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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:
LU-9J

Via certified First Class Mail and email

June 3, 2011

Mr. John Perkins
Tyco Fire & Security
One Town Center Road
Boca Raton, FL
33486-1010

Re: Review of *Sediment Removal Work Plan* and *Alternative Menominee River Sediment Removal Plan*, dated December 1, 2010
Tyco Safety Products – Ansul Stanton Street Facility
WID 006 125 215

Dear Mr. Perkins,

Thank you for a productive meeting on February 24, 2011. We both understand the importance of maintaining cooperation in achieving the remediation goals laid out in the Administrative Order on Consent (AOC). EPA also acknowledges receipt of your submission, *Sediment Remediation Approach*, dated May 20, 2011 (received 5/31/11). Given the lateness of the 5/20/11 letter, EPA will respond to any issues contained raised in that submission at a later time.

As stated in the AOC, Tyco was required to submit an approvable *Sediment Removal Work Plan* (SRWP) by December 1, 2010. Tyco also submitted the *Alternative Menominee River Sediment Removal Plan* AMRSRP) on the same day. EPA and WDNR have determined that the AMRSRP is not complete or approvable. Tyco has not adequately justified that the Sediment Removal Work Plan (SRWP) is technically or economically impracticable. Further, Tyco has not demonstrated that the AMRSRP meets the AOC requirements stated in paragraph VI.11.f. Consequently, we are **disapproving the AMRSRP** and **approving the SRWP as conditioned below.** EPA once again reminds Tyco, that the AOC requires that sediment remediation be finished by November 1, 2013.

From both the 2/24/11 meeting and the AMRSRP, it appears that Tyco believes that the SRWP is technically and economically impracticable. In the 2/24/11 meeting, Tyco provided the two arguments that follow:

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Containment Wall Integrity:

Tyco asserts that the removal of all sediment containing more than 50 ppm of arsenic will undermine the structural integrity of the containment wall recently constructed. However, EPA considers the AOC requirement of constructing a containment wall and sediment removal to 50 ppm arsenic to be unambiguous. Not removing contaminated sediment along the toe of the containment wall due to engineering considerations does not justify as technically impracticable the removal of the contaminated sediment in the Turning Basin and transition area. The Cost Estimate Review and Evaluation Memorandum (Attachment 1) finds: a) inadequate supporting information to validate a wall stability problem; and b) engineering reinforcing techniques to provide additional structural support to the containment wall are available and have been successfully used in other locations. It is likely that these techniques may have application here.

Obviously, Tyco is responsible for ensuring the structural integrity of the containment wall. Although Tyco asserts that it would be necessary to leave 5,000 cubic yards of highly contaminated sediment in place to support the containment wall, there are other alternatives available to maintain the structural integrity.

Potential for Acute Toxicity in the River:

Tyco asserts that dredging the semi-consolidated sediments would result in unacceptable concentrations of arsenic in surface water. However,

A) EPA believes the dredging scenario proposed by Tyco and provided in the SRWP can be improved upon to reduce the short-term toxicity involved with dredging activity. These improved approaches would involve dredging all of the soft and the semi-consolidated sediments until encountering refusal using an environmental dredge head. Any remaining semi-consolidated sediments would subsequently be removed by another technique proposed by Tyco that would minimize surface water quality impacts. For instance, hydraulic dredging could be employed to dredge the more resistant sediment and aid in minimizing potential arsenic releases to the surface water.

B) EPA also believes that the scenario whereby sediment would be dredged in the dry could be substantially extended. EPA always weighs both the short-term and long-term impacts that can be associated with environmental remediation proposals. These considerations lead EPA to believe that the removal of arsenic contaminated sediment is the best approach to initiating river recovery. Arsenic releases to the surface water will occur during dredging, but it is EPA's position that the use of best engineering practices will reduce these releases, potentially to environmentally acceptable levels.

EPA has included Figures 1 and 2, depicting Tyco's demarcation lines for Transition Areas 1 and 2 and the maximum arsenic concentrations found in soft and semi-consolidated sediment, respectively. A potential location for a cofferdam is indicated in both Figures by the heavy green line. Bathymetry data indicates shallow water depths beyond these locations. The use of this cofferdam configuration will allow for significantly greater volumes of sediment to be dredged in the dry. Since Tyco has proposed dredging the South Channel in the dry, this

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additional dry dredging zone should be feasible since the water depths are likewise relatively shallow and capable of being isolated. Dry dredging in these additional areas will increase costs (Attachment 3) but has the added environmental benefit of further minimizing arsenic releases to the surface water.

The performance based AOC is designed to provide maximum flexibility to TYCO in attaining the goals identified in the SRWP. Whether the removal is done in smaller segments or as a larger unit, EPA's focus is on expanding areas of dry sediment excavation.

In addition, paragraph VI.11.f of the AOC provides that an AMRSRP would have to demonstrate that it protects human health and the environment; is legally implementable; and achieves an equivalent level of protection to the selected remedy. Tyco has not demonstrated that the AMRSRP meets the AOC requirements as follows:

Sand cap construction over semi-consolidated sediment. EPA has performed a sediment cap performance calculation based on information provided by Tyco in Attachment 3 of the AMRSRP. Results indicate that a sand cap constructed over the semi-consolidated sediment would not be protective of the environment. This analysis used Tyco's assumption of no groundwater flow and, therefore only transport through diffusion, Tyco's site characterization information and a diffusion coefficient from Appendix 3 of the AMRSRP. This analysis indicates that construction of a sand cap will not be environmentally protective. It should be emphasized that this analysis did not include more probable transport mechanisms such as propeller wash, flooding and seiches, etc.. Results indicate that porewater arsenic concentrations would be environmentally unacceptable in a little more than a year. Similarly, State of Wisconsin water quality standards would likewise be violated within the same order-of-magnitude timeframe. Moreover, capping is also inconsistent with the AOC monitored natural recovery requirement which presumes that the porewater arsenic concentrations throughout the remediated area will decrease with time. See Attachments 2 and 5 for additional details.

Turning Basin Capping: The Turning Basin (TB) is part of the Federal Navigation Channel maintained by the US Army Corp of Engineers in the Menominee River and is Congressionally mandated to be 21 feet below Lake Michigan's low water datum of 577.5 feet above mean sea level. A cap on the TB's semi-consolidated sediments would violate these depth requirements. Therefore, Tyco's proposal is currently not legally implementable. Furthermore, EPA has contacted local commercial interests that use the TB as part of regular operations. These entities expressed concerns regarding the shallowing of the TB.

As stated above, the SRWP is approved subject to the conditions given below. Ansul must proceed with the implementation of the SRWP immediately. The SRWP is approved as modified by the following conditions:

1) Tyco must conduct Post-Dredging Sediment Confirmation Sampling. The dredging component of the remedy will not be complete in any of the units that Tyco has delineated in the Menominee River until all sediment equal to or greater than 50 ppm have been removed and properly disposed of off-site. EPA requires Tyco to use surface weighted average concentration (SWAC) procedures, similar to the SWAC currently being applied to dredge activities in the Lower Fox

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1) Tyco must conduct Post-Dredging Sediment Confirmation Sampling.. The dredging component of the remedy will not be complete in any of the units that Tyco has delineated in the Menominee River until all sediment equal to or greater than 50 ppm have been removed and properly disposed of off-site. EPA requires Tyco to use surface weighted average concentration (SWAC) procedures, similar to the SWAC currently being applied to dredge activities in the Lower Fox River (Wisconsin) Superfund removal. Ansul must submit a SWAC methodology to EPA within 45 days for EPA review and approval;

2) Ansul must expand the dry dredging footprint to incorporate the area behind the cofferdams depicted in Figures 1 and 2.

3) Ansul must develop an appropriate restoration plan for the river bottom in the south channel and adjacent areas scheduled for dredging in the dry; In the meantime, Ansul must proceed with all other work described in the SRWP. Ansul may submit the restoration plan for review and approval as late as December 31, 2011.

Ansul must contact the appropriate regulating entities, both Federal and State, to initiate the process of obtaining all permits required to implement the SRWP. As stated above, it may be necessary to request a waiver from the acute toxicity water quality standard for arsenic, even though best engineering practices will be employed. WDNR is in the process of assessing the ability to issue a temporary waiver(s) to address any short-term water quality impairment(s) associated with dredging in the river. Tyco must submit a formal request to initiate this process. Such an issuance would be predicated upon the long-term benefits of contaminated sediment removal outweighing short-term impacts to the River.

