALE IN FEET

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DRAWN BY: AGC DATE: 06/18/15

CHECKED BY: Y_Z DATE: 06/23/15

APPROVED BY: RJB DATE: 07/06/15

DRAWING NO: 1549-200-B06-3

REFERENCE: .

ESTIMATED EXTENT OF SOIL REQUIRING REMEDIAL ACTION - CR>10^{-6} OR HQ>1

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

FIGURE NO.
6-3

Jul 06, 2015 11:30am PLOTTED BY: ddudo SAVED BY: accwrse
Y:\ACAData\Projects\15\1549 Marinette\20-0 FS Report\1549-200-B06-3.dwg Layout1
IMAGES:
XREFS: Y:\ACAData\Projects\15\1549 Marinette\20-0 FS Report\XREF\1549-175-Base 4.dwg

ESTIMATED EXTENT OF GROUNDWATER REQUIRING REMEDIAL ACTION

ESTIMATED EXTENT OF NAPHTHALENE, APRIL 2014

ESTIMATED EXTENT OF BENZENE, APRIL 2014

ESTIMATED EXTENT OF BENZO(A)PYRENE, JANUARY 2013 THROUGH APRIL 2014 AVERAGE

MW303 MONITORING WELL

RIVER EDGE

PROPERTY BOUNDARY

FORMER SLOUGH

RAILROAD

BENZENE SL = 5 ug/L

NAPHTHALENE SL = 100 ug/L

BENZO(A)PYRENE SL = 0.2 ug/L

N

0 80 160

SCALE IN FEET

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10. MONITORING WELLS MW312 AND MW313 WERE SURVEYED BY WPSC IN AUGUST 2012.
11. PMW WELLS WERE IDENTIFIED IN AYERS ASSOCIATES SITE ASSESSMENT AND REMEDIAL ACTION OPTIONS REPORT. CITY OF MARINETTE PROPERTY 500 MANN STREET MARINETTE WISCONSIN 54143 DATED AUGUST 2010

DRAWN BY: AGC DATE: 06/19/15
CHECKED BY: Y_Z DATE: 06/23/15
APPROVED BY: RJB DATE: 07/06/15
DRAWING NO: 1549-200-B07
REFERENCE: .

ESTIMATED EXTENT OF GROUNDWATER REQUIRING REMEDIAL ACTION

FEASIBILITY STUDY REPORT
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/20.0

FIGURE NO.
7

TABLES

Table 1 - Preliminary List of Applicable or Relevant and Appropriate Requirements (ARARs), and To Be Considered (TBC) Guidance/Criteria
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No. V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BBRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical-Specific ARARs/TBC

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
WISCONSIN				
Groundwater Quality Standards	Wis. Admin. Code, ch. NR 140	Groundwater	Applicable to Alt. G2 thru G5. These alt. comply.	Establishes groundwater quality standards; NR 140 enforcement standards equivalent to federal Safe Drinking Water Act maximum contaminant levels (MCL)
Soil cleanup standards	Wis. Admin. Code, ch. 720 and 722	Soil	To Be Considered (TBC) to Alt. S2 thru S6. These alt. comply if the cancer risk of 10^{-6} is selected.	Includes generic, site specific, and performance-based soil cleanup standards; protects against groundwater contamination and direct contact exposure
Hazardous Waste	Wis. Admin. Code, ch. NR 660-679	Hazardous Waste	Applicable to Alt. S2 thru S6. These alt. comply.	Applies generally to the treatment, storage and disposal of identified hazardous wastes
Air Quality Standards	Wis Stat. ch. 285; Wis. Admin. Code, ch. NR 404, 415, 419, 431, 440, 445.	Air	Relevant and appropriate for Alt. S4 thru S6 and G4 thru G5. These alt. comply.	Establishes air pollution control standards for removal, treatment and disposal of contaminated sediments and surface water; includes control of dust or emissions from treatment systems, grading or other earth work
Control of Organic Compound Emissions	Wis. Admin. Code, ch. NR 419.07	Air	Relevant and appropriate for Alt. S4 thru S6 and G4 thru G5. These alt. comply.	Applies to all facilities and procedures used to remediate or dispose of soil or water contaminated with organic compounds which are direct air contaminant sources to their owners and operators.
Sediment Quality	Wis. Admin. Code, ch. NR 105 – 106; WDNR Guidance Document: “Assessing Sediment Quality in Water Bodies Associated with Manufactured Gas Plant Sites” (WDNR PUBL-WR-447-96, March 1996)	Sediment	TBC for Alt. SED2 and SED3. These alt. comply.	DNR guidance document provides framework for investigating potential sediment contamination at MGP sites
Surface Water Quality Standards	Wis. Stats. ch. 281; Wis. Admin. Code, ch. NR 102-105, 207	Sediment	TBC for Alt. SED2 thru SED3. These alt. comply.	WQS applies to surface water; with respect to sediment, a TBC (WQS applicable to point source discharges are addressed as Action-specific ARARs)

Table 1 - Preliminary List of Applicable or Relevant and Appropriate Requirements (ARARs), and To Be Considered (TBC) Guidance/Criteria
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USEPA WIN00050995 / Site Spill ID: B5BT / BBRTS #02-38-000047 / CERCLIS ID: WIN000509952

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
FEDERAL				
Resource Conservation and Recovery Act (RCRA)	40 C.F.R. § 260 et seq. – waste characterization and handling requirement Land disposal restrictions (40 C.F.R. § 268)	Hazardous Wastes	Potentially applicable to Alt. S4 thru S6. These alt. comply.	Establishes standard for hazardous waste characterization, storage, treatment and disposal; removed materials may be subject to RCRA requirements if a hazardous waste
Clean Air Act (CAA)	Air Quality Standards (40 C.F.R. § 50)	Air	Relevant and appropriate for Alt. S4 thru S6 and G4 thru G5. These alt. comply.	Establishes federal standards for various pollutants from mobile construction/ remediation sources
Clean Water Act (CWA) (Section 304)	Water quality standards (40 C.F.R. § 131) Discharge of dredge/fill material (33 C.F.R. § 323) Federal Total Maximum Daily Loads (TMDLs) for impaired waters (40 C.F.R. § 130.7)	Surface Water	TBC for Alt. SED2 thru SED3. These alt. comply.	Federal WQS are ARARs for point source discharges where state has not adopted standards. Federal WQS are TBC for Wisconsin as Wisconsin has adopted WQS applicable to point source discharges from remedial action.

Location-Specific ARARs

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
FEDERAL				
National Environmental Policy Act (NEPA)	Floodplain Management Executive Order 11988 (40 C.F.R. Part 6, App. A)	Floodplains	Relevant and appropriate for all alt. - all comply.	Regulates construction in floodplains and evaluates adverse effects associated with direct/indirect development of floodplains

NATURAL RESOURCE TECHNOLOGY

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
Fish and Wildlife Coordination Act	16 U.S.C. §§661-667e	Surface water body modification; endangered species; migratory species	TBC for all alt. - all comply.	Requires coordination/consultation with Federal and State agencies to provide protection of fish and wildlife from actions that affect species and habitat; requires consultation with U.S. Fish and Wildlife Service prior to water body modification
Endangered Species Act (ESA)	Species/habitat protection (50 C.F.R. Parts 17 and 402)	Endangered/ threatened species and habitat	Relevant and appropriate for all alt. - all comply.	Only relevant if threatened and/or endangered species are present in vicinity of site
Wild and Scenic Rivers Act	Waterway protection (36 C.F.R. § Part 297)	Rivers	Relevant and appropriate for Alt. SED2 thru SED3 - these alt. comply.	Establishes requirements to protect wild, scenic, or recreational rivers

Action-Specific ARARs

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
WISCONSIN				
Water Quality Standards (WQS)	Wis. Stats. ch. 281; Wis. Admin. Code, ch. NR 102-105	Surface Waters	Potentially applicable to Alt. S5 thru S6, and G4. These alt. comply.	Surface WQS are applicable only to point source discharges that may be part of a remedial action.
Water Quality Analytical Test Methods	Wis. Admin. Code, ch. NR 219	Surface Waters	Potentially Applicable to Alt. S5 thru S6, and G4. These alt. comply	Establishes analytical test methods applicable to effluent limitations for discharges from point sources.
Miscellaneous Structures in Navigable Waters	Wis. Stats. ch. 30; Wis. Admin. Code, ch. NR 329	Surface waters; sediment	Relevant and appropriate for Alt. SED2 and SED3. These alt. comply.	Minimize adverse effects of structures in waterways; requires permits for structures placed on, and/or dredging of, the beds of navigable waters.

NATURAL RESOURCE TECHNOLOGY

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CERCLA Docket No. V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BBRTS #02-38-000047 / CERCLIS ID: WIN000509952

STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
Wisconsin Pollutant Discharge Elimination System (WPDES)	Wis. Stat. ch. 283; Wis. Admin. Code, ch. NR 102, 104, 105, 106, 200, 207, 219, 220	Surface Waters	Potentially applicable to Alt. S5 thru S6, and G4. These alt. comply.	Requires compliance with permit limitations for discharge to navigable waters (including water quality effluent limits, water quality standards, state performance standards and toxic and pretreatment effluent standards) for actions involving discharges of effluent associated with dredging operations.
Dredging Requirements	Wis. Stat. § 30.20; Wis. Admin. Code, ch. 345-47	Surface waters; sediment	Relevant and appropriate for SED2 thru SED3 (if dredging) - dredging was completed as a non-time critical removal action.	For specific types of dredging projects, establishes sediment sampling and analysis requirements, evaluation criteria for dredging sites and disposal sites, and monitoring requirements for dredging projects regulated by the State for the removal, transport and disposal of sediments
Solid Waste Management	Wis. Stats. ch. 289; Wis. Admin. Code, ch. NR 500-590	Solid waste	Applicable for Alt. S5 – this alt. complies.	Establishes storage, transportation and disposal requirements for managing solid waste
Hazardous Waste Management	Wis. Stat. ch. 291; Wis. Admin. Code, ch. NR 661, 662, 664	Hazardous Waste	Applicable for Alt. S5 – this alt. complies.	Applicable to wastes generated on-site during remedial action; identification and listing of hazardous waste; specifies requirements that apply to small quantity generators of hazardous waste; specifies general requirements that apply to the storage, treatment and disposal of hazardous waste
Hazardous Substance Discharge	Wis. Admin. Code, ch. NR 706	Hazardous Substances	Applicable to Alt. S4 thru S6, and G4 and G5. These alt. comply.	Notification procedures and responsibilities for discharger of hazardous substances that may occur during remedial work, including containment, cleanup, disposal and restoration
Groundwater Protection Standards	Groundwater Monitoring Well Requirements (Wis. Admin. Code, ch. NR 141)	Groundwater	Relevant and appropriate for S4, S6, and G3 thru G5. These alt. comply.	Provides standards for design, construction, installation, abandonment and documentation of groundwater monitoring wells
Endangered and Threatened Species protection	Wis. Stats. ch. 29.604; Wis. Admin. Code, ch. 27	Endangered/threatened species	Relevant and appropriate for all alt. - all comply.	Applies only if threatened or endangered species exist at or in certain areas around site; establishes requirements for minimizing affects on such species
Soil Cleanup Requirements	Wis. Admin. Code, ch. NR 720	Soil	TBC to Alt. S3 thru S6. These alt. comply.	(See above) Specifies soil criteria to be used in conjunction with remedial actions
FEDERAL				

Table 1 - Preliminary List of Applicable or Relevant and Appropriate Requirements (ARARs), and To Be Considered (TBC) Guidance/Criteria
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No. V-W-06-C-847
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STANDARD, REQUIREMENT, CRITERIA, LIMITATION	CITATION	MEDIA	POTENTIAL ARAR / TBC	REQUIREMENT/COMMENTS
CWA	National Pollutant Discharge Elimination System (NPDES) (40 C.F.R. §§ 122 and 125)	Surface waters	Potentially applicable to Alt. S5 thru S6, and G4. These alt. comply.	Relevant for any wastewater discharge of treated groundwater to surface water body during course of remediation; establishes criteria and standards for imposing treatment requirements in permits.
CWA (Section 304)	Ambient Water Quality Criteria (40 C.F.R. Part 130)	Surface waters	Potentially applicable to Alt. S5 thru S6, and G4. These alt. comply.	Ambient Water Quality Criteria for the protection of aquatic life and human health developed for discharging treated water to a navigable waterway
CWA	NPDES (40 C.F.R. Part 403)	Publicly Owned Treatment Works (POTW)	Potentially applicable to Alt. S5 thru S6, and G4. These alt. comply.	Relevant to discharge of treated groundwater to POTW; establishes standards and requirements for discharge to a POTW
RCRA	Hazardous Waste Management System – General (40 C.F.R. Part 260) and Identification and Listing of Hazardous Waste (40 C.F.R. Part 261)	Offsite land disposal hazardous waste	Potentially applicable to Alt. S5. This alt. complies.	Identifies solid wastes subject to regulation as hazardous wastes and provides general standards for handling and disposal of hazardous wastes
RCRA	Standards for Hazardous Waste Generators (40 C.F.R. Part 262) and Hazardous Waste Transporters (40 C.F.R. Part 263)	Offsite land disposal hazardous waste	Potentially applicable to Alt. S5. This alt. complies.	General requirements for packaging, labeling, marking, and manifesting RCRA hazardous wastes for temporary storage and transportation offsite
RCRA	Land Disposal Restriction (40 C.F.R. Part 268)	Offsite land disposal hazardous waste	Applicable to Alt. S4 thru S6, and G4 and G5. These alt. comply.	Identifies hazardous wastes that are restricted from land disposal
RCRA	Municipal Solid Waste Landfills (40 C.F.R. Part 258)	Offsite land disposal non-hazardous waste	Potentially applicable to Alt. S5. This alt. complies.	Applicable to remedial actions that involve generation of non-hazardous waste; minimum national criteria for management of non-hazardous waste
U.S. Department of Transportation	Hazardous Waste Transport (49 C.F.R. Parts 107, 171 and 172)	Offsite land disposal hazardous waste	Potentially Applicable to Alt. S5. This alt. complies.	Applies to transportation, packaging and labeling of hazardous materials on public roadways
Rivers and Harbors Act, Section 10	33 C.F.R. Parts 320-323	Navigable waterway	Potentially applicable to Alt. SED2 and SED3. These alt. comply.	Applicable to site capping activities on sediment or navigable waterway; prohibits unauthorized obstruction or alteration of any navigable waterway or activities that could impede navigation and commerce

Table 2 - Estimated Volumes of MGP-Affected Soil
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
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Zone and Area		Cumulative Cancer Risk Greater than 10^{-4} or a Hazard Quotient Greater Than 1	Cumulative Cancer Risk Greater than 10^{-5} or a Hazard Quotient Greater Than 1	Cumulative Cancer Risk Greater than 10^{-6} or a Hazard Quotient Greater Than 1
Boom Landing Zone				
Source Area (North)	Assumed Surface Area (SF)	17,500		
	Assume Top of Source Material (Ft-Bgs)	6		
	Assume Bottom of Source Material (Ft-Bgs)	17		
	Estimated Volume of Non-Source Material (CY)	**3,900**		
	Estimated Volume of Source Material (CY)	**7,200**		
	Total Volume of MGP-affected Soil in Source Area (CY)	**11,100**		
Source Area (South)	Assumed Surface Area (SF)	44,500		
	Assume Top of Source Material (Ft-Bgs)	6		
	Assume Bottom of Source Material (Ft-Bgs)	14		
	Estimated Volume of Non-Source Material (CY)	**9,900**		
	Estimated Volume of Source Material (CY)	**13,200**		
	Total Volume of MGP-affected Soil in Source Area (CY)	**23,100**		
Non-source Area	Assumed Surface Area (SF)	61,800	66,000	141,100
	Assume Top (Ft-Bgs)	0	0	0
	Assume Bottom (Ft-Bgs)	15	15	15
	Estimated Volume (CY)	**34,400**	**36,700**	**78,400**

Table 2 - Estimated Volumes of MGP-Affected Soil
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Zone and Area		Cumulative Cancer Risk Greater than 10^{-4} or a Hazard Quotient Greater Than 1	Cumulative Cancer Risk Greater than 10^{-5} or a Hazard Quotient Greater Than 1	Cumulative Cancer Risk Greater than 10^{-6} or a Hazard Quotient Greater Than 1
WWTP Zone				
Source Area (North)	Assumed Surface Area (SF)	26,100		
	Assume Top of Source Material (Ft-Bgs)	8		
	Assume Bottom of Source Material (Ft-Bgs)	16		
	Estimated Volume of Non-Source Material (CY)	**7,800**		
	Estimated Volume of Source Material (CY)	**7,700**		
	Total Volume of MGP-affected Soil in Source Area (CY)	**15,500**		
Source Area (South)	Assumed Surface Area (SF)	8,000		
	Assume Top of Source Material (Ft-Bgs)	6		
	Assume Bottom of Source Material (Ft-Bgs)	13		
	Estimated Volume of Non-Source Material (CY)	**1,600**		
	Estimated Volume of Source Material (CY)	**2,300**		
	Total Volume of MGP-affected Soil in Source Area (CY)	**3,900**		
Non-source Area	Assumed Surface Area (SF)	175,700	298,200	302,900
	Assume Top (Ft-Bgs)	0	0	0
	Assume Bottom (Ft-Bgs)	17	17	17
	Estimated Volume (CY)	**110,700**	**187,800**	**190,800**

Notes:
SF - Square Feet
Ft-Bgs - Feet Below Ground Surface
CY - Cubic Yard

Table 3 - Comparison of General Response Actions (GRAs) with the Remedial Action Objective (RAOs)
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
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General Response Action (GRA)	Remedial Technology	Process Options	Carry Forward for Screening?	Rationale
SOIL Above and Below the Groundwater Table				
No Action	No Additional Action	No additional action	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions	Yes	Process option could be implemented as the primary groundwater remedy or as a component of a more comprehensive soil remedy to achieve RAOs. Retained for further screening.
Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers	Yes	Existing surfacing and clean fill layers on the Site will work as direct contact barriers to achieve RAOs.
In-situ Approaches	Physical/ Chemical Treatment	In-Situ Stabilization/Solidification	Yes	May achieve RAOs but may encounter implementable issues where development and utilities exist.
		Soil Vapor Extraction (SVE)/Air Sparging	Yes	Could potentially achieve the RAO for volatile constituents. Implementation may require a secondary remedial technology to address less volatile constituents. Retained for further screening.
		In-Situ Thermal Treatment	Yes	This process option is potentially effective at achieving RAOs but proximity to river and hydraulic conditions may reduce effectiveness or slow the remediation effort.
	Biological Treatment	Enhanced Bioremediation	Yes	Potentially effective at achieving RAOs in areas outside of the former slough where there is low-level contamination (non-source areas).
	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)	Yes	This process option is potentially effective for affected vadose zone and saturated soil deeper than 5 feet. May require extensive infrastructure to distribute chemicals and achieve RAOs.
Ex-situ Approaches	Excavation	Off-site Disposal	Yes	May achieve RAOs but may encounter implementable issues where development and utilities exist.
		On-site Treatment and On-site Disposal	Yes	
		On-site Treatment and Off-site Disposal	Yes	
GROUNDWATER				
No Action	No Additional Action	No additional action	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Legislative Restrictions	Groundwater Use Restrictions	Yes	Process option could be implemented as the primary groundwater remedy or as a component of a more comprehensive soil remedy to achieve RAOs.
Monitored Recovery	Monitored Natural Attenuation	Long-Term Groundwater Monitoring	Yes	Affected groundwater is generally localized to the former slough. This process option could achieve RAOs because monitoring has shown decreasing trends in COCs and favorable geochemical conditions for MNA.
Containment	Vertical Engineered Barriers	Physical barriers such as steel sheet piling, HDPE or slurry walls	Yes	Potentially effective at achieving RAOs but may require modifications to existing development, including utilities, buildings, and pavement.
	Hydraulic Control Barriers	Strategic groundwater extraction to intercept impacted groundwater to prevent offsite migration.	Yes	Potentially effective at achieving RAOs but may require substantial groundwater pumping to be effective due to the soil permeability and proximity to the river.
	Bottom Sealing Barrier	A horizontal barrier constructed below an impacted area to limit downward migration	No	RAOs would not be achieved with this process option because a natural horizontal barrier (confining layer) consisting of competent bedrock and clay layers is present at the Site as discussed in the RI Report.

Table 3 - Comparison of General Response Actions (GRAs) with the Remedial Action Objective (RAOs)
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General Response Action (GRA)	Remedial Technology	Process Options	Carry Forward for Screening?	Rationale
In-Situ Approaches	Physical/Chemical Treatment	In-Situ Stabilization/Solidification	Yes	Potentially effective at achieving RAOs; however, substantial disruption of existing development would be required and implementation would limit access to public facilities and the river.
		Permeable Reactive Barrier (PRB)	Yes	Groundwater within the former slough are the most affected by the former MGP. RAOs could potentially be achieved because the PRB would potentially prevent contaminant migration to down gradient receptors.
		In-Situ Thermal Treatment	Yes	This process option is potentially effective at achieving RAOs but proximity to river and hydraulic conditions may reduce effectiveness or slow the remediation effort.
	Chemical /Biological Treatment	Air Sparging	Yes	This process option is effective at achieving RAOs for organic contaminants; however, this process option is unlikely to achieve the RAO for NAPL and PAHs. Additionally, implementation of this process option may inadvertently mobilize the currently immobile NAPL.
	Biological Treatment	Enhanced Bioremediation	Yes	Potentially effective at achieving RAOs in areas outside of the former slough where there is low-level contamination (non-source areas).
	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)	Yes	Potentially effective at achieving RAOs in areas of low and high concentrations.
Ex-Situ Treatment	Groundwater Extraction	Onsite Treatment and Reinjection	Yes	Potentially effective at achieving RAOs but proximity to river and hydraulic conditions may reduce effectiveness and require large water treatment volumes.
		Onsite Treatment and Surface Water Discharge	Yes	
		Onsite Treatment and POTW Discharge	Yes	
		Offsite Treatment	Yes	
SOIL GAS				
No Action	No Additional Action	No additional action	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Physical, Land Use, or Legislative restrictions	Environmental Covenant, and/or Deed Restrictions	Yes	Implement ICs with other remedial technologies until media-specific RAOs are achieved.
Mitigation	Passive Mitigation	Sub-slab barriers (HDPE liners, spray-on asphaltic emulsions)	No	Existing buildings do not exceed vapor intrusion screening levels; therefore, ICs will be used to require this type of protective measure for future buildings.
		Passive Venting; used in conjunction with sub-slab barriers.	No	
	Active Mitigation	Building Mitigation; sub-slab (or sub-membrane) pressurization or depressurization.	No	
		Building Mitigation; building pressurization	No	
		Building Mitigation; Indoor air treatment	No	

Table 3 - Comparison of General Response Actions (GRAs) with the Remedial Action Objective (RAOs)
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General Response Action (GRA)	Remedial Technology	Process Options	Carry Forward for Screening?	Rationale
SEDIMENT				
No Action	No Additional Action	No additional action	Yes	RAOs have been achieved through the early action remedy in years 2012 and 2013 as described in the construction Final Report and Remedial Investigation Report.
Monitoring	Monitoring	Bathymetric survey and analytical sampling	Yes	Continue current monitoring program as described in the Residual Sand Cover Monitoring Plan dated September 27, 2013.
Institutional Controls	Physical, Use, and/or Legislative Restrictions	Waterway Use Restrictions	Yes	Institutional controls will be put in place to preserve the early action remedy completed in years 2012 and 2013.
		Signs	Yes	
		Fish Consumption Advisories and Fishing Bans	No	RAOs have been achieved through the early action remedy in years 2012 and 2013 as described in the construction Final Report and Remedial Investigation Report.
Monitored Natural Recovery	Monitored Natural Recovery	Long term surface water, porewater, sediment, or ecological monitoring	No	
	Enhanced Natural Recovery	Thin-Layer Cover	No	
Containment	Subaqueous Capping	Sand Cap	No	
		Sand Cap Amended with Contaminant Specific Adsorptive Media	No	
		Multi-Layer Cap	No	
		Armoring Cap	No	
In-Situ Treatment	Physical/Chemical Treatment	In-Situ Stabilization/Solidification	No	
Ex-situ Approaches	Dredging	Mechanical Dredging	No	
		Hydraulic Dredging	No	
	Excavation In The Dry	Conventional dry excavation of sediments through water diversion and dewatering	No	
Disposal of Dredge Spoils (Sediment and Water)	Sediment Management and Disposal	On-site sediment dewatering, stabilization, offsite disposal/reuse	No	
	Water Management and Disposal	On-site treatment, surface water discharge	No	
		On-site treatment, POTW discharge	No	

Notes:

- Eliminated based on the screening evaluation presented in this table (shaded grey)

NAPL - Non-aqueous Phase Liquid, identified as oil-wetted or oil-coated soil
HDPE - High Density Polyethylene
MNA - Monitored natural attenuation
POTW - Publically Owned Treatment Works
PVOC - Petroleum volatile organic compound
RAOs - Remedial Action Objectives
COCs - Contaminants of Concern

NATURAL RESOURCE TECHNOLOGY

Table 4-1 - Soil: Initial Screening of Remedial Technology Process Options
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General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
No Action	No Additional Action	No additional action	● No additional action.	● Will not achieve the remedial action objectives in the foreseeable future.	● There is no remedy to implement.	No Cost	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions	● WDNR GIS Registry and/or building codes that prohibit or restrict use of the site so that development or excavation is not allowed without proper controls.	● Minimal potential short term exposure risk. ● Administratively effective and reliable; relies on local government action to establish, enforce and restrict soil disturbance. ● Effective at reducing ingestion of contaminated soil. ● No reduction in mobility or volume of contaminants.	● Easy implementation. ● Administratively implementable.	Low	Yes	This process option will be needed in conjunction with one or more other remedial technologies to achieve media-specific RAOs.
Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers	● Soil, aggregate, asphalt, concrete, or geosynthetic caps used for creating a physical barrier separating impacted soil from surface receptors. Geosynthetic caps provide redundancy, impermeability, and allow for vegetative cover. Asphalt and concrete caps are relatively impermeable and allow for vehicular loadings.	● Process option does not reduce the volume of COCs, but does minimize exposure to affected soil. ● Also effective in preventing continued migration of contaminants from soil to groundwater due to precipitation if cap is impervious.	● Capping material composition may degrade, deteriorate, or be damaged intentionally or unintentionally. ● Requires monitoring of cap integrity. ● Process option has been used extensively and is relatively easy to implement unless barrier penetrations are required for utilities, etc.	Low to Moderate	Yes	Existing surfacing and clean fill layers on the Site will work as effective contact barriers to achieve RAOs. Therefore, this process option passes the screening criteria.
In-situ Approaches	Physical/ Chemical Treatment	In-Situ Stabilization/ Solidification	● Mobility of contaminants is reduced by physical bonding/chemical reactions. Most common technique for solidification is blending cement and other reagents with impacted soil/groundwater zone to produce a monolithic mass resistant to leaching. ● Methods for delivery include auger, injection, or mechanical mixing	● Effective for weathered coal tar, PAHs, VOCs, and metals. ● Limited effectiveness where high percentage of free product present, highly heterogeneous soil, or in soil with high peat content. ● May provide limited short-term risk reduction, and potentially acceptable long-term risk reduction ● Contaminants become immobilized by stabilization/ solidification methods but "weathering" or deterioration may release contaminants in the future.	● Implementation affected by obstructions and may require pre-excavation of material/debris. ● Requires construction monitoring of stabilized soil to verify optimal mixture is met and performance is achieved. ● Most reagents and additives are widely available. ● Less disruptive to local residents than excavation.	Moderate to High	No	The areas where MGP residuals are present are relatively small; implementing an ISS remedy in a small area is generally not cost effective. In addition, substantial disruption of existing development and utilities would be required. Implementation would limit access to public facilities and the river. Therefore, this process option does not pass the screening criteria.

Table 4-1 - Soil: Initial Screening of Remedial Technology Process Options
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General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
In-situ Approaches	Physical/ Chemical Treatment	Soil Vapor Extraction/Air Sparging	● Air is injected into the saturated zone to remediate volatile or biodegradable containments. ● A vacuum is applied to extraction wells to remove volatile contaminants from the vadose (unsaturated) zone. ● Groundwater extraction is occasionally implemented to keep the water table level from raising due to the vacuum extraction process.	● Effective at remediating PVOCs. ● Requires maintenance/replacement of air filter media/treatment system. ● High moisture in the soils require higher vacuums and can hinder operation of system. ● Removal rates may be reduced by high organic content, low hydraulic conductivity or high sorption capacity of PVOCs in soil.	● May require off-gas treatment system ● May also require limited groundwater extraction to keep groundwater from entering the vadose zone. ● Technology has been extensively used in the past which allows for a wide range of system choices and capabilities.	Moderate	Yes	Process option meets implementation criteria, but the affected soil typically consists of elevated PAHs and PVOCs - soil vapor extraction is not effective at addressing PAHs. Retained as requested by USEPA.
In-situ Approaches	Physical/ Chemical Treatment	In-Situ Thermal Treatment	● The temperature of the subsurface is increased through installation of thermal wells, steam injection, or electric resistance technologies. ● Increased subsurface temperature removes contaminants through steam stripping, displacement, and volatilization. ● A SVE or multiphase system is used to extract the contaminants for separation and treatment.	● Highly effective for tar saturated soil, VOCs, and PAHs. ● Treatment has been used to mobilize residual oils, coal tars, and other DNAPL, which can be removed using multiphase extraction. ● Soil type, contaminant characteristics, concentrations, geology, and hydrogeology can significantly impact remedial duration and effectiveness.	● This technique requires large energy input. ● Heating of shallow soil typically requires thermal insulation on ground surface. ● Resistance heating requires minimum soil moisture content of approximately 5% ● Monitoring of air and groundwater beyond the perimeter must occur to verify the contaminants are not mobilizing out of the treatment zone or leaching. ● Implementation under active buildings, roads, and utility corridors is possible; however, typically requires thermal compatibility studies, horizontal borings, vapor intrusion controls, and continuous monitoring to ensure protection of human health and existing infrastructure. ● Buried metal probes and high temperatures require extra safety precautions (e.g., security fencing, video surveillance, motion sensors, and automated electrical system deactivation when security measures are breached, etc.).	High	No	Process option meets implementation criteria but not effectiveness criteria because the majority of the affected soil is below the water table. Thermal technologies used to address saturated soil are generally limited to 100 degrees Celsius, well below the temperature needed to degrade the PAHs present. Moreover, provided the location of affected soil at the site, other technologies (such as excavation) are more likely to achieve the RAO and will do so with less cost and in shorter duration. Therefore, this process option does not pass the screening criteria.

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General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
In-situ Approaches	Biological Treatment	Enhanced Bioremediation	● Natural microbes are stimulated by providing supplemental nutrients to increase biological activity and contaminant degradation. Typical nutrients include carbon, nitrate, sulfate, and oxygen. ● Stimulation can be provide through injection of a nutrient slurry into the treatment zone or through low pressure sparging of air, oxygen, or nitrogen gas. ● Occasionally, the natural microbe colony is enhanced with injection of supplemental microbes (bioaugmentation).	● Effective at reducing concentrations of dissolved phase VOCs and certain PAHs. ● Achieving particularly low cleanup levels for certain PAHs can be impractical. ● Not effective process option if heavy contamination such as NAPL are still present. ● Effectiveness and duration to achieve remedial objectives is highly dependent on achieving and maintaining the specific geochemical conditions required for microbe growth. ● Enhanced bioremediation is only effective when amendment is in direct contact with contamination and microorganisms. Achieving sufficient contact can be challenging in low permeability or heterogeneous formations.	● Requires moderate to high moisture in vadose zone soil. ● Achieving adequate distribution for stimulation and/or augmentation injections is challenging in the vadose zone. ● Requires continued monitoring inside and outside the injection zones, which is more challenging in vadose zone than in groundwater. ● Subsurface geology and geochemistry must be well understood to properly design and implement process option. ● Bench-scale and pilot scale treatability studies may be required to select proper stimulants and augments. ● Typically requires multiple injections of stimulants over several years to achieve desired results. ● Requires regular monitoring of subsurface conditions.	Moderate	No	Process option meets implementation criteria, but does not meet effectiveness criteria. This process option could potentially be effective if the Site had distinct areas with low to moderately affected soil. MGP-affected soil at the Site is generally collocated with MGP residuals (NAPL). Therefore, developing treatment zones distinguishing highly affected soil with visual MGP residuals from moderately affected soil with elevated constituent detections will not be an effective remedial approach. Further, achieving proper amendment distribution in the vadose zone is a significant implementation challenge that would greatly reduce the potential effectiveness of this remedy.

Table 4-1 - Soil: Initial Screening of Remedial Technology Process Options
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General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
In-situ Approaches	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)	● Injection of chemical oxidants to break down contaminants to inert or less toxic compounds. Common chemical oxidants include ozone, hydrogen peroxide (modified Fenton's reagent), permanganate, and persulfate. ● Distribution of oxidant for soil remediation is typically performed using overlapping direct push pressure injection points or auger mixing. ● Surfactants and activators are sometimes added to enhance the effectiveness of certain oxidants.	● Effective for VOCs, and PAHs. ● Due to significant oxidant demand of free product, chemical oxidation has limited effectiveness in oxidizing free product. ● Oxidation reaction is only effective when oxidant is in direct contact with contamination. ● Achieving sufficient oxidant to soil contact is challenging in the vadose zone.	● Extensive subsurface conditions must be known to understand potential chemical oxidation reactions. ● Bench-scale and pilot scale treatability studies are required to select proper oxidant type and concentration. ● Potential for off gassing and heat generation, depending on oxidant type, activation method, and subsurface conditions. ● Oxidation reaction can oxidize inorganics from soil to more readily dissolved states. This is of particular concern for chromium, which is often converted from the moderately toxic trivalent state to the highly toxic hexavalent state. ● Requires handling, storage, distribution, and safety precautions for large quantities of oxidizing chemicals.	Moderate to High	Yes	This process option is potentially effective in vadose zone and saturated soil. This process option passes the screening criteria.
Ex-situ Approaches	Excavation	Off-site Disposal	● Impacted soil is excavated. The soil is staged, or directly loaded into trucks and disposed. Virgin soil or stone is often used to backfill the excavation.	● Effective for a wide range of contaminants. ● Requires erosion and access controls during construction for managing fugitive emissions, soil, and public access. ● Moderate potential short term exposure risk (odors, and construction worker and community exposures) ● Process option does not treat the soil or groundwater. The impacted material is removed and disposed in permitted facility. ● Highly effective and predictable timetable. ● Soil beneath subsurface structures or above ground structures cannot be removed, which can reduce the overall effectiveness of excavation.	● Limited to availability of space for staging and handling of soil material and water treatment system, if needed ● Air quality controls need to be implemented to monitor potential emissions and dust. ● Soil stability devices may be needed to support surface structures.	Moderate to High	Yes	This process option passes the screening criteria. However, this process option may encounter implementation challenges where development and utilities exist. In addition, there are significant implementation challenges to remove affected soil at depths greater than the water table due to dewatering and stability considerations.

