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U S NAVY RESPONSES TO U S EPA COMMENTS TO REVISED DRAFT FEASIBILITY STUDY SITE 8 WITH TRANSMITTAL NS NEWPORT RI
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December 8, 2011

Project Number 112G02124

Ms. Ginny Lombardo
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Reference: CLEAN Contract No. N62470-08-D-1001
Contract Task Order No. WE19

Subject: Navy Responses to EPA Comments on the Revised Draft Feasibility Study
Site 8, NUSC Disposal Area, Naval Station Newport, Rhode Island

Dear Ms. Lombardo:

On behalf of Ms. Maritza Montegross, U.S. Navy NAVFAC MIDLANT, Tetra Tech is pleased to provide responses to EPA's comments dated August 11 and September 8, 2011 on the revised draft Feasibility Study (FS) for Site 8 at the Naval Station Newport, Rhode Island. As noted, responses that are affected by RIDEM's formal dispute letter of October 5, 2011 are deferred until after the dispute resolution process is completed.

Please contact me at (978) 474-8449 or jim.ropp@tetratech.com should you have any questions.

Sincerely,

James Ropp, P.E.
Project Manager

Encl: Responses to EPA's Comments on the Revised Draft FS (email, hardcopy)

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Navy Responses to EPA Comments on the Revised Draft Feasibility Study for Site 8 – NUSC Disposal Area NAVSTA Newport, Rhode Island December 8, 2011

On August 11, 2011 and September 8, 2011, the United States Environmental Protection Agency (EPA) provided comments on the Revised Draft Feasibility Study (FS) for Site 8, the Naval Undersea Systems Center (NUSC) Disposal Area (Tetra Tech, July 2011) at the Naval Station (NAVSTA) Newport, Rhode Island. EPA's August 11, 2011 comments also referred to past comments on the Draft FS (August 2010). The Navy's responses are provided below.

AUGUST 11, 2011 COMMENT LETTER

Remaining EPA Comments (October 18, 2010) from the Draft FS (August 2010):

General Comment 6: The FS must include calculations of the total residual risks for all media and all receptors based on the proposed PRGs. The purpose of this is to ensure that by remediating the site contaminants to the proposed PRGs, the total residual risks from remaining contamination will be within the acceptable risk range and will not exceed 10^{-4}. [Note that RIDEM Regulations are an ARAR, so Navy must comply with the more stringent 10^{-5} total residual risk.]

Response: Disagree. The calculation of residual risk would not provide useful information to the team. EPA's *Risk Assessment Guidance for Superfund (RAGS) Part D Standardized Planning, Reporting, and Review of Superfund Risk Assessments* states that:

> **"The NCP indicates that for screening of remedial alternatives, the long-term and short-term aspects of three criteria – effectiveness, implementability, and cost – should be used to guide the development and screening of remedial alternatives.**
>
> **Consideration of effectiveness involves evaluating the long-term and short-term human health risks. Long-term risks associated with a remedial alternative are those risks that will remain after the remedy is complete; short-term risks associated with a remedial alternative are generally those risks that occur during implementation of the remedial alternative."**

The preliminary remediation goals (PRGs) in the FS are based on chemical-specific ARARs, background levels, or are back-calculated from acceptable risk levels. Therefore, the risk-based PRGs essentially serve as an evaluation of long-term risks associated with the remedial alternatives and, once the risk-based PRGs are met following the remedial action, then the residual risk would be less than the risk levels that the PRGs were set at.

Specific Comment 22: Page 1-20 [Page 1-34 in Revised Draft], Section 1.10.1: Although EPA's blood lead models recommend use of the average lead concentrations and the results of the models are below the EPA's level of concern, the maximum detected lead concentrations in surface and subsurface soils are 2,870 mg/kg and 4,650 mg/kg, respectively, in the exposed area. In the paved area, the maximum detected lead concentration in subsurface soil is 27,200 mg/kg. These concentrations exceed EPA's screening level of 400 mg/kg and RIDEM residential direct contact criteria of 150 mg/kg for lead. Since PRGs were not developed for lead and these high concentrations are proposed to be left in place without remediation, ICs are necessary to prevent any current or future exposures due to any potential development. [Provide further discussion of lead in this section.]