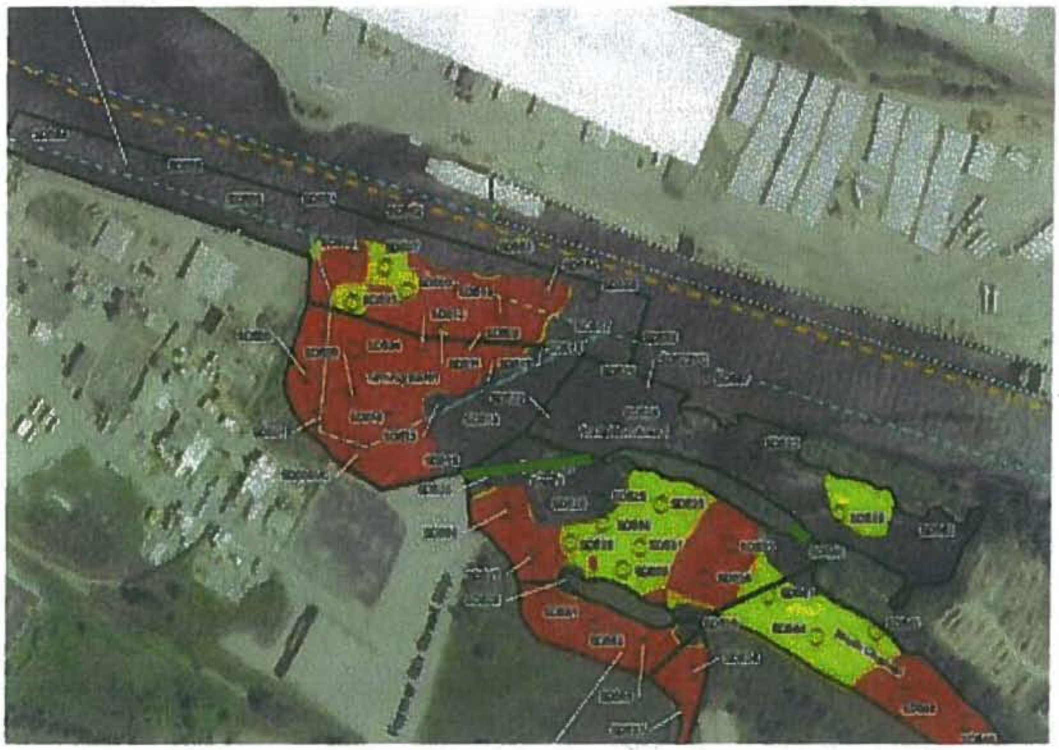
We look forward to working with you to restore the River ecology, and complete the corrective action work at the Ansul facility. If you have any questions, please do not hesitate to contact me at (312) 886-5902.

Sincerely,

Gary Cygan, Geologist and Project Manager
Corrective Action Section
U.S. EPA, Region 5
Cygan.gary@epa.gov

cc: Wayne Schloop, USCOE
Kristin du Fresne, WDNR

Maximum Arsenic in <u>Soft</u> Sediments
And Proposed Locations of Cofferdams



= **Proposed Cofferdams**

Figure 1

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Maximum Arsenic in <u>Semi-Consolidated</u> Sediments
And Proposed Locations of Cofferdams

= **Proposed Cofferdams** **Figure 2**

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MEMORANDUM

TO: Gary Cygan – EPA Region 5

FROM: Brad Martin – TechLaw, Inc.

SUBJECT: Tyco Safety Products - Ansul Incorporated – Draft Sediment Removal Alternatives Information

DATE: June 1, 2011

Based on information provided by EPA during the teleconference meeting on April 21, 2011 and subsequent communications, TechLaw was tasked with the following activities:

- Include background information on the site and specifically background on the each of the sediment removal options presented by Ansul.
- Provide the description of the dredging and capping costs in the Cost Memo to include a written quote from the vendor (Ryba Marine Construction Company, hereafter referred to as Ryba). In addition, provide background information on Ryba and their qualifications.
- Provide a detailed discussion of the disposal costs and include an assessment of whether Ansul used the closest disposal facility in the cost estimates. If not, include a determination of the nearest Subtitle D facility capable of accepting the sediments and information on their rates.
- Provide information on capping soluble arsenic in an environmentally safe manner. It is assumed that a sand cap is not protective.
- Provide information on the possibility of using a reactive cap to address known concentrations of arsenic and determine cost implications.
- Provide information on the costs an expanded dry dig area (moving the proposed coffer dam).
- Provide information on the use of blow counts as the basis for use of a clamshell bucket to excavate the soft sediments and use of a standard clamshell bucket for the semi-consolidated materials. Provide information on whether a two stage removal process is viable – use of an environmental bucket until refusal followed by hydraulic dredging on the remainder of the sediment to be removed. Check with Ryba on the feasibility of this approach and determine cost implications.
- Provide information on hydraulic dredging costs.
- Provide available information from Wisconsin Department of Natural Resources (WDNR) on barrier wall temporary support.
- Provide potential best management practices (BMPs) for minimizing sediment loss from mechanical dredging.
- Provide Operations and Maintenance (O&M) criteria for the proposed cap, and estimate costs.
- Provide qualitative information on natural sedimentation rates at the site and potential disturbances.

As requested by EPA, this Memo provides technical information and is not a technical review. A reference list is provided at the end of the text for the sources used in this evaluation.

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BACKGROUND

The Tyco Fire Products, LP (Tyco) facility is situated on approximately 63 acres in Marinette, Wisconsin, and currently manufactures hand-held fire extinguishers and blends fire suppression agents (hereinafter referred to as the facility or site). The Menominee River borders the site to the north; Water Street, City of Marinette property, Marinette District Property, and residential properties are located to the south; the 6th Street Slip and City of Marinette property are located to the east; and, Stanton Street and the Marinette Marine Corporation are located to the west (CH2MHill 2010a).

Operations at the facility first began in 1915 as lumber milling. Subsequent operations under Tyco and/or its predecessors included the manufacture of cattle feed, refrigerants, and specialty chemicals. From 1957 to 1977, operations also included manufacturing of arsenic-based herbicides. Since 1983, operations have only included manufacturing of fire extinguishers and blending of fire suppression agents (EPA 2009).

As a result of the arsenic-based herbicide manufacturing, a salt byproduct was produced which contained approximately two percent arsenic by weight. Between the early 1960s and the late 1970s, this salt was stored in uncovered, unlined stockpiles at several locations at the site, resulting in releases of arsenic to environmental media (CH2MHill 2010a; EPA 2007).

Five major investigations have been conducted at the site since 1996 to assess arsenic contamination in soil, groundwater, and sediment in Menominee River (CH2MHill, 2010a). Note that hazardous constituents in addition to arsenic have been detected at the site (including 1,2-dichlorobenzene, toluene, and methylene chloride); however, arsenic contamination is driving the Menominee River sediment corrective action.

BACKGROUND ON ALTERNATIVES EVALUATION AND REMEDY SELECTION:

The Menominee River is identified as a Great Lakes Area of Concern (GLAOC) under the Great Lakes Water Quality Agreement (GLWQA) of the United States of America and Canada. As such, the long term goals of the Menominee River GLAOC include (EPA 2011):

- Protect the aquatic ecosystem of the Menominee River and harbor from the effects of toxic and conventional pollutants.
- Maintain a balanced aquatic and terrestrial community to ensure long term health of the ecosystem.
- Maintain and enhance recreational and commercial uses of the Menominee River and Harbor, consistent with the long term maintenance of the natural resource base and a healthy economy.

Further, GLWQA lists 14 beneficial uses of these areas. Potential impairments to these uses are defined as action sufficient to cause any of the following:

- restrictions on fish and wildlife consumption
- tainting of fish and wildlife flavor
- degradation of fish wildlife populations
- fish tumors or other deformities
- bird or animal deformities or reproduction problems

- degradation of benthos
- restrictions on dredging activities
- eutrophication or undesirable algae
- restrictions on drinking water consumption, or taste and odor problems
- beach closings
- degradation of aesthetics
- added costs to agriculture or industry
- degradation of phytoplankton and zooplankton populations
- loss of fish and wildlife habitat

EPA has identified 17 objectives for meeting the long term goals (EPA 2011). In support of achieving these long term goals and to fulfill the requirements of the 1990 Administrative Order of Consent (AOC), Tyco - Ansul submitted Menominee River Sediment Remedial Alternatives Evaluation (MRSRAE) in 2003. In the MRSRAE, historical sediment quality data was used to develop an estimate of sediment volumes associated with a range of clean up values from 5 milligrams per kilogram (mg/kg) to 1000 mg/kg of arsenic. Remedial alternatives considered included hydraulic dredging, mechanical dredging, capping with sand, capping with synthetic material, and dry dredging (excavation). Dredging alternatives were based on a maximum dredge depth of 4.5 feet. Capping was eliminated as a comprehensive remedy in the MRSRAE. It was concluded that while it could be used in deeper areas of the Turning Basin as a component of an overall remedy, it could not be used in shallower areas because of potential interference with navigation and the fact that a synthetic cap has not been tested in an environment similar to the Turning Basin. Based on the cost benefit analysis, a clean up level of approximately 50 parts per million (ppm) arsenic was determined to be an optimal cleanup target regardless of the removal alternative (URS 2003).

The Statement of Basis issued in 2007 presented and explained the proposed clean-up remedy to address contaminated groundwater, soil, and Menominee River sediment at Ansul as the final proposed remedy for the site under the 1990 AOC. The Statement of Basis final proposed remedy for the Menominee River sediment was the cleanup of the sediment (river bottom mud) by removing contaminated sediment with arsenic concentration equal to or above 50 mg/kg by mechanical dredging and implement monitored natural recovery (MNR) to attain 20 mg/kg arsenic concentration in approximately 10 years (EPA 2007a).

The Final Decision issued in 2007 was entered into the Administrative Record for the Ansul Facility describing the response action for the Menominee River sediment removal as follows (EPA 2007b):

- Remove and properly dispose of all Menominee River Sediments at arsenic concentrations equal to or greater than 50 ppm using mechanical dredging techniques. Ansul will de-water and dispose of sediments appropriately off-site. Sediment removal activities will be conducted in accordance with all the applicable laws so as to minimize re-entrainment of contaminants in the water.
- Implement MNR using a comprehensive monitoring program to ensure the target cleanup arsenic value of 20 ppm for river sediments is achieved within 10 years of the completion of dredging and to ensure the long-term integrity of the remedy and protection of human health and the environment. During the MNR phase, institutional controls will be in place to prevent digging or trenching in the affected area in addition to a "no anchoring" zone being established.