Table 4-1 - Soil: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
Ex-situ Approaches	Excavation	On-site Treatment and On-site Disposal	● Impacted soil is excavated. The soil is staged and treated. Typical treatments include chemical oxidants, thermal desorption, and solidification. Once performance standards are reached, the treated soil is placed back into the excavation.	● Effective for a wide range of contaminants. ● Requires erosion and access controls during construction for managing fugitive emissions, soil, and public access ● Moderate potential short term exposure risk (odors, and construction worker and community exposures) ● Depending on treatment technology, contamination is destroyed or rendered inaccessible for human exposure. ● Highly effective and predictable timetable. ● Soil beneath subsurface structures or above ground structures cannot be removed, which can reduce the overall effectiveness of excavation.	● Large footprint required for ex-situ treatment infrastructure. ● Air quality controls need to be implemented to monitor potential emissions and dust. ● Soil stability devices may be needed to support surface structures. ● May require significant odor controls associated with on-site ex-situ treatment. ● Consistently achieving treatment performance standards for on-site disposal, particularly for PAHs, can be technically challenging. ● Typical thermal desorption can treat approximately 350 cubic yards of soil per day, resulting in extended remediation schedules.	Moderate to High	Yes	This process option passes the screening criteria. However, this process option may encounter implementation challenges where development and utilities exist. In addition, there are significant implementation challenges to remove affected soil at depths greater than the water table due to dewatering and stability considerations. Further, thermal desorption treatment utilities a large foot print and is typically limited to ~350 cubic yards per day. Reduce production and large foot print may limit the implementability of this process option at the Site. Retained as requested by USEPA.

NATURAL RESOURCE TECHNOLOGY

Table 4-1 - Soil: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL Above and Below the Groundwater Table								
		On-site Treatment and Off-site Disposal	● Impacted soil is excavated. The soil is staged and treated. Typical treatments include chemical oxidants, thermal desorption, and solidification. Once performance standards are reached, the treated soil is loaded onto trucks and disposed in a permitted facility. ● Typically implemented to treat characteristically hazardous material to meet Subtitle D landfill disposal requirements, thereby reducing disposal costs.	● Effective for a wide range of contaminants. ● Requires erosion and access controls during construction for managing fugitive emissions, soil, and public access ● Moderate potential short term exposure risk (odors, and construction worker and community exposures) ● Depending on treatment technology, contamination is destroyed or rendered inaccessible for human exposure. ● Highly effective and predictable timetable. ● Soil beneath subsurface structures or above ground structures cannot be removed, which can reduce the overall effectiveness of excavation.	● Large footprint required for ex-situ treatment infrastructure. ● Air quality controls need to be implemented to monitor potential emissions and dust. ● Soil stability devices may be needed to support surface structures. ● May require significant odor controls associated with on-site ex-situ treatment.	High	No	The affected soil is not hazardous, thus eliminating potential cost savings compared to other disposal options. Therefore, this process option does not pass the screening criteria.

Notes:
- Eliminated based on the screening evaluation presented in this table
GRA - General Response Action
NAPL - Non-aqueous Phase Liquid, identified as oil-wetted or oil-coated soil
PVOC - Petroleum volatile organic compound
RAOs - Remedial Action Objectives

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
No Action	No Additional Action	No additional action	● No additional action.	● Will not achieve the remedial action objectives in the foreseeable future.	● There is no remedy to implement.	No Cost	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Groundwater Use Restrictions	● WDNR GIS Registry, building codes, state, county, municipal legislation, and/or an ordinance to prohibit the use of groundwater within a defined zone.	● Minimal potential short term exposure risk. ● Administratively effective and reliable; relies on government action to establish, enforce, and restrict groundwater use. ● Effective in reducing ingestion of contaminated groundwater. ● No reduction in mobility or volume of contaminants.	● Easy implementation. ● Administratively implementable.	Low	Yes	Process option meets effectiveness and implementability criteria. Groundwater use restrictions would successfully prevent dermal contact and ingestion of affected groundwater.
Monitored Recovery	Monitored Natural Attenuation	Long-Term Groundwater Monitoring	● Verify reduction in contaminant mass and concentration is naturally occurring at an acceptable rate. ● Natural reduction/attenuation is demonstrated through monitoring of a groundwater sampling network, contaminant trend analysis, mass balance calculations, and modeling.	● Relies on biodegradation, dispersion, and dilution to reduce contaminant concentrations to acceptable levels. ● Typically only effective for low to moderate concentrations of dissolved organic contaminants. ● Effectiveness and timeframe of attenuation is highly dependent on physical, chemical, and biological characteristics. ● Effectiveness is evaluated through groundwater monitoring events.	● Easy implementation. ● Requires monitoring with relatively well-established methods. ● No construction or infrastructure required, aside from existing monitoring wells and occasional maintenance activities. ● Little disruption to local residents. ● Can be combined with other options.	Low to Moderate	Yes	Affected groundwater is generally localized to the former slough. This process option could achieve RAOs because monitoring has shown decreasing trends in COCs and favorable geochemical conditions for MNA. Therefore, this process option passes the screening criteria.
Containment	Vertical Engineered Barriers	Physical barriers such as steel sheet piling, HDPE or slurry walls	● Subsurface vertical barriers constructed from either sheet piling, HDPE, or slurry walls. ● Barriers extend into the underlying low permeability soil layer to prevent lateral migration of impacted groundwater. ● Typically implemented with a groundwater use restriction to prohibit consumption of impacted groundwater and a limited groundwater extraction system to control infiltration water.	● The mass of groundwater contamination is not reduced; however, the mobility of groundwater is reduced. ● Fully effective at immediately reducing offsite migration of impacted groundwater.	● Barrier material may degrade or deteriorate, through continuous contaminant exposure. ● Barrier may be damaged during future subsurface construction activities. ● Requires monitoring and limited groundwater extraction to verify contained impacted groundwater does not migrate beyond the barrier wall. ● Process option has been used extensively and is relatively easy to implement. ● Complexity of vertical barrier is increased if utilities, land improvements, or buried obstructions are located along barrier alignment.	Moderate	No	As indicated in the RI and BLRA, groundwater is not affecting the Menominee River (surface water is not a media of concern). In addition, existing development, including utilities, buildings, and pavement would severely limit the implementability of this process option and its ability to achieve RAOs.

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
Containment	Hydraulic Control Barriers	Strategic groundwater extraction to intercept impacted groundwater to prevent offsite migration.	● Gradient control resulting from strategic groundwater extraction designed to capture the contaminant plume, thereby controlling and maintaining the size and the location of the COCs.	● Effective at controlling offsite migration of impacted groundwater, particularly in a small to moderate size contaminant plume. ● Effectiveness is dependent on consistent system operations. ● Relies on overlapping cones of depression from groundwater extraction activities to create an effective barrier. As a result, the subsurface hydrogeology must be well understood.	● Easy to implement if groundwater hydrogeology is understood ● Operation and maintenance of groundwater extraction and treatment system may become difficult and costly because the system could run indefinitely.	Moderate	No	As indicated in the RI and BLRA, groundwater migration is not affecting the Menominee River (surface water is not a media of concern). In addition, the effectiveness of this process option will be limited because of the substantial groundwater pumping required due to the soil permeability and proximity to the river.
In-Situ Approaches	Physical/ Chemical Treatment	In-Situ Stabilization/Solidification	● Mobility and leachability of contaminants is reduced by physical bonding/chemical reactions. ● Admixtures can be designed to reduce the toxicity of contaminants. ● Most common technique for solidification is blending cement and other reagents with impacted soil/groundwater zone to produce a monolithic mass resistant to leaching. ● Methods for delivery include auger, injection, or mechanical mix.	● Effective for weathered coal tar, PAHs, PVOCs, and metals. ● Limited effectiveness where high percentage of free product is present in highly heterogeneous soil, or soil with high peat content. ● May provide limited short-term risk reduction, and potentially acceptable long-term risk reduction. ● Contaminants become immobilized by stabilization/ solidification methods but "weathering" or deterioration may release contaminants in the future.	● Implementation affected by obstructions may require pre-excavation of material/debris. ● Requires monitoring of stabilized soil to verify performance. ● Most reagents and additives are widely available. ● Less disruptive to local residents than excavation. ● Requires achieving optimal mix to meet desired performance criteria. ● Limited availability of qualified contractors.	Moderate to High	No	The size of the groundwater plume is relatively small; implementing an ISS remedy in a small area is generally not cost effective. In addition, substantial disruption of existing development would be required. Implementation would limit access to public facilities and the river. Therefore, this process option does not pass the screening criteria.
		Permeable Reactive Barrier (PRB)	● A permeable barrier is installed downgradient from the contaminant plume which is constructed with reactive or sorbent material. Barrier can either be created through backfilling an excavated trench or overlapping pressurized injections. As impacted groundwater flows through the barrier, contaminants are either degraded or retained in the barrier material. Typical backfill material includes zero-valent iron, carbon, organoclay, chelators, or microbes.	● Effective for low or moderate concentrations of certain dissolved contaminants. ● If present, NAPL can coat the reactive media, thereby reducing barrier effectiveness. ● System efficiency decreases as the PRB media becomes saturated with contaminants, or if natural biological fouling of reactive media occurs.	● Once installed, natural groundwater flow through the PRB will result in removal of contaminants from groundwater. ● Difficult to implement in highly variable groundwater flow or where, seasonal or long term groundwater flow direction can change. ● Requires monitoring to verify the continued groundwater flow through the PRB. ● Requires maintenance/replacement of PRB media.	Moderate	No	As indicated in the RI and BLRA, groundwater migration is not affecting the Menominee River (surface water is not a media of concern). In addition, existing development, including utilities, buildings, and pavement would severely limit the implementability of this process option and its ability to achieve RAOs.

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
In-Situ Approaches	Physical/ Chemical Treatment	In-Situ Thermal Treatment	● The temperature of the subsurface is increased through installation of thermal wells, steam injection, or electric resistance technologies. ● Increased subsurface temperature removes contaminants through steam stripping, displacement, and volatilization. ● A SVE or multiphase system is used to extract the contaminants, for separation and treatment.	● Highly effective for tar saturated soil and PVOCs in groundwater. ● Limited to moderately effective for PAHs in groundwater. ● Treatment has been used to mobilize residual oils, coal tars, and other DNAPL, which can be removed using multiphase extraction. ● Soil type, contaminant characteristics, concentrations, geology, and hydrogeology can significantly impact remedial duration and effectiveness.	● This technique requires large energy input. Influx of cold water from adjacent surface water body or high permeability aquifer increases the required energy input. ● Monitoring of air and groundwater beyond the perimeter must occur to verify the contaminants are not mobilizing out of the treatment zone or leaching. ● Implementation under active buildings, roads, and utility corridors is possible; however, typically requires thermal compatibility studies, horizontal borings, vapor intrusion controls, and continuous monitoring to ensure protection of human health and existing infrastructure. ● Buried metal probes and high temperatures require extra safety precautions (e.g., security fencing, video surveillance, motion sensors, and automated electrical system deactivation when security measures are breached, etc.).	High	No	This process option does not pass the screening criteria because existing development, including utilities, buildings, and pavement severely limits implementability. In addition, the majority of the contaminants are below the water table. Thermal technologies are generally limited to 100 degrees Celsius, well below the temperature needed to degrade the PAHs present. Further, source removal is anticipated as part of a soil remedy, thereby reducing the necessity of an aggressive groundwater remedy. In addition, the groundwater plume is generally localized to one or two wells. Implementation of thermal technologies to address an isolated plume is a challenge that greatly increases costs. Therefore, this process option does not pass the screening criteria.

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
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CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
In-Situ Approaches	Chemical/ Biological Treatment	Air Sparging	● The process uses horizontal and/or vertical wells to inject air directly into the groundwater. Injected air reduces dissolved contaminant mass through volatilization. ● Typically, volatilized contaminants are removed using an SVE system. ● Typically combined with soil vapor extraction systems to address affected soil.	● Effective for organic contaminants that readily volatilize from dissolved phase to vapor phase (high Henry's Constant). ● Not effective technology if heavy contamination such as free product are still present. ● May disrupt groundwater flow patterns and biological activities in the saturated and vadose soil zones. ● Not highly-effective for addressing PAHs and metals.	● Air injection system may also include recovery such as a SVE system. ● Complexity of implementation is increased if conducted near or under occupied structures. ● Injection of air may induce plume and or NAPL migration. ● Requires monitoring inside and outside the injection zones. ● Limited ability of recovery for stratified soils with low permeability layers such as clay or fractured rock.	Moderate	Yes	Process option meets implementation criteria, but the groundwater contaminant plume consists of a large PAH plume. Air Sparging has limited effectiveness in addressing PAHs. An air sparing system could also be operated at low flow rates to increase dissolved oxygen in groundwater, thereby enhancing bioremediation. Retained as requested by USEPA.
In-Situ Approaches	Biological Treatment	Enhanced Bioremediation	● Natural microbes are stimulated by injection of supplemental nutrients to increase biological activity and contaminant degradation. Typical nutrients include carbon, nitrate, sulfate, and oxygen. ● Stimulation can be provide through injection of a nutrient slurry into the treatment zone or through low pressure sparging of air, oxygen, or nitrogen gas. ●Occasionally the natural microbe colony is enhanced with injection of supplemental microbes (bioaugmentation).	● Effective at reducing concentrations of dissolved phase PVOCs and certain PAHs. ● Achieving low cleanup levels for certain PAHs can be impractical. ● Not effective process option if heavy contamination such as NAPL are still present. ● Effectiveness and duration to achieve remedial objectives is highly dependent on achieving and maintaining the specific geochemical conditions required for microbe growth. ● Enhanced bioremediation is only effective when reagent is in direct contact with contamination and microorganisms. Achieving sufficient contact can be challenging in low permeability or heterogeneous formations.	● Subsurface geology and geochemistry must be well understood to properly design and implement process option. ● Bench-scale and pilot scale treatability studies may be required to select proper stimulants and augments. ● Typically requires multiple injections of stimulants over several years to achieve desired results. ● Requires regular monitoring of subsurface conditions.	Moderate	No	This process option passes the screening criteria. However, enhanced bioremediation can also be performed through low flow injection of air through an Air Sparge System. As a result, the enhanced bioremediation process option will be evaluated under the Air Sparge Process Option.

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
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USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
In-Situ Approaches	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)	● Injection of chemical oxidants to break down contaminants to inert or less toxic compounds. Common chemical oxidants include ozone, hydrogen peroxide, permanganate, and persulfate. ● Distribution of oxidant is typically performed using overlapping pressurized injection points or through injection and recirculation via groundwater extraction. ● Surfactants and activators are sometimes added to enhance the effectiveness of certain oxidants.	● Highly effective for dissolved phase PVOCs and PAHs. ● Due to significant oxidant demand of free product, chemical oxidation has limited effectiveness in oxidizing free product. ● Oxidation reaction is only effective when oxidant is in direct contact with contamination. Achieving sufficient contact can be challenging in low permeability or heterogeneous formations.	● Extensive subsurface conditions must be known to understand potential chemical oxidation reactions. ● Bench-scale and pilot scale treatability studies are required to select proper oxidant type and concentration. ● Potential for off gassing and heat generation, depending on type of oxidant, activation method, and subsurface conditions. ● Oxidation reaction can oxidize inorganics from soil to more readily dissolved states. This is of particular concern for chromium, which is often converted from the moderately toxic trivalent state to the highly toxic hexavalent state. ● Requires handling, storage, distribution, and safety precautions for large quantities of oxidizing chemicals.	Moderate to High	Yes	This process option passes the screening criteria. Effective implementation in areas of visual MGP residuals is possible, but will be a significant implementation challenge due to the high oxidant demand of MGP residuals and the preferential paths in subsurface lithology.
Ex-Situ Treatment	Groundwater Extraction	Onsite Treatment and Reinjection	● Extraction of impacted groundwater using horizontal or vertical wells. ● Extracted groundwater is treated at the surface in an onsite water treatment plant prior to subsurface discharge through injection wells. ● Removal of impacted groundwater and influx of adjacent unimpacted groundwater reduces contaminant concentrations.	● Addresses a wide range of contaminants. ● Residual saturation of the contaminant in the soil pores is not easily removed by groundwater pumping. ● Effectiveness and timeframe of pump and treat recovery is difficult to accurately forecast.	● Groundwater pumping is not applicable for contaminants with high residual saturation, contaminants with high sorption capabilities, and homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec. ● Requires ongoing maintenance of extraction and treatment system and regular replacement of treatment media, which will increase cost and time to reach the remediation objectives. ● Typically requires obtaining a discharge permit and achieving strict injection standards.	Moderate to High	No	This process option does not pass the screening criteria because the effectiveness of this process option will be limited by the substantial groundwater pumping required due to the soil permeability and proximity to the river, which will increase cost and time to reach the remediation objectives.

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
Ex-Situ Treatment	Groundwater Extraction	Onsite Treatment and Surface Water Discharge	● Extraction of impacted groundwater using horizontal or vertical wells. ● Extracted groundwater is treated at the surface in an onsite water treatment plant prior to discharge to a surface water body. ● Removal of impacted groundwater and influx of adjacent unimpacted groundwater reduces contaminant concentrations.	● Addresses a wide range of contaminants. ● Residual saturation of the contaminant in the soil pores is not easily removed by groundwater pumping. ● Effectiveness and timeframe of pump and treat recovery is difficult to accurately forecast.	● Groundwater pumping is not applicable for contaminants with high residual saturation, contaminants with high sorption capabilities, and homogeneous aquifers with hydraulic conductivity less than 10-5 cm/sec. ● Requires ongoing maintenance of extraction and treatment system and regular replacement of treatment media, which will increase cost and time to reach the remediation objectives. ● Typically requires obtaining a discharge permit and achieving strict injection standards.	Moderate to High	No	This process option does not pass the screening criteria because the effectiveness of this process option will be limited by the substantial groundwater pumping required due to the soil permeability and proximity to the river, which will increase cost and time to reach the remediation objectives.
		Onsite Treatment and POTW Discharge	● Extraction of impacted groundwater using horizontal or vertical wells. ● Extracted groundwater is pre-treated at the surface in an onsite water treatment plant prior to discharge to a POTW for further treatment. ● Removal of impacted groundwater and influx of adjacent unimpacted groundwater reduces contaminant concentrations.		● Groundwater pumping is not applicable for contaminants with high residual saturation, contaminants with high sorption capabilities, or homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec. ● Requires ongoing maintenance of extraction and treatment system and regular replacement of treatment media. ● POTW's typically requires aggressive pre-treatment of water, restrictions on volume of discharge, and payment of fees.	High	No	

Table 4-2 - Groundwater: Initial Screening of Remedial Technology Process Options
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1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
GROUNDWATER								
Ex-Situ Treatment	Groundwater Extraction	Offsite Treatment	● Extraction of impacted groundwater using horizontal or vertical wells. ● Extracted groundwater is either containerized and trucked offsite for disposal or directly discharged to the POTW. ● Removal of impacted groundwater and influx of adjacent unimpacted groundwater reduces contaminant concentrations.	● Addresses a wide range of contaminants. ● Residual saturation of the contaminant in the soil pores is not easily removed by groundwater pumping. ● Effectiveness and timeframe of pump and treat recovery is difficult to accurately forecast.	● Groundwater pumping is not applicable for contaminants with high residual saturation, contaminants with high sorption capabilities, or homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec. ● Direct discharge or tanker truck transportation can be prohibitively expensive for large quantities of water.	Moderate to High	No	This process option does not pass the screening criteria because the effectiveness of this process option will be limited by the substantial groundwater pumping required due to the soil permeability and proximity to the river, which will increase cost and time to reach the remediation objectives.

Notes:
- Eliminated based on the screening evaluation presented in this table
GRA - General Response Action
HDPE - High Density Polyethylene
NAPL - Non-aqueous Phase Liquid, identified as oil-wetted or oil-coated soil
POTW - Publically Owned Treatment Works
PVOC - Petroleum volatile organic compound
RAOs - Remedial Action Objectives

Table 4-3 - Soil Gas: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SOIL GAS								
No Action	No Additional Action	No additional action.	● No additional action.	● Will not achieve the RAOs under a potential future development scenario.	● There is no remedy to implement.	No Cost	Yes	Retained for baseline comparison in accordance with CERCLA.
Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant, and/or Deed Restrictions	● WDNR GIS Registry, building codes, state, county, municipal legislation, and/or an ordinance to prohibit or restrict occupancy in building or specify conditions of occupancy.	● Minimal potential short term exposure risk. ● Administratively effective and reliable; relies on local government action to establish, enforce, and restrict.	● Easy implementation. ● Administratively implementable.	Low	Yes	This process option will be needed to protect human receptors under a potential future use scenario.

Notes:

GRA - General Response Option

RAOs - Remedial Action Objectives

Table 4-4 - Sediment: Initial Screening of Remedial Technology Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

General Response Action (GRA)	Remedial Technology	Process Option	Description of Process Option	Effectiveness	Implementability	Relative Cost	Carry Forward for Additional Screening?	Rationale
SEDIMENT								
No Action	No Additional Action	No additional action.	• No additional action.	• RAOs have been achieved through the NTCRA completed in years 2012 and 2013.	• There is no remedy to implement.	No Cost	Yes	Retained for baseline comparison in accordance with CERCLA.
Monitoring	Effectiveness Monitoring	Bathymetric survey and analytical sampling	• The presence of the residual sand cover will be demonstrated as defined in the Residual Sand Cover Monitoring Plan dated September 27, 2013.	• RAOs have been achieved through the NTCRA completed in years 2012 and 2013.	• Easy implementation.	Low	Yes	This process can be used to monitor residual sand cover.
Institutional Controls	Physical and/or Legislative Restrictions	Waterway Use Restrictions and signage	• Waterway use restrictions to reduce the disturbance to the existing remedy. • Signage to restrict boat anchoring	• Administratively effective and reliable; relies on local government action to establish, enforce, and restrict sediment disturbance.	• Easy implementation. • Administratively implementable.	Low	Yes	This process can be used in conjunction with one or more other remedial technologies.

Notes:
GRA - General Response Option
RAOs - Remedial Action Objectives

Table 5 - Matrix of Retained Soil Process Options by Soil Remediation Zone
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Process Option Retained for Detailed Analysis	Boom Landing Zone - Source Areas (North and South)	Boom Landing Zone - Non-Source Areas	WWTP Zone - Source Areas (North and South)	WWTP Zone - Non-Source Areas
S1 - No Further Action	Yes	Yes	Yes	Yes
S2 - Institutional Controls	Yes	Yes	Yes	Yes
S3 - Horizontal Engineered Surface Barriers	Yes	Yes	Yes	Yes
S4 - In-Situ Chemical Treatment	Yes	Yes	Yes	No - Chemical oxidation is not capable of addressing impacts in the top 5 feet of soil. Further, chemical oxidation is not able to address impacts beneath the WWTP buildings
S5a - Excavation and Offsite Disposal	Yes	Yes	Yes	No - It is technically impractical to fully excavate affected soil beneath and among the Wastewater Treatment Plant Process Units
S5b - Excavation and Onsite Treatment Disposal	Yes	Yes	Yes	No - It is technically impractical to fully excavate affected soil beneath and among the Wastewater Treatment Plant Process Units
S6 - Air Sparging and Soil Vapor Extraction	Yes	Yes	Yes	Yes

Table 6 - Summary of Retained Process Options
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Process Option	General Response Action (GRA)	Remedial Technology	Process Options
SOIL Above and Below the Groundwater Table (Boom Landing Zone Source Area)			
S1	No Action	No Additional Action	No additional action
S2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions
S3	Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers
S4	In-Situ Approaches	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)
S5a	Ex-situ Approaches	Excavation	Off-site Disposal
S5b	Ex-situ Approaches	Excavation	On-site Treatment and On-site Disposal
S6	In-Situ Approaches	Air Sparging/Soil Vapor Extraction	Air injection and soil vapor recovery system
SOIL Above and Below the Groundwater Table (Boom Landing Zone Non-Source Area)			
S1	No Action	No Additional Action	No additional action
S2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions
S3	Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers
S4	In-Situ Approaches	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)
S5a	Ex-situ Approaches	Excavation	Off-site Disposal
S5b	Ex-situ Approaches	Excavation	On-site Treatment and On-site Disposal
S6	In-Situ Approaches	Air Sparging/Soil Vapor Extraction	Air injection and soil vapor recovery system
SOIL Above and Below the Groundwater Table (WWTP Zone Source Area)			
S1	No Action	No Additional Action	No additional action
S2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions
S3	Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers
S4	In-Situ Approaches	Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)
S5a	Ex-situ Approaches	Excavation	Off-site Disposal
S5b	Ex-situ Approaches	Excavation	On-site Treatment and On-site Disposal
S6	In-Situ Approaches	Air Sparging/Soil Vapor Extraction	Air injection and soil vapor recovery system
SOIL Above and Below the Groundwater Table (WWTP Zone Non-Source Area)			
S1	No Action	No Additional Action	No additional action
S2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant and/or Deed Restrictions
S3	Containment	Horizontal Engineered Surface Barriers	Soil, asphalt, concrete, or geosynthetic covers
S6	In-Situ Approaches	Air Sparging/Soil Vapor Extraction	Air injection and soil vapor recovery system
GROUNDWATER			
G1	No Action	No Additional Action	No additional action
G2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Groundwater Use Restrictions
G3	Monitored Recovery	Monitored Natural Attenuation	Long-Term Groundwater Monitoring
G4	In-Situ Approaches	Chemical/Biological Treatment	Air Sparging
G5		Chemical Treatment	Chemical Oxidants (including ozone, hydrogen peroxide, permanganate, and persulfate)
SOIL GAS			
SG1	No Action	No Additional Action	No additional action
SG2	Institutional Controls	Physical, Land Use, and/or Legislative Restrictions	Environmental Covenant, and/or Deed Restrictions
SEDIMENT			
SED1	No Action	No Additional Action	No additional action
SED2	Monitoring	Monitoring	Bathymetric survey and analytical sampling
SED3	Institutional Controls	Physical or Legislative Restrictions	Waterway Use Restrictions and signage

Notes:

GRA - General Response Option

Table 7-1: Summary of Soil Remedial Alternatives Costs for Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient of 1
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Soil (Boom Landing Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 780,000	$ 225,000	$ 560,000	$ 1,340,000	**$ 1,100,000**
Alternative S4 - In-Situ Chemical Treatment	$ 16,600,000	$ 210,000	$ 510,000	$ 17,110,000	**$ 16,900,000**
Alternative S5a - Excavation and Offsite Disposal	$ 8,700,000	$ -	$ -	$ 8,700,000	**$ 8,700,000**
Alternative S5b - Excavation and Onsite Treatment Disposal	$ 11,200,000	$ -	$ -	$ 11,200,000	**$ 11,200,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 1,200,000	$ 3,400,000	$ -	$ 1,200,000	**$ 4,600,000**
Soil (Boom Landing Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 600,000	$ 229,000	$ 570,000	$ 1,170,000	**$ 830,000**
Alternative S4 - In-Situ Chemical Treatment	$ 5,500,000	$ 229,000	$ 570,000	$ 6,070,000	**$ 5,800,000**
Alternative S5a - Excavation and Offsite Disposal	$ 7,900,000	$ -	$ -	$ 7,900,000	**$ 7,900,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 10,300,000	$ -	$ -	$ 10,300,000	**$ 10,300,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 1,200,000	$ 2,000,000	$ 2,500,000	$ 3,700,000	**$ 3,200,000**
Soil (WWTP Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 660,000	$ 209,000	$ 510,000	$ 1,170,000	**$ 870,000**
Alternative S4 - In-Situ Chemical Treatment	$ 10,900,000	$ 209,000	$ 510,000	$ 11,410,000	**$ 11,200,000**
Alternative S5a - Excavation and Offsite Disposal	$ 4,000,000	$ -	$ -	$ 4,000,000	**$ 4,000,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 5,700,000	$ -	$ -	$ 5,700,000	**$ 5,700,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 890,000	$ 2,900,000	$ 3,700,000	$ 4,590,000	**$ 3,800,000**
Soil (WWTP Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 1,800,000	$ 230,000	$ 570,000	$ 2,370,000	**$ 2,100,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 2,800,000	$ 5,400,000	$ 7,000,000	$ 9,800,000	**$ 8,200,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Table 7-2: Summary of Soil Remedial Alternatives Costs for Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient of 1
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Soil (Boom Landing Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 780,000	$ 225,000	$ 560,000	$ 1,340,000	**$ 1,100,000**
Alternative S4 - In-Situ Chemical Treatment	$ 16,600,000	$ 210,000	$ 510,000	$ 17,110,000	**$ 16,900,000**
Alternative S5a - Excavation and Offsite Disposal	$ 8,700,000	$ -	$ -	$ 8,700,000	**$ 8,700,000**
Alternative S5b - Excavation and Onsite Treatment Disposal	$ 11,200,000	$ -	$ -	$ 11,200,000	**$ 11,200,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 1,200,000	$ 3,400,000	$ -	$ 1,200,000	**$ 4,600,000**
Soil (Boom Landing Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 670,000	$ 232,000	$ 580,000	$ 1,250,000	**$ 910,000**
Alternative S4 - In-Situ Chemical Treatment	$ 5,600,000	$ 232,000	$ 580,000	$ 6,180,000	**$ 5,900,000**
Alternative S5a - Excavation and Offsite Disposal	$ 8,300,000	$ -	$ -	$ 8,300,000	**$ 8,300,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 10,900,000	$ -	$ -	$ 10,900,000	**$ 10,900,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 1,200,000	$ 2,000,000	$ 2,600,000	$ 3,800,000	**$ 3,200,000**
Soil (WWTP Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 660,000	$ 209,000	$ 510,000	$ 1,170,000	**$ 870,000**
Alternative S4 - In-Situ Chemical Treatment	$ 10,900,000	$ 209,000	$ 510,000	$ 11,410,000	**$ 11,200,000**
Alternative S5a - Excavation and Offsite Disposal	$ 4,000,000	$ -	$ -	$ 4,000,000	**$ 4,000,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 5,700,000	$ -	$ -	$ 5,700,000	**$ 5,700,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 890,000	$ 2,900,000	$ 3,700,000	$ 4,590,000	**$ 3,800,000**
Soil (WWTP Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 2,800,000	$ 243,000	$ 610,000	$ 3,410,000	**$ 3,100,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 4,100,000	$ 8,100,000	$ 10,500,000	$ 14,600,000	**$ 12,200,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Table 7-3: Summary of Soil Remedial Alternatives Costs for Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient of 1
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Soil (Boom Landing Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 780,000	$ 225,000	$ 560,000	$ 1,340,000	**$ 1,100,000**
Alternative S4 - In-Situ Chemical Treatment	$ 16,600,000	$ 210,000	$ 510,000	$ 17,110,000	**$ 16,900,000**
Alternative S5a - Excavation and Offsite Disposal	$ 8,700,000	$ -	$ -	$ 8,700,000	**$ 8,700,000**
Alternative S5b - Excavation and Onsite Treatment Disposal	$ 11,200,000	$ -	$ -	$ 11,200,000	**$ 11,200,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 1,200,000	$ 3,400,000	$ -	$ 1,200,000	**$ 4,600,000**
Soil (Boom Landing Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 930,000	$ 270,000	$ 670,000	$ 1,600,000	**$ 1,200,000**
Alternative S4 - In-Situ Chemical Treatment	$ 10,800,000	$ 670,000	$ 670,000	$ 11,470,000	**$ 11,500,000**
Alternative S5a - Excavation and Offsite Disposal	$ 16,100,000	$ -	$ -	$ 16,100,000	**$ 16,100,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 20,600,000	$ -	$ -	$ 20,600,000	**$ 20,600,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 2,300,000	$ 3,600,000	$ 4,700,000	$ 7,000,000	**$ 5,900,000**
Soil (WWTP Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 660,000	$ 209,000	$ 510,000	$ 1,170,000	**$ 870,000**
Alternative S4 - In-Situ Chemical Treatment	$ 10,900,000	$ 209,000	$ 510,000	$ 11,410,000	**$ 11,200,000**
Alternative S5a - Excavation and Offsite Disposal	$ 4,000,000	$ -	$ -	$ 4,000,000	**$ 4,000,000**
Alternative S5b - Excavation and Onsite Treatment and Disposal	$ 5,700,000	$ -	$ -	$ 5,700,000	**$ 5,700,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 890,000	$ 2,900,000	$ 3,700,000	$ 4,590,000	**$ 3,800,000**
Soil (WWTP Non-Source Areas)					
Alternative S1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative S2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative S3 - Horizontal Engineered Surface Barriers	$ 2,900,000	$ 244,000	$ 610,000	$ 3,510,000	**$ 3,200,000**
Alternative S6 - Air Sparging and Soil Vapor Extraction	$ 4,200,000	$ 8,200,000	$ 10,700,000	$ 14,900,000	**$ 12,400,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

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Table 8: Summary of Groundwater Remedial Alternatives Costs
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Groundwater					
Alternative G1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative G2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative G3 - Monitored Natural Attenuation	$ 180,000	$ 568,000	$ 1,400,000	$ 1,580,000	**$ 750,000**
Alternative G4 - Air Sparging and Soil Vapor Extraction	$ 3,200,000	$ 6,800,000	$ 8,800,000	$ 12,000,000	**$ 10,000,000**
Alternative G5 - In-Situ Chemical Treatment	$ 25,000,000	$ -	$ -	$ 25,000,000	**$ 25,000,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

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Table 9: Summary of Soil Gas Remedial Alternatives Costs
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Soil Gas					
Alternative V1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative V2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Table 10: Summary of Sediment Remedial Alternatives Costs
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Remedial Alternatives	Total Capital Cost	Total Present Value of O&M Cost	Total O&M Cost, No Discount Factor	Total Alternative Cost, No Discount Factor	Total Present Value Cost of Alternative
Sediment					
Alternative SED1 - No Further Action	$ -	$ 41,000	$ 120,000	$ 120,000	**$ 41,000**
Alternative SED2 - Institutional Controls	$ 140,000	$ 41,000	$ 120,000	$ 260,000	**$ 190,000**
Alternative SED3 - Monitoring	$ 140,000	$ 280,000	$ 710,000	$ 850,000	**$ 420,000**

Notes:

1. - Assumes a discount rate of 7% over a 30 year analysis period

Date: 7/9/2015
Estimated By: RCW
Reviewed By: MDB

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Table 11 - Soil Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria						
							Present Worth Cost[1]		
Remedial Alternatives	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness (duration)	Implementability	Cancer Risk Greater than 10^{-4} or a Hazard Quotient of 1	Cancer Risk Greater than 10^{-5} or a Hazard Quotient of 1	Cancer Risk Greater than 10^{-6} or a Hazard Quotient of 1
Soil (Boom Landing Zone Source Area)									
Alternative S1 - No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000	$ 41,000	$ 41,000
Alternative S2 - Institutional Controls	Fully Meets	Partially Meets - Alternative does not involve removal or barrier to protect against surface soil above PRGs	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through restricting land use and intrusive activities	Fully Meets (6 Months)	Fully Meets	$ 190,000	$ 190,000	$ 190,000
Alternative S3 - Horizontal Engineered Surface Barriers	Fully Meets	Fully Meets	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through direct contact barriers and restricting land use/ intrusive activities	Fully Meets (1 Year)	Fully Meets	$ 1,100,000	$ 1,100,000	$ 1,100,000
Alternative S4 - In-Situ Chemical Treatment	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (2.5 Years)	Fully Meets	$ 16,900,000	$ 16,900,000	$ 16,900,000
Alternative S5a - Excavation and Off-Site Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1 Year)	Fully Meets	$ 8,700,000	$ 8,700,000	$ 8,700,000
Alternative S5b - Excavation and On-Site Treatment/Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1.5 Years)	Partially Meets - The surface area the required staging area and the reduced production rate of thermal desorption treatment will complicate implementation	$ 11,200,000	$ 11,200,000	$ 11,200,000
Alternative S6 - Air Sparging/SVE	Fully Meets	Fully Meets	Does Not Meet - Source material and PAHs are expected to exceed PRGs despite treatment.	Partially Meets - Air Sparging/Soil Vapor Extraction is typically ineffective at remediating highly-affected soil and source material to PRGs.	Partially Meets - Alternative is expected to meet a point of diminishing returns after approximately 7 years of operation.	Fully Meets	$ 4,600,000	$ 4,600,000	$ 4,600,000

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Table 11 - Soil Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria						
							Present Worth Cost[1]		
Remedial Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume through Treatment**	**Short-Term Effectiveness (duration)**	**Implementability**	**Cancer Risk Greater than 10^{-4} or a Hazard Quotient of 1**	**Cancer Risk Greater than 10^{-5} or a Hazard Quotient of 1**	**Cancer Risk Greater than 10^{-6} or a Hazard Quotient of 1**
Soil (Boom Landing Zone Non-Source Area)									
Alternative S1 - No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000	$ 41,000	$ 41,000
Alternative S2 Institutional Controls	Fully Meets	Partially Meets - Alternative does not involve removal or barrier to protect against surface soil above PRGs	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through restricting land use and intrusive activities	Fully Meets (6 Months)	Fully Meets	$ 190,000	$ 190,000	$ 190,000
Alternative S3 - Horizontal Engineered Surface Barriers	Fully Meets	Fully Meets	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through direct contact barriers and restricting land use/ intrusive activities	Fully Meets (1 Year)	Fully Meets	$ 830,000	$ 910,000	$ 1,200,000
Alternative S4 - In-Situ Chemical Treatment	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1.5 Years)	Fully Meets	$ 5,800,000	$ 5,900,000	$ 11,500,000
Alternative S5a - Excavation and Off-Site Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1.5 Years)	Fully Meets	$ 7,900,000	$ 8,300,000	$ 16,100,000
Alternative S5b - Excavation and On-Site Treatment/Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (2 Years)	Partially Meets - The surface area the required staging area and the reduced production rate of thermal desorption treatment will complicate implementation	$ 10,300,000	$ 10,900,000	$ 20,600,000
Alternative S6 - Air Sparging/SVE	Fully Meets	Fully Meets	Does Not Meet - PAHs are expected to exceed PRGs despite treatment.	Partially Meets - Air Sparging/Soil Vapor Extraction is typically ineffective at remediating highly-affected soil with PAHs to PRGs.	Partially Meets - Alternative is expected to meet a point of diminishing returns after approximately 7 years of operation.	Fully Meets	$ 3,200,000	$ 3,200,000	$ 5,900,000

Natural Resource Technology

Table 11 - Soil Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria						
							Present Worth Cost[1]		
Remedial Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume through Treatment**	**Short-Term Effectiveness (duration)**	**Implementability**	**Cancer Risk Greater than 10^{-4} or a Hazard Quotient of 1**	**Cancer Risk Greater than 10^{-5} or a Hazard Quotient of 1**	**Cancer Risk Greater than 10^{-6} or a Hazard Quotient of 1**
Soil (WWTP Zone Source Area)									
Alternative S1 - No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000	$ 41,000	$ 41,000
Alternative S2 Institutional Controls	Fully Meets	Partially Meets - Alternative does not involve removal or barrier to protect against surface soil above PRGs	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through restricting land use and intrusive activities	Fully Meets (6 Months)	Fully Meets	$ 190,000	$ 190,000	$ 190,000
Alternative S3 - Horizontal Engineered Surface Barriers	Fully Meets	Fully Meets	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through direct contact barriers and restricting land use/ intrusive activities	Fully Meets (1 Year)	Fully Meets	$ 870,000	$ 870,000	$ 870,000
Alternative S4 - In-Situ Chemical Treatment	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1.5 Years)	Fully Meets	$ 11,200,000	$ 11,200,000	$ 11,200,000
Alternative S5a - Excavation and Off-Site Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1 Year)	Fully Meets	$ 4,000,000	$ 4,000,000	$ 4,000,000
Alternative S5b - Excavation and On-Site Treatment/Disposal	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (1.5 Years)	Partially Meets - The surface area the required staging area and the reduced production rate of thermal desorption treatment will complicate implementation	$ 5,700,000	$ 5,700,000	$ 5,700,000
Alternative S6 - Air Sparging/SVE	Fully Meets	Fully Meets	Does Not Meet - Source material and PAHs are expected to exceed PRGs despite treatment.	Partially Meets - Air Sparging/Soil Vapor Extraction is typically ineffective at remediating highly-affected soil and source materials to PRGs.	Partially Meets - Alternative is expected to meet a point of diminishing returns after approximately 7 years of operation.	Fully Meets	$ 3,800,000	$ 3,800,000	$ 3,800,000

Natural Resource Technology

Table 11 - Soil Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria						
							Present Worth Cost[1]		
Remedial Alternatives	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness (duration)	Implementability	Cancer Risk Greater than 10^{-4} or a Hazard Quotient of 1	Cancer Risk Greater than 10^{-5} or a Hazard Quotient of 1	Cancer Risk Greater than 10^{-6} or a Hazard Quotient of 1
Soil (WWTP Zone Non-Source Area)									
Alternative S1 - No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000	$ 41,000	$ 41,000
Alternative S2 Institutional Controls	Fully Meets	Partially Meets - Alternative does not involve removal or barrier to protect against surface soil above PRGs	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through restricting land use and intrusive activities	Fully Meets (6 Months)	Fully Meets	$ 190,000	$ 190,000	$ 190,000
Alternative S3 - Horizontal Engineered Surface Barriers	Fully Meets	Fully Meets	Fully Meets	Partially Meets - Risk resulting from toxicity is reduced through direct contact barriers and restricting land use/ intrusive activities	Fully Meets (1 Year)	Fully Meets	$ 2,100,000	$ 3,100,000	$ 3,200,000
Alternative S6 - Air Sparging/SVE	Fully Meets	Fully Meets	Does Not Meet - PAHs are expected to exceed PRGs despite treatment.	Partially Meets - Air Sparging/Soil Vapor Extraction is typically ineffective at remediating highly-affected soil with PAHs to PRGs.	Partially Meets - Alternative is expected to meet a point of diminishing returns after approximately 7 years of operation.	Fully Meets	$ 8,200,000	$ 12,200,000	$ 12,400,000

Notes:
1. At request of USEPA and consistent with USEPA's July 2000 A Guide for Developing and Documenting Cost Estimates During the Feasibility Study, present values were calculated using a real discount rate of 7% for non-federally funded sites. See FS Report Section 3.3 for additional discussion.

Table 12 - Groundwater Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria				
Remedial Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume through Treatment**	**Short-Term Effectiveness (duration)**	**Implementability**	**Present Worth Cost[1]**
Groundwater							
Alternative G1 No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000
Alternative G2 Institutional Controls	Partially Meets - Does not provide remedial action or monitoring to determine if contingency actions are required to prevent migration of groundwater to surface water	Fully Meets	Fully Meets	Partially Meets - Alternative does not involve active monitoring of groundwater; however, attenuation is anticipated to achieve PRGs in 30 years	Fully Meets (6 Years)	Fully Meets	$ 190,000
Alternative G3 Monitored Natural Attenuation	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets assuming remediated soil source areas (30 Years)	Fully Meets	$ 750,000
Alternative G4 Air Sparing/SVE	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets assuming remediated soil source areas (7 Years)	Fully Meets	$ 10,000,000
Alternative G5 In-Situ Chemical Treatment	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (2.5 Years)	Fully Meets	$ 25,000,000

Notes:
1. At request of USEPA and consistent with USEPA's July 2000 A Guide for Developing and Documenting Cost Estimates During the Feasibility Study, present values were calculated using a real discount rate of 7% for non-federally funded sites. See FS Report Section 3.3 for additional discussion.

Table 13 - Soil Gas Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria				
Remedial Alternatives	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness (duration)	Implementability	Present Worth Cost[1]
Soil Gas							
Alternative SG1 No Further Action	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets (0 Years)	Fully Meets	$ 41,000
Alternative SG2 Institutional Controls	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (6 Months)	Fully Meets	$ 190,000

Notes:
1. At request of USEPA and consistent with USEPA's July 2000 A Guide for Developing and Documenting Cost Estimates During the Feasibility Study, present values were calculated using a real discount rate of 7% for non-federally funded sites. See FS Report Section 3.3 for additional discussion.

NATURAL RESOURCE TECHNOLOGY

Table 14 - Sediment Remedial Alternatives Comparative Analysis
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

	Threshold Criteria		Balancing Criteria				
Remedial Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume through Treatment**	**Short-Term Effectiveness (duration)**	**Implementability**	**Present Worth Cost[1]**
Sediment							
Alternative SED1 - No Further Action	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (0 Years)	Fully Meets	$ 41,000
Alternative SED2 - Institutional Controls	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (6 Months)	Fully Meets	$ 190,000
Alternative SED3 - Monitoring	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets (6 Months)	Fully Meets	$ 420,000

Notes:

1. At request of USEPA and consistent with USEPA's July 2000 A Guide for Developing and Documenting Cost Estimates During the Feasibility Study, present values were calculated using a real discount rate of 7% for non-federally funded sites. See FS Report Section 3.3 for additional discussion.

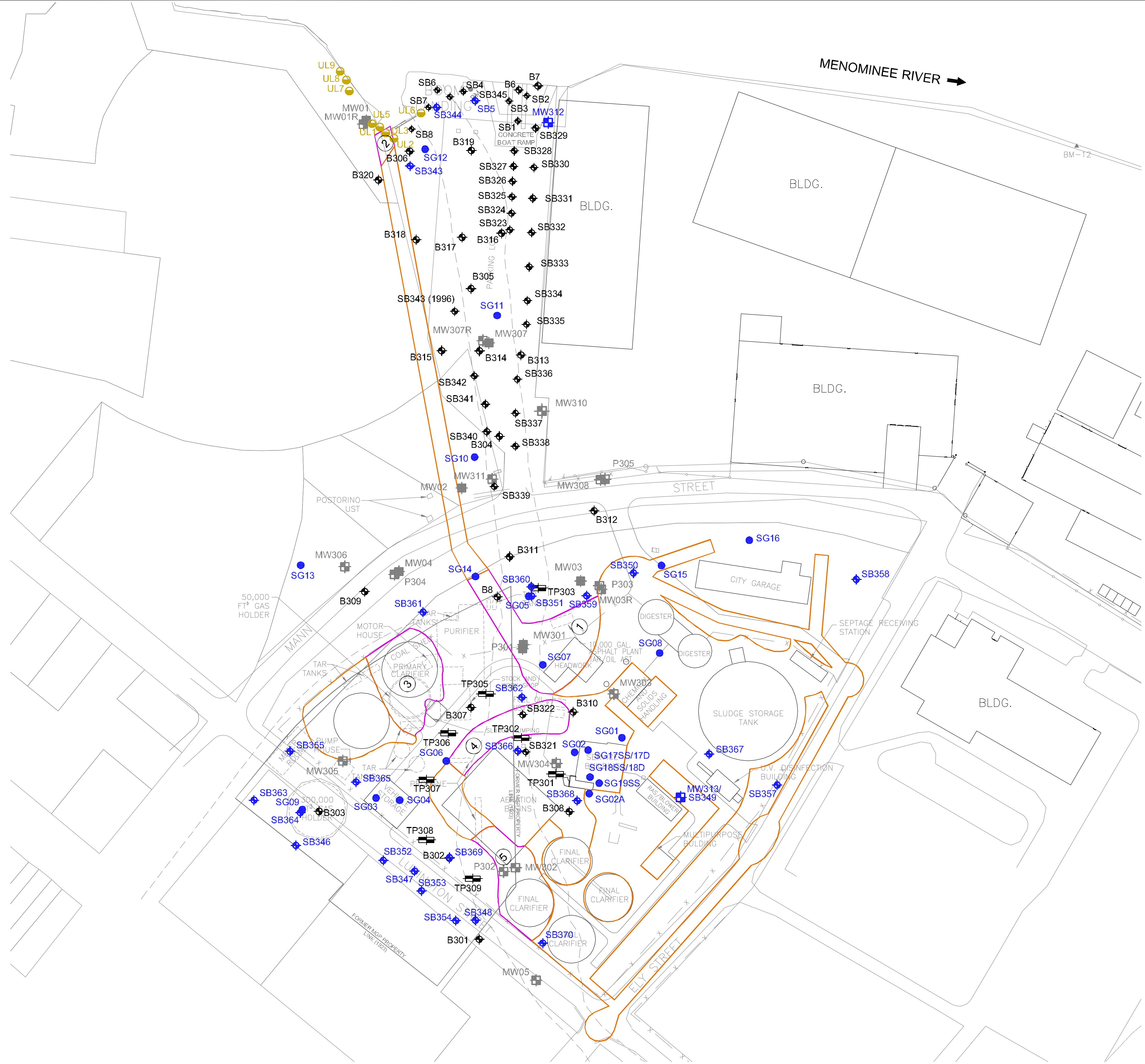
NATURAL RESOURCE TECHNOLOGY

APPENDIX A

REMEDIAL INVESTIGATION DATA

APPENDIX A1

REMEDIAL INVESTIGATION RESULTS



MW303	MONITORING WELL
P303	PIEZOMETER
MW02	ABANDONED MONITORING WELL
UL8	SEDIMENT REMOVAL WALL SAMPLE
SB340	SOIL BORING
SG06	SOIL GAS PROBE
TP305	TEST PIT LOCATION
	PROPERTY BOUNDARY
	FORMER SLOUGH
	FORMER MGP PROPERTY LINE (1923)
	FORMER MGP STRUCTURE
	EXISTING STRUCTURE
	AREAS EXCAVATED BY CITY OF MARINETTE EXHIBITING NO EVIDENCE OF MGP RESIDUALS IN SOIL
	AREAS EXHIBITING EVIDENCE OF MGP RESIDUALS IN SOIL EXCAVATED AND BACKFILLED WITH CLEAN MATERIAL, BY CITY OF MARINETTE
1	AREAS OF AFFECTED SOIL WERE NUMBERED FOR DISCUSSION IN THE TEXT

NOTES:

1. SAMPLING LOCATIONS IN BLUE WERE COMPLETED AS PART OF REMEDIAL INVESTIGATION ACTIVITIES IN 2012/2013/2014.
2. SAMPLING LOCATIONS IN GOLD WERE COLLECTED AS PART OF SEDIMENT REMOVAL ACTIONS IN 2012.

N

0 80 160
SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001. VERTICAL CONTROL IS U.S.G.S. DATUM. BUILDING AND STREET LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
3. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
4. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
5. VERTICAL CONTROL IS NAVD88 DATUM
6. WELL LOCATIONS FROM A SURVEY BY WPSC DATED OCTOBER 8, 2003, REVISED OCTOBER 31, 2003.
7. BRICK INTERCEPTOR SEWER REPLACEMENT TAKEN FROM DRAWING BY AYRES ASSOCIATES, GREEN BAY, WISCONSIN, JOB NO. 16-0189.10, DRAWING NO. P101, SHEET NO. 7, DATED 3/14/03.
8. MONITORING WELLS MW2R, MW3R, MW307R INSTALLED OCTOBER 2004 AND MW308, MW310, P305 INSTALLED JUNE 2004. SURVEYED BY WPSC IN JANUARY 2005. (NAVD88, MARINETTE COUNTY COORDINATES).
9. MONITORING WELLS MW312 AND MW313 WERE SURVEYED BY WPSC IN AUGUST 2012.
10. EXCAVATION WALL SAMPLE LOCATIONS TAKEN BY NATURAL RESOURCE TECHNOLOGY INC. FROM NOVEMBER 2012 THROUGH JANUARY 2013.
11. SAMPLING LOCATIONS SB352 THROUGH SB370 COLLECTED BY NRT, OCTOBER 2014.

DRAWN BY: DMD DATE: 11/24/14
CHECKED BY: NDK DATE: 11/24/14
APPROVED BY: BGH DATE: 01/21/15
DRAWING NO: 1549-155-B05
REFERENCE:

SOIL SAMPLING LOCATIONS

REMEDIAL INVESTIGATION REPORT - REVISION 2
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/15.5

FIGURE NO.
5

Jan 21, 2015 1:38pm PLOTTED BY: ddudo SAVED BY: ddudo
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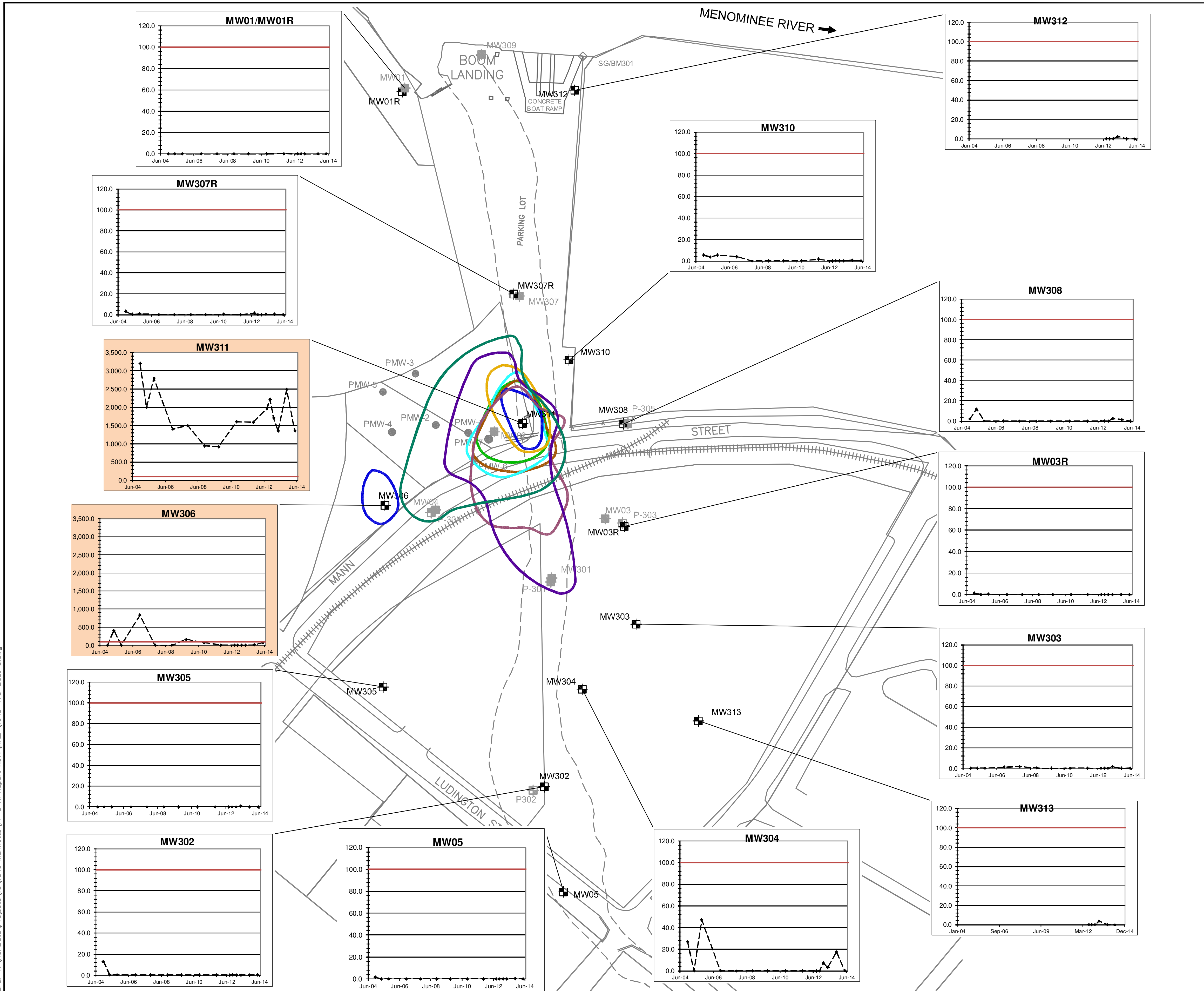

ESTIMATED EXTENT OF NAPHTHALENE, **SEPTEMBER 2009**

ESTIMATED EXTENT OF NAPHTHALENE, **OCTOBER 2010**

ESTIMATED EXTENT OF NAPHTHALENE, **AUGUST 2012**

ESTIMATED EXTENT OF NAPHTHALENE, **OCTOBER 2012**

ESTIMATED EXTENT OF NAPHTHALENE, **JANUARY 2013**

ESTIMATED EXTENT OF NAPHTHALENE, **APRIL 2013**

ESTIMATED EXTENT OF NAPHTHALENE, **OCTOBER 2013**

ESTIMATED EXTENT OF NAPHTHALENE, **APRIL 2014**

MW303 MONITORING WELL

P303 PIEZOMETER

MW02 ABANDONED MONITORING WELL

PMW-7 POSTORINO PAINT ABANDONED MONITORING WELL

RIVER EDGE

PROPERTY BOUNDARY

FORMER SLOUGH

RAILROAD

NAPHTHALENE µg/L NON-DETECTS WERE PLOTTED USING THE FULL REPORTING LIMIT

NAPHTHALENE WI SL = 100 µg/L

SHADED GRAPHS WERE PLOTTED WITH A LARGER RANGE OF Y-AXIS VALUES

N

0 80 160

SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001.
3. VERTICAL CONTROL IS NAVD 88 DATUM
4. BUILDING LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
5. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
6. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS 2/22/90, AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
7. WELL LOCATIONS FROM A SURVEY BY WPSC DATED OCTOBER 8, 2003, REVISED OCTOBER 31, 2003.
8. BRICK INTERCEPTOR SEWER REPLACEMENT TAKEN FROM DRAWING BY AYRES ASSOCIATES, GREEN BAY, WISCONSIN, JOB NO. 16-0189.10, DRAWING NO. P101, SHEET NO. 7, DATED 3/14/03.
9. MONITORING WELLS MW2R, MW3R, MW307R INSTALLED OCTOBER 2004 AND MW308, MW310, P305 INSTALLED JUNE 2004. SURVEYED BY WPSC IN JANUARY 2005. (NAVD88, MARINETTE COUNTY COORDINATES).
10. MONITORING WELLS MW312 AND MW313 WERE SURVEYED BY WPSC IN AUGUST 2012.
11. PMW WELLS WERE IDENTIFIED IN AYERS ASSOCIATES SITE ASSESSMENT AND REMEDIAL ACTION OPTIONS REPORT. CITY OF MARINETTE PROPERTY 500 MANN STREET MARINETTE WISCONSIN 54143 DATED AUGUST 2010

DRAWN BY:	DMD	DATE:	11/24/14
CHECKED BY:	NDK	DATE:	11/24/14
APPROVED BY:	BGH	DATE:	01/21/15
DRAWING NO:	1549-175-B18		
REFERENCE: .			

NAPHTHALENE RESULTS IN GROUNDWATER - COMPOSITE

REMEDIAL INVESTIGATION REPORT - REVISION 2
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/17.5

FIGURE NO.
18

Jan 21, 2015 3:56pm PLOTTED BY: dduda SAVED BY: dduda
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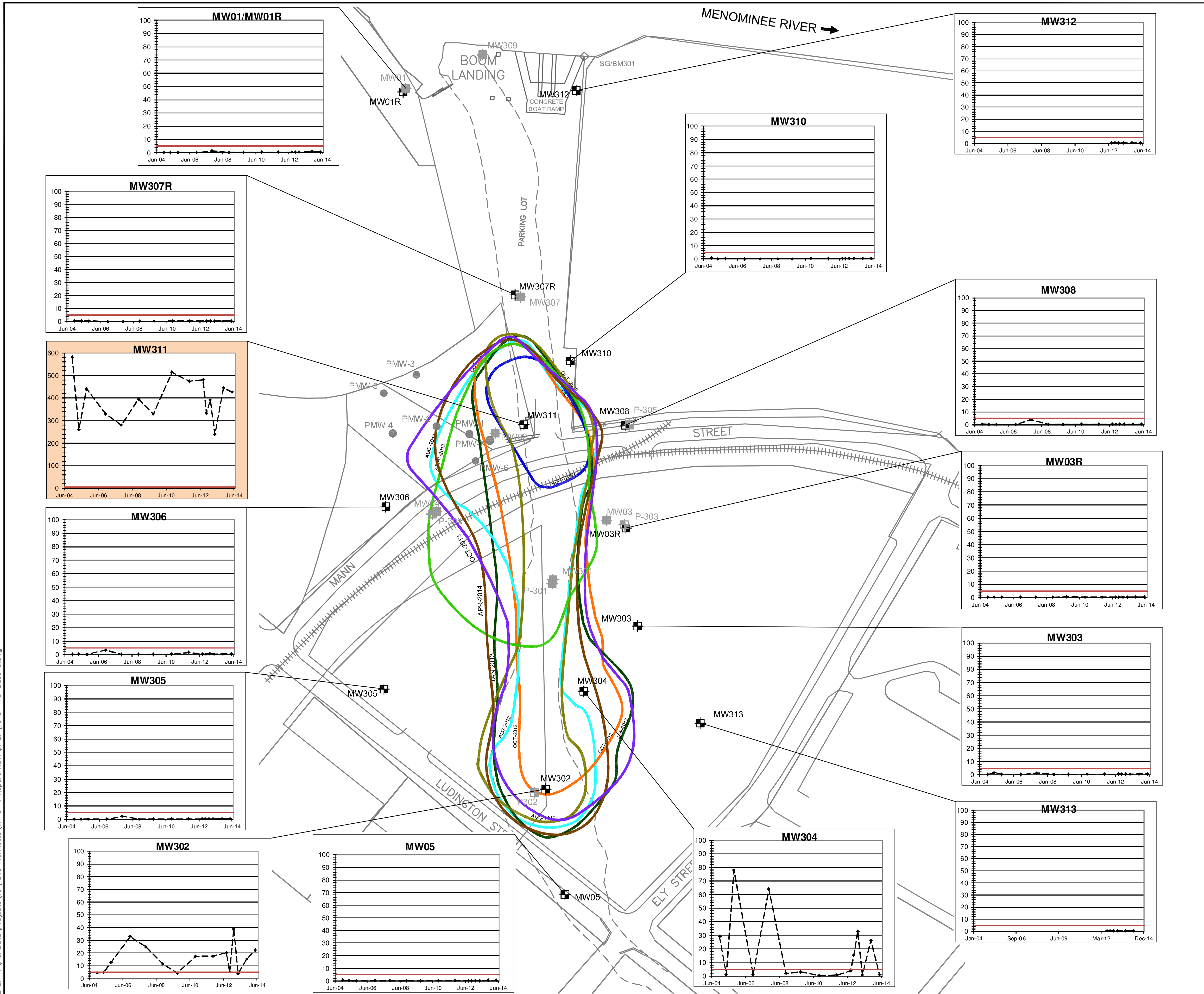

ESTIMATED EXTENT OF BENZENE, **SEPTEMBER 2009**

ESTIMATED EXTENT OF BENZENE, **OCTOBER 2010**

ESTIMATED EXTENT OF BENZENE, **AUGUST 2012**

ESTIMATED EXTENT OF BENZENE, **OCTOBER 2012**

ESTIMATED EXTENT OF BENZENE, **JANUARY 2013**

ESTIMATED EXTENT OF BENZENE, **APRIL 2013**

ESTIMATED EXTENT OF BENZENE, **OCTOBER 2013**

ESTIMATED EXTENT OF BENZENE, **APRIL 2014**

MW303 MONITORING WELL

P303 PIEZOMETER

MW02 ABANDONED MONITORING WELL

PMW-7 POSTORINO PAINT ABANDONED MONITORING WELL

RIVER EDGE

PROPERTY BOUNDARY

FORMER SLOUGH

RAILROAD

NOTES:

1. POSTORINO WELLS (PMW), MW02, AND MW04 WERE BELOW THE SCREENING LEVELS PRIOR TO ABANDONMENT.
2. MW301 WAS ABOVE THE SCREENING LEVELS PRIOR TO ABANDONMENT IN 2004.

BENZENE µg/L
NON-DETECTS WERE PLOTTED USING THE FULL REPORTING LIMIT

BENZENE
SL = 5 µg/L

SHADED GRAPHS WERE PLOTTED WITH A LARGER RANGE OF Y-AXIS VALUES

N

0 80 160

SCALE IN FEET

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A MAP BY THE CITY OF MARINETTE.
2. PORTIONS OF THE DRAWING ARE FROM A DIGITAL FILE FROM STS CONSULTANTS, LTD. CONSULTING ENGINEERS, GREEN BAY, WISCONSIN, PROJECT NUMBER 26936, REVISED JANUARY 2001. HYDROGRAPHIC SURVEY OF RIVER WAS PERFORMED BY AYRES AND ASSOCIATES ON JULY 24-26, 2001.
3. VERTICAL CONTROL IS NAVD 88 DATUM
4. BUILDING LOCATIONS NORTH OF RAILROAD TRACKS WERE SUPPLIED BY MARINETTE MARINE CORPORATION.
5. PORTIONS OF THIS DRAWING ARE FROM HYDRO-SEARCH DRAWING.
6. EXISTING STRUCTURES AND UTILITIES FROM FOTH & VAN DYKE ENGINEERS/ARCHITECTS, GRADING PLAN, DIGITAL FILE 7m755c06.DWG, RECORD DRAWING REVISIONS , AND FROM SMET CONSTRUCTION SERVICES PDF DRAWING SET "MARINETTE MARINE BLDG 32 OUTFITTING", SHEET C1.1, DATED APRIL 24, 2012.
7. WELL LOCATIONS FROM A SURVEY BY WPSC DATED OCTOBER 8, 2003, REVISED OCTOBER 31, 2003.
8. BRICK INTERCEPTOR SEWER REPLACEMENT TAKEN FROM DRAWING BY AYRES ASSOCIATES, GREEN BAY, WISCONSIN, JOB NO. 16-0189.10, DRAWING NO. P101, SHEET NO. 7, DATED 3/14/03.
9. MONITORING WELLS MW2R, MW3R, MW307R INSTALLED OCTOBER 2004 AND MW308, MW310, P-305 INSTALLED JUNE 2004. SURVEYED BY WPSC IN JANUARY 2005. (NAVD88, MARINETTE COUNTY COORDINATES).
10. MONITORING WELLS MW312 AND MW313 WERE SURVEYED BY WPSC IN AUGUST 2012.
11. PMW WELLS WERE IDENTIFIED IN AYERS ASSOCIATES SITE ASSESSMENT AND REMEDIAL ACTION OPTIONS REPORT. CITY OF MARINETTE PROPERTY 500 MANN STREET MARINETTE WISCONSIN 54143 DATED AUGUST 2010.

DRAWN BY: DMD DATE: 11/24/14
CHECKED BY: NDK DATE: 11/24/14
APPROVED BY: BGH DATE: 01/21/15
DRAWING NO: 1549-175-B22
REFERENCE: .

BENZENE RESULTS IN GROUNDWATER - COMPOSITE

REMEDIAL INVESTIGATION REPORT - REVISION 2
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/17.5

FIGURE NO.
22

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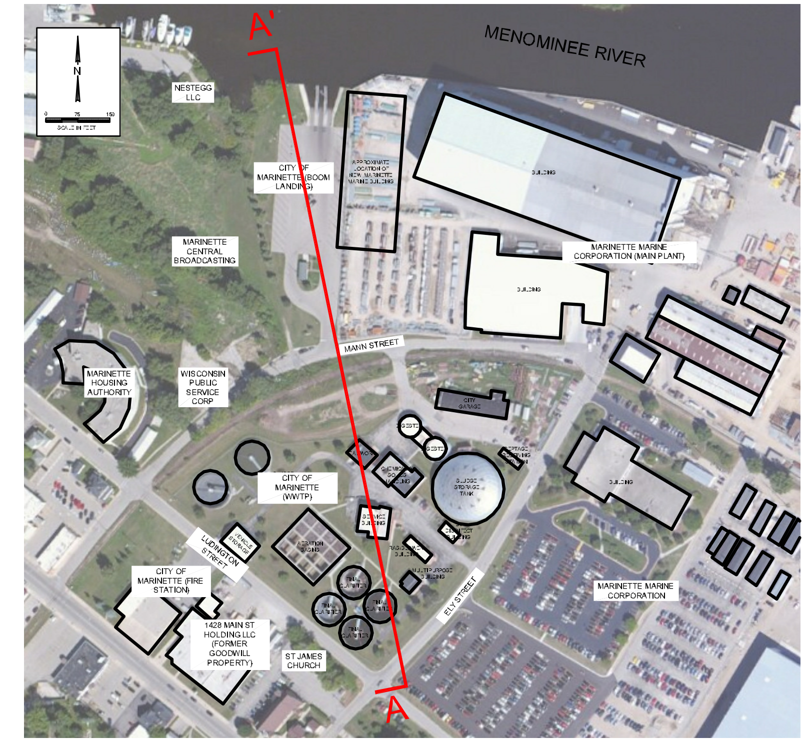
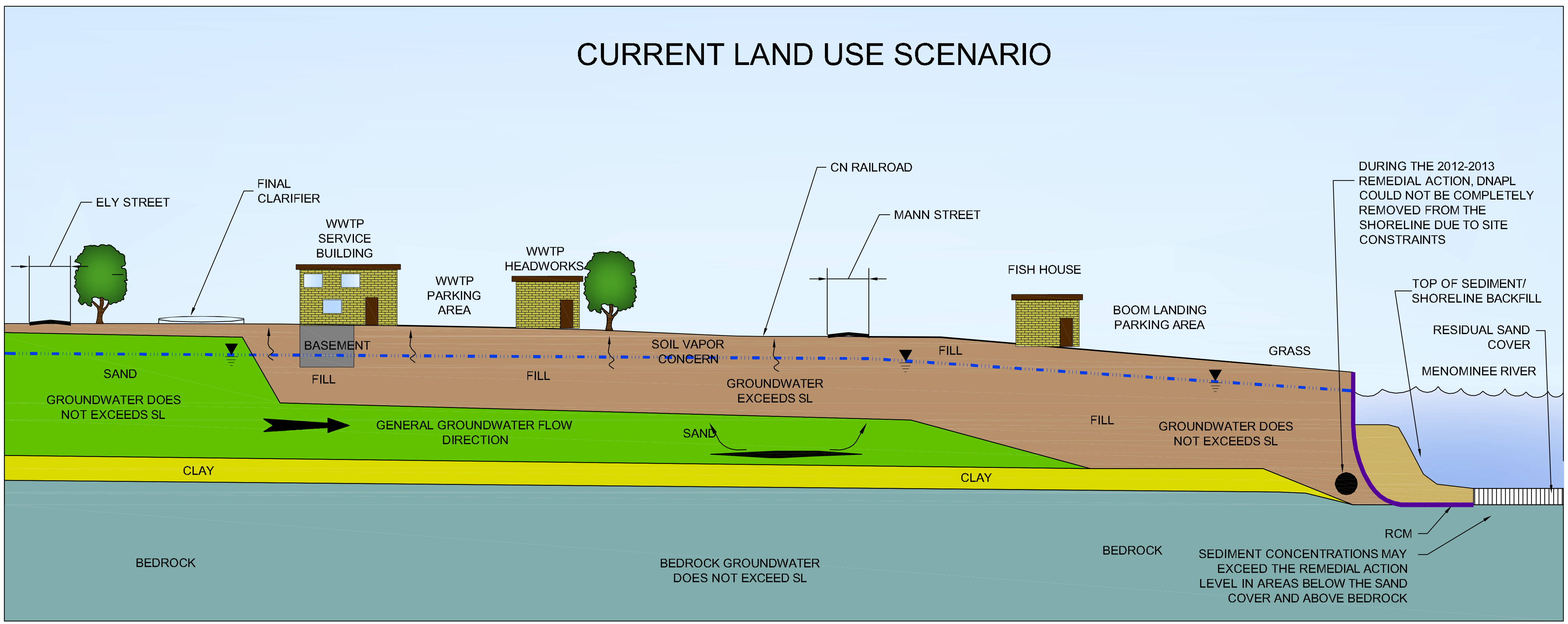
SAND COVER
REACTIVE CORE MAT (RCM)
FILL
SAND
SEDIMENT/SHORELINE BACKFILL
CLAY
DOLOMITE BEDROCK
DNAPL
GROUNDWATER TABLE

NOTE: SL = SCREENING LEVEL





SECTION A-A'

GRAPHICAL REPRESENTATION WITH VERTICAL EXAGGERATION NOT TO SCALE

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CHECKED BY:	NDK	DATE:	11/24/14
APPROVED BY:	BGH	DATE:	01/21/15
DRAWING NO:	1549-175-B30		
REFERENCE: .			