Response: Aspects of this comment pertain to RIDEM's formal dispute letter dated October 5, 2011. Therefore, a full response to this comment is deferred pending the outcome of the dispute resolution process. However, please note that the maximum concentration of lead detected in

subsurface soil at the paved area is 159 mg/kg, not 27,200 mg/kg. The detection of 27,200 mg/kg was from sediment sample DA-SD100-071207.

Specific Comment 29: Section 2.2.2, Human Health PRGs, Table 2-4: The selected soil PRGs for construction workers, industrial workers, lifelong recreational users, and hypothetical lifelong residents were set at target cancer risk level of 10^{-5}. These PRGs exceed RIDEM Direct Contact Criteria for almost all COCs. The RIDEM standards are ARARs that must be achieved by the soil remediation alternatives. For Hypothetical Lifelong Residents, all chemical risks except for naphthalene are based on RSLs (note the RSL should be 3.6). Please clarify why naphthalene is different.

Response: This comment refers to the version of Table 2-4 (PRGs for soil) in the draft FS of August 2010. An updated version of Table 2-4 was presented in the revised draft FS. Naphthalene is no longer identified as a COC in soil, as per Table 6-2 (Refinement of COCs in Soil) and Table 6-6 (Summary of COCs Retained for the FS) of the final Supplemental Remedial Investigation (SRI).

As agreed at the September 21, 2011 meeting, the draft final FS will include PRGs for the individual PAH COCs rather than using a benzo(a)pyrene-equivalent (see also the response to the new Specific Comment #4 below). Soil PRGs will be developed for the identified COCs based on the lower of the calculated risk-based values and RIDEM's Method 1 criteria, or the background level if it is higher. The PRG for arsenic (18 mg/kg) is based on background levels although it exceeds RIDEM's Direct Exposure Criterion (DEC) of 7 mg/kg.

Specific Comment 38: Page 3-10 – 3-11 [Pages 3-9 – 3-10 in Revised Draft], Section 3.3.3: The Impermeable Cap option is eliminated because Navy contends that construction of an impermeable cap would not be possible at the Paved Storage Area due to access restrictions and because infiltration would increase in areas that are not capped. EPA does not accept the premise that Navy's operational access restrictions should prevent a CERCLA cleanup nor does EPA accept that construction of an impermeable cap should be eliminated from consideration as a viable remedy. The paved area could be considered an impermeable or low permeability cover or the cap could be constructed to allow it to be paved to restore its current use. Note that if an impermeable cap is needed to comply with RIDEM Remediation Regulations leachability criteria, the cap construction would need to comply with applicable requirements. An impermeable cap option should be evaluated in the FS.

Response: RIDEM's leachability criteria were considered for soil during the development of PRGs. Table 2-4 of the draft final FS will be updated with PRGs for the individual PAH COCs and will reference the leachability criteria for the identified COCs. As summarized below, the representative site COC concentrations do not exceed leachability criteria. The maximum concentrations of benzo(a)pyrene exceeded the leachability criterion at only two adjacent locations by the northwest corner of the paved area (440 mg/kg at SB110 and 1,300 mg/kg to 1,500 mg/kg at two depths in TP15). An impermeable cap for the site is not warranted to address these two locations which can be addressed through selective excavation instead.