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- Ansul will prepare a MNR Plan to demonstrate the natural recovery is successfully occurring and to predict when levels will reach the target clean-up concentration of 20 ppm based on the risk analysis presented in the Statement of Basis. The predicted rate of natural recovery will be evaluated by taking samples of sediment at specific intervals to see if the arsenic in the sediment is decreasing at the expected rate. If the sediment levels are not decreasing at the expected rate, the EPA will require a back-up measure, such as additional dredging.

The final remedy was determined to provide the best balance among the alternatives with respect to the evaluation criteria described in the Statement of Basis. EPA, therefore, determined that the selected remedy for the Ansul Facility is appropriate and protective of human health and the environment. It should be noted that the Statement of Basis and the Final Decision did not differentiate between soft sediment and semi-consolidated sediment, and that parts of the Statement of Basis refer to the removal of sediments in the river having an average arsenic concentrations of greater than 50 mg/kg [with the specific averaging methods to be determined by Ansul in accordance with available EPA guidance documents (e.g. Methods for Evaluating the Attainment of Cleanup Standards, EPA, 1989)]. Additionally, some less-contaminated sediment (on average less than 50 mg/kg) will be left in place following the dredging.

On February 26, 2009, EPA issued an AOC to Ansul. The AOC specifies that Ansul must implement the remedy selected in the EPA's Statement of Basis and Final Decision Document as amended by the Order and Scope of Work. Sections VI.11.d and e reiterate the final remedy for contaminated sediment removal as selected in the Final Decision document which includes the additional classification of the contaminated sediment as follows:

VI.11.d. Ansul will remove from the river all soft sediments and semi-consolidated sands and silts which contain arsenic concentrations greater than or equal to 50 ppm. Soft sediments are those sediments that overlay the more consolidated subsoils (i.e., semi-consolidated silts, lacustrine clays, glacial till and bedrock). The depth of the removal will not exceed the top of the glacial till layer.

VI.11.e. Ansul will use MNR to remediate sediments remaining after sediment removal activities to a concentration of 20 ppm of arsenic. If Ansul does not meet the 20 ppm arsenic concentration within 10 years of the completion of the sediment removal then Ansul will submit to EPA for review and approval a plan for meeting the 20 ppm arsenic concentration or that will achieve an equivalent level of protection to that of MNR within 2 years of EPA's approval of the plan.

The AOC allows Ansul the option of proposing an alternative to removal of the layer between the soft sediments and the glacial till pursuant to paragraph "f" of Section VI.11 as follows:

VI.11.f. Ansul may propose an alternative to removal of the sediment layer, should any exist, between the soft sediments and glacial till as required in pargraph [sic] "d" above ("Alternative River Sediment Plan") provided that :i) such alternative is presented to EPA for review and approval by no later than the time when it submits the River Sediment Removal Work Plan; ii) Ansul demonstrates that removal beneath the soft sediments is economically and technologically impractical; and iii) Ansul demonstrates that its alternative protects human health and the environment; is legally implementable; and achieves an equivalent level of protection to that of MNR (i.e., sediment concentration of arsenic of 20 ppm by November 1, 2023).

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In December 2010, Ansul submitted two separate sediment remediation plans for sediment contamination at the site, a Draft Sediment Removal Work Plan (SRWP) to EPA, along with a Draft Alternative Menominee River Sediment Removal Plan (AMRSRP) (CH2MHill 2010a).

SUMMARY OF PROPOSED SEDIMENT REMOVAL ALTERNATIVES

The following is a summary of the proposed sediment remediation plans to address sediment contamination as presented in the Draft SRWP and the Draft AMRSRP. Each plan includes a breakdown of remedial activities into four separate phases. Three of the four phases [Phase I (dredging of soft sediment), III (dry excavation), and IV (MNR)] of both plans are identical.

Phase I is the mechanical dredging of contaminated soft sediment. Soft sediment with arsenic concentrations greater than 50 ppm are proposed to be dredged with an environmental clamshell bucket, stabilized on-site, and disposed off-site at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill (CH2MHill 2010b).

The Phase II alternative presented in the Draft SRWP calls for the mechanical dredging of contaminated semi-consolidated material. Semi-consolidated material beneath the soft sediment with arsenic concentrations greater than 50 ppm would be dredged and disposed of as described in Phase I above (CH2MHill 2010a).

The Phase II alternative presented in the Draft Alternative AMRSRP calls for the capping of semi-consolidated material. Semi-consolidated material with concentrations of arsenic greater than 50 ppm (estimated to be approximately 149,000 cubic yards) would be left in place and will be capped with a minimum of 12 inches of granular fill and 16 inches of rip-rap. The area of the proposed cap is estimated to be approximately 400,000 square feet (CH2MHill 2010b).

Phase III is the dry excavation of soft sediment from the south channel. Prior to excavation, sheet piling would be installed at the western end of the channel, and the area would be dewatered. Soft sediment would then be excavated using conventional excavation equipment and disposed off-site at a RCRA Subtitle D landfill (CH2MHill 2010b).

Phase IV is MNR. Sediment containing arsenic concentrations less than 50 ppm will be left in place, and MNR will be conducted for a period of ten years (CH2MHill 2010b).

Ansul submitted two plans for the remedy of the Menominee River contaminated sediment. The Draft SRWP (CH2MHILL 2010a) is submitted to satisfy the requirements of the Final Decision and the specific requirements of the AOC (i.e., paragraph "d" of Section VI.11).

The Draft AMRSRP (CH2MHILL 2010b) is based on paragraph "f" of Section VI.11 of the AOC. This Memo evaluates whether Ansul has sufficiently met the three conditions identified for EPA acceptance in paragraph "f" of Section VI.11 of the AOC:

- Ansul must present such an alternative to EPA for review and approval by no later than the time when it submits the River Sediment Removal Work Plan - December 1, 2010;

US EPA ARCHIVE DOCUMENT

- Ansul must demonstrate that removal beneath the soft sediments is economically and technologically impractical;
- Ansul must demonstrate that the alternate alternative:
  - Protects human health and the environment;
  - Is legally implementable; and
  - Achieves an equivalent level of protection to that of MNR (i.e., sediment concentration of arsenic of 20 ppm by November 1, 2023).

It should also be noted that the Draft AMRSRP lists the Remedial Action Objectives (RAOs) for the alternate alternative as:

- Be more protective of human health and the environment than removal of the semi-consolidated material; and
- Provide a barrier between the contaminated semi-consolidated material and benthic organisms

INFORMATION RELATED TO THE PROPOSED SEDIMENT REMOVAL ALTERNATIVES

TechLaw was tasked with the following activities:

- Include background information on the site and specifically background on the each of the sediment removal options presented by Ansul.
- Provide a description of the dredging and capping costs in the Cost Memo to include a written quote from the Ryba. In addition, provide background information on Ryba and their qualifications.
- Provide a detailed discussion of the disposal costs and include an assessment of whether Ansul used the closest disposal facility in the cost estimates. If not, include a determination of the nearest Subtitle D facility capable of accepting the sediments and information on their rates.
- Provide information on capping soluble arsenic in an environmentally safe manner. It is assumed that a sand cap is not protective.
- Provide information on the possibility of using a reactive cap to address known concentrations of arsenic and determine cost implications.
- Provide information on the costs an expanded dry dig area (moving the proposed coffer dam).
- Provide information on the use of blow counts as the basis for use of a clamshell bucket to excavate the soft sediments and use of a standard clamshell bucket for the semi-consolidated materials. Provide information on whether a two stage removal process is viable – use of an environmental bucket until refusal followed by hydraulic dredging on the remainder of the sediment to be removed. Check with Ryba on the feasibility of this approach and determine cost implications.
- Provide information on hydraulic dredging costs.
- Provide available information from WDNR on barrier wall temporary support.
- Provide potential BMPs for minimizing sediment loss from mechanical dredging.
- Provide O&M criteria for the proposed cap, and estimate costs.
- Provide qualitative information on natural sedimentation rates at the site and potential disturbances.

In addition, TechLaw reviewed the existing cost estimates prepared by CH2MHill in the Appendix F, Cost Estimate, of the Draft SRWP and Appendix E of the Draft AMRSRP. Technical reviewed these cost estimates and provided comments which are included as Attachment 1. The following sections of

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this Memo focus on providing information for the listed items. A reference list is provided at the end of the text for the sources used in this evaluation.

Dredging and Capping Costs

In order to evaluate unit prices for certain critical components of the cost estimates (e.g., line item costs which represent a significant percentage of the total cost) presented in Appendix F, Cost Estimate, of the Draft SRWP and Appendix E of the Draft AMRSRP, TechLaw contacted Ryba, a Great Lakes area contractor that routinely performs mechanical dredging and capping at contaminated sediment sites. Based on the information provided by Ryba (see Attachment 2), the unit prices provided by Ansul for sediment removal (i.e., mechanical dredging) and cap placement appear to be comparable. Information on Ryba's qualifications is also provided as part of Attachment 2.