GRAPHICAL CONCEPTUAL SITE MODEL

REMEDIAL INVESTIGATION REPORT - REVISION 2
FORMER MARINETTE MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MARINETTE, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1549/17.5

FIGURE NO.
30

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XREFS:

APPENDIX A2

GROUNDWATER ANALYTICAL RESULTS

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
(pink)	Value exceeds SL				
(green)	Not detected above reported limit				
(white)	Detected below SL				
(gray)	Not analyzed				
MW1	11/22/04	< 0.018	< 0.018	< 0.016	0.14
MW1	04/13/05	< 0.018	< 0.018	< 0.017	0.055
MW1	09/26/05	< 0.018	< 0.016	< 0.019	0.093
MW1	11/13/06	< 0.018	< 0.016	< 0.019	0.024
MW1	10/16/07	0.025	0.024	0.03	0.031
MW1	10/20/08	0.0068	0.0058	0.0085	0.09
MW1	09/01/09	< 0.0029	< 0.0034	< 0.0035	0.032
MW1	10/06/10	0.036	0.035	0.026	0.028
MW1	10/12/11	0.014	0.016	0.016	0.2
MW1	08/06/12	< 0.0029	< 0.0034	< 0.0035	0.011
MW1	10/16/12	0.0044	0.0045	0.0071	< 0.047
MW1	01/08/13	< 0.0031	< 0.0036	0.0056	0.0094
MW1R	10/22/13	< 0.0029	0.004	< 0.0035	0.13
MW1R	04/23/14	< 0.0087	< 0.0062	0.0087	0.041
MW3R	11/22/04	< 0.018	< 0.018	< 0.016	< 1.1
MW3R	04/14/05	< 0.018	< 0.018	< 0.016	< 0.022
MW3R	09/26/05	< 0.15	< 0.13	< 0.15	< 0.38
MW3R	11/13/06	0.027	0.034	0.025	< 0.012
MW3R	10/16/07	< 0.039	< 0.033	< 0.04	0.19
MW3R	10/20/08	< 0.0054	< 0.0051	< 0.007	< 0.016
MW3R	09/01/09	< 0.0029	< 0.0034	< 0.0035	0.041
MW3R	10/06/10	< 0.0029	0.004	< 0.0035	0.014
MW3R	10/12/11	0.0089	0.014	0.0099	0.051
MW3R	08/06/12	0.033	0.035	0.031	0.014
MW3R	10/16/12	0.018	0.017	0.02	< 0.047
MW3R	01/09/13	< 0.003	< 0.0036	< 0.0037	0.0061
MW3R	04/16/13	0.021	0.023	0.024	< 0.047
MW3R	10/22/13	0.0056	0.008	0.016	< 0.0049
MW3R	04/24/14	0.01	0.0099	0.012	< 0.0081

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Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW5	11/22/04	< 0.018	< 0.018	0.025	1.4
MW5	04/14/05	< 0.018	< 0.018	< 0.016	< 0.022
MW5	09/26/05	< 0.018	< 0.016	< 0.019	0.033
MW5	11/13/06	< 0.018	< 0.016	< 0.019	0.017
MW5	10/16/07	< 0.019	< 0.016	< 0.019	< 0.012
MW5	10/20/08	< 0.0054	< 0.0051	< 0.007	0.031
MW5	09/01/09	< 0.0029	< 0.0034	< 0.0035	0.12
MW5	10/05/10	< 0.0029	< 0.0034	< 0.0035	0.1
MW5	10/12/11	0.0034	0.0048	0.0055	0.024
MW5	08/06/12	0.0082	0.007	0.016	0.0096
MW5	10/16/12	< 0.0029	< 0.0034	< 0.0035	< 0.047
MW5	01/09/13	< 0.0031	< 0.0036	< 0.0037	0.012
MW5	04/16/13	0.0049	0.005	0.0052	< 0.047
MW5	10/22/13	0.0033	0.004	0.0055	0.25
MW5	04/24/14	< 0.0087	0.0069	0.0091	< 0.0081
MW302	11/22/04	**80**	**45**	**59**	13
MW302	04/14/05	**3**	**2.3**	**1.9**	< 0.45
MW302	09/26/05	**0.41**	**0.3**	**0.3**	0.51
MW302	11/13/06	**0.48**	**0.34**	**0.36**	0.32
MW302	10/16/07	0.17	0.12	0.14	0.036
MW302	10/20/08	0.071	0.049	0.043	0.074
MW302	09/01/09	0.12	0.09	0.12	0.11
MW302	10/06/10	0.08	0.05	0.084	0.16
MW302	10/12/11	0.044	0.045	0.047	0.12
MW302	08/07/12	0.13	0.075	0.15	0.17
MW302	10/16/12	**0.28**	0.17	**0.25**	< 0.25
MW302	01/09/13	0.087	0.064	0.072	0.094
MW302	04/15/13	**0.78**	**0.53**	**0.55**	< 0.19
MW302	10/22/13	0.055	0.031	0.062	0.099
MW302	04/23/14	0.043	0.025	0.057	0.29

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Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW303	11/22/04	< 0.018	< 0.018	< 0.016	0.032
MW303	04/14/05	< 0.018	< 0.018	< 0.016	0.18
MW303	09/26/05	**0.23**	**0.22**	0.14	0.069
MW303	11/13/06	0.021	0.036	0.021	1.1
MW303	10/16/07	0.02	0.027	0.024	1.7
MW303	10/20/08	**0.25**	**0.27**	0.18	0.24
MW303	09/01/09	0.0055	0.01	0.0077	0.017
MW303	10/06/10	0.0029	0.0034	0.0044	0.11
MW303	10/12/11	0.0046	0.006	0.0077	0.042
MW303	08/07/12	< 0.003	< 0.0036	0.0039	0.012
MW303	10/16/12	0.0089	0.014	0.017	< 0.047
MW303	01/09/13	**0.52**	**0.66**	**0.4**	0.027
MW303	04/15/13	0.031	0.053	0.044	1.5
MW303	10/22/13	0.038	0.049	0.05	0.018
MW303	04/23/14	0.019	0.034	0.024	0.071
MW304	11/22/04	< 1.8	< 1.8	< 1.6	27
MW304	04/14/05	0.023	0.036	0.025	0.06
MW304	09/26/05	< 1.8	< 1.6	< 1.9	47
MW304	11/13/06	0.022	0.03	0.022	0.058
MW304	10/16/07	< 0.019	< 0.016	< 0.019	< 0.012
MW304	10/20/08	0.012	0.023	0.015	0.38
MW304	09/01/09	0.07	0.098	0.083	0.14
MW304	10/06/10	0.0036	< 0.0034	0.0044	0.027
MW304	10/12/11	0.015	0.023	0.02	0.068
MW304	08/07/12	0.0045	0.0045	0.0065	0.011
MW304	10/16/12	0.004	< 0.0036	0.0057	< 0.0051
MW304	01/09/13	< 0.061	< 0.072	< 0.074	7.3
MW304	04/15/13	0.17	**0.22**	0.2	3.2
MW304	10/22/13	< 0.29	< 0.34	< 0.35	17.5
MW304	04/23/14	0.015	0.011	0.015	0.12

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW305	11/22/04	< 0.018	< 0.018	< 0.016	< 0.022
MW305	04/14/05	0.2	**0.24**	**0.21**	0.098
MW305	09/26/05	0.15	0.18	0.15	0.072
MW305	11/13/06	< 0.018	< 0.016	< 0.019	0.023
MW305	10/16/07	**0.36**	**0.38**	**0.41**	0.079
MW305	10/20/08	0.0058	0.0089	0.007	0.033
MW305	09/01/09	0.0033	0.0039	0.0044	0.11
MW305	10/06/10	0.013	0.015	0.019	0.1
MW305	10/12/11	0.012	0.015	0.015	0.014
MW305	08/07/12	< 0.003	< 0.0036	< 0.0037	0.017
MW305	10/16/12	0.0047	0.0045	0.0067	< 0.047
MW305	01/09/13	0.01	0.012	0.016	0.024
MW305	04/15/13	**1.3**	**1.3**	**1.4**	0.73
MW305	10/22/13	0.011	0.011	0.016	0.021
MW305	04/23/14	0.019	0.018	0.027	0.028
MW306	11/22/04	< 0.018	< 0.018	< 0.016	0.37
MW306	04/13/05	< 0.018	< 0.018	< 0.017	**410**
MW306	09/26/05	< 0.018	< 0.016	< 0.019	1.9
MW306	11/13/06	< 1.8	< 1.6	< 1.9	**830**
MW306	10/16/07	< 0.018	< 0.016	< 0.019	< 0.012
MW306	10/20/08	0.037	0.04	0.033	0.15
MW306	09/01/09	< 0.057	< 0.068	< 0.07	**160**
MW306	10/06/10	< 0.0029	0.0036	< 0.0035	71
MW306	10/11/11	< 0.0029	< 0.0034	0.0035	1.2
MW306	08/06/12	< 0.03	< 0.036	< 0.037	0.87
MW306	10/16/12	< 0.0029	< 0.0034	0.0038	0.24
MW306	01/09/13	< 0.003	< 0.0036	< 0.0037	0.14
MW306	04/15/13	0.13	0.14	0.14	1
MW306	10/21/13	< 0.057	< 0.068	< 0.07	9.3
MW306	04/24/14	< 1.7	< 1.2	< 0.61	68.5

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW307R	11/22/04	**0.31**	0.18	**0.34**	3.2
MW307R	04/13/05	< 0.18	< 0.18	< 0.17	0.48
MW307R	09/26/05	< 0.37	< 0.31	< 0.38	< 0.94
MW307R	11/13/06	**0.64**	**0.4**	**0.76**	0.25
MW307R	10/16/07	**0.91**	**0.52**	**1.1**	0.3
MW307R	10/20/08	0.11	< 0.1	0.18	< 0.33
MW307R	09/01/09	< 0.057	< 0.068	0.13	0.2
MW307R	10/05/10	0.17	0.12	0.2	0.45
MW307R	10/12/11	< 0.057	< 0.068	0.13	0.099
MW307R	08/06/12	0.071	0.047	0.19	1.4
MW307R	10/16/12	**1.3**	**0.82**	**1.5**	0.17
MW307R	01/08/13	**0.33**	**0.22**	**0.53**	0.23
MW307R	04/15/13	**0.36**	**0.36**	**0.48**	< 0.47
MW307R	10/22/13	0.043	< 0.034	0.14	0.58
MW307R	04/23/14	0.086	0.07	0.092	0.37
MW308	11/22/04	< 1.8	< 1.8	< 1.6	< 2.2
MW308	04/13/05	< 1.8	< 1.8	< 1.7	12
MW308	09/26/05	< 0.018	< 0.016	< 0.019	< 0.047
MW308	11/13/06	< 0.018	< 0.016	< 0.019	0.035
MW308	10/16/07	< 0.021	< 0.018	< 0.022	< 0.014
MW308	10/20/08	0.025	0.029	0.03	0.017
MW308	09/01/09	0.0038	0.0046	0.0053	0.019
MW308	10/06/10	0.0044	0.0044	0.0064	0.011
MW308	10/11/11	0.0082	0.01	0.012	0.014
MW308	08/06/12	0.0039	0.0037	0.0086	0.024
MW308	10/16/12	< 0.0029	< 0.0034	< 0.0035	< 0.047
MW308	01/09/13	< 0.003	< 0.0036	< 0.0037	0.012
MW308	04/15/13	0.056	0.066	0.075	2.6
MW308	10/22/13	< 0.011	< 0.014	0.017	1.5
MW308	04/23/14	< 0.0087	0.0072	0.011	0.0087

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW310	11/22/04	< 0.018	< 0.018	0.035	5.4
MW310	04/13/05	< 0.37	< 0.36	< 0.33	3.7
MW310	09/26/05	**2.3**	**1.6**	**2.9**	5.4
MW310	11/13/06	< 0.73	< 0.63	< 0.76	4.1
MW310	10/16/07	0.069	0.044	0.072	0.014
MW310	10/20/08	< 0.027	< 0.026	< 0.035	0.092
MW310	09/01/09	0.022	0.017	0.027	0.022
MW310	10/05/10	0.025	0.015	0.034	0.062
MW310	10/12/11	0.036	0.034	0.04	1.7
MW310	08/06/12	0.055	0.038	0.057	0.014
MW310	10/16/12	0.018	0.013	0.032	< 0.05
MW310	01/08/13	0.082	0.082	0.11	0.36
MW310	04/15/13	**0.74**	**0.72**	**0.91**	< 0.24
MW310	10/22/13	0.033	0.024	0.046	0.6
MW310	04/24/14	0.031	0.025	0.042	0.029
MW311	11/22/04	< 1.8	< 1.8	< 1.6	**3,200**
MW311	04/13/05	< 3.6	< 3.6	< 3.3	**2,000**
MW311	09/26/05	< 180	< 160	< 190	**2,800**
MW311	11/13/06	< 1.8	< 1.6	< 1.9	**1,400**
MW311	10/16/07	< 1.8	< 1.6	< 1.9	**1,500**
MW311	10/20/08	< 0.54	< 0.51	< 0.7	**945**
MW311	09/01/09	**0.29**	0.18	**0.52**	**923**
MW311	10/05/10	**0.34**	< 0.34	**0.69**	**1,610**
MW311	10/12/11	< 0.29	< 0.34	< 0.35	**1,590**
MW311	08/06/12	< 0.3	< 0.36	**0.43**	**1,960**
MW311	10/16/12	< 30.3	< 36	< 36.9	**2,220**
MW311	01/08/13	< 0.3	< 0.36	**0.89**	**1,710**
MW311	04/15/13	< 2.9	< 3.4	< 3.5	**1,350**
MW311	10/22/13	< 28.6	< 34	< 34.8	**2,490**
MW311	04/23/14	< 43.8	< 31.1	< 15.3	**1,350**

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
MW312	08/06/12	0.057	0.037	0.077	0.11
MW312	10/16/12	0.016	0.012	0.029	0.1
MW312	01/08/13	0.023	0.018	0.032	0.13
MW312	04/15/13	0.071	0.077	0.087	2.4
MW312	10/22/13	0.0096	0.0076	0.022	0.042
MW312	04/23/14	< 0.0087	< 0.0062	0.012	0.0082
MW313	08/07/12	0.012	0.0094	0.024	0.1
MW313	10/16/12	< 0.029	< 0.034	0.042	< 0.048
MW313	01/09/13	0.014	0.016	0.027	0.048
MW313	04/15/13	**0.32**	**0.5**	**0.43**	3.6
MW313	10/22/13	< 0.029	< 0.034	0.048	< 0.049
MW313	04/23/14	< 0.0087	0.0079	0.0099	0.016
P302	11/22/04	< 0.018	< 0.018	< 0.016	< 0.022
P302	04/14/05	< 0.018	< 0.018	< 0.016	< 0.022
P302	09/26/05	< 0.019	< 0.016	< 0.019	0.029
P302	11/13/06	< 0.018	0.016	< 0.019	0.018
P302	10/16/07	< 0.018	< 0.016	< 0.019	0.25
P302	10/20/08	0.0054	0.0077	< 0.007	0.016
P302	09/01/09	0.0042	0.0041	0.0039	0.017
P302	10/06/10	< 0.0029	< 0.0034	< 0.0035	0.023
P302	10/12/11	0.0036	0.0048	0.0052	0.04
P302	08/07/12	< 0.003	< 0.0036	< 0.0037	0.013
P302	10/16/12	< 0.003	< 0.0036	< 0.0037	< 0.05
P302	10/22/13	< 0.0029	< 0.0034	0.0045	0.012

Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
P303	11/22/04	0.041	0.026	0.039	< 0.022
P303	04/14/05	< 0.018	< 0.018	< 0.016	< 0.022
P303	09/26/05	0.16	0.11	0.13	< 0.023
P303	11/13/06	0.03	0.023	0.028	0.015
P303	10/16/07	< 0.018	< 0.016	< 0.019	< 0.012
P303	10/20/08	0.074	0.049	0.071	0.017
P303	09/01/09	0.014	0.012	0.014	0.044
P303	10/06/10	0.046	0.028	0.044	0.014
P303	10/12/11	0.03	0.027	0.034	0.023
P303	08/06/12	0.041	0.026	0.045	0.0054
P303	10/16/12	0.18	0.12	0.18	< 0.047
P303	10/22/13	0.018	0.018	0.026	0.01
P304	04/14/05	< 0.14	< 0.14	< 0.12	< 0.17
P304	11/13/06	0.023	0.018	0.024	0.068
P304	10/16/07	< 0.018	< 0.016	< 0.019	< 0.012
P304	10/20/08	< 0.0054	< 0.0051	< 0.007	< 0.016
P304	09/01/09	0.01	0.0078	0.012	0.014
P304	10/06/10	0.017	0.017	0.02	0.028
P304	10/12/11	0.0052	0.0064	0.0081	0.0081
P304	08/06/12	0.0086	0.0064	0.011	0.0054
P304	10/16/12	0.058	0.091	0.074	< 0.022
P304	10/21/13	0.047	0.032	0.058	0.0069

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Table 8. Groundwater PAHs/SVOCs Analytical Results Exceeding SLs

Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		PAH			
Location	Sample Date	Benzo(a)pyrene (µg/l)	Benzo(b)fluoranthene (µg/l)	Chrysene (µg/l)	Naphthalene (PAH) (µg/l)
	Groundwater SL	**0.2**	**0.2**	**0.2**	**100**
P305	11/22/04	< 0.018	< 0.018	< 0.016	0.025
P305	04/14/05	< 0.018	< 0.018	< 0.016	0.026
P305	09/26/05	< 0.018	< 0.016	0.036	3.3
P305	11/13/06	< 0.37	< 0.31	< 0.38	0.41
P305	10/16/07	< 0.019	< 0.016	< 0.02	0.022
P305	10/20/08	< 0.13	< 0.13	< 0.17	0.9
P305	09/01/09	0.0058	0.004	0.025	0.85
P305	10/06/10	< 0.29	< 0.34	< 0.35	16.2
P305	10/11/11	0.0064	0.0064	0.013	0.016
P305	08/06/12	< 0.3	< 0.36	< 0.37	27
P305	10/16/12	< 0.3	< 0.36	< 0.37	6.8
P305	10/22/13	0.0034	< 0.0034	0.016	0.1
	Total Number of Samples Analyzed:	237	237	237	237
	Number of Detections:	128	129	147	190
	Min:	0.0029	0.0034	0.0035	0.0054
	Max:	80	45	59	3,200
	Groundwater SL	0.2	0.2	0.2	100
	Number of Samples that Exceed GW SL:	**22**	**20**	**23**	**18**

[O:ECK 11/5/14,C:SGW 11/12/14][R:AJS 12/04/14]

NOTES:
BOLD = Value exceeds SL
< = Concentration is less than reported limit
-- = Analysis not performed
NS = No Standard
PAH = polycyclic aromatic hydrocarbon
SL = Screening Level
SLs used on this table were presented in the Multi-Site Risk Assessment Framework (RAF) Addendum Revision 3 (Exponent, July 2014). The groundwater SL presented is the more conservative of the State and MCL values presented in the RAF Addendum Revision 3.

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

Location	Sample Date	BTEX: Benzene (µg/l)	BTEX: Ethylbenzene (µg/l)	Metals: Manganese, Dissolved (µg/l)	Inorganics: Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
MW1	11/22/04	< 0.14	< 0.4	**810**	54
MW1	04/13/05	< 0.14	< 0.4	**1,300**	< 5
MW1	09/26/05	< 0.21	< 0.4	--	< 5
MW1	11/13/06	< 0.14	< 0.4	--	--
MW1	10/16/07	< 0.14	< 0.4	--	--
MW1	10/20/08	< 0.23	< 0.4	--	--
MW1	09/01/09	0.75	< 0.4	--	--
MW1	10/06/10	< 0.39	< 0.41	--	--
MW1	10/12/11	< 0.39	< 0.41	**450**	--
MW1	08/06/12	< 0.39	< 0.41	**718**	--
MW1	10/16/12	< 0.41	< 0.54	**423**	--
MW1	01/08/13	< 0.41	< 0.54	**901**	--
MW1R	10/22/13	1.2	< 0.5	**712**	--
MW1R	04/23/14	< 0.5	< 0.5	**831**	--
MW3R	11/22/04	< 0.14	< 0.4	**1,200**	< 5
MW3R	04/14/05	< 0.14	< 0.4	21	< 5
MW3R	09/26/05	< 0.21	< 0.4	--	< 5
MW3R	11/13/06	< 0.14	< 0.4	--	--
MW3R	10/16/07	1.3	1.9	--	--
MW3R	10/20/08	< 0.23	< 0.4	--	--
MW3R	09/01/09	< 0.23	< 0.4	--	--
MW3R	10/06/10	< 0.39	< 0.41	--	--
MW3R	10/12/11	< 0.39	< 0.41	**1,040**	--
MW3R	08/06/12	< 0.39	< 0.41	**1,620**	--
MW3R	10/16/12	< 0.41	< 0.54	**1,050**	--
MW3R	01/09/13	< 0.41	< 0.54	**1,440**	--
MW3R	04/16/13	< 0.41	< 0.54	1	--
MW3R	10/22/13	< 0.5	< 0.5	**1,070**	--
MW3R	04/24/14	< 0.5	< 0.5	2.5	--
MW4	04/13/05	--	--	--	< 5
MW5	11/22/04	0.73	0.63	**480**	< 5
MW5	04/14/05	< 0.14	< 0.4	**420**	< 5
MW5	09/26/05	< 0.21	< 0.4	**730**	< 5
MW5	11/13/06	< 0.14	< 0.4	--	--
MW5	10/16/07	< 0.14	< 0.4	--	--
MW5	10/20/08	< 0.23	< 0.4	--	--
MW5	09/01/09	< 0.23	< 0.4	--	--
MW5	10/05/10	< 0.39	< 0.41	--	--
MW5	10/12/11	< 0.39	< 0.41	**1,080**	--
MW5	08/06/12	< 0.39	< 0.41	**604**	--
MW5	10/16/12	< 0.41	< 0.54	**394**	--
MW5	01/09/13	< 0.41	< 0.54	**360**	--
MW5	04/16/13	< 0.41	< 0.54	174	--
MW5	10/22/13	< 0.5	< 0.5	**1,240**	--
MW5	04/24/14	< 0.5	< 0.5	**519**	--

Legend:
- Value exceeds SL
- Not detected above reported limit
- Detected below SL
- Not analyzed

NATURAL RESOURCE TECHNOLOGY

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		BTEX		Metals	Inorganics
Location	Sample Date	Benzene (µg/l)	Ethylbenzene (µg/l)	Manganese, Dissolved (µg/l)	Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
MW302	11/22/04	4.6	8.6	130	69
MW302	04/14/05	4.9	0.57	160	8
MW302	09/26/05	**13**	1.3	100	< 5
MW302	11/13/06	**33**	9	--	--
MW302	10/16/07	**25**	1.1	--	--
MW302	10/20/08	**11.6**	1.8	--	--
MW302	09/01/09	4.3	< 0.4	--	--
MW302	10/06/10	**17.6**	2.2	--	--
MW302	10/12/11	**17.7**	< 0.41	68.6	--
MW302	08/07/12	**20.4**	2.3	84.5	--
MW302	10/16/12	**5.1**	< 0.54	48.1	--
MW302	01/09/13	**38.9**	1.3	29.4	--
MW302	04/15/13	4.1	< 0.54	52.3	--
MW302	10/22/13	**15.3**	< 0.5	81.5	--
MW302	04/23/14	**22.5**	0.82	87.9	--
MW303	11/22/04	< 0.14	< 0.4	**1,300**	38
MW303	04/14/05	1.5	0.53	**920**	< 5
MW303	09/26/05	< 0.21	< 0.4	--	< 5
MW303	11/13/06	< 0.14	< 0.4	--	--
MW303	10/16/07	1.3	0.86	--	--
MW303	10/20/08	< 0.23	< 0.4	--	--
MW303	09/01/09	< 0.23	< 0.4	--	--
MW303	10/06/10	< 0.39	< 0.41	--	--
MW303	10/12/11	< 0.39	< 0.41	**914**	--
MW303	08/07/12	< 0.39	< 0.41	**664**	--
MW303	10/16/12	< 0.41	< 0.54	**683**	--
MW303	01/09/13	< 0.41	< 0.54	**783**	--
MW303	04/15/13	< 0.41	< 0.54	**527**	--
MW303	10/22/13	< 0.5	< 0.5	**707**	--
MW303	04/23/14	< 0.5	< 0.5	**543**	--
MW304	11/22/04	**29**	5.9	250	**660**
MW304	04/14/05	1.1	< 0.4	**320**	8
MW304	09/26/05	**78**	11	45	< 5
MW304	11/13/06	1.1	< 0.4	--	--
MW304	10/16/07	**64**	6	--	--
MW304	10/20/08	2	0.44	--	--
MW304	09/01/09	3	< 0.4	--	--
MW304	10/06/10	< 0.39	< 0.41	--	--
MW304	10/12/11	0.68	< 0.41	99	--
MW304	08/07/12	3.9	0.49	124	--
MW304	10/16/12	**15.3**	1.7	39.1	--
MW304	01/09/13	**33**	2.1	44.4	--
MW304	04/15/13	0.66	1	20.8	--
MW304	10/22/13	**26.4**	2.3	53.9	--
MW304	04/23/14	1.2	< 0.5	50.5	--

NATURAL RESOURCE TECHNOLOGY

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		BTEX		Metals	Inorganics
Location	Sample Date	Benzene (µg/l)	Ethylbenzene (µg/l)	Manganese, Dissolved (µg/l)	Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
MW305	11/22/04	< 0.14	< 0.4	0.45	22
MW305	04/14/05	< 0.14	< 0.4	8.1	< 5
MW305	09/26/05	< 0.21	< 0.4	--	< 5
MW305	11/13/06	< 0.14	< 0.4	--	--
MW305	10/16/07	2.3	1.4	--	--
MW305	10/20/08	< 0.23	< 0.4	--	--
MW305	09/01/09	< 0.23	< 0.4	--	--
MW305	10/06/10	< 0.39	< 0.41	--	--
MW305	10/12/11	< 0.39	< 0.41	1.9	--
MW305	08/07/12	< 0.39	< 0.41	< 0.32	--
MW305	10/16/12	< 0.41	< 0.54	0.42	--
MW305	01/09/13	< 0.41	< 0.54	1.1	--
MW305	04/15/13	< 0.41	< 0.54	4.4	--
MW305	10/22/13	< 0.5	< 0.5	0.49	--
MW305	04/23/14	< 0.5	< 0.5	2.1	--
MW306	11/22/04	0.2	0.41	**390**	28
MW306	04/13/05	< 0.34	350	**650**	< 5
MW306	09/26/05	< 0.21	22	**590**	< 5
MW306	11/13/06	< 3.4	**1,700**	--	--
MW306	10/16/07	< 0.14	0.53	--	--
MW306	10/20/08	< 0.23	1.4	--	--
MW306	09/01/09	< 0.23	252	--	--
MW306	10/06/10	< 0.39	211	--	--
MW306	10/11/11	< 1.6	215	**571**	--
MW306	08/06/12	0.44	172	**373**	--
MW306	10/16/12	< 0.41	3.3	**747**	--
MW306	01/09/13	< 0.82	4.5	**840**	--
MW306	04/15/13	< 0.41	24.6	**522**	--
MW306	10/21/13	< 0.5	17.2	294	--
MW306	04/24/14	< 0.5	81.6	231	--
MW307R	11/22/04	0.61	< 0.4	**2,300**	46
MW307R	04/13/05	0.57	< 0.4	**2,900**	< 5
MW307R	09/26/05	0.44	< 0.4	--	< 5
MW307R	11/13/06	< 0.14	< 0.4	--	--
MW307R	10/16/07	< 0.14	< 0.4	--	--
MW307R	10/20/08	< 0.23	< 0.4	--	--
MW307R	09/01/09	< 0.23	< 0.4	--	--
MW307R	10/05/10	< 0.39	< 0.41	--	--
MW307R	10/12/11	< 0.39	< 0.41	**1,340**	--
MW307R	08/06/12	< 0.39	< 0.41	**777**	--
MW307R	10/16/12	< 0.41	< 0.54	**1,950**	--
MW307R	01/08/13	< 0.41	< 0.54	**1,790**	--
MW307R	04/15/13	< 0.41	< 0.54	**1,220**	--
MW307R	10/22/13	< 0.5	< 0.5	**629**	--
MW307R	04/23/14	< 0.5	< 0.5	**2,080**	--

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		BTEX		Metals	Inorganics
Location	Sample Date	Benzene (µg/l)	Ethylbenzene (µg/l)	Manganese, Dissolved (µg/l)	Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
MW308	11/22/04	0.61	< 0.4	**1,500**	27
MW308	04/13/05	0.33	0.71	**1,500**	< 5
MW308	09/26/05	< 0.21	< 0.4	**2,100**	< 5
MW308	11/13/06	< 0.14	< 0.4	--	--
MW308	10/16/07	4	5	--	--
MW308	10/20/08	< 0.23	< 0.4	--	--
MW308	09/01/09	< 0.23	< 0.4	--	--
MW308	10/06/10	< 0.39	< 0.41	--	--
MW308	10/11/11	< 0.39	< 0.41	**1,130**	--
MW308	08/06/12	< 0.39	< 0.41	**749**	--
MW308	10/16/12	< 0.41	< 0.54	**1,480**	--
MW308	01/09/13	< 0.41	< 0.54	**1,890**	--
MW308	04/15/13	< 0.41	< 0.54	**503**	--
MW308	10/22/13	< 0.5	< 0.5	**2,050**	--
MW308	04/23/14	< 0.5	< 0.5	**1,890**	--
MW310	11/22/04	0.68	0.89	**2,200**	68
MW310	04/13/05	< 0.14	< 0.4	**1,500**	< 5
MW310	09/26/05	0.45	< 0.4	**2,000**	< 5
MW310	11/13/06	< 0.14	< 0.4	--	--
MW310	10/16/07	< 0.14	< 0.4	--	--
MW310	10/20/08	< 0.23	< 0.4	--	--
MW310	09/01/09	< 0.23	< 0.4	--	--
MW310	10/05/10	< 0.39	< 0.41	--	--
MW310	10/12/11	< 0.39	< 0.41	**375**	--
MW310	08/06/12	< 0.39	< 0.41	**655**	--
MW310	10/16/12	< 0.41	< 0.54	**550**	--
MW310	01/08/13	< 0.41	< 0.54	**864**	--
MW310	04/15/13	< 0.41	< 0.54	**500**	--
MW310	10/22/13	< 0.5	< 0.5	**956**	--
MW310	04/24/14	< 0.5	< 0.5	**438**	--
MW311	11/22/04	**580**	**1,200**	**3,000**	12
MW311	04/13/05	**260**	700	**2,700**	5.1
MW311	09/26/05	**440**	**920**	**2,500**	< 5
MW311	11/13/06	**330**	680	--	--
MW311	10/16/07	**280**	640	--	--
MW311	10/20/08	**395**	610	--	--
MW311	09/01/09	**329**	506	--	--
MW311	10/05/10	**514**	449	--	--
MW311	10/12/11	**474**	404	**2,000**	--
MW311	08/06/12	**481**	625	**2,180**	--
MW311	10/16/12	**333**	461	**1,630**	--
MW311	01/08/13	**391**	587	**1,720**	--
MW311	04/15/13	**239**	330	**1,720**	--
MW311	10/22/13	**445**	640	**1,990**	--
MW311	04/23/14	**426**	460	**2,250**	--

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		BTEX		Metals	Inorganics
Location	Sample Date	Benzene (µg/l)	Ethylbenzene (µg/l)	Manganese, Dissolved (µg/l)	Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
MW312	08/06/12	< 0.39	< 0.41	**476**	--
MW312	10/16/12	< 0.41	< 0.54	**561**	--
MW312	01/08/13	< 0.41	< 0.54	**629**	--
MW312	04/15/13	< 0.41	< 0.54	**1,090**	--
MW312	10/22/13	< 0.5	< 0.5	**684**	--
MW312	04/23/14	< 0.5	< 0.5	**897**	--
MW313	08/07/12	< 0.39	< 0.41	**2,850**	--
MW313	10/16/12	< 0.41	< 0.54	**2,600**	--
MW313	01/09/13	< 0.41	< 0.54	**1,750**	--
MW313	04/15/13	< 0.41	0.58	**1,590**	--
MW313	10/22/13	< 0.5	< 0.5	**2,240**	--
MW313	04/23/14	< 0.5	< 0.5	**592**	--
P302	11/22/04	< 0.14	< 0.4	230	< 5
P302	04/14/05	< 0.14	< 0.4	230	< 5
P302	09/26/05	< 0.21	< 0.4	260	< 5
P302	11/13/06	< 0.14	< 0.4	--	--
P302	10/16/07	1.1	1.1	--	--
P302	10/20/08	< 0.23	< 0.4	--	--
P302	09/01/09	< 0.23	< 0.4	--	--
P302	10/06/10	< 0.39	< 0.41	--	--
P302	10/12/11	< 0.39	< 0.41	**302**	--
P302	08/07/12	< 0.39	< 0.41	**429**	--
P302	10/16/12	< 0.41	< 0.54	**375**	--
P302	10/22/13	< 0.5	< 0.5	**634**	--
P303	11/22/04	< 0.14	< 0.4	3.8	53
P303	04/14/05	< 0.14	< 0.4	34	< 5
P303	09/26/05	< 0.21	< 0.4	240	< 5
P303	11/13/06	< 0.14	< 0.4	--	--
P303	10/16/07	< 0.14	< 0.4	--	--
P303	10/20/08	< 0.23	< 0.4	--	--
P303	09/01/09	< 0.23	< 0.4	--	--
P303	10/06/10	< 0.39	< 0.41	--	--
P303	10/12/11	< 0.39	< 0.41	32.2	--
P303	08/06/12	< 0.39	< 0.41	0.78	--
P303	10/16/12	< 0.41	--	59.8	--
P303	10/22/13	< 0.5	< 0.5	10.7	--
P304	04/14/05	< 0.14	< 0.4	--	< 5
P304	09/26/05	< 0.21	< 0.4	--	--
P304	11/13/06	< 0.14	< 0.4	--	--
P304	10/16/07	< 0.14	< 0.4	--	--
P304	10/20/08	< 0.23	< 0.4	--	--
P304	09/01/09	< 0.23	< 0.4	--	--
P304	10/06/10	< 0.39	< 0.41	--	--
P304	10/12/11	< 0.39	< 0.41	--	--
P304	08/06/12	< 0.39	< 0.41	43.1	--
P304	10/16/12	< 0.41	--	--	--
P304	10/21/13	< 0.5	< 0.5	--	--

Natural Resource Technology

Table 10. Groundwater VOCs/Inorganics Analytical Results Exceeding SLs
Wisconsin Public Service Corporation, Marinette
Former Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
BRRTS# : 02-38-000047 USEPA# : WIN000509952

		BTEX		Metals	Inorganics
Location	Sample Date	Benzene (µg/l)	Ethylbenzene (µg/l)	Manganese, Dissolved (µg/l)	Cyanide, Available (µg/l)
	Groundwater SL	**5**	**700**	**300**	**200**
P305	11/22/04	< 0.14	< 0.4	**1,700**	< 5
P305	04/14/05	< 0.14	< 0.4	**1,800**	< 5
P305	09/26/05	< 0.21	< 0.4	**2,000**	< 5
P305	11/13/06	< 0.14	< 0.4	--	--
P305	10/16/07	1.7	2.3	--	--
P305	10/20/08	0.24	< 0.4	--	--
P305	09/01/09	< 0.23	< 0.4	--	--
P305	10/06/10	< 0.39	< 0.41	--	--
P305	10/11/11	< 0.39	< 0.41	**822**	--
P305	08/06/12	0.5	< 0.41	**1,190**	--
P305	10/16/12	< 0.41	< 0.54	**1,460**	--
P305	10/22/13	< 0.5	< 0.5	**1,150**	--
	Total Number of Samples Analyzed:	238	236	148	47
	Number of Detections:	65	60	147	14
	Min:	0.2	0.41	0.42	5.1
	Max:	580	1,700	3,000	660
	Groundwater SL	5	700	300	200
	Number of Samples that Exceed Groundwater SL:	**32**	**3**	**103**	**1**

[O:ECK 11/5/14, C:SGW 11/11/14][R:AJS 12/04/14]

NOTES:
BOLD = Value exceeds SL
< = Concentration is less than reported limit
-- = Analysis not performed
BTEX = benzene, toluene, ethylbenzene, and xylene
NS = No Standard
SL = Screening Level
SLs used on this table were presented in the Multi-Site Risk Assessment Framework (RAF) Addendum Revision 3 (Exponent, July 2014). The groundwater SL presented is the more conservative of the State and MCL values presented in the RAF Addendum Revision 3.