Disposal Costs

TechLaw conducted a search to determine the nearest Subtitle D facility capable of accepting the sediments and information on their rates. Ansul has proposed to use a Subtitle D landfill that is within 40 miles of the facility to estimate disposal costs; however, it appears the closest RCRA Subtitle D landfill is Waste Management landfill located at W. 6111 Elmwood Rd, Menomonee, MI, approximately eight miles from the Ansul faciltiy. TechLaw contacted Waste Management to determine the disposal costs and other facility information. Information provided by Waste Management included the following:

Fees

$35.00/ton – 3 ton minimum
$0.21/ton – tax
$10.00/truck – environmental fee
6.5% - field surcharge
$50.00 – profile review

Location

W. 6111 Elmwood Rd.
Menomonee, MI

Hours

Monday-Friday
7-3:45

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Based on information in the Draft SRWP and Draft AMRSRP regarding the amount of material assumed for non-hazardous disposal and capping, and the assumption that each truckload transporting material to the landfill or from a quarry, would contain approximately 20 tons or approximately 15 cubic yards, the total number of truckloads needed for disposal/capping for each option would be approximately:

- Draft SRWP – 385,056 tons = 19,253 truckloads
- Draft AMRSRP – 104,936 tons for disposal, 136,900 cubic yards for capping (44,000 square yard area, 37" thick cap) = 14,373 truckloads

In addition, TechLaw contacted Waste Management to attempt to determine the truck route from the site to the landfill. A figure showing the estimated truck route is included as Figure 1 of this Memo. According to Waste Management, there are not truck restrictions along the route.

Capping Alternatives

Reactive Cap

To provide information on potentially capping soluble arsenic in an environmentally safe manner and using a reactive cap to address known concentrations, TechLaw initiated a literature search on potential case studies/research available for organic arsenic reactive caps. It should be noted several projects were found during this literature search that have addressed heavy metal contamination; however, it is unclear from the available literature whether organic arsenic was one of the heavy metals addressed. This information is provided in Attachment 3.
TechLaw also reviewed information on EPA's Technology Innovation and Field Services Division, Contaminated Site Clean-Up Information (CLU-IN) website (www.clu-in.org); however, no organic arsenic reactive cap case studies were available.

In addition, TechLaw contacted the reactive cap vendors, CETCO and Adventus Group, in an effort to obtain case studies and other information on potential reactive caps for organic arsenic.

Adventus Group provided TechLaw information on their reactive AquaBlok product; however, it was not specific to organic arsenic.

CETCO provided several case studies; however, again these studies were not specific to organic arsenic. CETCO stated, in correspondence with TechLaw,

> "It is confirmed that arsenic [at the Ansul site] is the combination of arsenate+arsenite+dimethylarsenic acid (cacodylic acid)+monomethylarsonic acid. 3 out of 4 arsenic is in their pentavalent state. I would think MRM [Reactive cap consisting of the CETCO Organoclay® MRM product] should be effective, but I am not sure it would meet the design requirement unless the actual data is collected. The methylated arsenic compounds are extremely toxic, particularly their vapor phases. I will be very hesitate [sp] to test these chemicals in our lab."

The costs associated with reactive caps are dependent on the size of the remediation area and the amount of requisite detailed bench-scale studies of contaminants and reactive materials. Therefore, a cost comparison between reactive caps and the proposed cap could not be performed. In addition,

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available literature search material did not include detailed cost information. Given the extremely large concentrations of arsenic currently at the site, arsenic may have the potential to overwhelm the reactive fraction of the cap or may greatly increase the quantity of reactive material necessary, thus potentially substantially raising the costs.

TechLaw is also including in Attachment 3, information on potential implementation of a reactive cap. This information was available from the In Situ Sediment Capping – NEWMOA Workshop – Remediation of Contaminated Sediment Sites, Schuck, R., dated April 2010. Information from this workshop is also summarized below.

Application of in-site reactive caps is related to site-specific conditions. A general understanding of site hydrodynamics (e.g., seasonal variability, storm effects, sediment stability, and groundwater discharge) and biogeochemistry is required.

In-situ capping is a reasonable option under the following conditions:

- Low groundwater flux
- Lower velocity flows/lower susceptibility to erosion
- Site contaminants will remain stable after burial
- Deeper water bodies – no impacts to navigation, limited flood storage loss
- Small portion of a water body (minimal flood storage loss)
- Remedial goals are not attainable via removal
- Area to be capped has a generally level bottom

In-situ capping is not favorable under the following conditions:

- Shallow environments
    - Littoral zones – Capping would create emergent conditions
- High erosion potential
- Flood prone areas
- High groundwater flux with dissolved contaminants

Barrier Wall Alternatives

The Draft SRWP indicates that sediment removal near the vertical barrier walls has the potential to compromise theses walls. It must be noted that the Order required that the walls be anchored in the glacial till or bedrock and the potential compromise created due to a design flaw should not be used as a justification for the capping alternative. In addition, supporting information to validate the conclusion that the barrier wall would fail was not provided in the Draft SRWP. Alternative solutions may be available to temporarily support the wall during dredging activities and these should be presented and evaluated. TechLaw contacted WDNR to inquire into similar types of projects. WDNR provided TechLaw with information on the Sheboygan River/Camp Marina site which included a similar situation where sediment was being removed adjacent to a sheet-pile wall. The following techniques were compared for the Sheboygan River/Camp Marina site and may be appropriate for further evaluation at the Ansul site:

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- Phased removal activities in the vicinity of the walls, and immediate placement of supporting backfill materials
- Drilled Shafts to support the wall
- Tiebacks

Information provided by WDNR is presented in Attachment 4.

It appears that Ansul should evaluate the barrier wall structural augmentation in a timely manner to ensure that this issue can be addressed prior to implementation of the remedy.

In addition, for consideration, TechLaw has prepared preliminary cost estimates for a focused cap for these areas near the barrier wall. The sediment in these locations has been estimated by Ansul as 5,000 cubic yards. Focused capping of the portion of the sediment immediately adjacent to the vertical barrier walls may alleviate this issue. Further, the cost of capping the 5,000 cubic yards is insignificant so it would have little impact on the overall costs. It should be noted that the cap was assumed to be the same cross-section as presented in the
Draft AMRSRP (12 inches of granular fill with a 3 inch buffer and 16 inches of rip-rap with a 6 inch buffer). Additional information, including this specific cost estimate is included as part of Attachment 1 to this Memo.

Capping/Navigation

To provide information on issues associated with capping the site, TechLaw also searched for information on the navigation issues in the Menominee River. Based on available information, portions of the Main Channel and Turning Basin fall within the federally authorized navigation channel and the authorized dredging depth in the federal navigation channel is 21 feet below the Lake Michigan low water datum (LWD) of 577.5 feet above mean sea level referenced to the International Great Lakes Datum of 1985. Periodic dredging may be necessary to maintain this channel; however, the proposed placement of the cap may put a limit on future dredging of the turning basin and ship channel. In addition, significant additional removal may be necessary to have a proposed cap comply with navigational requirements.

EPA has indicated that a navigational dredging project was conducted by the City of Menominee to allow for ocean going vessels to access the lower part of the Menominee River. The City completed this effort in summer 1998. The dredging project partially restored navigation, which ultimately improved the beneficial use of the Menominee River by allowing the river to be used by commercial and industrial entities for transport of materials, thereby increasing the value of the waterfront (EPA 2011).

Natural Sedimentation

In order to provide qualitative information on natural sedimentation rates at the site and potential disturbances, TechLaw reviewed the *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites,* EPA-540-R-05-012, Office of Solid Waste and Emergency Response, OSWER 9355.0-85 December 2005, for information on sedimentation. The following is a summary of information gleaned from this document, which has been augmented with site-specific information.

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Isolation and mixing of contaminants through natural sedimentation is the process most frequently relied upon for contaminated sediment. However, in most aquatic environments, surface sediment and associated contaminants move over time. This movement can be caused by a variety of natural and man-made factors including: flooding, ice-scour, human recreational use of a waterway (propellers, anchors), commercial use (propellers, anchors, water jets propulsion). In addition, erosion may re-expose those contaminants in the future. An accurate assessment of sediment mobility and contaminant fate and transport can be one of the most important factors in identifying areas suitable for monitored natural recovery (MNR), in-situ caps, or near-water confined disposal facilities (CDFs).

Alternatives should include consideration of disruption from man-made (anthropogenic) causes such as propeller scour and natural causes such as floods and ice scour. Generally, this evaluation should include the 100-year flood and other events with a similar probability of occurrence (future dredging by the Army Corps of Engineers).

The long-term protectiveness provided by sedimentation depends upon the physical stability of the new sediment bed and the rates of movement of contaminants through the new sediment. Major events, such as severe floods or ice movements may scour the buried sediment, exposing contaminated sediment and releasing the contaminants into the water column. Depending upon their extent, events such as these may extend the natural recovery period or, in some cases, inhibit it altogether. It should be noted that cohesive or well-armored sediment is resistant to re-suspension.

At the Ansul site, several of these potential man-made or natural causes of sediment re-suspension or movement are present. These include:

- Marinette Marine – Ships up to 400' in length, including both waterjet and propeller powered units
- Flooding
- Ice scour
- Recreational motor boat use of the Menominee River

These potential causes likely will cause major uncertainty in predicting future sedimentation rates in a dynamic environment such as the Ansul site. Some of these mechanisms for physical disruption, such as ice scour or flooding, may be only partly manageable to not manageable at all.

Potential Expanded Dry Excavation Area

In order to provide information that may be beneficial in resolving issues identified by Ansul to completing the SRWP, including the integrity of the barrier wall, acute ecological issues potentially raised by dredging semi-consolidated sediments, TechLaw has provided information on the costs an expanded dry dig area (moving the proposed coffer dam). As indicated by Ansul, there is a potential for release of arsenic from dredging activities, even with the use of BMPs, and therefore an expanded dry excavation can address this issue.
A figure showing a potential expanded dry excavation area is included as Figure 1 of this Memo. For consideration, TechLaw has prepared preliminary cost estimates for an expanded cap based on the area presented in Figure 1. The cost estimate information is included as part of Attachment 1 to

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this Memo. In addition, TechLaw prepared a more detailed cost estimate of the dry excavation costs as a stand-alone remedial cost. These cost estimates were prepared using CH2MHill costs. This information is also included as part of Attachment 1 to this Memo.

It should be noted that the expansion of the dry excavation would reduce the overall expanse of the cap or reduce the dredging area as shown on the attached Figure 1. The expansion of the dry dig area may also result in reduced costs due to potential access issues for dredging in these shallow sections of the river.

Mechanical Dredging - Best Management Practices

In order to provide information on potential BMPs for minimizing sediment loss from mechanical dredging, TechLaw contacted Ryba. Based on discussion with Ryba, a typical procedure for using an environmental clam-shell bucket would include maximizing the use of an environmental clam-shell bucket. (i.e., use of the environmental clam-shell bucket until refusal). Following refusal, a standard clam-shell bucket would be required. While blow-count information obtained prior to initiation would be used as a guide to determine the approximate extent of dredging using the environmental clam-shell bucket, the field implantation would be based on actual refusal.

As an example, Ryba has provided a series of BMPs used at the Kinnickinnic River project. These BMPs are included as Attachment 5 of this Memo. A project summary of this project is included as part of Attachment 2.

Hydraulic Dredging

EPA ask TechLaw to develop a cost estimate for using hydraulic dredging for the Ansul site. TechLaw contacted Ryba to obtain this estimate; however, Ryba did not provided a site-specific cost estimate due to the many uncertainties associated with the site. These uncertainties include potential space limitation at the site and the likelihood that mechanical equipment (standard clam-shell bucket) would have to be brought in for removal the harder material (i.e., semi-consolidated materials). Based on this information Ryba indicated that hydraulic dredging appeared to be a substantially higher cost remedial option, even for a limited area in the Turning Basin. In addition, the likely need to use a standard clam-shell bucket for removal of semi-consolidated materials will potentially mitigate a portion of the benefits of hydraulic dredging. Based on this information, it appears that Ansul should prepare a detailed cost evaluation of these options based on their site-specific information regarding the site.

Operations and Maintenance

Both the Draft SRWP and the Draft AMRSRP approaches do not clearly identify the operation and maintenance requirements of the remedy.

Potential O&M activities identified by TechLaw include the following, some of which were identified in MRSRAE (URS 2003) as well:

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Capping:

- Monitor to establish evidence that the contamination under the cap remains isolated from the aquatic environment and is mitigating migration of contaminants into or out of the cap
- Monitor to comply with MNR requirements
- Monitor to verify maintenance of cap thickness
- Inspect and test the cap to document continued integrity
- Repair of the cap if scour or settlement occurs, and additional placement of cap components as necessary

The extent of O&M will depend on the quality of cap placement, quality of capping material used and the dynamics of the river environment. It is assumed that these O&M activities will be implemented at a minimum for 30 years or as agreed by stakeholders.

Dredging:
The SRWP approach will require the following O&M activities:

- Monitor to comply with MNR requirements
- Maintain BMPs during dredging of the semi-consolidated material and performance of assessment steps to ensure the BMPs are successful
- Monitor of water quality to assess impacts if any and modify approach as needed.

If you have any questions regarding this memorandum, please contact Brad Martin at 312-345-8960.

cc: A. Wojtas, EPA Region 5
C. Kerzhner, EPA HQ (electronic only)
B. Smith/Central Files (electronic only)
TechLaw Chicago Files

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REFERENCES

U.S. Environmental Protection Agency (EPA). 2011. http://www.epa.gov/glnpo/aoc/menominee.html (accessed on May 2, 2011)

CH2MHILL, 2010a. Draft Sediment Removal Work Plan, Prepared for Tyco Fire Products LP. December 2010.

CH2MHILL, 2010b. Draft Alternative Menominee River Sediment Removal Plan, Prepared for Tyco Fire Products LP. December 2010.

EPA. 2009. Administrative Order on Consent, Ansul Incorporated, Stanton Street Facility, Marrinette, Wisconsin, February.

EPA. 2009b. Administrative Order on Consent Attached Scope of Work, Ansul Incorporated, Marrinette, Wisconsin, February.

EPA. 2007. Statement of Basis for Ansul Fire Protection, Stanton Street Facility. September 12, 2007.

EPA. 2007b. Ansul Final Decision and Response to Comments, for Ansul Fire & Saftey, Inc., Marrinette, Wisconsin, 2007.

EPA, 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, EPA-540-R-05-012, Office of Solid Waste and Emergency Response, OSWER 9355.0-85 December 2005.

URS Corporation (URS). 2003. Menominee River Sediment Remedial Alternatives Evaluation, Tyco Safety Products – Ansul, Stanton Street Facility. November 24, 2003.

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ATTACHMENT 2

IN-SITU SUBAQUEOUS CAPPING RELATED TO ARSENIC

PRESENTATIONS ON IN-SITU SUBAQUEOUS CAPPING

In Situ Sediment Capping – NEWMOA Workshop – Remediation of Contaminated Sediment Sites – April 2010
Schuck, R.

CASE STUDIES / RESEARCH - ARSENIC/METALS

Design Consideration Involving Active Sediment Caps
Barth, E. and Reible, D. Undated.

Referenced Use of Semi-Permeable Cap: "Semi-permeable caps allow the contamination from upwelling ground water to interact with the sequestering material as the water moves through the material. An example of this is the multiple use of semi-permeable caps over hot spot areas at the McCormick and Baxter, Oregon wood-preserving site."

Referenced Use of Non-permeable Cap: "An example of a non-permeable cap to divert the upwelling ground water away from the contaminated sediments, yet having the capability to sorb contaminants is the AquaBlok^{R} cap placed in the Anacostia River cap demonstration area in Washington, DC. The upwelling ground water velocity prior to capping was approximately 4-6 cm/d, but was reduced to negligible or even negative values after capping with the AquaBlok material (USEPA, 2007)."

Issues: "Colder environments that experience freeze/thaw cycles or ice-scouring are a concern. Larger groundwater upwelling velocities, wave action, flooding, and extreme tidal movements may also result in cap heaving."

ADDITIONAL INFORMATION

TechLaw also reviewed information on EPA's Technology Innovation and Field Services Division, Contaminated Site Clean-Up Information (CLU-IN) website (www.clu-in.org); however, no organic arsenic reactive cap case studies were available.

In addition, TechLaw contacted the following reactive cap vendors, CETCO and Adventus Group, in an effort to obtain case studies and other information on potential reactive caps for organic arsenic.

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Adventus Group provided TechLaw was information on their reactive AquaBlok product; however, it was not specific to organic arsenic.

CETCO provided several case studies; however, again these studies were not specific to organic arsenic. CETCO stated, in correspondence with TechLaw,
"It is confirmed that arsenic [at the Ansul site] is the combination of arsenate+arsenite+dimethylarsenic acid (cacodylic acid)+monomethylarsonic acid.

3 out of 4 arsenic is in their pentavalent state. I would think MRM [Reactive cap consisting of the CETCO Organoclay® MRM product] should be effective, but I am not sure it would meet the design requirement unless the actual data is collected.

The methylated arsenic compounds are extremely toxic, particularly their vapor phases. I will be very hesitate [sp] to test these chemicals in our lab."

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ATTACHMENT 3

Cost Estimates

Evqluation of Tyco Cost Estimates

The Cost Estimates (Appendix F in the Draft SRWP and Appendix E in the Draft AMRSRP), of both the Draft SRWP and the Draft AMRSRP, do not present the estimated costs in a manner that supports the discussions in Section 3.2, Proposed SRWP Corrective Action Plan, of the Draft SRWP and Section 1.3, Proposed AMRSRP Corrective Action Plan for Semi-Consolidated Material, of the Draft AMRSRP. For example, the two referenced sections present the project elements in Phase I through Phase IV activities, while Appendix F of the SRWP and Appendix E of the Draft AMRSRP present lump sum and unit price items. As a result, a direct comparison of the estimated costs presented in the Appendices with respect to thee activities listed in the text of each document cannot be performed, and verification that the proposed costs are appropriate is difficult.

In order to evaluate unit prices for certain critical components of the cost estimates (e.g., line item costs which represent a significant percentage of the total cost) presented in Appendix F, Cost Estimate, of the Draft SRWP and Appendix E of the Draft AMRSRP, TechLaw contacted Ryba, a Great Lakes area contractor that routinely performs mechanical dredging and capping at contaminated sediment sites. Based on the information provided by Ryba (see Attachment 2), the unit prices for sediment removal (i.e., mechanical dredging) and cap placement appear to be reasonable. Information on Ryba's qualifications is also provided as part of Attachment 2.