APPENDIX B

REMEDIAL ALTERNATIVES COST ESTIMATES

APPENDIX B1

SOIL REMEDIAL ALTERNATIVE COST ESTIMATES

Alternative G1, S1, V1, SED1 - No Further Action

Cost Estimate Summary Worksheet

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: No additional action

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					**$ -**	
Contingency						
SUBTOTAL					**$ -**	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls — **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)
Description: Wisconsin GIS Registry

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$25,000	$25,000		Assumed at 10% of construction costs
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" Compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 65,400**	
Cap Construction						
Disposal of Soil (0-2 ft)	2,800	Tons	$40	$112,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	2,800	Tons	$10	$28,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	2,200	CY	$26	$57,200		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	2,200	CY	$1	$2,200		Assumes performance based compaction of 3 passes with 200 HP Dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 209,400**	
Professional Services						
Remedial Engineering Design	1	LS	$41,220	$41,200		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$27,480	$27,500		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$21,984	$22,000		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 90,700**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$47,720		
Scope Estimating Contingency: 15% of Total Capital Costs				$71,580		
SUBTOTAL					**$ 119,300**	
Total Capital Costs					**$ 600,000**	

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^{4} or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$10,500	$10,500		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,550		
Scope Estimating Contingency - 15% of Periodic Costs				$3,825		
SUBTOTAL					**$ 31,875**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 570,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 69,000**	
Total Present Worth of Alternative					**$ 830,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$34,900	$34,900		Assumed at 10% of construction costs
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft. tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft. high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 81,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	4,100	Tons	$40	$164,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	4,100	Tons	$10	$41,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	3,200	CY	$26	$83,200		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	3,200	CY	$1	$3,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 301,400**	
Professional Services						
Remedial Engineering Design	1	LS	$57,465	$57,500		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$38,310	$38,300		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$30,648	$30,600		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 126,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$62,120		
Scope Estimating Contingency: 15% of Total Capital Costs				$93,180		
SUBTOTAL					**$ 155,300**	
Total Capital Costs					**$ 780,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers	Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,380		
Scope Estimating Contingency - 15% of Periodic Costs				$3,570		
SUBTOTAL					**$ 29,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 560,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 65,000**	
Total Present Worth of Alternative					**$ 1,100,000**	

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$75,000	$75,000		Engineer's estimate
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 121,800**	
Cap Construction						
Disposal of Soil (0-2 ft)	12,600	Tons	$40	$504,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	12,600	Tons	$10	$126,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	9,700	CY	$26	$252,200		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	9,700	CY	$1	$9,700		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 901,900**	
Professional Services						
Remedial Engineering Design	1	LS	$122,844	$122,800		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$81,896	$81,900		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$61,422	$61,400		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 266,100**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$140,150		
Scope Estimating Contingency: 15% of Total Capital Costs				$210,225		
SUBTOTAL					**$ 350,375**	
Total Capital Costs					**$ 1,800,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$10,900	$10,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,590		
Scope Estimating Contingency - 15% of Periodic Costs				$3,885		
SUBTOTAL					**$ 32,375**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 570,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 160,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 70,000**
Total Present Worth of Alternative	**$ 2,100,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$28,100	$28,100		Assumed at 10% of construction costs
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 63,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	3,300	Tons	$40	$132,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	3,300	Tons	$10	$33,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	2,600	CY	$26	$67,600		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	2,600	CY	$1	$2,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 245,200**	
Professional Services						
Remedial Engineering Design	1	LS	$46,335	$46,300		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$30,890	$30,900		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$24,712	$24,700		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 101,900**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$52,250		
Scope Estimating Contingency: 15% of Total Capital Costs				$78,375		
SUBTOTAL					**$ 130,625**	
Total Capital Costs					**$ 660,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 49,000**	
Total Present Worth of Alternative					**$ 870,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment | **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$321,000	$321,000		
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 356,900**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	3,300	Tons	$40	$132,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	3,300	Tons	$10	$33,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 165,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$349,000	$349,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 625 wells
Onsite Injection Program	1	LS	$2,154,000	$2,154,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 116 injection days
Reagents	1	LS	$299,000	$299,000		Includes 511,018 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	420	Samples	$300	$126,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 3,008,300**	
Site Restoration						
Backfill Material and Delivery	2,600	CY	$26	$67,600		Assumes 95% general fill and 5% topsoil
Backfill Placement	2,600	CY	$1	$2,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	40,600	SF	$5	$203,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 283,200**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$122,000	$122,000		
Project Management during Construction	1	LS	$37,000	$37,000		
SUBTOTAL					**$ 409,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$433,410		
Scope Estimating Contingency: 15% of Total Capital Costs				$650,115		
SUBTOTAL					**$ 1,083,525**	
Total Capital Costs					**$ 5,500,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$10,500	$10,500		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,550		
Scope Estimating Contingency - 15% of Periodic Costs				$3,825		
SUBTOTAL					**$ 31,875**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 570,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 69,000**	
Total Present Worth of Alternative					**$ 5,800,000**	

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$516,000	$516,000		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 555,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilitie
Disposal of Impacted Soil	5,700	Tons	$40	$228,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,700	Tons	$10	$57,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 285,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$314,000	$314,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 554 well
Onsite Injection Program	1	LS	$5,742,000	$5,742,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 427 injection day
Reagents	1	LS	$6,064,000	$6,064,000		Includes 10,465,947 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	420	Samples	$300	$126,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 12,326,300**	
Site Restoration						
Backfill Material and Delivery	4,400	CY	$26	$114,400		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,400	CY	$1	$4,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 291,800**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$449,000	$449,000		
Project Management during Construction	1	LS	$134,000	$134,000		
SUBTOTAL					**$ 833,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 5% of Total Capital Costs				$720,145		
Scope Estimating Contingency: 10% of Total Capital Costs				$1,440,290		
SUBTOTAL					**$ 2,160,435**	
Total Capital Costs					**$ 16,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 5% of Annual Costs				$500		
Scope Estimating Contingency - 10% of Annual Costs				$1,000		
SUBTOTAL					**$ 11,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 5% of Periodic Costs				$1,190		
Scope Estimating Contingency - 10% of Periodic Costs				$2,380		
SUBTOTAL					**$ 27,370**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 150,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 60,000**	
Total Present Worth of Alternative					**$ 16,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$306,000	$306,000		
Silt Fence Installation	1,000	LF	$1	$1,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,000	LF	$15	$15,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 329,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	5,200	Tons	$40	$208,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,200	Tons	$10	$52,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 260,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$187,000	$187,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 314 wells
Onsite Injection Program	1	LS	$3,393,000	$3,393,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 252 injection days
Reagents	1	LS	$3,579,000	$3,579,000		Includes 6,011,616 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor Documentation
Soil and Groundwater Sampling and Analysis	210	Samples	$300	$63,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 7,302,300**	
Site Restoration						
Backfill Material and Delivery	4,000	CY	$26	$104,000		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,000	CY	$1	$4,000		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 137,500**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$244,000	$244,000		
Project Management during Construction	1	LS	$79,000	$79,000		
SUBTOTAL					**$ 573,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$871,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,307,040		
SUBTOTAL					**$ 2,178,400**	
Total Capital Costs					**$ 10,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 49,000**	
Total Present Worth of Alternative					**$ 11,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal — Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Description: Excavation of Non-Source Areas and offsite disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Building Demolition	0	CF	$0.35	$0		
Transportation/Disposal of Building Debris	0	Tons	$40	$0		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					$ 461,800	
Excavation						
Temporary Shoring (Sheeting & Bracing)	18,000	SF	$26	$468,000		
Disposal of Impacted Soil	58,500	Tons	$40	$2,340,000		Removal of Non-Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	58,500	Tons	$10	$585,000		
Temporary Excavation Dewatering and Treatment	3.0	Month	$40,000	$120,000		
Excavation Sidewall and Base Soil Samples	150	Ea	$250	$37,500		
SUBTOTAL					$ 3,550,500	
Site Restoration						
Backfill Material and Delivery	44,800	CY	$26	$1,164,800		Assumes general fill
Backfill/Topsoil Placement	44,800	CY	$1	$44,800		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					$ 1,834,300	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$141,000	$141,000		
Project Management during Construction	1	LS	$30,000	$30,000		
SUBTOTAL					$ 421,000	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$626,760		
Scope Estimating Contingency: 15% of Total Capital Costs				$940,140		
SUBTOTAL					$ 1,566,900	
Total Capital Costs					**$ 7,900,000**	

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal		Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:**	Excavation of Non-Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 7,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1	**Description:** Excavation of Source Areas and offsite disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,500	LF	$1	$2,600		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,500	LF	$15	$37,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 466,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Disposal of Impacted Soil	58,200	Tons	$40	$2,328,000		Removal of North and South Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	58,200	Tons	$10	$582,000		
Temporary Excavation Dewatering and Treatment	3.0	Month	$40,000	$120,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 3,959,100**	
Site Restoration						
Backfill Material and Delivery	44,600	CY	$26	$1,159,600		Assumes general fill
Backfill/Topsoil Placement	44,600	CY	$1	$44,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,828,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$375,234	$375,200		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$34,000	$34,000		
SUBTOTAL					**$ 659,200**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$691,310		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,036,965		
SUBTOTAL					**$ 1,728,275**	
Total Capital Costs					**$ 8,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 8,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 174,000**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	27,900	Tons	$40	$1,116,000		Removal of North and South Source Areas at the WWTP Area. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil	27,900	Tons	$10	$279,000		
Temporary Excavation Dewatering and Treatment	1.2	Month	$40,000	$48,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 1,829,600**	
Site Restoration						
Backfill Material and Delivery	21,400	CY	$26	$556,400		Assumes general fill
Backfill/Topsoil Placement	21,400	CY	$1	$21,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 634,600**	
Professional Services						
Remedial Engineering Design	1	LS	$211,056	$211,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$158,292	$158,300		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$17,000	$17,000		
SUBTOTAL					**$ 386,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$313,630		
Scope Estimating Contingency: 15% of Total Capital Costs				$470,445		
SUBTOTAL					**$ 784,075**	
Total Capital Costs					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Non-Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Building Demolition	0	CF	$0.35	$0		
Transportation/Disposal of Building Debris	0	Tons	$40	$0		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,069,900**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	18,000	SF	$26	$468,000		
Impacted Soils - Disposal	5,900	Tons	$40	$236,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Impacted Soils - Transportation and Handling for Disposal	5,900	Tons	$10	$59,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	5.5	Month	$40,000	$220,000		
Excavation Sidewall and Base Soil Samples	150	Ea	$250	$37,500		
SUBTOTAL					**$ 1,020,500**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	52,700	Tons	$50	$2,635,000		Assumes 90% of Non-Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	52,700	Tons	$15	$790,500		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	120	Days	$11,965	$1,435,800		Assumes 90% of Non-Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	70	Ea	$250	$17,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 4,878,800**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5b (Boom Non-Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	3,500	CY	$26	$91,000		Assumes general fill
Backfill/Topsoil Placement	3,500	CY	$1	$3,500		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,410	$4,400		
Preconstruction, Interim and As-Built Survey	1	LS	$5,250	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 719,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$249,000	$249,000		
Project Management during Construction	1	LS	$51,000	$51,000		
SUBTOTAL					**$ 550,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$823,830		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,235,745		
SUBTOTAL					**$ 2,059,575**	
Total Capital Costs					**$ 10,300,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$**	**-**
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$**	**-**
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$**	**-**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$**	**-**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$**	**-**
Total Present Worth of Alternative	**$ 10,300,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Source Areas) - Excavation and Onsite Treatment Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,077,900**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Impacted Soils - Disposal	5,900	Tons	$40	$236,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfi
Impacted Soils - Transportation and Handling for Disposal	5,900	Tons	$10	$59,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	5.5	Month	$40,000	$220,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 1,444,100**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	52,400	Tons	$50	$2,620,000		Assumes 90% of North and South Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	52,400	Tons	$15	$786,000		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	120	Days	$11,965	$1,435,800		Assumes 90% of North and South Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	70	Ea	$250	$17,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 4,859,300**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Source Areas) - Excavation and Onsite Treatment Disposal						**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)					**Description:**	Excavation of Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	4,600	CY	$26	$119,600		Assumes general fill
Backfill/Topsoil Placement	4,600	CY	$1	$4,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 748,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$487,764	$487,800		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$51,000	$51,000		
SUBTOTAL					**$ 788,800**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$891,820		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,337,730		
SUBTOTAL					**$ 2,229,550**	
Total Capital Costs					**$ 11,200,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Total Present Worth of Alternative	**$ 11,200,000**	

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,100	LF	$1	$3,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,100	LF	$15	$46,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 799,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	2,800	Tons	$40	$112,000		Assumes 10% of North and South Source Areas at the WWTP Area require landfill disposal at a Subtitle D landfill. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil (Disposal)	2,800	Tons	$10	$28,000		
Temporary Excavation Dewatering and Treatment	2.5	Month	$40,000	$100,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 626,600**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	25,100	Tons	$50	$1,255,000		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption. Assume 5,000 SF area under railroad is inaccessible
Utility Costs	25,100	Tons	$15	$376,500		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	60	Days	$11,965	$717,900		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption
Soil Treatment Confirmation Samples	30	Ea	$250	$7,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 2,356,900**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	2,200	CY	$26	$57,200		Assumes general fill
Backfill/Topsoil Placement	2,200	CY	$1	$2,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 116,200**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$233,964	$234,000		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$26,000	$26,000		
SUBTOTAL					**$ 510,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$452,110		
Scope Estimating Contingency: 15% of Total Capital Costs				$678,165		
SUBTOTAL					**$ 1,130,275**	
Total Capital Costs					**$ 5,700,000**	

OPERATIONS AND MAINTENANCE COSTS

DESCRIPTION	SUBTOTAL
Annual Operations and Maintenance - Cost Per Year	
SUBTOTAL	**$ -**
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event	
SUBTOTAL	**$ -**
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**
Total Present Worth of Alternative	**$ 5,700,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S6 (Boom Landing Non-Source Areas) - Air Sparging and Soil Vapor Extraction

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$7,000	$7,000		
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					$ 42,900	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$301,000	$301,000		64 sparge wells, 20 ft spacing, 320 cfm injection rate. 29 SVE wells, 30 ft spacing, 960 cfm extraction rate
System Closeout Costs	1	LS	$82,000	$82,000		Includes system demobilization and well abandonment
SUBTOTAL					$ 431,000	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	46,100	SF	$5	$230,500		Replace existing pavements located above treatment areas
SUBTOTAL					$ 244,000	
Professional Services						
Remedial Engineering Design	1	LS	$86,148	$86,100		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$57,432	$57,400		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$43,074	$43,100		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					$ 186,600	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$90,450		
Scope Estimating Contingency: 15% of Total Capital Costs				$135,675		
SUBTOTAL					$ 226,125	
Total Capital Costs					**$ 1,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$167,300	$167,300		
Performance Monitoring and Reporting	1	LS	$89,600	$89,600		Assumes quarterly groundwater sampling (8 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$28,430		
Scope Estimating Contingency - 15% of Annual Costs				$42,645		
SUBTOTAL					$ 355,375	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 2,500,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 2,000,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 3,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (Boom Landing Source Areas) - Air Sparging and Soil Vapor Extraction — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$7,300	$7,300		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 46,400**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$386,000	$386,000		64 sparge wells, 20 ft spacing, 640 cfm injection rate. 29 SVE wells, 30 ft spacing, 1,920 cfm extraction rate
System Closeout Costs	1	LS	$84,000	$84,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 518,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 176,500**	
Professional Services						
Remedial Engineering Design	1	LS	$88,908	$88,900		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$59,272	$59,300		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$44,454	$44,500		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 192,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$93,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$140,040		
SUBTOTAL					**$ 233,400**	
Total Capital Costs					**$ 1,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$305,700	$305,700		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$49,270		
Scope Estimating Contingency - 15% of Annual Costs				$73,905		
SUBTOTAL					**$ 615,875**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 4,400,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 3,400,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (WWTP Non-Source Areas) - Air Sparging and Soil Vapor Extraction

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone, in conjunction with institutional controls for larger WWTP operation structures

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$8,400	$8,400		
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 58,800**	
Air Sparging and Soil Vapor Extraction						Assumes no remediation under large WWTP structures
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$40,000	$40,000		
Installation/Construction Costs	1	LS	$1,133,000	$1,133,000		270 sparge wells, 15 ft spacing, 1,350 cfm injection rate. 98 SVE wells, 25 ft spacing, 4,050 cfm extraction rate
System Closeout Costs	1	LS	$200,000	$200,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 1,383,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	35,300	SF	$5	$176,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 190,000**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$130,544	$130,500		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$97,908	$97,900		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 478,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$222,190		
Scope Estimating Contingency: 15% of Total Capital Costs				$333,285		
SUBTOTAL					**$ 555,475**	
Total Capital Costs					**$ 2,800,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$612,800	$612,800		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$79,980		
Scope Estimating Contingency - 15% of Annual Costs				$119,970		
SUBTOTAL					**$ 999,750**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 7,000,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 5,400,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 8,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (WWTP Source Areas) - Air Sparging and Soil Vapor Extraction

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^4 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$6,500	$6,500		
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 37,600**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$373,000	$373,000		63 sparge wells, 15 ft spacing, 630 cfm injection rate. 23 SVE wells, 25 ft spacing, 1,890 cfm extraction rate
System Closeout Costs	1	LS	$68,000	$68,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 489,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 33,000**	
Professional Services						
Remedial Engineering Design	1	LS	$67,152	$67,200		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$44,768	$44,800		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$33,576	$33,600		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 145,600**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$70,520		
Scope Estimating Contingency: 15% of Total Capital Costs				$105,780		
SUBTOTAL					**$ 176,300**	
Total Capital Costs					**$ 890,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$301,400	$301,400		
Performance Monitoring and Reporting	1	LS	$89,600	$89,600		Assumes quarterly groundwater sampling (8 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$41,840		
Scope Estimating Contingency - 15% of Annual Costs				$62,760		
SUBTOTAL					**$ 523,000**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 3,700,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 2,900,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 3,800,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G1, S1, V1, SED1 - No Further Action	**Cost Estimate Summary Worksheet**
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	**Description:** No additional action
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					**$ -**	
Contingency						
SUBTOTAL					**$ -**	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls — **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)
Description: Wisconsin GIS Registry

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$28,600	$28,600		Assumed at 10% of construction costs
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" Compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 69,000**	
Cap Construction						
Disposal of Soil (0-2 ft)	3,300	Tons	$40	$132,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	3,300	Tons	$10	$33,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	2,600	CY	$26	$67,600		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	2,600	CY	$1	$2,600		Assumes performance based compaction of 3 passes with 200 HP Dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 245,200**	
Professional Services						
Remedial Engineering Design	1	LS	$47,130	$47,100		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$31,420	$31,400		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$25,136	$25,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 103,600**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$52,950		
Scope Estimating Contingency: 15% of Total Capital Costs				$79,425		
SUBTOTAL					**$ 132,375**	
Total Capital Costs					**$ 670,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$11,600	$11,600		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,660		
Scope Estimating Contingency - 15% of Periodic Costs				$3,990		
SUBTOTAL					**$ 33,250**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 580,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 72,000**	
Total Present Worth of Alternative					**$ 910,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$34,900	$34,900		Assumed at 10% of construction costs
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft. tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft. high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 81,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	4,100	Tons	$40	$164,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	4,100	Tons	$10	$41,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	3,200	CY	$26	$83,200		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	3,200	CY	$1	$3,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 301,400**	
Professional Services						
Remedial Engineering Design	1	LS	$57,465	$57,500		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$38,310	$38,300		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$30,648	$30,600		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 126,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$62,120		
Scope Estimating Contingency: 15% of Total Capital Costs				$93,180		
SUBTOTAL					**$ 155,300**	
Total Capital Costs					**$ 780,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,380		
Scope Estimating Contingency - 15% of Periodic Costs				$3,570		
SUBTOTAL					**$ 29,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 560,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 65,000**	
Total Present Worth of Alternative					**$ 1,100,000**	

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$75,000	$75,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 137,900**	
Cap Construction						
Disposal of Soil (0-2 ft)	21,600	Tons	$40	$864,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	21,600	Tons	$10	$216,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	16,600	CY	$26	$431,600		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	16,600	CY	$1	$16,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,538,200**	
Professional Services						
Remedial Engineering Design	1	LS	$201,132	$201,100		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$134,088	$134,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$100,566	$100,600		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 435,800**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$222,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$333,540		
SUBTOTAL					**$ 555,900**	
Total Capital Costs					**$ 2,800,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$15,700	$15,700		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$3,070		
Scope Estimating Contingency - 15% of Periodic Costs				$4,605		
SUBTOTAL					**$ 38,375**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 610,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 83,000**	
Total Present Worth of Alternative					**$ 3,100,000**	

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$28,100	$28,100		Assumed at 10% of construction costs
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 63,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	3,300	Tons	$40	$132,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	3,300	Tons	$10	$33,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	2,600	CY	$26	$67,600		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	2,600	CY	$1	$2,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 245,200**	
Professional Services						
Remedial Engineering Design	1	LS	$46,335	$46,300		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$30,890	$30,900		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$24,712	$24,700		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 101,900**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$52,250		
Scope Estimating Contingency: 15% of Total Capital Costs				$78,375		
SUBTOTAL					**$ 130,625**	
Total Capital Costs					**$ 660,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 49,000**	
Total Present Worth of Alternative					**$ 870,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment — Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$329,000	$329,000		
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition:
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 364,900**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilitie
Disposal of Impacted Soil	4,600	Tons	$40	$184,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	4,600	Tons	$10	$46,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 230,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$349,000	$349,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 625 well
Onsite Injection Program	1	LS	$2,154,000	$2,154,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 116 injection day
Reagents	1	LS	$299,000	$299,000		Includes 511,018 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	450	Samples	$300	$135,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 3,017,300**	
Site Restoration						
Backfill Material and Delivery	3,600	CY	$26	$93,600		Assumes 95% general fill and 5% topsoil
Backfill Placement	3,600	CY	$1	$3,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	46,100	SF	$5	$230,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 337,700**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$122,000	$122,000		
Project Management during Construction	1	LS	$37,000	$37,000		
SUBTOTAL					**$ 409,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$447,060		
Scope Estimating Contingency: 15% of Total Capital Costs				$670,590		
SUBTOTAL					**$ 1,117,650**	
Total Capital Costs					**$ 5,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment		**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:**	Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$11,600	$11,600		Assumes crack sealing and tack coat to be performed once every fiv years
Bid Estimating Contingency - 10% of Periodic Costs				$2,660		
Scope Estimating Contingency - 15% of Periodic Costs				$3,990		
SUBTOTAL					**$ 33,250**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 580,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 160,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 72,000**
Total Present Worth of Alternative	**$ 5,900,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$516,000	$516,000		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition:
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 555,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilitie
Disposal of Impacted Soil	5,700	Tons	$40	$228,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,700	Tons	$10	$57,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 285,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$314,000	$314,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 554 well
Onsite Injection Program	1	LS	$5,742,000	$5,742,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 427 injection day
Reagents	1	LS	$6,064,000	$6,064,000		Includes 10,465,947 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	420	Samples	$300	$126,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 12,326,300**	
Site Restoration						
Backfill Material and Delivery	4,400	CY	$26	$114,400		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,400	CY	$1	$4,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 291,800**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$449,000	$449,000		
Project Management during Construction	1	LS	$134,000	$134,000		
SUBTOTAL					**$ 833,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 5% of Total Capital Costs				$720,145		
Scope Estimating Contingency: 10% of Total Capital Costs				$1,440,290		
SUBTOTAL					**$ 2,160,435**	
Total Capital Costs					**$ 16,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment

PRGs: Cumulative Cancerous Risk Greater than 10^{5} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 5% of Annual Costs				$500		
Scope Estimating Contingency - 10% of Annual Costs				$1,000		
SUBTOTAL					**$ 11,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 5% of Periodic Costs				$1,190		
Scope Estimating Contingency - 10% of Periodic Costs				$2,380		
SUBTOTAL					**$ 27,370**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 150,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 60,000**	
Total Present Worth of Alternative					**$ 16,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$306,000	$306,000		
Silt Fence Installation	1,000	LF	$1	$1,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,000	LF	$15	$15,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 329,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	5,200	Tons	$40	$208,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,200	Tons	$10	$52,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 260,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$187,000	$187,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 314 well
Onsite Injection Program	1	LS	$3,393,000	$3,393,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 252 injection day
Reagents	1	LS	$3,579,000	$3,579,000		Includes 6,011,616 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor Documentation
Soil and Groundwater Sampling and Analysis	210	Samples	$300	$63,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 7,302,300**	
Site Restoration						
Backfill Material and Delivery	4,000	CY	$26	$104,000		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,000	CY	$1	$4,000		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 137,500**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$244,000	$244,000		
Project Management during Construction	1	LS	$79,000	$79,000		
SUBTOTAL					**$ 573,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$871,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,307,040		
SUBTOTAL					**$ 2,178,400**	
Total Capital Costs					**$ 10,900,000**	

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment | **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 510,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 49,000**	
Total Present Worth of Alternative					**$ 11,200,000**	

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Description: Excavation of Non-Source Areas and offsite disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Building Demolition	0	CF	$0.35	$0		
Transportation/Disposal of Building Debris	0	Tons	$40	$0		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 461,800**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	18,000	SF	$26	$468,000		
Disposal of Impacted Soil	62,400	Tons	$40	$2,496,000		Removal of Non-Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	62,400	Tons	$10	$624,000		
Temporary Excavation Dewatering and Treatment	3.2	Month	$40,000	$128,000		
Excavation Sidewall and Base Soil Samples	160	Ea	$250	$40,000		
SUBTOTAL					**$ 3,756,000**	
Site Restoration						
Backfill Material and Delivery	47,800	CY	$26	$1,242,800		Assumes general fill
Backfill/Topsoil Placement	47,800	CY	$1	$47,800		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,915,300**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$161,000	$161,000		
Project Management during Construction	1	LS	$34,000	$34,000		
SUBTOTAL					**$ 445,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$657,810		
Scope Estimating Contingency: 15% of Total Capital Costs				$986,715		
SUBTOTAL					**$ 1,644,525**	
Total Capital Costs					**$ 8,300,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^{5} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Non-Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 8,300,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal — Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)
Description: Excavation of Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,500	LF	$1	$2,600		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,500	LF	$15	$37,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 466,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Disposal of Impacted Soil	58,200	Tons	$40	$2,328,000		Removal of North and South Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	58,200	Tons	$10	$582,000		
Temporary Excavation Dewatering and Treatment	3.0	Month	$40,000	$120,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 3,959,100**	
Site Restoration						
Backfill Material and Delivery	44,600	CY	$26	$1,159,600		Assumes general fill
Backfill/Topsoil Placement	44,600	CY	$1	$44,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,828,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$375,234	$375,200		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$34,000	$34,000		
SUBTOTAL					**$ 659,200**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$691,310		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,036,965		
SUBTOTAL					**$ 1,728,275**	
Total Capital Costs					**$ 8,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal | **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^{5} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 8,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 174,000**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	27,900	Tons	$40	$1,116,000		Removal of North and South Source Areas at the WWTP Area. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil	27,900	Tons	$10	$279,000		
Temporary Excavation Dewatering and Treatment	1.2	Month	$40,000	$48,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 1,829,600**	
Site Restoration						
Backfill Material and Delivery	21,400	CY	$26	$556,400		Assumes general fill
Backfill/Topsoil Placement	21,400	CY	$1	$21,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 634,600**	
Professional Services						
Remedial Engineering Design	1	LS	$211,056	$211,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$158,292	$158,300		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$17,000	$17,000		
SUBTOTAL					**$ 386,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$313,630		
Scope Estimating Contingency: 15% of Total Capital Costs				$470,445		
SUBTOTAL					**$ 784,075**	
Total Capital Costs					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5b (Boom Landing Non-Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Building Demolition	0	CF	$0.35	$0		
Transportation/Disposal of Building Debris	0	Tons	$40	$0		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,069,900**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	18,000	SF	$26	$468,000		
Impacted Soils - Disposal	6,300	Tons	$40	$252,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfi
Impacted Soils - Transportation and Handling for Disposal	6,300	Tons	$10	$63,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	6.0	Month	$40,000	$240,000		
Excavation Sidewall and Base Soil Samples	160	Ea	$250	$40,000		
SUBTOTAL					**$ 1,063,000**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	56,200	Tons	$50	$2,810,000		Assumes 90% of Non-Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	56,200	Tons	$15	$843,000		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	130	Days	$11,965	$1,555,500		Assumes 90% of Non-Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	70	Ea	$250	$17,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 5,226,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Alternative S5b (Boom Landing Non-Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	3,800	CY	$26	$98,800		Assumes general fill
Backfill/Topsoil Placement	3,800	CY	$1	$3,800		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,410	$4,400		
Preconstruction, Interim and As-Built Survey	1	LS	$5,250	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 727,200**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$270,000	$270,000		
Project Management during Construction	1	LS	$55,000	$55,000		
SUBTOTAL					**$ 575,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$866,110		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,299,165		
SUBTOTAL					**$ 2,165,275**	
Total Capital Costs					**$ 10,900,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Total Present Worth of Alternative	**$ 10,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5b (Boom Landing Source Areas) - Excavation and Onsite Treatment Disposal	Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,077,900**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Impacted Soils - Disposal	5,900	Tons	$40	$236,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfi
Impacted Soils - Transportation and Handling for Disposal	5,900	Tons	$10	$59,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	5.5	Month	$40,000	$220,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 1,444,100**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	52,400	Tons	$50	$2,620,000		Assumes 90% of North and South Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	52,400	Tons	$15	$786,000		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	120	Days	$11,965	$1,435,800		Assumes 90% of North and South Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	70	Ea	$250	$17,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 4,859,300**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Landing Source Areas) - Excavation and Onsite Treatment Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	4,600	CY	$26	$119,600		Assumes general fill
Backfill/Topsoil Placement	4,600	CY	$1	$4,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 748,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$487,764	$487,800		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$51,000	$51,000		
SUBTOTAL					**$ 788,800**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$891,820		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,337,730		
SUBTOTAL					**$ 2,229,550**	
Total Capital Costs					**$ 11,200,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Total Present Worth of Alternative	**$ 11,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,100	LF	$1	$3,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,100	LF	$15	$46,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 799,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	2,800	Tons	$40	$112,000		Assumes 10% of North and South Source Areas at the WWTP Area require landfill disposal at a Subtitle D landfill. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil (Disposal)	2,800	Tons	$10	$28,000		
Temporary Excavation Dewatering and Treatment	2.5	Month	$40,000	$100,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 626,600**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	25,100	Tons	$50	$1,255,000		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption. Assume 5,000 SF area under railroad is inaccessible
Utility Costs	25,100	Tons	$15	$376,500		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	60	Days	$11,965	$717,900		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption
Soil Treatment Confirmation Samples	30	Ea	$250	$7,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 2,356,900**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	2,200	CY	$26	$57,200		Assumes general fill
Backfill/Topsoil Placement	2,200	CY	$1	$2,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 116,200**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$233,964	$234,000		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$26,000	$26,000		
SUBTOTAL					**$ 510,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$452,110		
Scope Estimating Contingency: 15% of Total Capital Costs				$678,165		
SUBTOTAL					**$ 1,130,275**	
Total Capital Costs					**$ 5,700,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 5,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (Boom Landing Non-Source Areas) - Air Sparging and Soil Vapor Extraction	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$7,000	$7,000		
Silt Fence Installation	1,800	LF	$1	$1,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,800	LF	$15	$27,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 42,900**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$317,000	$317,000		68 sparge wells, 20 ft spacing, 340 cfm injection rate. 31 SVE wells, 30 ft spacing, 1,020 cfm extraction rate
System Closeout Costs	1	LS	$85,000	$85,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 450,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	46,100	SF	$5	$230,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 244,000**	
Professional Services						
Remedial Engineering Design	1	LS	$88,428	$88,400		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$58,952	$59,000		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$44,214	$44,200		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 191,600**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$92,850		
Scope Estimating Contingency: 15% of Total Capital Costs				$139,275		
SUBTOTAL					**$ 232,125**	
Total Capital Costs					**$ 1,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$176,000	$176,000		
Performance Monitoring and Reporting	1	LS	$89,600	$89,600		Assumes quarterly groundwater sampling (8 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$29,300		
Scope Estimating Contingency - 15% of Annual Costs				$43,950		
SUBTOTAL					**$ 366,250**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 2,600,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 2,000,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 3,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S6 (Boom Landing Source Areas) - Air Sparging and Soil Vapor Extraction	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$7,300	$7,300		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 46,400**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$386,000	$386,000		64 sparge wells, 20 ft spacing, 640 cfm injection rate. 29 SVE wells, 30 ft spacing, 1,920 cfm extraction rate
System Closeout Costs	1	LS	$84,000	$84,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 518,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 176,500**	
Professional Services						
Remedial Engineering Design	1	LS	$88,908	$88,900		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$59,272	$59,300		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$44,454	$44,500		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 192,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$93,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$140,040		
SUBTOTAL					**$ 233,400**	
Total Capital Costs					**$ 1,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$305,700	$305,700		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$49,270		
Scope Estimating Contingency - 15% of Annual Costs				$73,905		
SUBTOTAL					**$ 615,875**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 4,400,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 3,400,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (WWTP Non-Source Areas) - Air Sparging and Soil Vapor Extraction