Given that these critical line item unit costs appear reasonable, it generally follows that the overall costs appear reasonable; however, the following exceptions were noted which may impact the overall costs:

- Appendices F and E, Cost Estimate, of the Draft SRWP and the Draft AMRSRP, respectively, do not include post-dredging confirmation sampling costs. Since the Draft SRWP and Draft AMRSRP present different approaches, confirmation costs may differ. As a result, the estimated costs for confirmation sampling for each alternative cannot be directly compared. In addition, the cost estimates for both the Draft SRWP and Draft AMRSRP do not contain line items for either long-term monitoring of arsenic, or, in the case of the Draft AMRSRP, long-term monitoring/operations and maintenance (O&M) of the cap. Based on the AOC and remedies proposed, costs should be included for O&M and confirmation sampling and in the case of the long term O&M, discounted to a common base year to evaluate expenditures over time. TechLaw has prepared preliminary cost estimates for O&M activities which are included in this Attachment.

- Appendices F and E, Cost Estimate, of the Draft SRWP and the Draft AMRSRP, respectively, appear to contain a conversion of cubic yards to tons which is not consistent with the type of material present an is not supported with site-specific information. For example, the total amount of dredged and excavated materials is presented as 220,300 cubic yards in the SRWP

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and is estimated to be mixed with 11,243 tons of reagent. However, the cubic yardage of materials for disposal is 385,056 tons, which implies that the cubic yard to tonnage conversion is 1.7 cubic yards/tons. Typically, for soil materials, the conversion rate is typically 1.4 to 1.5 cubic yards/ton. While it is understood that soft sediment may be saturated and potentially are denser, these constitute a smaller percentage of dredged materials. It appears that site specific data should be used. Using a conversion rate of 1.4 cubic yards/ton would reduce the cost of the SRWP by over $2,000,000.

- Appendix F, Cost Estimate, of the Draft SRWP includes $ 4,297,266 for Mechanical Dredging of Semi-consolidated Sands and Silts generating 149,000 cubic yards of material. This volume was estimated using a three dimensional (3D) interpolation method using the analytical results from core sampling and drill rig sampling conducted during April and May of 2010. The arsenic concentration distribution was modeled within the 3D mesh using kriging interpolation. While this method produces a more accurate estimation of the distribution of the contamination when compared to classical statistical methods, there are uncertainties as to how closely this method compares to the volume estimates for payment using bathymetric surveys. If the volume of sediment is overestimated, then the cost of the dredging, stabilization, wastewater treatment will also be overestimated making the Draft SRWP approach less attractive economically. For example, Appendix F of the Draft SRWP contains an estimated $12,827,747 for disposal of 385,056 cubic yards of material at a RCRA Subtitle D landfill as a result of the estimated 149,000 cubic yards of sands and silts dredged from the semi-consolidated layer. Together these estimates represent approximately 55% of the estimated costs for the Draft AMRSRP. If these estimates are not accurate, the cost analysis between the Draft SRWP and the Draft AMRSRP would be dramatically affected.

- The insurance premium and performance and payment bond estimated costs in Appendix F of the Draft SRWP of $992,654 equate to more than 2.5 times that of the insurance premium and performance payment bond estimated costs in Appendix E of the Draft AMRSRP of $372,470. While it appears that this is related to the overall costs of each alternative, these costs are not discussed in the text of the Draft SRWP or the Draft AMRSRP, and currently this disparity is not substantiated.

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As part of the overall evaluation of the proposed AMRSRP cover alternative, various cost components were considered by TechLaw. The various cost components assessed include the following:

- **Operation and Maintenance (O&M):** O&M costs were not estimated in the AMRSRP alternative. Unit costs for this estimate were derived from the Menominee River Sediment Remedial Alternative Evaluation (URS 2003) and were escalated to the current year. The estimate is based on 30 years and a discount rate of 5%. Based on this estimate, an additional $3,123,908 will be required for AMRSRP alternative, which will bring the total cost of the alternative to $19,831,597.

- **Dry Excavation:** Increasing the area of the excavation as shown on Figure 1would result in an estimated incremental cost of $1,901,134. As a result of the expansion of the dry excavation, the cap footprint would be reduced. The associated reduction in the costs for capping would equate to approximately the same amount as the increase noted for the dry excavation expansion. Therefore, this configuration change has very little effect on overall cost. However, it should be noted that this cost estimate is only an analysis of the unit cost for dry excavation and does not include other costs such as water treatment, etc.
  In addition, TechLaw prepared a more detailed cost estimate of the dry excavation costs as a stand-alone remedial cost using CH2MHill costs. Based on this analysis the dry excavation costs were $14,889,052. The total SRWP with the expanded dry excavation is estimated to cost $35,375,960. The total AMRSRP with the expanded dry excavation is estimated to cost $24,675,826.

- **Focused Capping:** One of Ansul's arguments in proposing the AMRSRP alternative is that dredging the semi-consolidated sediment will compromise the vertical barrier walls in some areas of the river. The sediment in these locations has been estimated as 5,000 cubic yards. Focused capping of the portion of the sediment immediately adjacent to the vertical barrier walls would alleviate this argument. Further, the cost of capping the 5,000 cubic yards is insignificant so it would have little impact of the overall costs. It should be noted that the cap was assumed to be the same cross-section as presented in the Draft AMRSRP (12 inches of granular fill with a 3 inch buffer and 16 inches of rip-rap with a 6 inch buffer).

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ATTACHMENT 4

Questions for Marinette Marine

1) Describe how Marinette Marine (MM) uses the Turning Basin, please include a map of turning area MM uses.

MMC utilizes the turning basin during two periods of time. The first period is right after the ship is launched into the Menominee River. Attached is a powerpoint presentation illustrating the most recent launch of the second Littoral Combat Ship (LCS). The ship was towed with two tugs with 100' lines over the turning basin. The LCS was then rotated 180 degrees and brought back to MMC's dockwall. This was needed to complete some tasks on the ship more efficiently over the winter. This is typical though it does not always occur. The second period when the turning basin is used is during sea trials. MMC always drives the ship through the Ogden street bridge bow first. At some point returning from trials the ship has to use the turning basin to face the proper direction to pass through the bridge in preparation for the next trial day. During this trials period the ship's propulsion system is used and is sometimes escorted by one or two tugs for added security depending a number of factors (weather, ship's reliability and customer requests). MMC intends to launch LCS ships every 6 months along with some additional projects each year. MMC intends to have sea trials every 2 months or so with the exception of winter.

2) Describe recent historical trends of vessel size MM has been building. Include known drafts of your to date constructed vessels, including those of unsuccessful bids ,if any. Would you tell us what you could of the DOD ship propulsion system, such as the water pressures generated at the nozzles and intakes?

Attached is a table of recent MMC projects and vessel particulars. Most of the past projects had traditional propeller propulsion, though some of the propulsion system could azimuth or rotate to achieve steering in lieu of a traditional rudder arrangement. The LCS has waterjet propulsion similar to that of a jet ski. A waterjet propulsion system takes suctions from below the ship and thrusts the water through jets at the stern. There are four inlet tunnels under the ship that are each five feet in diameter. The LCS will typically run on diesel propulsion alone for maneuvering but will have over 20,000 horsepower from the diesels alone for this maneuvering mode. The waterjet thrust will vary with conditions, but the four waterjets are capable of a combined suction/discharge exceeding 1.5 million gallons per minute or 25,000 gallons per second.

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Ship	Type	Qty	Year	Length	Draft	Propulsion Type
WLB	Seagoing Buoy Tender	14	1993-2004	225'	12.6'	(1) Single Shaft Bird Johnson CP Propeller
WLM	Oceangoing Buoy Tender	16	1993-2000	175'	7.9'	(2) Ulstein 360° Steerable Z-Drive Propellers
APL	Berthing Barges	2	1998-2000	269'	5.17'	
K-Sea	Tug	1	2007-2009	131'	15-16'	GE 16V250 Diesel
Staten Island Ferry	Double Ended Ferry	3	2001-2006	310'	13.6'	Convential fixed pitch (double ended)
Vane	Tug	2	2005-2007	123'	16-19'	(2) Reintjes WAF 3455 Reduction Gears with John Deere Generator Sets (2-SSDG's & 1-EDG).
GLIB	Icebreaker	1	2001-2005	240'	16'	(2) ABB 3350 KW, Azimuthing
INLS	7 Designs - Lighterage System	191	2003-2008	78 - 87'	4 ft	
LCS	Combat Ship	4	2004-Present	377.3'	13.1'	(2) Fairbanks Morse Colt Pielstick Diesel Engines & (2) Rolls Royce Gas Turbines for a combined 84.8 MW
NOAA	Fisheries Research Vessel	1	2010-Present	208.6'	19.3'	Convential fixed pitch propeller
ARRV	Icebreaking Research Vessel	1	2010-Present	260'	19.5'	Azimuthing thruster
Bid-AHTS	Anchor Handler-ICE	2	2009	330.7'	26.24'	Azimuthing thruster
Bid-AHTS	Anchor Handler	2	2006	243.7'	26.24'	Convential fixed pitch propeller

3) **Describe concern MM may have if Ansul is allowed to put a "cap" over the soluble contamination in perpetuity.**

During the use of the turning basin, the amount of thrust needed to rotate the ship varies with the weather conditions at the time. Winds and currents in the Menominee River are not predictable even to the most experienced sea trial captain. As the ship rotates the sail area of the ship changes and the ships thrust is adjusted accordingly to compensate. MMC chief concern is the safety of the ship and the people on board and will thrust as needed during turning evolutions with little regard to the river bottom. Based on this, it concerns MMC if any limitations are placed on how we use the turning basin as it would impact our ability to safely operate the ships for a very critical validation phase of shipbuilding.