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone, in conjunction with institutional controls for larger WWTP operation structures

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$9,200	$9,200		
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 67,600**	
Air Sparging and Soil Vapor Extraction						Assumes no remediation under large WWTP structures
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$42,000	$42,000		
Installation/Construction Costs	1	LS	$1,872,000	$1,872,000		453 sparge wells, 15 ft spacing, 2,265 cfm injection rate. 164 SVE wells, 25 ft spacing, 6,795 cfm extraction rate
System Closeout Costs	1	LS	$314,000	$314,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 2,238,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	53,500	SF	$5	$267,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 281,000**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$155,196	$155,200		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$129,330	$129,300		Assumed at 5% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 534,500**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$323,280		
Scope Estimating Contingency: 15% of Total Capital Costs				$484,920		
SUBTOTAL					**$ 808,200**	
Total Capital Costs					**$ 4,100,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$1,008,500	$1,008,500		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$119,550		
Scope Estimating Contingency - 15% of Annual Costs				$179,325		
SUBTOTAL					**$ 1,494,375**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 10,500,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 8,100,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 12,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S6 (WWTP Source Areas) - Air Sparging and Soil Vapor Extraction — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^5 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$6,500	$6,500		
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 37,600**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$373,000	$373,000		63 sparge wells, 15 ft spacing, 630 cfm injection rate. 23 SVE wells, 25 ft spacing, 1,890 cfm extraction rate
System Closeout Costs	1	LS	$68,000	$68,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 489,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 33,000**	
Professional Services						
Remedial Engineering Design	1	LS	$67,152	$67,200		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$44,768	$44,800		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$33,576	$33,600		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 145,600**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$70,520		
Scope Estimating Contingency: 15% of Total Capital Costs				$105,780		
SUBTOTAL					**$ 176,300**	
Total Capital Costs					**$ 890,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$301,400	$301,400		
Performance Monitoring and Reporting	1	LS	$89,600	$89,600		Assumes quarterly groundwater sampling (8 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$41,840		
Scope Estimating Contingency - 15% of Annual Costs				$62,760		
SUBTOTAL					**$ 523,000**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 3,700,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 2,900,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 3,800,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G1, S1, V1, SED1 - No Further Action

Cost Estimate Summary Worksheet

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: No additional action

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					**$ -**	
Contingency						
SUBTOTAL					**$ -**	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls	**Cost Estimate Summary Worksheet**
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	**Description:** Wisconsin GIS Registry
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$45,600	$45,600		Assumed at 10% of construction costs
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" Compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 100,500**	
Cap Construction						
Disposal of Soil (0-2 ft)	5,500	Tons	$40	$220,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	5,500	Tons	$10	$55,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	4,300	CY	$26	$111,800		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	4,300	CY	$1	$4,300		Assumes performance based compaction of 3 passes with 200 HP Dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 401,100**	
Professional Services						
Remedial Engineering Design	1	LS	$60,192	$60,200		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$40,128	$40,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$30,096	$30,100		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 130,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$74,370		
Scope Estimating Contingency: 15% of Total Capital Costs				$111,555		
SUBTOTAL					**$ 185,925**	
Total Capital Costs					**$ 930,000**	

Alternative S3 (Boom Landing Non-Source Areas) - Horizontal Engineered Surface Barriers	Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$23,500	$23,500		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$3,850		
Scope Estimating Contingency - 15% of Periodic Costs				$5,775		
SUBTOTAL					**$ 48,125**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 670,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 110,000**	
Total Present Worth of Alternative					**$ 1,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the Boom Landing Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$34,900	$34,900		Assumed at 10% of construction costs
Silt Fence Installation	2,200	LF	$1	$2,200		Assumes 3 ft. tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,200	LF	$15	$33,000		Assumes temporary fencing, 8 ft. high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 81,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	4,100	Tons	$40	$164,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Soil (0-2 ft)	4,100	Tons	$10	$41,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	3,200	CY	$26	$83,200		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	3,200	CY	$1	$3,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 301,400**	
Professional Services						
Remedial Engineering Design	1	LS	$57,465	$57,500		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$38,310	$38,300		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$30,648	$30,600		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 126,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$62,120		
Scope Estimating Contingency: 15% of Total Capital Costs				$93,180		
SUBTOTAL					**$ 155,300**	
Total Capital Costs					**$ 780,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (Boom Landing Source Areas) - Horizontal Engineered Surface Barriers	Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$2,380		
Scope Estimating Contingency - 15% of Periodic Costs				$3,570		
SUBTOTAL					**$ 29,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 560,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 65,000**	
Total Present Worth of Alternative					**$ 1,100,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Non-Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$75,000	$75,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 137,900**	
Cap Construction						
Disposal of Soil (0-2 ft)	22,000	Tons	$40	$880,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	22,000	Tons	$10	$220,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	16,900	CY	$26	$439,400		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	16,900	CY	$1	$16,900		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,566,300**	
Professional Services						
Remedial Engineering Design	1	LS	$204,504	$204,500		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$136,336	$136,300		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$102,252	$102,300		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 443,100**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$225,900		
Scope Estimating Contingency: 15% of Total Capital Costs				$338,850		
SUBTOTAL					**$ 564,750**	
Total Capital Costs					**$ 2,900,000**	

Alternative S3 (WWTP Non-Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$16,000	$16,000		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$3,100		
Scope Estimating Contingency - 15% of Periodic Costs				$4,650		
SUBTOTAL					**$ 38,750**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 610,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 160,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 84,000**
Total Present Worth of Alternative	**$ 3,200,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						Excavation of surface soils required in the WWTP Source Areas. Existing structures and pavements would remain
Mob./Demob.	1	LS	$28,100	$28,100		Assumed at 10% of construction costs
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		
SUBTOTAL					**$ 63,700**	
Cap Construction						
Disposal of Soil (0-2 ft)	3,300	Tons	$40	$132,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY. Does not include costs for excavation of soils beneath railroad
Excavation/Handling of Soil (0-2 ft)	3,300	Tons	$10	$33,000		Assumes excavated soil is characteristically non-hazardous and disposed at Subtitle D landfill. Assumes material density of 1.7 tons/CY
Backfill (Cap) Material and Delivery	2,600	CY	$26	$67,600		Assumes 95% general fill and 5% topsoil
Backfill (Cap) Placement	2,600	CY	$1	$2,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 245,200**	
Professional Services						
Remedial Engineering Design	1	LS	$46,335	$46,300		Assumed at 15% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$30,890	$30,900		Assumed at 10% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$24,712	$24,700		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 101,900**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$52,250		
Scope Estimating Contingency: 15% of Total Capital Costs				$78,375		
SUBTOTAL					**$ 130,625**	
Total Capital Costs					**$ 660,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S3 (WWTP Source Areas) - Horizontal Engineered Surface Barriers	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Existing asphalt and concrete covers will be used in conjunction with surficial soil excavations, soil covers and institutional controls. Utility protection/relocation not required for surficial soil excavations

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 510,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 160,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 49,000**
Total Present Worth of Alternative	**$ 870,000**

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$653,000	$653,000		
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 703,400**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	10,200	Tons	$40	$408,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	10,200	Tons	$10	$102,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 510,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$698,000	$698,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 1,250 wells
Onsite Injection Program	1	LS	$4,307,000	$4,307,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 231 injection days
Reagents	1	LS	$597,000	$597,000		Includes 1,022,035 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	930	Samples	$300	$279,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 5,961,300**	
Site Restoration						
Backfill Material and Delivery	7,800	CY	$26	$202,800		Assumes 95% general fill and 5% topsoil
Backfill Placement	7,800	CY	$1	$7,800		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	103,500	SF	$5	$517,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 738,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$243,000	$243,000		
Project Management during Construction	1	LS	$73,000	$73,000		
SUBTOTAL					**$ 566,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$859,050		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,288,575		
SUBTOTAL					**$ 2,147,625**	
Total Capital Costs					**$ 10,800,000**	

Alternative S4 (Boom Landing Non-Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of Institutional Controls
Crack Sealing and Sealcoating	1	LS	$23,500	$23,500		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$3,850		
Scope Estimating Contingency - 15% of Periodic Costs				$5,775		
SUBTOTAL					**$ 48,125**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 670,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 0% Discount Rate)	**$ 380,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 0% Discount Rate)	**$ 290,000**
Total Present Worth of Alternative	**$ 11,500,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$516,000	$516,000		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 555,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	5,700	Tons	$40	$228,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,700	Tons	$10	$57,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 285,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$314,000	$314,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 554 well
Onsite Injection Program	1	LS	$5,742,000	$5,742,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 427 injection day
Reagents	1	LS	$6,064,000	$6,064,000		Includes 10,465,947 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Soil and Groundwater Sampling and Analysis	420	Samples	$300	$126,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 12,326,300**	
Site Restoration						
Backfill Material and Delivery	4,400	CY	$26	$114,400		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,400	CY	$1	$4,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 291,800**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$449,000	$449,000		
Project Management during Construction	1	LS	$134,000	$134,000		
SUBTOTAL					**$ 833,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 5% of Total Capital Costs				$720,145		
Scope Estimating Contingency: 10% of Total Capital Costs				$1,440,290		
SUBTOTAL					**$ 2,160,435**	
Total Capital Costs					**$ 16,600,000**	

Alternative S4 (Boom Landing Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 5% of Annual Costs				$500		
Scope Estimating Contingency - 10% of Annual Costs				$1,000		
SUBTOTAL					**$ 11,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$8,800	$8,800		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 5% of Periodic Costs				$1,190		
Scope Estimating Contingency - 10% of Periodic Costs				$2,380		
SUBTOTAL					**$ 27,370**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 510,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 150,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 60,000**
Total Present Worth of Alternative	**$ 16,900,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$306,000	$306,000		
Silt Fence Installation	1,000	LF	$1	$1,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,000	LF	$15	$15,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 329,100**	
Excavations						Assumes excavation of impacted soils from 0-5 ft bgs in areas not located under existing horizontal barriers and/or utilities
Disposal of Impacted Soil	5,200	Tons	$40	$208,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
Excavation/Handling of Impacted Soil	5,200	Tons	$10	$52,000		Assumes excavated soil is characteristically non-hazardous and disposed at a Subtitle D landfill. Assumes material density of 1.7 tons/CY
SUBTOTAL					**$ 260,000**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$187,000	$187,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 314 well
Onsite Injection Program	1	LS	$3,393,000	$3,393,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 252 injection day
Reagents	1	LS	$3,579,000	$3,579,000		Includes 6,011,616 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor Documentation
Soil and Groundwater Sampling and Analysis	210	Samples	$300	$63,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 7,302,300**	
Site Restoration						
Backfill Material and Delivery	4,000	CY	$26	$104,000		Assumes 95% general fill and 5% topsoil
Backfill Placement	4,000	CY	$1	$4,000		Assumes performance based compaction of 3 passes with 200 HP dozer
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 137,500**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$244,000	$244,000		
Project Management during Construction	1	LS	$79,000	$79,000		
SUBTOTAL					**$ 573,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$871,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,307,040		
SUBTOTAL					**$ 2,178,400**	
Total Capital Costs					**$ 10,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S4 (WWTP Source Areas) - In-Situ Chemical Treatment	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Chemical oxidants (hydrogen peroxide) are applied through direct injections. Excavation and offsite disposal, horizontal barriers and institutional controls for 0 - 5 feet of affected soil, which cannot be addressed by chemical injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting of institutional controls
Crack Sealing and Sealcoating	1	LS	$2,900	$2,900		Assumes crack sealing and tack coat to be performed once every five years
Bid Estimating Contingency - 10% of Periodic Costs				$1,790		
Scope Estimating Contingency - 15% of Periodic Costs				$2,685		
SUBTOTAL					**$ 22,375**	

Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ 510,000**
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 160,000**
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ 49,000**
Total Present Worth of Alternative	**$ 11,200,000**

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal	Cost Estimate Summary Worksheet
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1	**Description:** Excavation of Non-Source Areas and offsite disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	15,500	SY	$14	$217,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Building Demolition	13,600	CF	$0.35	$4,800		
Transportation/Disposal of Building Debris	300	Tons	$40	$12,000		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 528,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	42,100	SF	$26	$1,094,600		
Disposal of Impacted Soil	133,300	Tons	$40	$5,332,000		Removal of Non-Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	133,300	Tons	$10	$1,333,000		
Temporary Excavation Dewatering and Treatment	7.4	Month	$40,000	$296,000		
Excavation Sidewall and Base Soil Samples	330	Ea	$250	$82,500		
SUBTOTAL					**$ 8,138,100**	
Site Restoration						
Backfill Material and Delivery	102,000	CY	$26	$2,652,000		Assumes general fill
Backfill/Topsoil Placement	102,000	CY	$1	$102,000		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	139,500	SF	$5	$697,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 3,513,700**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$321,000	$321,000		
Project Management during Construction	1	LS	$68,000	$68,000		
SUBTOTAL					**$ 639,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$1,281,950		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,922,925		
SUBTOTAL					**$ 3,204,875**	
Total Capital Costs					**$ 16,100,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Non-Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1

Description: Excavation of Non-Source Areas and offsite disposal

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)

Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 16,100,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1	**Description:** Excavation of Source Areas and offsite disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	2,500	LF	$1	$2,600		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,500	LF	$15	$37,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 466,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Disposal of Impacted Soil	58,200	Tons	$40	$2,328,000		Removal of North and South Source Areas at the Boom Landing Area
Transportation and Handling of Impacted Soil	58,200	Tons	$10	$582,000		
Temporary Excavation Dewatering and Treatment	3.0	Month	$40,000	$120,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 3,959,100**	
Site Restoration						
Backfill Material and Delivery	44,600	CY	$26	$1,159,600		Assumes general fill
Backfill/Topsoil Placement	44,600	CY	$1	$44,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 1,828,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$375,234	$375,200		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$34,000	$34,000		
SUBTOTAL					**$ 659,200**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$691,310		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,036,965		
SUBTOTAL					**$ 1,728,275**	
Total Capital Costs					**$ 8,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (Boom Landing Source Areas) - Excavation and Offsite Disposal

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					$ -	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 8,700,000**	

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal | **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 174,000**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	27,900	Tons	$40	$1,116,000		Removal of North and South Source Areas at the WWTP Area. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil	27,900	Tons	$10	$279,000		
Temporary Excavation Dewatering and Treatment	1.2	Month	$40,000	$48,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 1,829,600**	
Site Restoration						
Backfill Material and Delivery	21,400	CY	$26	$556,400		Assumes general fill
Backfill/Topsoil Placement	21,400	CY	$1	$21,400		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 634,600**	
Professional Services						
Remedial Engineering Design	1	LS	$211,056	$211,100		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$158,292	$158,300		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$17,000	$17,000		
SUBTOTAL					**$ 386,400**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$313,630		
Scope Estimating Contingency: 15% of Total Capital Costs				$470,445		
SUBTOTAL					**$ 784,075**	
Total Capital Costs					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5a (WWTP Source Areas) - Excavation and Offsite Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and offsite disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Landing Non-Source Areas) - Excavation and Onsite Treatment and Disposal — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	15,500	SY	$14	$217,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Building Demolition	13,600	CF	$0.35	$4,800		
Transportation/Disposal of Building Debris	300	Tons	$40	$12,000		
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,136,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	42,100	SF	$26	$1,094,600		
Impacted Soils - Disposal	13,400	Tons	$40	$536,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfi
Impacted Soils - Transportation and Handling for Disposal	13,400	Tons	$10	$134,000		Assumes 10% of Non-Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	13.0	Month	$40,000	$520,000		
Excavation Sidewall and Base Soil Samples	330	Ea	$250	$82,500		
SUBTOTAL					**$ 2,367,100**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	120,000	Tons	$50	$6,000,000		Assumes 90% of Non-Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	120,000	Tons	$15	$1,800,000		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	270	Days	$11,965	$3,230,600		Assumes 90% of Non-Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	150	Ea	$250	$37,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 11,068,100**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S5b (Boom Landing Non-Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Non-Source Areas and onsite thermal desorption treatment and disposal

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	7,900	CY	$26	$205,400		Assumes general fill
Backfill/Topsoil Placement	7,900	CY	$1	$7,900		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,410	$4,400		
Preconstruction, Interim and As-Built Survey	1	LS	$5,250	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	139,500	SF	$5	$697,500		
Concrete Boat Ramp Restoration	4,000	SF	$8.10	$32,400		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 972,900**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$560,000	$560,000		
Project Management during Construction	1	LS	$114,000	$114,000		
SUBTOTAL					**$ 924,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$1,646,880		
Scope Estimating Contingency: 15% of Total Capital Costs				$2,470,320		
SUBTOTAL					**$ 4,117,200**	
Total Capital Costs					**$ 20,600,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Total Present Worth of Alternative	**$ 20,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (Boom Landing Source Areas) - Excavation and Onsite Treatment Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse condition
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways, Concrete Boat Ramp)	12,500	SY	$14	$175,000		Assumes removal of parking pavements, roads, boat ramps and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Maintenance of Traffic for Close (Mann Street)	1	LS	$50,000	$50,000		Assumes developing and implementing maintenance of traffic plans
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Water, Sanitary, Storm, Overhead Electric, Underground Electric)	1	LS	$90,000	$90,000		
SUBTOTAL					**$ 1,077,900**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	34,100	SF	$26	$886,600		
Impacted Soils - Disposal	5,900	Tons	$40	$236,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfi
Impacted Soils - Transportation and Handling for Disposal	5,900	Tons	$10	$59,000		Assumes 10% of North and South Source Areas at the Boom Landing Area require landfill disposal at a Subtitle D landfill
Temporary Excavation Dewatering and Treatment	5.5	Month	$40,000	$220,000		
Excavation Sidewall and Base Soil Samples	170	Ea	$250	$42,500		
SUBTOTAL					**$ 1,444,100**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	52,400	Tons	$50	$2,620,000		Assumes 90% of North and South Source Areas at the Boom Landing Area treated by thermal desorption
Utility Costs	52,400	Tons	$15	$786,000		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	120	Days	$11,965	$1,435,800		Assumes 90% of North and South Source Areas at the Boom Landing Area treated onsite by thermal desorption
Soil Treatment Confirmation Samples	70	Ea	$250	$17,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 4,859,300**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Alternative S5b (Boom Landing Source Areas) - Excavation and Onsite Treatment Disposal						**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1					**Description:**	Excavation of Source Areas and onsite thermal desorption treatment and disposal
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)						
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)						

DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**ITEM COST**	**SUBTOTAL**	**ASSUMPTIONS/REFERENCES**
Site Restoration						
Backfill Material and Delivery	4,600	CY	$26	$119,600		Assumes general fill
Backfill/Topsoil Placement	4,600	CY	$1	$4,600		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	112,500	SF	$5	$562,500		
Concrete Boat Ramp Restoration	3,900	SF	$8.10	$31,600		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 748,100**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$487,764	$487,800		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$51,000	$51,000		
SUBTOTAL					**$ 788,800**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$891,820		
Scope Estimating Contingency: 15% of Total Capital Costs				$1,337,730		
SUBTOTAL					**$ 2,229,550**	
Total Capital Costs					**$ 11,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 11,200,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment and Disposal — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$100,000	$100,000		Engineer's estimate
Silt Fence Installation	3,100	LF	$1	$3,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,100	LF	$15	$46,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
Asphalt Working Pad	120,000	SF	$5	$600,000		Asphalt working pad for soil & debris stockpiles, screened stockpile, mechanical equipment, burners, desorbers and load out areas
Removal of Surface Pavements (Parking Lot, Walkways)	600	SY	$14	$8,400		Assumes removal of parking pavements, roads and walkways all located within the remediation area. Assumes stockpile and reuse for backfill or road reconstruction
Clearing and Grubbing of Trees/Vegetation	1	Acre	$4,500	$4,500		Assumes removal of trees in excavation areas and working pad
Utility Relocation (Sanitary, Storm, Overhead Electric, Underground Electric, Gas)	1	LS	$30,000	$30,000		
SUBTOTAL					**$ 799,700**	
Excavation						
Temporary Shoring (Sheeting & Bracing)	14,100	SF	$26	$366,600		
Disposal of Impacted Soil	2,800	Tons	$40	$112,000		Assumes 10% of North and South Source Areas at the WWTP Area require landfill disposal at a Subtitle D landfill. Assume 5,000 SF area under railroad is inaccessible
Transportation and Handling of Impacted Soil (Disposal)	2,800	Tons	$10	$28,000		
Temporary Excavation Dewatering and Treatment	2.5	Month	$40,000	$100,000		
Excavation Sidewall and Base Soil Samples	80	Ea	$250	$20,000		
SUBTOTAL					**$ 626,600**	
Medium Temperature Thermal Desorption Construction and Operation						
Mobilization, Construction, Operation, and Demobilization	25,100	Tons	$50	$1,255,000		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption. Assume 5,000 SF area under railroad is inaccessible
Utility Costs	25,100	Tons	$15	$376,500		
Excavation, Transportation, Handling, Screening and Backfill of Impacted Soil (Thermal Desorption)	60	Days	$11,965	$717,900		Assumes 90% of North and South Source Areas at the WWTP Area treated by thermal desorption
Soil Treatment Confirmation Samples	30	Ea	$250	$7,500		Assume sample collected for every 500 CY of soil treated
SUBTOTAL					**$ 2,356,900**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S5b (WWTP Source Areas) - Excavation and Onsite Treatment and Disposal	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Excavation of Source Areas and onsite thermal desorption treatment and disposal, in conjunction with institutional controls for inaccessible soils beneath the railroad

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
Site Restoration						
Backfill Material and Delivery	2,200	CY	$26	$57,200		Assumes general fill
Backfill/Topsoil Placement	2,200	CY	$1	$2,200		Assumes performance based compaction of 3 passes with 200 HP dozer
Compaction Testing	1	LS	$10,000	$10,000		
Seeding and Erosion Control	1	Acre	$4,500	$4,500		
Preconstruction, Interim and As-Built Survey	1	LS	$5,300	$5,300		Assumes 30 hours of professional land surveying to complete survey and associated deliverables
Parking Lots and Road Replacement (4" - Asphalt Pavement)	5,400	SF	$5	$27,000		
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
SUBTOTAL					**$ 116,200**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$233,964	$234,000		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$26,000	$26,000		
SUBTOTAL					**$ 510,000**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$452,110		
Scope Estimating Contingency: 15% of Total Capital Costs				$678,165		
SUBTOTAL					**$ 1,130,275**	
Total Capital Costs					**$ 5,700,000**	

OPERATIONS AND MAINTENANCE COSTS

Annual Operations and Maintenance - Cost Per Year		
SUBTOTAL	**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event		
SUBTOTAL	**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor	**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)	**$ -**	
Total Present Worth of Alternative	**$ 5,700,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S6 (Boom Landing Non-Source Areas) - Air Sparging and Soil Vapor Extraction — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$8,400	$8,400		
Silt Fence Installation	2,700	LF	$1	$2,800		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,700	LF	$15	$40,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 58,800**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$39,000	$39,000		
Installation/Construction Costs	1	LS	$637,000	$637,000		145 sparge wells, 20 ft spacing, 725 cfm injection rate. 65 SVE wells, 30 ft spacing, 2,175 cfm extraction rate
System Closeout Costs	1	LS	$152,000	$152,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 838,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	103,500	SF	$5	$517,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 531,000**	
Professional Services						
Remedial Engineering Design	1	LS	$171,336	$171,300		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$114,224	$114,200		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$85,668	$85,700		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 371,200**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$179,900		
Scope Estimating Contingency: 15% of Total Capital Costs				$269,850		
SUBTOTAL					**$ 449,750**	
Total Capital Costs					**$ 2,300,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$342,500	$342,500		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$52,950		
Scope Estimating Contingency - 15% of Annual Costs				$79,425		
SUBTOTAL					**$ 661,875**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 4,700,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 3,600,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 5,900,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (Boom Landing Source Areas) - Air Sparging and Soil Vapor Extraction

Cost Estimate Summary Worksheet

PRGs: Cumulative Cancerous Risk Greater than 10^{6} or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$7,300	$7,300		
Silt Fence Installation	2,000	LF	$1	$2,000		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	2,000	LF	$15	$30,000		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 46,400**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$386,000	$386,000		64 sparge wells, 20 ft spacing, 640 cfm injection rate. 29 SVE wells, 30 ft spacing, 1,920 cfm extraction rate
System Closeout Costs	1	LS	$84,000	$84,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 518,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	32,600	SF	$5	$163,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 176,500**	
Professional Services						
Remedial Engineering Design	1	LS	$88,908	$88,900		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$59,272	$59,300		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$44,454	$44,500		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 192,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$93,360		
Scope Estimating Contingency: 15% of Total Capital Costs				$140,040		
SUBTOTAL					**$ 233,400**	
Total Capital Costs					**$ 1,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$305,700	$305,700		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$49,270		
Scope Estimating Contingency - 15% of Annual Costs				$73,905		
SUBTOTAL					**$ 615,875**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 4,400,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 3,400,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 4,600,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative S6 (WWTP Non-Source Areas) - Air Sparging and Soil Vapor Extraction	**Cost Estimate Summary Worksheet**
PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1 **Site:** Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549) **Phase:** Feasibility Study Level Cost Estimate (-30% to +50%)	**Description:** Injection of air into the saturated zone, with soil vapor extraction in the vadose zone, in conjunction with institutional controls for larger WWTP operation structures

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$9,200	$9,200		
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 67,600**	
Air Sparging and Soil Vapor Extraction						Assumes no remediation under large WWTP structures
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$42,000	$42,000		
Installation/Construction Costs	1	LS	$1,909,000	$1,909,000		462 sparge wells, 15 ft spacing, 2,310 cfm injection rate. 167 SVE wells, 25 ft spacing, 6,930 cfm extraction rate
System Closeout Costs	1	LS	$320,000	$320,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 2,281,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	54,700	SF	$5	$273,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 287,000**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$158,136	$158,100		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$131,780	$131,800		Assumed at 5% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 539,900**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$328,720		
Scope Estimating Contingency: 15% of Total Capital Costs				$493,080		
SUBTOTAL					**$ 821,800**	
Total Capital Costs					**$ 4,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$1,027,900	$1,027,900		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$121,490		
Scope Estimating Contingency - 15% of Annual Costs				$182,235		
SUBTOTAL					**$ 1,518,625**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 10,700,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 8,200,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 12,400,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

Alternative S6 (WWTP Source Areas) - Air Sparging and Soil Vapor Extraction — **Cost Estimate Summary Worksheet**

PRGs: Cumulative Cancerous Risk Greater than 10^6 or a Hazard Quotient Greater than 1
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$6,500	$6,500		
Silt Fence Installation	1,500	LF	$1	$1,500		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	1,500	LF	$15	$22,500		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 37,600**	
Air Sparging and Soil Vapor Extraction						
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$38,000	$38,000		
Installation/Construction Costs	1	LS	$373,000	$373,000		63 sparge wells, 15 ft spacing, 630 cfm injection rate. 23 SVE wells, 25 ft spacing, 1,890 cfm extraction rate
System Closeout Costs	1	LS	$68,000	$68,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 489,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's Estimate
Asphalt/Concrete Repairs	3,900	SF	$5	$19,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 33,000**	
Professional Services						
Remedial Engineering Design	1	LS	$67,152	$67,200		Assumed at 12% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$44,768	$44,800		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$33,576	$33,600		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 145,600**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$70,520		
Scope Estimating Contingency: 15% of Total Capital Costs				$105,780		
SUBTOTAL					**$ 176,300**	
Total Capital Costs					**$ 890,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$301,400	$301,400		
Performance Monitoring and Reporting	1	LS	$89,600	$89,600		Assumes quarterly groundwater sampling (8 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 10% of Annual Costs				$41,840		
Scope Estimating Contingency - 15% of Annual Costs				$62,760		
SUBTOTAL					**$ 523,000**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 3,700,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 2,900,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 3,800,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

APPENDIX B2

GROUNDWATER REMEDIAL ALTERNATIVES COST ESTIMATES

Alternative G1, S1, V1, SED1 - No Further Action | **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: No additional action

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					**$ -**	
Contingency						
SUBTOTAL					**$ -**	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls

Cost Estimate Summary Worksheet

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Wisconsin GIS Registry

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G3 - Monitored Natural Attenuation — **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)
Description: Long-term groundwater monitoring

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Professional Services						
Remedial Engineering Design	1	LS	$25,000	$25,000		Assumes Generation LTM Plans, QAPP, and associated documents to implement monitored natural attenuatio
SUBTOTAL					**$ 25,000**	
Construction Capital Costs						
SUBTOTAL					**$ -**	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$13,670		
Scope Estimating Contingency: 15% of Total Capital Costs				$20,505		
SUBTOTAL					**$ 34,175**	
Total Capital Costs					**$ 180,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Field Labor and Expenses - Spring	3	Days	$1,500	$4,500		Assumes 5 samples per sampler per day, vehicle, sampling equipment, and expendables
Annual Analytical Costs - Spring	16	Samples	$500	$8,000		Assumes sampling from 13 onsite wells for VOC, PAH, Arsenic, Manganese, Iron, Sulfate, Nitrate. Assumes 10% field duplicates and 5% MS/MSD
Field Labor and Expenses - Fall	3	Days	$1,500	$4,500		Assumes 5 samples per sampler per day, vehicle, sampling equipment, and expendables
Annual Analytical Costs - Fall	16	Samples	$500	$8,000		Assumes sampling from 13 onsite wells for VOC, PAH, Arsenic, Manganese, Iron, Sulfate, Nitrate. Assumes 10% field duplicates and 5% MS/MSD
Project Management, Data Validation, and Annual Report	1	LS	$15,000	$15,000		Engineer's estimate
SUBTOTAL					**$ 40,000**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Well Maintenance and Redevelopment	1	LS	$10,000	$10,000		Assumes well maintenance to be performed every 5 years
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$2,500		
Scope Estimating Contingency - 15% of Periodic Costs				$3,750		
SUBTOTAL					**$ 31,250**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 1,400,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)*					**$ 500,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)*					**$ 68,000**	
Total Present Worth of Alternative					**$ 750,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G4 - Air Sparging and Soil Vapor Extraction — **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Injection of air into the saturated zone, with soil vapor extraction in the vadose zone

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$9,200	$9,200		
Silt Fence Installation	3,200	LF	$1	$3,300		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,200	LF	$15	$48,000		Assumes temporary fencing, 4 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 67,600**	
Air Sparging and Soil Vapor Extraction						Assumes no remediation under large WWTP structures
Bench-scale	1	LS	$10,000	$10,000		
Pilot-scale	1	LS	$42,000	$42,000		
Installation/Construction Costs	1	LS	$1,674,000	$1,674,000		404 sparge wells, 15 ft spacing, 2,020 cfm injection rate. 146 SVE wells, 25 ft spacing, 6,060 cfm extraction rate
System Closeout Costs	1	LS	$284,000	$284,000		Includes system demobilization and well abandonment
SUBTOTAL					**$ 2,010,000**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	46,700	SF	$5	$233,500		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 247,000**	
Professional Services						
Remedial Engineering Design	1	LS	$185,968	$186,000		Assumed at 8% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Construction Oversight	1	LS	$139,476	$139,500		Assumed at 6% based on USEPA Guide to Developing Feasibility Study Cost Estimates
Project Management during Construction	1	LS	$116,230	$116,200		Assumed at 5% based on USEPA Guide to Developing Feasibility Study Cost Estimates
SUBTOTAL					**$ 441,700**	
Contingency						
Bid Estimating Contingency: 5% of Total Capital Costs				$138,315		
Scope Estimating Contingency: 10% of Total Capital Costs				$276,630		
SUBTOTAL					**$ 414,945**	
Total Capital Costs					**$ 3,200,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Operations and Maintenance	1	LS	$902,500	$902,500		
Performance Monitoring and Reporting	1	LS	$159,600	$159,600		Assumes quarterly groundwater sampling (15 wells) and 2 air samples/month
Project Management	1	LS	$27,400	$27,400		
Bid Estimating Contingency - 5% of Annual Costs				$54,475		
Scope Estimating Contingency - 10% of Annual Costs				$108,950		
SUBTOTAL					**$ 1,252,925**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 8,800,000**	
Present Worth of Annual Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ 6,800,000**	
Present Worth of Periodic Costs (7 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 10,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G5 - In-Situ Chemical Treatment

Cost Estimate Summary Worksheet

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: Chemical oxidants (hydrogen peroxide) are applied through direct injections

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
Mob./Demob.	1	LS	$1,624,000	$1,624,000		
Silt Fence Installation	3,100	LF	$1	$3,200		Assumes 3 ft tall silt fence, 50 percent installed in ideal conditions and 50 percent in adverse conditions
Perimeter Construction Fencing	3,100	LF	$15	$46,500		Assumes temporary fencing, 8 ft high, chain link
Stabilized Construction Entrance	100	SY	$16	$1,600		
Staging and Decon Area Construction	1	LS	$5,500	$5,500		Assumes 6" compacted 3/4" aggregate base course under laid by a impermeable liner
SUBTOTAL					**$ 1,680,800**	
In-Situ Chemical Oxidation						
Bench-scale Study	1	LS	$10,000	$10,000		
Pilot-scale Study	1	LS	$63,000	$63,000		
Injector Fabrication/Installation	1	LS	$1,061,000	$1,061,000		Includes injection and vent well materials (riser, screen and fittings) and subcontracted drilling services for 2,118 wells
Onsite Injection Program	1	LS	$11,263,000	$11,263,000		Includes labor, mobile injection units, vent flow balance system and daily process monitoring for 525 injection day
Reagents	1	LS	$6,222,000	$6,222,000		Includes 13,068,000 pounds of 34% hydrogen peroxide and catalyst, with delivery and onsite staging
Project Documentation	1	LS	$7,300	$7,300		Contractor documentation
Groundwater Sampling and Analysis	20	Samples	$300	$6,000		Assume pre- and post-treatment sampling
SUBTOTAL					**$ 18,632,300**	
Site Restoration						
Preconstruction, Interim and As-Built Survey	1	LS	$3,500	$3,500		Assumes 20 hours of professional land surveying to complete survey and associated deliverables
Site Restoration	1	LS	$10,000	$10,000		Engineer's estimate
Asphalt/Concrete Repairs	77,600	SF	$5	$388,000		Replace existing pavements located above treatment areas
SUBTOTAL					**$ 401,500**	
Professional Services						
Remedial Engineering Design	1	LS	$250,000	$250,000		
Construction Oversight	1	LS	$552,000	$552,000		
Project Management during Construction	1	LS	$164,000	$164,000		
SUBTOTAL					**$ 966,000**	
Contingency						
Bid Estimating Contingency: 5% of Total Capital Costs				$1,084,030		
Scope Estimating Contingency: 10% of Total Capital Costs				$2,168,060		
SUBTOTAL					**$ 3,252,090**	
Total Capital Costs					**$ 25,000,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
SUBTOTAL					**$ -**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ -**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Total Present Worth of Alternative					**$ 25,000,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

APPENDIX B3

SOIL GAS REMEDIAL ALTERNATIVES COST ESTIMATES

Alternative G1, S1, V1, SED1 - No Further Action | **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: No additional action

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					$ -	
Contingency						
SUBTOTAL					$ -	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					$ -	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls	**Cost Estimate Summary Worksheet**
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	**Description:** Wisconsin GIS Registry
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

NATURAL RESOURCE TECHNOLOGY

APPENDIX B4

SEDIMENT REMEDIAL ALTERNATIVES COST ESTIMATES

Alternative G1, S1, V1, SED1 - No Further Action | **Cost Estimate Summary Worksheet**

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)

Description: No additional action

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
SUBTOTAL					**$ -**	
Contingency						
SUBTOTAL					**$ -**	
Total Capital Costs					**$ -**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 41,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative G2, S2, V2, SED2 - Institutional Controls

Cost Estimate Summary Worksheet

Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)
Description: Wisconsin GIS Registry

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
GIS Registry						
GIS Registry Package Preparation	1	Ea	$35,000	$35,000		Includes notifications to property oweners
Soil GIS Registry Fee	1	LS	$300	$300		
Groundwater GIS Registry Fee	1	LS	$350	$350		
Sediment GIS Registry Fee	1	LS	$1,050	$1,050		
SUBTOTAL					**$ 36,700**	
Professional Services						
Survey with Legal Description	5	Ea	$3,000	$15,000		Assumes legal description to be completed for each affected parcel to assist in implementation of institutional contro
Institutional Control Implementation Plan	1	LS	$15,000	$15,000		
Soil Management Plan	1	LS	$15,000	$15,000		
Groundwater Use Restriction Plan	1	LS	$15,000	$15,000		
Sediment Management Plan	1	LS	$15,000	$15,000		
SUBTOTAL					**$ 75,000**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
SUBTOTAL					**$ -**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes five year review site visit and associated reporting
Bid Estimating Contingency - 10% of Periodic Costs				$1,500		
Scope Estimating Contingency - 15% of Periodic Costs				$2,250		
SUBTOTAL					**$ 18,750**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 120,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ -**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 41,000**	
Total Present Worth of Alternative					**$ 190,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

Alternative SED3 - Monitoring	**Cost Estimate Summary Worksheet**
Site: Former Marinette Manufactured Gas Plant Site, WI (NRT Project 1549)	**Description:** Sand layer (cap) monitoring
Phase: Feasibility Study Level Cost Estimate (-30% to +50%)	

DESCRIPTION	QTY	UNIT	UNIT COST	ITEM COST	SUBTOTAL	ASSUMPTIONS/REFERENCES
CAPITAL COSTS						
Site Preparation						
SUBTOTAL					$ -	
Cap Construction						The 2013 Non-Time Critical Remedy was sufficient and no further dredging required
SUBTOTAL					$ -	
Professional Services						
SUBTOTAL					$ -	
Institutional Controls						
GIS Registry Package Preparation	1	LS	$36,700	$36,700		See Alternative G2, S2, V2, SED2 - Institutional Controls
Professional Services	1	LS	$75,000	$75,000		See Alternative G2, S2, V2, SED2 - Institutional Controls
SUBTOTAL					**$ 111,700**	
Contingency						
Bid Estimating Contingency: 10% of Total Capital Costs				$11,170		
Scope Estimating Contingency: 15% of Total Capital Costs				$16,755		
SUBTOTAL					**$ 27,925**	
Total Capital Costs					**$ 140,000**	
OPERATIONS AND MAINTENANCE COSTS						
Annual Operations and Maintenance - Cost Per Year						
Semiannual Inspection and Reporting	2	Ea	$5,000	$10,000		Assumes semiannual site visit and compliance report to document cap condition
Bid Estimating Contingency - 10% of Annual Costs				$1,000		
Scope Estimating Contingency - 15% of Annual Costs				$1,500		
SUBTOTAL					**$ 12,500**	
Periodic (Every 5 Years) Operations and Maintenance - Cost Per Event						
Five Year Review	1	LS	$15,000	$15,000		Assumes 5 Year Review site visit and associated reporting of institutional controls
Sand Layer (Cap) Monitoring	1	LS	$11,100	$11,100		Every 5 years for 30 years
Sand Layer (Cap) Maintenance	1	LS	$17,800	$17,800		Assume 25% of initial cover construction cost over 30 year period
Bid Estimating Contingency - 10% of Periodic Costs				$4,390		
Scope Estimating Contingency - 15% of Periodic Costs				$6,585		
SUBTOTAL					**$ 54,875**	
Total Cost of Annual And Periodic Maintenance, No Discount Factor					**$ 710,000**	
Present Worth of Annual Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 160,000**	
Present Worth of Periodic Costs (30 Year Analysis Period and a 7% Discount Rate)					**$ 120,000**	
Total Present Worth of Alternative					**$ 420,000**	

Date: 7/6/2015
Estimated By: RCW
Reviewed By: MDB

Natural Resource Technology

APPENDIX C

CALCULATIONS AND SUPPORTING DATA

APPENDIX C1

CUMULATIVE SOIL RISK SUMMARY

Table C1 - Cumulative Soil Risks - Residential Land Use
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Zone	Station	Date	Sample ID	Depth	Up Depth (ft)	Low Depth (ft)	BLRA Depth Category	Cancer Risk Sum	Noncancer Hazard Quotient Sum	CR>1E-6 or HQ>1	CR>1E-5 or HQ>1	CR>1E-4 or HQ>1	Comment on Calculated Risks	Comment on Samples and Data
WWTP	B301	3/31/1994	B301_30-91	1-3 FT	1	3	Surface	Elevated DLs; risks not calculated						
WWTP	B302	3/31/1994	B302_213-274	7-9 FT	7	9	Subsurface	Elevated DLs; risks not calculated						
WWTP	B303	3/31/1994	B303_61-122	2-4 FT	2	4	Subsurface	3.2E-04	0.00	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	
Boom	B304	3/31/1994	B304_152-213	5-7 FT	5	7	Subsurface	1.2E-02	5.91	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	
Boom	B305	3/31/1994	B305_30-91	1-3 FT	1	3	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
Boom	B306	3/31/1994	B306_91-152	3-5 FT	3	5	Subsurface	4.3E-04	0.87	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/27/1994
WWTP	B307	3/31/1994	B307_213-274	7-9 FT	7	9	Subsurface	2.6E-03	0.47	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	
WWTP	B308	4/1/1994	B308_152-213	5-7 FT	5	7	Subsurface	Elevated DLs; risks not calculated						
WWTP	B309	4/1/1994	B309_30-91	1-3 FT	1	3	Subsurface	Elevated DLs; risks not calculated						
WWTP	B310	3/30/1994	B310_122-183	4-6 FT	4	6	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/27/1994
WWTP	B311	5/27/1994	B311_274	9 FT	9	9	Subsurface	3.3E-03	0.42	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/27/1994
WWTP	B312	5/27/1994	B312_213	7 FT	7	7	Subsurface	Elevated DLs; risks not calculated						
Boom	B313	5/27/1994	B313_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B314	5/27/1994	B314_91-152	3-5 FT	3	5	Subsurface	Elevated DLs; risks not calculated						
Boom	B315	5/26/1994	B315_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B316	5/27/1994	B316_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B317	5/29/1994	B317_122	4 FT	4	4	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
Boom	B318	5/29/1994	B318_152	5 FT	5	5	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
Boom	B319	5/26/1994	B319_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B320	5/26/1994	B320_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
WWTP	MW303	6/12/1996	MW303_61	1-3 FT	1	3	Subsurface	3.0E-05	0.00	Yes	Yes	No	Elevated DLs (benzene); risks not significantly impacted	Combined samples at 1-3 ft and 2 ft
WWTP	MW304	6/12/1996	MW304_91	2-4 FT	2	4	Subsurface	3.7E-03	0.49	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	Combined samples at 2-4 ft and 3 ft
WWTP	MW305	6/12/1996	MW305_91	2-4 FT	2	4	Subsurface	5.1E-04	0.08	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	Combined samples at 2-4 ft and 3 ft
Boom	MW306	6/12/1996	MW306_30	0-2 FT	0	2	Subsurface	1.5E-06	0.00	Yes	No	No	Elevated DLs (benzene); risks may be biased low by a factor of 10	Combined samples at 0-2 ft and 1 ft
WWTP	MW313/SB349	7/25/2012	MW313/SB349_91-152	3-5 FT	3	5	Subsurface	1.3E-03	0.11	Yes	Yes	Yes		
Boom	SB01	9/19/2003	SB01_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB01	9/22/2003	SB01_427-488	14-16 FT	14	16	Subsurface	9.4E-06	0.00	Yes	No	No	Missing BTEX; risks may be biased low	
Boom	SB02	9/19/2003	SB02_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB02	9/22/2003	SB02_183-305	6-10 FT	6	10	Subsurface	1.9E-06	0	Yes	No	No	Missing BTEX; risks may be biased low	
Boom	SB03	9/19/2003	SB03_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB03	9/19/2003	SB03_61-122	2-4 FT	2	4	Subsurface	2.5E-06	0	Yes	No	No	Missing BTEX; risks may be biased low	
Boom	SB04	9/19/2003	SB04_152-213	5-7 FT	5	7	Subsurface	3.2E-05	0.00	Yes	Yes	No		
Boom	SB05	9/19/2003	SB05_305-366	10-12 FT	10	12	Subsurface	2.2E-06	0	Yes	No	No		
Boom	SB06	9/19/2003	SB06_152-213	5-7 FT	5	7	Subsurface	Missing PAHs; risks not calculated						
Boom	SB06	9/19/2003	SB06_305-366	10-12 FT	10	12	Subsurface	0	0	No	No	No	Missing BTEX; risks may be biased low	
Boom	SB07	9/19/2003	SB07_305-366	10-12 FT	10	12	Subsurface	1.8E-06	0.00	Yes	No	No		
Boom	SB327	4/1/1996	SB327_61-122	2-4 FT	2	4	Subsurface	6.3E-05	1.34	Yes	Yes	Yes	Missing PAHs; risks may be underestimated	
Boom	SB337	4/2/1996	SB337_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB339	4/2/1996	SB339_61-122	2-4 FT	2	4	Subsurface	1.9E-05	1.58	Yes	Yes	Yes	Missing PAHs; risks may be underestimated	
Boom	SB340	4/2/1996	SB340_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB342	4/2/1996	SB342_30-91	1-3 FT	1	3	Subsurface	Missing PAHs; risks not calculated						
Boom	SB343 004	7/24/2012	SB343 004_0-61	0-2 FT	0	2	Surface	1.1E-04	0.00	Yes	Yes	Yes		
Boom	SB344	7/24/2012	SB344_0-61	0-2 FT	0	2	Surface	4.0E-04	0.00	Yes	Yes	Yes		
Boom	SB345 002	7/24/2012	SB345 002_0-61	0-2 FT	0	2	Surface	2.9E-05	0.00	Yes	Yes	No		
WWTP	SB346	7/24/2012	SB346_305-366	10-12 FT	10	12	Subsurface	0	0	No	No	No		
WWTP	SB347	7/24/2012	SB347_183-244	6-8 FT	6	8	Subsurface	5.5E-07	0.00	No	No	No		
WWTP	SB347	7/24/2012	SB347_91-152	3-5 FT	3	5	Subsurface	1.3E-03	1.25	Yes	Yes	Yes		
WWTP	SB348	7/24/2012	SB348_91-152	3-5 FT	3	5	Subsurface	0	0	No	No	No		
WWTP	SB350	7/24/2012	SB350_183-244	6-8 FT	6	8	Subsurface	0	0	No	No	No		
WWTP	SB351	7/25/2012	SB351_472-488	15.5-16 FT	15.5	16	Subsurface	2.7E-04	0.38	Yes	Yes	Yes		
Ludington St. ROW	SB352	10/9/2014	SB352_36-60	3-5 FT	3	5	Subsurface	0	0	No	No	No		
Ludington St. ROW	SB353	10/9/2014	SB353_36-60	3-5 FT	3	5	Subsurface	5.1E-04	0.02	Yes	Yes	Yes		
Ludington St. ROW	SB353	10/9/2014	SB353_60-84	5-7 FT	5	7	Subsurface	1.3E-04	0.00	Yes	Yes	Yes		
Ludington St. ROW	SB354	10/9/2014	SB354_36-60	3-5 FT	3	5	Subsurface	0	0	No	No	No		
Ludington St. ROW	SB355	10/9/2014	SB355_24-48	2-4 FT	2	4	Subsurface	4.5E-05	0.00	Yes	Yes	No		
Ely St. ROW	SB357	10/9/2014	SB357_36-60	3-5 FT	3	5	Subsurface	1.6E-05	0.00	Yes	Yes	No		
Property north of WWTP	SB358	10/10/2014	SB358_0-24	0-2 FT	0	2	Surface	3.0E-05	0.00	Yes	Yes	No		
Property north of WWTP	SB359	10/10/2014	SB359_0-20.4	0-1.7 FT	0	1.7	Surface	7.5E-05	0	Yes	Yes	No		
Property north of WWTP	SB360	10/10/2014	SB360_0-24	0-2 FT	0	2	Surface	7.1E-05	0	Yes	Yes	No		
Property north of WWTP	SB361	10/10/2014	SB361_0-24	0-2 FT	0	2	Surface	6.1E-04	0.03	Yes	Yes	Yes		
WWTP	SB362	10/9/2014	SB362_0-24	0-2 FT	0	2	Surface	6.4E-05	0.00	Yes	Yes	No		

Table C1 - Cumulative Soil Risks - Residential Land Use
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Zone	Station	Date	Sample ID	Depth	Up Depth (ft)	Low Depth (ft)	BLRA Depth Category	Cancer Risk Sum	Noncancer Hazard Quotient Sum	CR>1E-6 or HQ>1	CR>1E-5 or HQ>1	CR>1E-4 or HQ>1	Comment on Calculated Risks	Comment on Samples and Data
Property south of WWTF	SB363	10/10/2014	SB363_0-24	0-2 FT	0	2	Surface	3.8E-05	0.00	Yes	Yes	No		
Property south of WWTF	SB364	10/10/2014	SB364_0-24	0-2 FT	0	2	Surface	1.0E-04	0.00	Yes	Yes	Yes		
WWTP	SB365	10/9/2014	SB365_0-24	0-2 FT	0	2	Surface	2.1E-04	0.00	Yes	Yes	Yes		
WWTP	SB366	10/9/2014	SB366_0-24	0-2 FT	0	2	Surface	4.5E-04	0.00	Yes	Yes	Yes		
WWTP	SB367	10/9/2014	SB367_0-24	0-2 FT	0	2	Surface	8.9E-05	0.00	Yes	Yes	No		
WWTP	SB368	10/9/2014	SB368_0-24	0-2 FT	0	2	Surface	2.3E-04	0.00	Yes	Yes	Yes		
WWTP	SB369	10/9/2014	SB369_0-24	0-2 FT	0	2	Surface	1.8E-04	0.01	Yes	Yes	Yes		
WWTP	SB370	10/9/2014	SB370_0-24	0-2 FT	0	2	Surface	6.3E-04	0.01	Yes	Yes	Yes		
WWTP	SG02	7/25/2012	SG02_152-213	5-7 FT	5	7	Subsurface	6.1E-06	0.00	Yes	No	No		
WWTP	SG05	7/24/2012	SG05_183-244	6-8 FT	6	8	Subsurface	1.1E-02	1.18	Yes	Yes	Yes		
WWTP	SG05	7/24/2012	SG05_244-305	8-10 FT	8	10	Subsurface	3.4E-03	0.03	Yes	Yes	Yes		
Boom	SG12	7/23/2012	SG12_91-152	3-5 FT	3	5	Subsurface	4.0E-03	1.52	Yes	Yes	Yes		
WWTP	TP301	3/29/1994	TP301_183	6 FT	6	6	Subsurface	2.4E-02	14.94	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP302	3/29/1994	TP302_244	8 FT	8	8	Subsurface	3.3E-03	0.12	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP303	3/30/1994	TP303_122	4 FT	4	4	Subsurface	3.2E-02	0.00	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP304	3/30/1994	TP304_183	6 FT	6	6	Subsurface	1.1E-03	0.26	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP305	3/29/1994	TP305_183	6 FT	6	6	Subsurface	1.3E-03	0.15	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP306	3/29/1994	TP306_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP307	3/29/1994	TP307_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP308	3/30/1994	TP308_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP309	3/30/1994	TP309_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994

Note: For soil samples for which a risk could not be calculated, a note is provided. For samples for which a risk could be calculated, but the results may be biased high or low based on the available data, a comment is provided.
Values highlighted in yellow are sample cancer risks that exceed 1E-4.
Values highlighted in peach are sample noncancer risks that exceed 1.
BTEX – benzene, toluene, ethylbenzene, and total xylenes
DL – detection limit
PAH – polynuclear aromatic hydrocarbon

Table C1 - Cumulative Soil Risks - Industrial Land Use
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Zone	Station	Date	Sample ID	Depth	Up Depth (ft)	Low Depth (ft)	BLRA Depth Category	Cancer Risk Sum	Noncancer Hazard Quotient Sum	CR>1E-6 or HQ>1	CR>1E-5 or HQ>1	CR>1E-4 or HQ>1	Comment on Calculated Risks	Comment on Samples and Data
WWTP	B301	3/31/1994	B301_30-91	1-3 FT	1	3	Surface	Elevated DLs; risks not calculated						
WWTP	B302	3/31/1994	B302_213-274	7-9 FT	7	9	Subsurface	Elevated DLs; risks not calculated						
WWTP	B303	3/31/1994	B303_61-122	2-4 FT	2	4	Subsurface	Elevated DLs; risks not calculated						
Boom	B304	3/31/1994	B304_152-213	5-7 FT	5	7	Subsurface	6.4E-04	0.89	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	
Boom	B305	3/31/1994	B305_30-91	1-3 FT	1	3	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
Boom	B306	3/31/1994	B306_91-152	3-5 FT	3	5	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/27/1994
WWTP	B307	3/31/1994	B307_213-274	7-9 FT	7	9	Subsurface	1.3E-04	0.08	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	
WWTP	B308	4/1/1994	B308_152-213	5-7 FT	5	7	Subsurface	Elevated DLs; risks not calculated						
WWTP	B309	4/1/1994	B309_30-91	1-3 FT	1	3	Subsurface	Elevated DLs; risks not calculated						
WWTP	B310	3/30/1994	B310_122-183	4-6 FT	4	6	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/27/1994
WWTP	B311	5/27/1994	B311_274	9 FT	9	9	Subsurface	1.7E-04	0.09	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	B312	5/27/1994	B312_213	7 FT	7	7	Subsurface	7.4E-06	0	Yes	No	No	All analytes ND; elevated DLs; risks based on 1/2 DL	
Boom	B313	5/27/1994	B313_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B314	5/27/1994	B314_91-152	3-5 FT	3	5	Subsurface	Elevated DLs; risks not calculated						
Boom	B315	5/26/1994	B315_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B316	5/27/1994	B316_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B317	5/29/1994	B317_122	4 FT	4	4	Subsurface	7.4E-06	0	Yes	No	No	All analytes ND; elevated DLs; risks based on 1/2 DL	BTEX from 5/26/1994
Boom	B318	5/29/1994	B318_152	5 FT	5	5	Subsurface	7.4E-06	0	Yes	No	No	All analytes ND; elevated DLs; risks based on 1/2 DL	BTEX from 5/26/1994
Boom	B319	5/26/1994	B319_91	3 FT	3	3	Subsurface	Elevated DLs; risks not calculated						
Boom	B320	5/26/1994	B320_91	3 FT	3	3	Subsurface	3.9E-05	0	Yes	Yes	No	All analytes ND; elevated DLs; risks based on 1/2 DL	
WWTP	MW303	6/12/1996	MW303_61	1-3 FT	1	3	Subsurface	1.6E-06	0.00	Yes	No	No	Elevated DLs (benzene); risks not significantly impacted	Combined samples at 1-3 ft and 2 ft
WWTP	MW304	6/12/1996	MW304_91	2-4 FT	2	4	Subsurface	1.9E-04	0.05	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	Combined samples at 2-4 ft and 3 ft
WWTP	MW305	6/12/1996	MW305_91	2-4 FT	2	4	Subsurface	2.7E-05	0.00	Yes	Yes	No		Combined samples at 2-4 ft and 3 ft
Boom	MW306	6/12/1996	MW306_30	0-2 FT	0	2	Subsurface	7.8E-08	0	No	No	No	Elevated DLs (benzene); risks may be biased low by a factor of >1(	Combined samples at 0-2 ft and 1 ft
WWTP	MW313/SB349	7/25/2012	MW313/SB349_91-152	3-5 FT	3	5	Subsurface	6.8E-05	0.02	Yes	Yes	No		
Boom	SB01	9/19/2003	SB01_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB01	9/22/2003	SB01_427-488	14-16 FT	14	16	Subsurface	4.9E-07	0.00	No	No	No	Missing BTEX; risks may be biased low	
Boom	SB02	9/19/2003	SB02_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB02	9/22/2003	SB02_183-305	6-10 FT	6	10	Subsurface	1.0E-07	0	No	No	No	Missing BTEX; risks may be biased low	
Boom	SB03	9/19/2003	SB03_122-183	4-6 FT	4	6	Subsurface	Missing PAHs; risks not calculated						
Boom	SB03	9/19/2003	SB03_61-122	2-4 FT	2	4	Subsurface	1.3E-07	0	No	No	No	Missing BTEX; risks may be biased low	
Boom	SB04	9/19/2003	SB04_152-213	5-7 FT	5	7	Subsurface	1.7E-06	0.00	Yes	No	No		
Boom	SB05	9/19/2003	SB05_305-366	10-12 FT	10	12	Subsurface	1.1E-07	0	No	No	No		
Boom	SB06	9/19/2003	SB06_152-213	5-7 FT	5	7	Subsurface	Missing PAHs; risks not calculated						
Boom	SB06	9/19/2003	SB06_305-366	10-12 FT	10	12	Subsurface	0	0	No	No	No	Missing BTEX; risks may be biased low	
Boom	SB07	9/19/2003	SB07_305-366	10-12 FT	10	12	Subsurface	9.5E-08	0.00	No	No	No		
Boom	SB327	4/1/1996	SB327_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB337	4/2/1996	SB337_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB339	4/2/1996	SB339_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB340	4/2/1996	SB340_61-122	2-4 FT	2	4	Subsurface	Missing PAHs; risks not calculated						
Boom	SB342	4/2/1996	SB342_30-91	1-3 FT	1	3	Subsurface	Missing PAHs; risks not calculated						
Boom	SB343 004	7/24/2012	SB343 004_0-61	0-2 FT	0	2	Surface	5.5E-06	0.00	Yes	No	No		
Boom	SB344	7/24/2012	SB344_0-61	0-2 FT	0	2	Surface	2.1E-05	0.00	Yes	Yes	No		
Boom	SB345 002	7/24/2012	SB345 002_0-61	0-2 FT	0	2	Surface	1.5E-06	0.00	Yes	No	No		
WWTP	SB346	7/24/2012	SB346_305-366	10-12 FT	10	12	Subsurface	0	0	No	No	No		
WWTP	SB347	7/24/2012	SB347_183-244	6-8 FT	6	8	Subsurface	3.5E-08	0.00	No	No	No		
WWTP	SB347	7/24/2012	SB347_91-152	3-5 FT	3	5	Subsurface	7.6E-05	0.23	Yes	Yes	No		
WWTP	SB348	7/24/2012	SB348_91-152	3-5 FT	3	5	Subsurface	0	0	No	No	No		
WWTP	SB350	7/24/2012	SB350_183-244	6-8 FT	6	8	Subsurface	0	0	No	No	No		
WWTP	SB351	7/25/2012	SB351_472-488	15.5-16 FT	15.5	16	Subsurface	1.6E-05	0.08	Yes	Yes	No		
Ludington St. ROW	SB352	10/9/2014	SB352_36-60	3-5 FT	3	5	Subsurface	0	0	No	No	No		
Ludington St. ROW	SB353	10/9/2014	SB353_36-60	3-5 FT	3	5	Subsurface	2.6E-05	0.00	Yes	Yes	No		
Ludington St. ROW	SB353	10/9/2014	SB353_60-84	5-7 FT	5	7	Subsurface	6.6E-06	0.00	Yes	No	No		
Ludington St. ROW	SB354	10/9/2014	SB354_36-60	3-5 FT	3	5	Subsurface	0	0	No	No	No		
Ludington St. ROW	SB355	10/9/2014	SB355_24-48	2-4 FT	2	4	Subsurface	2.3E-06	0.00	Yes	No	No		
Ely St. ROW	SB357	10/9/2014	SB357_36-60	3-5 FT	3	5	Subsurface	8.2E-07	0.00	No	No	No		
Property north of WWTP	SB358	10/10/2014	SB358_0-24	0-2 FT	0	2	Surface	1.6E-06	0.00	Yes	No	No		
Property north of WWTP	SB359	10/10/2014	SB359_0-20.4	0-1.7 FT	0	1.7	Surface	3.9E-06	0	Yes	No	No		
Property north of WWTP	SB360	10/10/2014	SB360_0-24	0-2 FT	0	2	Surface	3.7E-06	0	Yes	No	No		
Property north of WWTP	SB361	10/10/2014	SB361_0-24	0-2 FT	0	2	Surface	3.2E-05	0.00	Yes	Yes	No		
WWTP	SB362	10/9/2014	SB362_0-24	0-2 FT	0	2	Surface	3.3E-06	0.00	Yes	No	No		
Property south of WWTF	SB363	10/10/2014	SB363_0-24	0-2 FT	0	2	Surface	2.0E-06	0.00	Yes	No	No		

Table C1 - Cumulative Soil Risks - Industrial Land Use
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Zone	Station	Date	Sample ID	Depth	Up Depth (ft)	Low Depth (ft)	BLRA Depth Category	Cancer Risk Sum	Noncancer Hazard Quotient Sum	CR>1E-6 or HQ>1	CR>1E-5 or HQ>1	CR>1E-4 or HQ>1	Comment on Calculated Risks	Comment on Samples and Data
Property south of WWTF	SB364	10/10/2014	SB364_0-24	0-2 FT	0	2	Surface	5.3E-06	0.00	Yes	No	No		
WWTP	SB365	10/9/2014	SB365_0-24	0-2 FT	0	2	Surface	1.1E-05	0.00	Yes	Yes	No		
WWTP	SB366	10/9/2014	SB366_0-24	0-2 FT	0	2	Surface	2.3E-05	0.00	Yes	Yes	No		
WWTP	SB367	10/9/2014	SB367_0-24	0-2 FT	0	2	Surface	4.6E-06	0.00	Yes	No	No		
WWTP	SB368	10/9/2014	SB368_0-24	0-2 FT	0	2	Surface	1.2E-05	0.00	Yes	Yes	No		
WWTP	SB369	10/9/2014	SB369_0-24	0-2 FT	0	2	Surface	9.2E-06	0.00	Yes	No	No		
WWTP	SB370	10/9/2014	SB370_0-24	0-2 FT	0	2	Surface	3.2E-05	0.00	Yes	Yes	No		
WWTP	SG02	7/25/2012	SG02_152-213	5-7 FT	5	7	Subsurface	3.3E-07	0.00	No	No	No		
WWTP	SG05	7/24/2012	SG05_183-244	6-8 FT	6	8	Subsurface	6.0E-04	0.18	Yes	Yes	Yes		
WWTP	SG05	7/24/2012	SG05_244-305	8-10 FT	8	10	Subsurface	1.8E-04	0.00	Yes	Yes	Yes		
Boom	SG12	7/23/2012	SG12_91-152	3-5 FT	3	5	Subsurface	2.1E-04	0.27	Yes	Yes	Yes		
WWTP	TP301	3/29/1994	TP301_183	6 FT	6	6	Subsurface	1.3E-03	2.77	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP302	3/29/1994	TP302_244	8 FT	8	8	Subsurface	1.7E-04	0.03	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP303	3/30/1994	TP303_122	4 FT	4	4	Subsurface	1.6E-03	0.00	Yes	Yes	Yes	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994
WWTP	TP304	3/30/1994	TP304_183	6 FT	6	6	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP305	3/29/1994	TP305_183	6 FT	6	6	Subsurface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP306	3/29/1994	TP306_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP307	3/29/1994	TP307_30	1 FT	1	1	Surface	Elevated DLs; risks not calculated						BTEX from 5/26/1994
WWTP	TP308	3/30/1994	TP308_30	1 FT	1	1	Surface	7.4E-06	0	No	No	No	All analytes ND; elevated DLs; risks based on 1/2 DL	BTEX from 5/26/1994
WWTP	TP309	3/30/1994	TP309_30	1 FT	1	1	Surface	1.1E-06	0	Yes	No	No	Risks may be underestimated because of elevated DLs	BTEX from 5/26/1994

Note: For soil samples for which a risk could not be calculated, a note is provided. For samples for which a risk could be calculated, but the results may be biased high or low based on the available data, a comment is provided.
Values highlighted in yellow are sample cancer risks that exceed 1E-4.
Values highlighted in peach are sample noncancer risks that exceed 1.
BTEX – benzene, toluene, ethylbenzene, and total xylenes
DL – detection limit
ND – not detected
PAH – polynuclear aromatic hydrocarbon

APPENDIX C2

PRELIMINARY REMEDIATION GOALS CALCULATIONS FOR SOIL

Table C2-A - Summary of Input Parameters in USEPA RSL Web Calculator - Soil TR = 10^{-4}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Variable	Value
TR (target cancer risk) unitless	1.00E-04
THQ (target hazard quotient) unitless	1
LT (lifetime - resident) year	70
ETrs (exposure time) hour	24
ETrsc (child exposure time) hour	24
ETrsa (adult exposure time) hour	24
EDr (exposure duration) year	30
EDc (exposure duration - child) year	6
EDa (exposure duration - adult) year	24
ED0-2 (mutagenic exposure duration) year	2
ED2-6 (mutagenic exposure duration) year	4
ED6-16 (mutagenic exposure duration) year	10
ED16-26 (mutagenic exposure duration) year	14
BWc (body weight - child) kg	15
BWa (body weight - adult) kg	70
BW0-2 (mutagenic body weight) kg	15
BW2-6 (mutagenic body weight) kg	15
BW6-16 (mutagenic body weight) kg	70
BW16-26 (mutagenic body weight) kg	70
SAc (skin surface area - child) cm2/day	2800
SAa (skin surface area - adult) cm2/day	5700
SA0-2 (mutagenic skin surface area) cm2/day	2800
SA2-6 (mutagenic skin surface area) cm2/day	2800
SA6-16 (mutagenic skin surface area) cm2/day	5700
SA16-26 (mutagenic skin surface area) cm2/day	5700
EFr (exposure frequency) day/year	350
EFc (exposure frequency - child) day/year	350
EFa (exposure frequency - adult) day/year	350
EF0-2 (mutagenic exposure frequency) day/year	350
EF2-6 (mutagenic exposure frequency) day/year	350
EF6-16 (mutagenic exposure frequency) day/year	350
EF16-26 (mutagenic exposure frequency) day/year	350
IFSadj (age-adjusted soil ingestion factor) mg/kg	40000
IFSMadj (mutagenic age-adjusted soil ingestion factor) mg/kg	171333.333
IRSc (soil intake rate - child) mg/day	200
IRSa (soil intake rate - adult) mg/day	100
IRS0-2 (mutagenic soil intake rate) mg/day	200
IRS2-6 (mutagenic soil intake rate) mg/day	200
IRS6-16 (mutagenic soil intake rate) mg/day	100
IRS16-26 (mutagenic soil intake rate) mg/day	100
AFa (skin adherence factor - adult) mg/cm2	0.07
AFc (skin adherence factor - child) mg/cm2	0.2
AF0-2 (mutagenic skin adherence factor) mg/cm2	0.2
AF2-6 (mutagenic skin adherence factor) mg/cm2	0.2
AF6-16 (mutagenic skin adherence factor) mg/cm2	0.07
AF16-26 (mutagenic skin adherence factor) mg/cm2	0.07
DFSadj (age-adjusted soil dermal factor) mg/kg	126280
DFSMadj (mutagenic age-adjusted soil dermal factor) mg/kg	505913.333
City (Climate Zone) PEF Selection	Chicago, IL (7)
As (acres) PEF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) PEF Selection	93.77
PEF (particulate emission factor) m3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
Um (mean annual wind speed) m/s	4.69
Ut (equivalent threshold value)	11.32
F(x) (function dependant on Um/Ut) unitless	0.194
City (Climate Zone) VF Selection	Chicago, IL (7)
As (acres) VF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) VF Selection	98.43071
foc (fraction organic carbon in soil) g/g	0.006
ρb (dry soil bulk density) g/cm3	1.5
ρs (soil particle density) g/cm3	2.65
θw (water-filled soil porosity) Lwater/Lsoil	0.15
T (exposure interval) s	950000000
A (VF Dispersion Constant)	16.8653
B (VF Dispersion Constant)	18.7848
C (VF Dispersion Constant)	215.0624

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)