4) **Describe concern if EPA establishes legal restrictions to boat traffic that may include "no trenching, or anchoring "in areas where caps are allowed in perpetuity.**

MMC builds vessels of many sizes and functions to meet customer needs. Sea trials are by definition a trial period. Over the many years of building ships, we have experienced some issues on the maiden voyage of a ship that force us to drop anchor and re-evaluate the situation. If restrictions were placed that prohibited anchoring in the turning basin area, it would limit our options and potentially put the ship and its crew at risk if an unanticipated problem arises. We don't think there is an issue with trenching as long as the NOAA operating depths are maintained.

5) **Would MM have issues if there were limits placed on the amount of turbulence allowed in the TB?**

As discussed in item #3 above, limitations on turbulence would limit our sea trial captains on the ability to safely rotate the ship. For rotating evolutions after launch using tugs turbulence limitations would similarly reduce the tug captain's ability to safely rotate the ship. As seen in the power point presentation, one of the tugs (1800 hp) will operate in 15 feet of water and thrust as needed to hold or pull the ship in the

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turning basin to achieve the proper orientation of the ship. With a 400' ship and two towing lines each of 100' length, the 600' overall length of the tow utilizes most of the turning basin area.

6) Would MM have issues if there were decreases in the authorized TB depth?

As discussed in item #5, after the launch of LCS we utilized all of the current area and depth to safely rotate the ship. If there was any decrease in depth, that would restrict our ability to utilize tugs and rotate the ship. It would endanger MMC's ability to perform the US Navy contracts and contracts with other customers.

**Please note the LCS Contract carries a D0-A3 Rating in accordance with FAR 52.211-15, this contract is a rated order certified for national defense, emergency preparedness, and energy program use, and the Contractor shall follow all of the requirements of the Defense Priorities and Allocations System regulation (15 CFR Part 700).

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ATTACHMENT 5

Date: June 1, 2011

Subject: Diffusion Performance Prediction for a Proposed Sediment Cap

From: Dave Petrovski, Environmental Scientist, LCD

To: Gary Cygan, Tyco Project Manager, LCD

Summary: This memo provides performance predictions for a proposed sediment cap that would be placed over Menominee River arsenic-contaminated sediments adjacent to the Tyco Fire Products LP Facility in Marinette, Wisconsin. The performance predictions were obtained using a solution to a one-dimensional version of Fick's second law subject to the boundary conditions appropriate for sediment caps. Using site-characterization and transport-coefficient information provided by Tyco, and presuming an absence of advection (ground-water flow), this analysis predicts an increasing sequence of dissolved arsenic concentrations in the pore water of the cap over time. The time versus concentration predictions were then compared to 1.) the State of Wisconsin's Water Quality Criteria, and 2.) a 20 ppm Monitored Natural Recovery (MNR) stipulation provided in the facility's RCRA order. This analysis predicts the arsenic concentrations in the pore water at the base of the biologically-active zone of the cap will exceed the Water Quality Criteria for arsenic within 14 months and the RCRA MNR criterion within 5 years.

Introduction:

Provided below is a performance prediction for a proposed sediment cap that would be placed over the arsenic-contaminated semi-consolidated sediments in the Menominee River adjacent to the Tyco Fire Products LP (Tyco) Facility in Marinette, Wisconsin. This performance prediction was obtained through the use of equation 2 provided below. Equation 2 is a solution to a one-dimensional version of Fick's second law subject to the boundary conditions appropriate for sediment capping scenarios. This approach presumes an absence of advection (ground-water flow) within the cap and describes the migration of dissolved arsenic through the influence of the differing arsenic concentrations in the overly surface water and the pore water of the sediments at the base of the cap. This generates time-dependent concentration gradients and the vertical migration of dissolved arsenic into and through the sediment cap. The presumed absence of advection is consistent with the assumptions associated with Tyco's cap performance submittal (Tyco, 12/2010, Attachment 3). Although Region 5 has voiced concerns and continues to question the validity of the no advection assumption, it is presumed for the purposes of this cap performance predictive calculation. Diffusion is the end of a transport continuum and represents the minimum rate of dissolved contaminant migration through the cap.

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Specifically and subject to the presumptions outlined below, the analysis that follows provides a prediction of the time needed for diffusion to transport sufficient dissolved arsenic to exceed the State of Wisconsin's acute and chronic Water Quality Criteria in the pore water of the cap at a position six inches below its top. This was assumed to be the base of the biologically-active zone in the proposed sediment cap. Wisconsin's acute exposure Water Quality Criterion for arsenic is 339.8 μg/L or 0.3398 ppm (Section NR 105.06 (8) (c) Table 1, Wisconsin Administrative Code). The chronic exposure Water Quality Criterion is 152.2 μg/L or 0.1522 ppm (Section NR 105.06 (8) (c) Table 5, Wisconsin Administrative Code). An estimate for the time needed for the dissolved arsenic in the pore water of the cap at this location (again, 6 inches below the top of the cap) to exceed a 20 ppm MNR sediment cleanup standard for arsenic provided in the facility's RCRA order has also been prepared (U.S. EPA, Region 5, 2/2009). Should upward ground water flow occur intermittently due to the generation of natural or artificial gradients (e.g., due to floods, seiches, prop wash, etc.), the assumptions inherent in this analysis would no longer apply and the rate of arsenic transport through the cap would increase. This in turn would shorten the transit times predicted by this analysis.

This analysis addresses all the dissolved arsenic species observed at the site including; arsenate, arsenite, monomethylarsonic acid and dimethylarsonic acid; the summation of which is termed total dissolved arsenic. Total dissolved arsenic concentrations at the Tyco facility have been observed in excess of 5,000 ppm in ground-water monitoring wells adjacent to the River (5,840 ppm in MW015 on 11/23/02 and 5,800 ppm in GW029 on 1/23/03). These data indicate both the highly soluble nature of the arsenic at the Marinette facility and the proximity of ground water with elevated arsenic concentrations to the River. Using a stated average sediment concentration (there was no indication of how this average was determined), Tyco indicated that the percentage of the total arsenic contamination in the sediments that will partition (dissolve) to the aqueous phase pore water ranges from 3.44 to 5.55 percent (Tyco, 12/2010, Attachment 3). For this analysis, these partitioning percentages were applied to the arsenic concentrations provided by Tyco on a sediment isoconcentration map (Tyco, 2003), which summarized the existing sediment data at that time. On this map Tyco noted a large area of sediment 2.5 to 4.5 feet below the sediment/water interface with an arsenic concentration in excess of 10,000 ppm, and a peak sediment arsenic concentration of 18,200 mg/kg (ppm). A large portion of these materials are the semi-consolidated sediments that would be capped under Tyco's sediment capping proposal. 3.44 and 5.55 percent of 10,000 ppm arsenic is 344 ppm and 555 ppm respectively, while 3.44 and 5.55 percent of 18,200 ppm is 626 ppm and 1010 ppm respectively. Based upon these results, a source concentration (C_o) of 500 ppm for the total dissolved arsenic concentration in the pore water at the base of the cap was assumed for this analysis. This concentration is less than 10 percent of the dissolved arsenic concentrations that have been observed in the ground water adjacent to the River at the facility and within the lower end of the range of dissolved concentrations (344 ppm to 1010 ppm) obtained via the partitioning approach outlined by Tyco in Attachment 3 for the sediment that would be capped under this proposal.

The essential assumptions inherent in this analysis include: 1.) the pore water within the cap is hydrostatic (diffusion is the only transport process); 2.) arsenic in the cap is in the dissolved phase and sorption to the cap solids is unimportant; 3.) the transport process through a horizontally-oriented two-dimensional cap can be described by a vertically-oriented one-dimensional model; 4.) an effective diffusion coefficient of 4.1×10^{-10} m^2/s can be used for all of the dissolved arsenic species (total dissolved arsenic) in the sediments at the site (see equation 3 below and the accompanying discussion); and 5.) the initial arsenic concentration in the pore water throughout the cap at the start of the transport

US EPA ARCHIVE DOCUMENT

process is zero. Use of a single diffusion coefficient can be interpreted in terms of either a homogeneous cap or as a spatial average. The latter interpretation implies that approximately half of the cap will be associated with longer and half with shorter transit times than predicted by this analysis.