Table C2-A - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-4}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk $(ug/m^3)^{-1}$	Subchronic RfD (mg/kg-day)	Subchronic RfC (mg/m^3)	GIABS	ABS	RBA	Volatilization Factor (m^3/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)
Benz[a]anthracene	56-55-3	Yes	Yes	7.30E-01	1.10E-04	–	–	1	0.13	1	6.86E+06	–	1.36E+09
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	1.10E-03	–	–	1	0.13	1	–	–	1.36E+09
Benzo[b]fluoranthene	205-99-2	Yes	No	0.73	0.00011	–	–	1	0.13	1	–	–	1.36E+09
Benzo[k]fluoranthene	207-08-9	Yes	No	0.073	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Dibenz[a,h]anthracene	53-70-3	Yes	No	7.30E+00	1.20E-03	–	–	1	0.13	1	–	–	1.36E+09
Ethylbenzene	100-41-4	No	Yes	1.10E-02	2.50E-06	1.00E-01	1.00E+00	1	–	1	8.81E+03	4.80E+02	1.36E+09
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	No	7.30E-01	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Methylnaphthalene, 2-	91-57-6	No	Yes	–	–	4.00E-03	–	1	0.13	1	9.01E+04	–	1.36E+09
Naphthalene	91-20-3	No	Yes	–	3.40E-05	2.00E-02	3.00E-03	1	0.13	1	7.20E+04	–	1.36E+09
Xylenes	1330-20-7	No	Yes	–	–	2.00E-01	1.00E-01	1	–	1	1.01E+04	2.58E+02	1.36E+09

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)
SL - Screening Level
VOC - Volitile Organic Compound
TR- Target Cancer Risk
HQ- Target Hazard Quotient
ca - Carcinogenic Risk Based
nc - Noncarcinogenic Risk Based

Table C2-A - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-4}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	Ingestion SL TR= 1.0E-4 (mg/kg)	Dermal SL TR= 1.0E-4 (mg/kg)	Inhalation SL TR= 1.0E-4 (mg/kg)	Carcinogenic SL TR=1.0E-4 (mg/kg)	Ingestion SL Child HQ=1 (mg/kg)	Dermal SL Child HQ=1 (mg/kg)	Inhalation SL Child HQ=1 (mg/kg)	Noncarcinogenic SL Child HI=1 (mg/kg)	Ingestion SL Adult HQ=1 (mg/kg)	Dermal SL Adult HQ=1 (mg/kg)	Inhalation SL Adult HQ=1 (mg/kg)	Noncarcinogenic SL Adult HI=1 (mg/kg)	RSL Web Calculatator Screening Level (mg/kg)	Basis of RSL Web Calculatator Screening Level (mg/kg)
Benz[a]anthracene	2.04E+01	53.2	5.96E+03	1.48E+01	–	–	–	–	–	–	–	–	1.48E+01	ca
Benzo[a]pyrene	2.04E+00	5.32E+00	1.19E+05	1.48E+00	–	–	–	–	–	–	–	–	1.48E+00	ca
Benzo[b]fluoranthene	20.4	53.2	1190000	14.8	–	–	–	–	–	–	–	–	1.48E+01	ca
Benzo[k]fluoranthene	204	532	1.19E+06	1.48E+02	–	–	–	–	–	–	–	–	1.48E+02	ca
Dibenz[a,h]anthracene	2.04E+00	5.32E+00	1.09E+05	1.48E+00	–	–	–	–	–	–	–	–	1.48E+00	ca
Ethylbenzene	5.81E+03	–	8.57E+02	7.47E+02	7.82E+03	–	9.18E+03	4.22E+03	7.30E+04	–	9.18E+03	8160	7.47E+02	sat
Indeno[1,2,3-cd]pyrene	2.04E+01	5.32E+01	1.19E+06	1.48E+01	–	–	–	–	–	–	–	–	1.48E+01	ca
Methylnaphthalene, 2-	–	–	–	–	3.13E+02	8.59E+02	–	2.29E+02	2.92E+03	5.63E+03	–	1920	2.29E+02	nc
Naphthalene	–	–	5.15E+02	5.15E+02	1.56E+03	4.30E+03	2.25E+02	1.88E+02	1.46E+04	2.81E+04	2.25E+02	2.20E+02	1.88E+02	nc
Xylenes	–	–	–	–	1.56E+04	–	1.05E+03	9.83E+02	1.46E+05	–	1.05E+03	1040	9.83E+02	sat

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)
SL - Screening Level
VOC - Volitile Organic Compound
TR- Target Cancer Risk
HQ- Target Hazard Quotient
ca - Carcinogenic Risk Based
nc - Noncarcinogenic Risk Based

Table C2-B - Summary of Input Parameters in USEPA RSL Web Calculator - Soil TR = 10^{-5}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Variable	Value
TR (target cancer risk) unitless	1.00E-05
THQ (target hazard quotient) unitless	1
LT (lifetime - resident) year	70
ETrs (exposure time) hour	24
ETrsc (child exposure time) hour	24
ETrsa (adult exposure time) hour	24
EDr (exposure duration) year	30
EDc (exposure duration - child) year	6
EDa (exposure duration - adult) year	24
ED0-2 (mutagenic exposure duration) year	2
ED2-6 (mutagenic exposure duration) year	4
ED6-16 (mutagenic exposure duration) year	10
ED16-26 (mutagenic exposure duration) year	14
BWc (body weight - child) kg	15
BWa (body weight - adult) kg	70
BW0-2 (mutagenic body weight) kg	15
BW2-6 (mutagenic body weight) kg	15
BW6-16 (mutagenic body weight) kg	70
BW16-26 (mutagenic body weight) kg	70
SAc (skin surface area - child) cm2/day	2800
SAa (skin surface area - adult) cm2/day	5700
SA0-2 (mutagenic skin surface area) cm2/day	2800
SA2-6 (mutagenic skin surface area) cm2/day	2800
SA6-16 (mutagenic skin surface area) cm2/day	5700
SA16-26 (mutagenic skin surface area) cm2/day	5700
EFr (exposure frequency) day/year	350
EFc (exposure frequency - child) day/year	350
EFa (exposure frequency - adult) day/year	350
EF0-2 (mutagenic exposure frequency) day/year	350
EF2-6 (mutagenic exposure frequency) day/year	350
EF6-16 (mutagenic exposure frequency) day/year	350
EF16-26 (mutagenic exposure frequency) day/year	350
IFSadj (age-adjusted soil ingestion factor) mg/kg	40000
IFSMadj (mutagenic age-adjusted soil ingestion factor) mg/kg	171333.333
IRSc (soil intake rate - child) mg/day	200
IRSa (soil intake rate - adult) mg/day	100
IRS0-2 (mutagenic soil intake rate) mg/day	200
IRS2-6 (mutagenic soil intake rate) mg/day	200
IRS6-16 (mutagenic soil intake rate) mg/day	100
IRS16-26 (mutagenic soil intake rate) mg/day	100
AFa (skin adherence factor - adult) mg/cm2	0.07
AFc (skin adherence factor - child) mg/cm2	0.2
AF0-2 (mutagenic skin adherence factor) mg/cm2	0.2
AF2-6 (mutagenic skin adherence factor) mg/cm2	0.2
AF6-16 (mutagenic skin adherence factor) mg/cm2	0.07
AF16-26 (mutagenic skin adherence factor) mg/cm2	0.07
DFSadj (age-adjusted soil dermal factor) mg/kg	126280
DFSMadj (mutagenic age-adjusted soil dermal factor) mg/kg	505913.333
City (Climate Zone) PEF Selection	Chicago, IL (7)
As (acres) PEF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) PEF Selection	93.77
PEF (particulate emission factor) m3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
Um (mean annual wind speed) m/s	4.69
Ut (equivalent threshold value)	11.32
F(x) (function dependant on Um/Ut) unitless	0.194
City (Climate Zone) VF Selection	Chicago, IL (7)
As (acres) VF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) VF Selection	98.43071
foc (fraction organic carbon in soil) g/g	0.006
ρb (dry soil bulk density) g/cm3	1.5
ρs (soil particle density) g/cm3	2.65
θw (water-filled soil porosity) Lwater/Lsoil	0.15
T (exposure interval) s	950000000
A (VF Dispersion Constant)	16.8653
B (VF Dispersion Constant)	18.7848
C (VF Dispersion Constant)	215.0624

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)

Table C2-B - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-5}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk $(ug/m^3)^{-1}$	Subchronic RfD (mg/kg-day)	Subchronic RfC (mg/m^3)	GIABS	ABS	RBA	Volatilization Factor (m^3/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)
Benz[a]anthracene	56-55-3	Yes	Yes	7.30E-01	1.10E-04	–	–	1	0.13	1	6.86E+06	–	1.36E+09
Benzene	71-43-2	No	Yes	5.50E-02	7.80E-06	0.004	0.03	1	–	1	5490	1820	1.36E+09
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	1.10E-03	–	–	1	0.13	1	–	–	1.36E+09
Benzo[b]fluoranthene	205-99-2	Yes	No	0.73	0.00011	–	–	1	0.13	1	–	–	1.36E+09
Benzo[k]fluoranthene	207-08-9	Yes	No	0.073	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Chrysene	218-01-9	Yes	No	0.0073	0.000011	–	–	1	0.13	1	–	–	1.36E+09
Dibenz[a,h]anthracene	53-70-3	Yes	No	7.30E+00	1.20E-03	–	–	1	0.13	1	–	–	1.36E+09
Ethylbenzene	100-41-4	No	Yes	1.10E-02	2.50E-06	1.00E-01	1.00E+00	1	–	1	8.81E+03	4.80E+02	1.36E+09
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	No	7.30E-01	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Methylnaphthalene, 1-	90-12-0	No	Yes	2.90E-02	–	7.00E-02	–	1	0.13	1	9.11E+04	–	1.36E+09
Methylnaphthalene, 2-	91-57-6	No	Yes	–	–	4.00E-03	–	1	0.13	1	9.01E+04	–	1.36E+09
Naphthalene	91-20-3	No	Yes	–	3.40E-05	2.00E-02	3.00E-03	1	0.13	1	7.20E+04	–	1.36E+09
Xylenes	1330-20-7	No	Yes	–	–	2.00E-01	1.00E-01	1	–	1	1.01E+04	2.58E+02	1.36E+09

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)
SL - Screening Level
VOC - Volitile Organic Compound
TR- Target Cancer Risk
HQ- Target Hazard Quotient
Ca - Carcinogenic Risk Based
Nc - Noncarcinogenic Risk Based

Table C2-B - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-5}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	Ingestion SL TR= 1.0E-5 (mg/kg)	Dermal SL TR= 1.0E-5 (mg/kg)	Inhalation SL TR= 1.0E-5 (mg/kg)	Carcinogenic SL TR=1.0E-5 (mg/kg)	Ingestion SL Child HQ=1 (mg/kg)	Dermal SL Child HQ=1 (mg/kg)	Inhalation SL Child HQ=1 (mg/kg)	Noncarcinogenic SL Child HI=1 (mg/kg)	Ingestion SL Adult HQ=1 (mg/kg)	Dermal SL Adult HQ=1 (mg/kg)	Inhalation SL Adult HQ=1 (mg/kg)	Noncarcinogenic SL Adult HI=1 (mg/kg)	RSL Web Calculatator Screening Level (mg/kg)	Basis of RSL Web Calculatator Screening Level (mg/kg)
Benz[a]anthracene	2.04E+00	5.32	5.96E+02	1.48E+00	–	–	–	–	–	–	–	–	1.48E+00	ca
Benzene	1.16E+02	–	1.71E+01	1.49E+01	313	–	172	111	2920	–	172	1.62E+02	1.49E+01	ca**
Benzo[a]pyrene	2.04E-01	5.32E-01	1.19E+04	1.48E-01	–	–	–	–	–	–	–	–	1.48E-01	ca
Benzo[b]fluoranthene	2.04	5.32	119000	1.48	–	–	–	–	–	–	–	–	1.48E+00	ca
Benzo[k]fluoranthene	20.4	53.2	1.19E+05	1.48E+01	–	–	–	–	–	–	–	–	1.48E+01	ca
Chrysene	204	532	1190000	148	–	–	–	–	–	–	–	–	1.48E+02	ca
Dibenz[a,h]anthracene	2.04E-01	5.32E-01	1.09E+04	1.48E-01	–	–	–	–	–	–	–	–	1.48E-01	ca
Ethylbenzene	5.81E+02	–	8.57E+01	7.47E+01	7.82E+03	–	9.18E+03	4.22E+03	7.30E+04	–	9.18E+03	8160	7.47E+01	ca*
Indeno[1,2,3-cd]pyrene	2.04E+00	5.32E+00	1.19E+05	1.48E+00	–	–	–	–	–	–	–	–	1.48E+00	ca
Methylnaphthalene, 1-	2.20E+02	5.37E+02	–	1.56E+02	5.48E+03	1.50E+04	–	4.01E+03	5.11E+04	9.85E+04	–	3.36E+04	1.56E+02	ca*
Methylnaphthalene, 2-	–	–	–	–	3.13E+02	8.59E+02	–	2.29E+02	2.92E+03	5.63E+03	–	1920	2.29E+02	nc
Naphthalene	–	–	5.15E+01	5.15E+01	1.56E+03	4.30E+03	2.25E+02	1.88E+02	1.46E+04	2.81E+04	2.25E+02	2.20E+02	5.15E+01	ca**
Xylenes	–	–	–	–	1.56E+04	–	1.05E+03	9.83E+02	1.46E+05	–	1.05E+03	1040	9.83E+02	sat

Notes:
Extracted from USEPA RSL Web Calculator, Access 3/29/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)
SL - Screening Level
VOC - Volitile Organic Compound
TR- Target Cancer Risk
HQ- Target Hazard Quotient
Ca - Carcinogenic Risk Based
Nc - Noncarcinogenic Risk Based

Table C2-C - Summary of Input Parameters in USEPA RSL Web Calculator - Soil TR = 10^{-6}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
Site Spill ID: B5BT
CERCLIS ID: WIN000509952

Variable	Value
TR (target cancer risk) unitless	1.00E-06
THQ (target hazard quotient) unitless	1
LT (lifetime - resident) year	70
ETrs (exposure time) hour	24
ETrsc (child exposure time) hour	24
ETrsa (adult exposure time) hour	24
EDr (exposure duration) year	30
EDc (exposure duration - child) year	6
EDa (exposure duration - adult) year	24
ED0-2 (mutagenic exposure duration) year	2
ED2-6 (mutagenic exposure duration) year	4
ED6-16 (mutagenic exposure duration) year	10
ED16-26 (mutagenic exposure duration) year	14
BWc (body weight - child) kg	15
BWa (body weight - adult) kg	70
BW0-2 (mutagenic body weight) kg	15
BW2-6 (mutagenic body weight) kg	15
BW6-16 (mutagenic body weight) kg	70
BW16-26 (mutagenic body weight) kg	70
SAc (skin surface area - child) cm2/day	2800
SAa (skin surface area - adult) cm2/day	5700
SA0-2 (mutagenic skin surface area) cm2/day	2800
SA2-6 (mutagenic skin surface area) cm2/day	2800
SA6-16 (mutagenic skin surface area) cm2/day	5700
SA16-26 (mutagenic skin surface area) cm2/day	5700
EFr (exposure frequency) day/year	350
EFc (exposure frequency - child) day/year	350
EFa (exposure frequency - adult) day/year	350
EF0-2 (mutagenic exposure frequency) day/year	350
EF2-6 (mutagenic exposure frequency) day/year	350
EF6-16 (mutagenic exposure frequency) day/year	350
EF16-26 (mutagenic exposure frequency) day/year	350
IFSadj (age-adjusted soil ingestion factor) mg/kg	40000
IFSMadj (mutagenic age-adjusted soil ingestion factor) mg/kg	171333.333
IRSc (soil intake rate - child) mg/day	200
IRSa (soil intake rate - adult) mg/day	100
IRS0-2 (mutagenic soil intake rate) mg/day	200
IRS2-6 (mutagenic soil intake rate) mg/day	200
IRS6-16 (mutagenic soil intake rate) mg/day	100
IRS16-26 (mutagenic soil intake rate) mg/day	100
AFa (skin adherence factor - adult) mg/cm2	0.07
AFc (skin adherence factor - child) mg/cm2	0.2
AF0-2 (mutagenic skin adherence factor) mg/cm2	0.2
AF2-6 (mutagenic skin adherence factor) mg/cm2	0.2
AF6-16 (mutagenic skin adherence factor) mg/cm2	0.07
AF16-26 (mutagenic skin adherence factor) mg/cm2	0.07
DFSadj (age-adjusted soil dermal factor) mg/kg	126280
DFSMadj (mutagenic age-adjusted soil dermal factor) mg/kg	505913.333
City (Climate Zone) PEF Selection	Chicago, IL (7)
As (acres) PEF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) PEF Selection	93.77
PEF (particulate emission factor) m3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
Um (mean annual wind speed) m/s	4.69
Ut (equivalent threshold value)	11.32
F(x) (function dependant on Um/Ut) unitless	0.194
City (Climate Zone) VF Selection	Chicago, IL (7)
As (acres) VF Selection	0.5
Q/Cwp (g/m2-s per kg/m3) VF Selection	98.43071
foc (fraction organic carbon in soil) g/g	0.006
ρb (dry soil bulk density) g/cm3	1.5
ρs (soil particle density) g/cm3	2.65
θw (water-filled soil porosity) Lwater/Lsoil	0.15
T (exposure interval) s	950000000
A (VF Dispersion Constant)	16.8653
B (VF Dispersion Constant)	18.7848
C (VF Dispersion Constant)	215.0624

Notes:
Extracted from USEPA RSL Web Calculator, Access 06/03/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)

Table C2-C - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-6}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk $(ug/m^3)^{-1}$	Subchronic RfD (mg/kg-day)	Subchronic RfC (mg/m^3)	GIABS	ABS	RBA	Volatilization Factor (m^3/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)
Benz[a]anthracene	56-55-3	Yes	Yes	7.30E-01	1.10E-04	–	–	1	0.13	1	6.86E+06	–	1.36E+09
Benzene	71-43-2	No	Yes	5.50E-02	7.80E-06	0.004	0.03	1	–	1	5490	1820	1.36E+09
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	1.10E-03	–	–	1	0.13	1	–	–	1.36E+09
Benzo[k]fluoranthene	207-08-9	Yes	No	0.073	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Chrysene	218-01-9	Yes	No	0.0073	0.000011	–	–	1	0.13	1	–	–	1.36E+09
Dibenz[a,h]anthracene	53-70-3	Yes	No	7.30E+00	1.20E-03	–	–	1	0.13	1	–	–	1.36E+09
Ethylbenzene	100-41-4	No	Yes	1.10E-02	2.50E-06	1.00E-01	1.00E+00	1	–	1	8.81E+03	4.80E+02	1.36E+09
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	No	7.30E-01	1.10E-04	–	–	1	0.13	1	–	–	1.36E+09
Methylnaphthalene, 1-	90-12-0	No	Yes	2.90E-02	–	7.00E-02	–	1	0.13	1	9.11E+04	–	1.36E+09
Methylnaphthalene, 2-	91-57-6	No	Yes	–	–	4.00E-03	–	1	0.13	1	9.01E+04	–	1.36E+09
Naphthalene	91-20-3	No	Yes	–	3.40E-05	2.00E-02	3.00E-03	1	0.13	1	7.20E+04	–	1.36E+09
Xylenes	1330-20-7	No	Yes	–	–	2.00E-01	1.00E-01	1	–	1	1.01E+04	2.58E+02	1.36E+09

Notes:

Extracted from USEPA RSL Web Calculator, Access 06/03/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)

SL - Screening Level

VOC - Volitile Organic Compound

TR- Target Cancer Risk

HQ- Target Hazard Quotient

Ca - Carcinogenic Risk Based

Nc - Noncarcinogenic Risk Based

Table C2-C - Summary of Output of USEPA RSL Web Calculator - TR = 10^{-6}, HQ = 1.0
Wisconsin Public Service Corporation - Former Marinette Manufactured Gas Plant Site
1603 Ely Street, Marinette, Wisconsin
CERCLA Docket No.: V-W-06-C-847
USEPA WIN00050995 / Site Spill ID: B5BT / BRRTS #02-38-000047 / CERCLIS ID: WIN000509952

Chemical	Ingestion SL TR= 1.0E-6 (mg/kg)	Dermal SL TR= 1.0E-6 (mg/kg)	Inhalation SL TR= 1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL Child HQ=1 (mg/kg)	Dermal SL Child HQ=1 (mg/kg)	Inhalation SL Child HQ=1 (mg/kg)	Noncarcinogenic SL Child HI=1 (mg/kg)	Ingestion SL Adult HQ=1 (mg/kg)	Dermal SL Adult HQ=1 (mg/kg)	Inhalation SL Adult HQ=1 (mg/kg)	Noncarcinogenic SL Adult HI=1 (mg/kg)	RSL Web Calculatator Screening Level (mg/kg)	Basis of RSL Web Calculatator Screening Level (mg/kg)
Benz[a]anthracene	2.04E-01	0.532	5.96E+01	1.48E-01	–	–	–	–	–	–	–	–	1.48E-01	ca
Benzene	1.16E+01	–	1.71E+00	1.49E+00	313	–	172	111	2920	–	172	1.62E+02	1.49E+00	ca*
Benzo[a]pyrene	2.04E-02	5.32E-02	1.19E+03	1.48E-02	–	–	–	–	–	–	–	–	1.48E-02	ca
Benzo[k]fluoranthene	2.04	5.32	1.19E+04	1.48E+00	–	–	–	–	–	–	–	–	1.48E+00	ca
Chrysene	20.4	53.2	119000	14.8	–	–	–	–	–	–	–	–	1.48E+01	ca
Dibenz[a,h]anthracene	2.04E-02	5.32E-02	1.09E+03	1.48E-02	–	–	–	–	–	–	–	–	1.48E-02	ca
Ethylbenzene	5.81E+01	–	8.57E+00	7.47E+00	7.82E+03	–	9.18E+03	4.22E+03	7.30E+04	–	9.18E+03	8160	7.47E+00	ca
Indeno[1,2,3-cd]pyrene	2.04E-01	5.32E-01	1.19E+04	1.48E-01	–	–	–	–	–	–	–	–	1.48E-01	ca
Methylnaphthalene, 1-	2.20E+01	5.37E+01	–	1.56E+01	5.48E+03	1.50E+04	–	4.01E+03	5.11E+04	9.85E+04	–	3.36E+04	1.56E+01	ca
Methylnaphthalene, 2-	–	–	–	–	3.13E+02	8.59E+02	–	2.29E+02	2.92E+03	5.63E+03	–	1920	2.29E+02	nc
Naphthalene	–	–	5.15E+00	5.15E+00	1.56E+03	4.30E+03	2.25E+02	1.88E+02	1.46E+04	2.81E+04	2.25E+02	2.20E+02	5.15E+00	ca*
Xylenes	–	–	–	–	1.56E+04	–	1.05E+03	9.83E+02	1.46E+05	–	1.05E+03	1040	9.83E+02	sat

Notes:
Extracted from USEPA RSL Web Calculator, Access 06/03/2015, (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)
SL - Screening Level
VOC - Volitile Organic Compound
TR- Target Cancer Risk
HQ- Target Hazard Quotient
Ca - Carcinogenic Risk Based
Nc - Noncarcinogenic Risk Based

APPENDIX C3

GROUNDWATER MONITORED NATURAL ATTENUATION DURATION CALCULATIONS

	Groundwater Remedy Alternative Monitored Natural Attenuation CALCULATION SHEET	By: Meng Wang, PH.D, PE		Date:6/9/15	
NATURAL RESOURCE TECHNOLOGY		Chkd by: Brian Hennings, PE		Date:6/10/15	
	Feasibility Study Former Marinette MGP Site Marinette, Wisconsin	Revision	Date	By:	App'd
Client: IBS - Marinette					
NRT Project #: 1549 / 20					

Problem Statement:

This alternative involves Monitored Natural Attenuation (MNA) of groundwater to rely on naturally occurring biological degradation in order to address manufactured gas plant (MGP) residuals in groundwater. Field monitoring data show that MNA has been occurring on the Site under the current condition. The overall groundwater monitoring time frame for MNA was determined in this document by calculating the estimated times for various contaminants of concerns (COCs) to decay to the target levels assuming the MGP source material has been remediated or removed.

References:

[1]. USEPA, December 2011, *An Approach for Evaluating the Progress of Natural Attenuation in Groundwater* , EPA/600/R-11/204.

[2]. Wisconsin Department of Natural Resources, January 2014, *Guidance on Natural Attenuation for Petroleum Releases,* RR-614.

[3]. E. F. Neuhauser et al., 2009, *Monitored Natural Attenuation of Manufactured Gas Plant Tar Mono- and Polycyclic Aromatic Hydrocarbons in Ground Water: A 14-Year Field Study,* Ground Water Monitoring and Remediation 29, no. 3, pages 66-76.

Assumptions:

• Benzene, naphthalene and benzo(a)pyrene are chosen as representative COCs to estimate the duration of the applied remedial approach.

• A first-order time decay model is assumed for COC decay on Site. The model has been fitted and proven in Section 4.2.2 of the Remedial Investigation (RI) Report, Revision 2 for Former Marinette Manufactured Gas Plant Site submitted to USEPA by Natural Resource Technology in February, 2015.

• The MNA remedy duration is estimated based on the historical monitoring data, thus, the decay rates were calculated under the condition that source materials are still present. The decay rates of COCs fitted for MW304 are used to represent the overall MNA duration. MW304 is located at the edge of plume and its monitoring data from 2004 to 2015 are adequate and representative to exhibit a MNA process for groundwater condition for the overall site condition when source materials are removed (the condition assessed in this calculation).

• The initial concentrations of COCs are chosen as the maximum concentrations monitored from any well on site since 2011 until the most recent monitoring data. The concentrations provide a high-end estimate of the groundwater quality when source materials are removed.

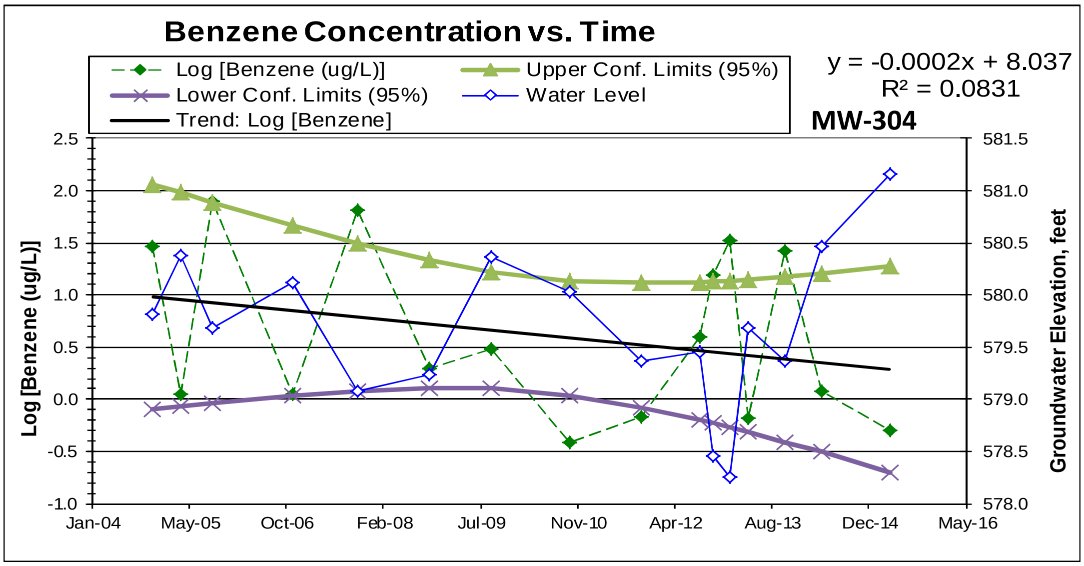
Known:

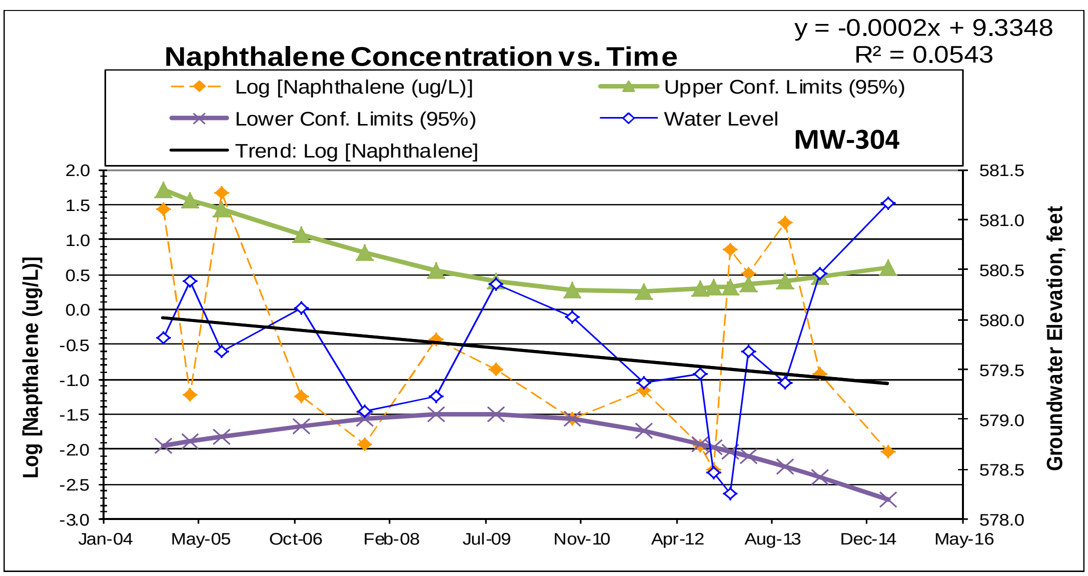
• The target levels of the representative COCs, shown in Table 1 below, are described in RI report, Revision 2.

• The initial concentrations are selected as
benzene - 481 μg/L (collected at MW311 on 8/6/2012),
naphthalene - 2490 μg/L (collected at MW311 on 10/22/2013),
benzo(a)pyrene - 1.3 μg/L (collected at MW305 on 04/15/2013).

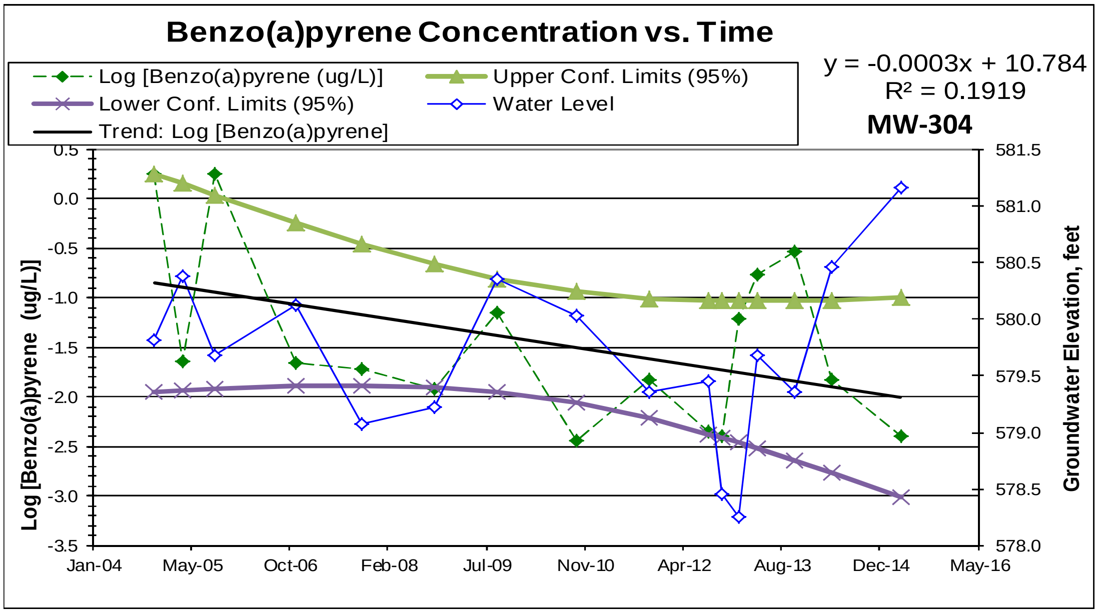
NATURAL RESOURCE TECHNOLOGY	**Groundwater Remedy Alternative** **Monitored Natural Attenuation** **CALCULATION SHEET**	By: Meng Wang, PH.D, PE		Date:6/9/15	
		Chkd by: Brian Hennings, PE		Date:6/10/15	
	Feasibility Study Former Marinette MGP Site Marinette, Wisconsin	Revision	Date	By:	App'd
Client: IBS - Marinette					
NRT Project #: 1549 / 20					

• The first order decay rates for benzene and naphthalene were presented in Table 12 of the RI Report, Revision 2 and the regression plots were attached as Appendix I3. The first order decay rate for benzo(a)pyrene was calculated for the first time as part of this evaluation. The regression plots including statistics to calculate the decay rates were updated for this evaluation to include all available groundwater results through April 2015 and are shown as follows:





Natural Resource Technology	Groundwater Remedy Alternative Monitored Natural Attenuation **CALCULATION SHEET**	By: Meng Wang, PH.D, PE		Date:6/9/15	
		Chkd by: Brian Hennings, PE		Date:6/10/15	
	Feasibility Study Former Marinette MGP Site Marinette, Wisconsin	Revision	Date	By:	App'd
Client: IBS - Marinette					
NRT Project #: 1549 / 20					



Calculations:

The first-order time decay for the COC concentrations can be expressed as:

$$C(t) = C_o\, e^{-(kt)} = C_o\, 10^{-(k't)}$$

where

$C(t)$ = concentration (µg/L) at time t (day)

C_o = initial concentration (µg/L)

k = first-order degradation rate (per day)

k' = k/[ln(10)] = k/2.303

Therefore, the duration for COC concentration to decrease from Co to target levels can be calculated as:

$$T = -\,[\ln (C_t/C_o)]/k$$

where

C_t = target level of COC compound (µg/L), defined as preliminary remediation goal in this study.

T = duration of COC concentration to decrease to target level (days)

The calculation of remedial duration based on the above inputs and equations is listed in Table 1.

Table 1: Duration (Years) Calculated for COCs to Decrease to Target Levels

Compound	Preliminary Remediation Goal C(t) (µg/L)	Initial Concentration C_o (µg/L)	k' (per day)	k (per day)	Duration (T)	
					Days	Years
Benzene	5	481	1.84E-04	4.24E-04	10767	30
Naphthalene	100	2490	2.47E-04	5.68E-04	5657	16
Benzo(a)pyrene	0.2	1.3	3.04E-04	6.99E-04	2678	8

Summary and Conclusions:

The time to remediate the Site implementing MNA was assessed assuming the MGP source material was remediated or removed. The model was calibrated using 2004 through 2015 data. As shown in Table 1, benzo(a)pyrene would decay to the target level relatively quickly, whereas benzene would be persistent for a while due to its relatively high concentration to the preliminary remediation goal. It would take approximately 8 years for benzo(a)pyrene to decay and approximately 30 years for benzene to decay to their target levels, respectively. The estimated timeframe of 30 years is a conservative value, since the initial concentration used in the calculation is collected from MW311, a well located in the centerline of the source area. The estimated duration assumes the source is removed; therefore, the overall groundwater concentrations of representative COCs would be lower than found in MW311 and would require a shorter timeframe of cleanup.

The regression analysis of the historical groundwater data stated in this document demonstrates a clear and meaningful trend of decreasing contaminant concentration over time at the appropriate monitoring point MW304, which reasonably represents the groundwater quality condition after source removal. This approach is adequate for use during the remedy selection process to approximate the duration for MNA when a concentration-based goal for cleanup has been identified. Therefore, it is reasonable to choose 30 years as the overall MNA timeframe.