Method:

Fick's second law in one dimension is:

1.)
2.)

$$\partial C/\partial t = D_e\, \partial^2 C/\partial x^2$$

where: $\partial C/\partial t$ = change in the dissolved arsenic concentration with time $\{(M/L^3)/T\}$

$\partial^2 C/\partial x^2$ = change in arsenic gradient ($\partial C/\partial x$) with vertical distance $\{(M/L^3)/L^2\}$

D_e = effective diffusion coefficient (L^2/T)

A solution to this equation appropriate for predicting the migration of dissolved contaminants by diffusion through a sediment cap with time is (U.S. ACE, 2005, equation 52):

3.)
4.)

$$C(x,t) = C_o \operatorname{erfc} \{x / 2\, (D_e\ t)^{0.5}\}$$

where:

C = dissolved arsenic concentration at a distance x units above the cap's base at time t (M/L^3)

C_o = source concentration, sediment's pore water dissolved arsenic concentration (M/L^3)

x = distance within the cap above the base where the arsenic concentration is predicted (L)

t = time since the diffusion process began (T)

erfc = complementary error function (dimensionless)

Given conformance with the assumptions outlined above, equation 2 provides a forecast for the dissolved arsenic concentrations in the pore water at any elevation (x) within the cap as measured from its base as a function of time.

This calculation also assumes an effective diffusion coefficient (D_e) of 4.1×10^{-10} m^2/s for the dissolved arsenic in the cap. Although the information supplied in the submittal was not explicit, this value was inferred from the information provided by Tyco in Attachment 3 which presented their cap performance calculations (Tyco, 12/2010). Tyco's cap performance prediction approach placed different values for the diffusion coefficient, tortuosity, porosity, and the arsenic concentration gradient into Fick's first law to estimate the time needed for diffusion (assuming no ground-water flow) to transport 40 percent of the capped arsenic through the cap. Associated with what were labeled "low, medium and high mobility scenarios," these estimates were 960, 5,000 and 120,000 years respectively. Under Tyco's medium mobility scenario, an in-water diffusion coefficient (D) of 1.06×10^{-9} m^2/s was provided for the dissolved arsenic species at the facility (total dissolved arsenic). Tyco justified the use

US EPA ARCHIVE DOCUMENT

of this value by citing the in-water diffusion coefficient values for sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-) provided by Fetter, 1999. As stated in Attachment 3, the dissolved arsenic at the facility "is expected to be in a similar anionic form as these ions and therefore apparently should have a comparable in-water diffusion coefficient." Using this value for D, a value of "tortuosity" equal to (1.24), an effective porosity (φ) value of (0.6) (all provided under the medium mobility scenario) and the numerical hints provided by Tyco in Attachment 3, the effective diffusion coefficient (D_e) used in this memorandum was determined as follows:

3. $$D_e = (\varphi D/ \theta^2) = (0.6)\,(1.06 \times 10^{-9}\ m^2/s)/(1.24)^2 = 4.1 \times 10^{-10}\ m^2/s$$

where: φ = effective porosity, Tyco's "relative pore volume in sediments" (dimensionless)

D = molecular diffusion coefficient in water (L^2/T)

θ = tortuosity (dimensionless)

The Cap proposed by Tyco has a minimal thickness of 28 inches, consisting of 12 inches of "granular fill" and 16 inches of riprap (Tyco, 12/2010, Section 4.10). Although not evaluated by Tyco, the performance for permeable caps is commonly defined in terms of the dissolved contaminant concentration in the pore water at specified depth below the top of the cap. The purpose of this performance criterion is to provide an appropriate level of ecological protection for burrowing benthic organisms within the biologically-active zone in the sediments. For this analysis as mentioned above, the biologically-active depth was assumed to extend 6 inches (0.15 m) below the top of the 28 inch minimal cap thickness, or 22 inches (0.56 meters) above the cap's base. As discussed, for this analysis Wisconsin's acute (0.3398 ppm) and chronic (0.1522 ppm) Water Quality Criteria for dissolved arsenic in the pore water of the cap will be used. Consequently, this analysis will determine the time needed for the dissolved arsenic concentrations 0.56 meters above the base of the cap to reach 0.1522 ppm (the chronic Water Quality Criterion) and 0.3398 ppm (the acute Water Quality Criterion) subject to the assumptions discussed above. Given the propensity of the riprap to settle into the granular fill, it should be also noted that the actual cap thickness could be significantly less than the 28 inches assumed.

In addition, the time needed for the dissolved arsenic concentrations to exceed the MNR criterion of 20 ppm provided in the RCRA order (U.S. EPA, Region 5, 2/2009) is also provided. According to the order, Tyco would remove all of the sediment in the River with an arsenic concentration equal to or in excess of 50 ppm by November 1, 2013. Tyco could then use MNR to reduce the residual sediment contamination to 20 ppm by November 1, 2023. This MNR provision obviously assumes that the sediment and therefore pore water concentrations will decrease post remediation with time, both before November 1, 2023 as well as after. Unfortunately, this is at odds with the predicted increase in the dissolved arsenic concentrations forecast for the pore water in the cap produced by this analysis.
The RCRA 20 ppm MNR provision is subject to several interpretations:

1.) as the dissolved arsenic concentration in the pore water of the cap;

2.) as a "whole" sediment concentration; or,

3.) as a "dry" sediment concentration.

US EPA ARCHIVE DOCUMENT

Under interpretation number 1, the MNR provision would be violated if the pore water concentration was in excess of 20 ppm. Under interpretation number 2, the 20 ppm would apply to an analysis of the sediment as a whole, including both the pore water and the sediment solids. As this analysis only addresses the transport of arsenic in the dissolved phase and doesn't consider sorption to the sediment solids, a dissolved phase concentration in excess of 20 ppm would be needed to attain a whole sediment concentration of 20 ppm. Assuming partitioning to the cap solids is unimportant, a porosity of 60 percent (discussed above) and a sediment solids density equal to 2.65 gm/cm^3 (equal to the density of quartz), a dissolved arsenic concentration in the pore water of 55 ppm was calculated. Consequently under interpretation number 2, when the dissolved arsenic concentration 0.56 meters above the base of the cap exceeds 55 ppm, the MNA criterion provided in the RCRA order would be exceeded. Under interpretation 3, the arsenic in the pore water of the sediment is retained when the sediment is dried. Due to the elevated density of the solids, it was calculated that a dissolved pore-water arsenic concentration of 35 ppm was needed to produce a dry sediment concentration of 20 ppm.

Cap Performance Calculations:

Inserting the values discussed above ($x = 0.56$ m, $D_e = 4.1 \times 10^{-10}$ m^2/s, $C_o = 500$ ppm) into equation 2 produces:

$$C(x,t) = C(0.56\text{ m}, t) = 500\text{ ppm}\ \ [\text{erfc}\{0.56\text{ m} / 2 \cdot (4.1 \times 10^{-10}\text{ m}^2/\text{s} \cdot \text{time})^{0.5}\}]$$

Selecting various values for t and solving for C iteratively:

Time (t)	$0.56\text{m} / 2 \times (4.1 \times 10^{-10}\text{ m}^2/\text{s} \cdot \text{time})^{0.5}$	erfc {x, D_e, t}	C (x,t)
0.92 yr = 2.9×10^7 s	2.57	0.00028	0.14 ppm
1.0 yr = 3.15×10^7 s	2.46	0.0005	0.25 ppm
1.1 yr = 3.46×10^7 s	2.35	0.00089	0.45 ppm
2.0 yr = 6.3×10^7 s	1.74	0.014	7.0 ppm
3.0 yr = 9.45×10^7 s	1.42	0.045	22.5 ppm
4.0 yr = 1.26×10^8 s	1.23	0.082	41 ppm
5.0 yr = 1.57×10^8 s	1.10	0.12	60 ppm

Interpretation and Conclusions:

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Subject to the assumptions outlined above, this calculation predicts the dissolved arsenic concentration in the pore water at the base of the biologically-active zone 6 inches (0.15 m) below the top of a 28 inch thick cap (the cap/surface water interface) will exceed Wisconsin's chronic Water Quality Criterion for arsenic of 0.1522 ppm prior to the end of the first year (3.15×10^7 s), while Wisconsin's acute Water Quality Criterion of 0.3398 ppm would be exceeded within 14 months of the start of the diffusion process. Subsequently, the dissolved arsenic concentrations are projected to rise rapidly. After two years, the dissolved arsenic is predicted to exceed the higher acute standard of (0.34 ppm) by a factor of 20. Within 3 years, the dissolved arsenic concentration within the pore water would exceed the MNR criterion in the RCRA order of 20 ppm (interpretation number 1 discussed above), while within four years the pore water concentration will exceed 35 ppm and a "dry" sediment analysis would exceed the RCRA-order MNR criterion of 20 ppm (interpretation number 3). Within five years, the dissolved arsenic concentration in the pore water is projected to exceed 55 ppm and therefore the 20 ppm "whole" sediment MNA standard established under the RCRA order (interpretation number 2). After 5 years, dissolved arsenic at this location within the cap will also be approximately 175 times the acute exposure and 400 times the chronic exposure Water Quality Criteria for the State of Wisconsin. As time continues to progress, this analysis predicts the arsenic concentration will continue to rise until the assumed source concentration (C_o) of 500 ppm is attained. This is inconsistent with the RCRA MNR provision which assumes that the post-remediation sediment and pore water concentrations will decrease with time, both before November 1, 2023 as well as after. As noted, should upward ground water flow occur intermittently due to the generation of natural or artificial gradients, the underlying assumptions inherent in this analysis are no longer valid, and the rate of arsenic transport through the cap would increase. This in turn would reduce the time needed for the dissolved arsenic concentration to exceed the Water Quality Criteria as well as the 20 ppm RCRA MNA standard under any of the interpretations outlined above.

If you have any questions or would like to discuss this issue further, please contact me by e-mail or phone (886-0997) at your earliest convenience.

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