Soil COCs	HHRA 95% UCL in Soil (Table 6-2 of the SRI) mg/kg	ERA Average in Soil (Table 6-5 of the SRI) mg/kg	RIDEM GA Leachability mg/kg	RIDEM GB Leachability mg/kg
Benzo(a)anthracene	92.9	--	--	--
Benzo(a)pyrene	74.6	--	240	--
Benzo(b)fluoranthene	64.6	--	--	--
Dibenz(a,h)anthracene	16.2	--	--	--
Indeno(1,2,3-cd)pyrene	42.4	--	--	--
Arsenic	17.9	--	--	--

Cadmium	--	1.2	for TCLP/SPLP only	--
Chromium	--	16.5	for TCLP/SPLP only	--

Specific Comment 39: Page 3-12, Section 3.3.4: The text states: "*due to the mission critical use of the Paved Storage Area, only partial excavation is considered, which would exclude the material beneath the Paved Storage Area.*" EPA does not accept the premise that Navy's operational access restrictions should prevent a CERCLA cleanup. Site uses could be temporarily relocated while an excavation action is taken.

Response: The Navy's remedy selection will need to consider both achieving a successful CERCLA cleanup and minimizing disruptions to ongoing facility operations. As discussed during the September 21, 2011 meeting, the FS will be revised to acknowledge that the paved storage area has not been fully investigated and may contain additional buried debris. The existing pavement and fencing will prevent exposure to COCs and debris in soil beneath the paved storage area (waste management unit). Land Use Controls (LUCs) will be implemented to ensure the pavement is maintained and the groundwater monitoring program will verify that COCs are not migrating from that area over time. See also the response to EPA's August 11, 2011 General Comment #1 (below) regarding the use of LUCs to address this concern.

Specific Comment 50: Page 3-36 [Page 3-29 in Revised Draft], Section 3.5.3, Cover System and Section 6.1.3: In Section 3.5.3, under the "Consolidation and Cover System" option, the text states: "*As a result, stormwater storage capacity of the pond would be reduced*." Should this issue and associated water storage implications also be considered under the "Cover System" option? In Section 6.1.3, the sediment alternative, SD3, includes a 1 foot cover system. Again, should stormwater storage capacity implications be considered here? An additional consideration is the habitat alteration associated with capping sediment in the absence of any dredging. Given that the pond is already shallow, the addition of substrate to cover contamination could make areas too shallow to be suitable habitat for pond biota. Any site remediation should not accelerate the natural filling and possible eutrophication of the pond. Once the extent of the PRG exceedances is fully determined, it will be necessary to determine the pond depths in these areas to better decide on the appropriateness of capping. It may be necessary to use a combination of dredging and capping to ensure that habitat is not lost. Note that the sediment remedies may require mitigation for lost federal and State wetland resources, which would likely include creation/excavation of replacement pond/wetland resources.

Response: The sediment capping alternatives in the FS will be modified to further account for stormwater storage capacity (e.g., through a combination of dredging and capping).

The Navy agrees that mitigation may be required if wetlands are permanently lost, but mitigation would not be required for wetlands that are temporarily impacted if a portion of the pond is dredged.

Specific Comment 61: Sections 4.1.2 and 4.1.3: Any alternatives that leave contaminated soil in place need to be covered and meet the applicable or relevant and appropriate standards for covers, in this case likely the RI Remediation Regulations or the RI Solid Waste Regulations. The cover needs to address both contact and leachability risks posed by the contaminated soil.

Response: Comment noted regarding soil cover ARARs (see also the ARAR discussions below). Regarding leachability criteria, see the response to Specific Comment #38 above.

Specific Comment 63: Page 4-9, ARARs Section: There also needs to be a determination as to which alternative poses the Least Environmentally Damaging Practicable Alternative for protecting wetland resources under the federal Clean Water Act.

Response: The FS will be modified to include a statement regarding the Least Environmentally Damaging Practicable Alternative. See also Attachment 2 for the updated ARAR tables. Potential

impacts to wetlands are evaluated as part of the detailed analysis of alternatives and the preferred remedial alternative will be selected based on the best balance of the nine NCP criteria.

Specific Comment 77: Page 6-5, Section 6.1.3, LUCs: LUCs may also include requirements to maintain the dam for the pond to keep covered sediments from being released downstream.

Response: The LUCs do not need to include maintenance of the dam. The dam is a pre-existing site feature that is not part of the remedial alternatives. No modifications or operation of the dam (e.g., adjusting water levels) is being proposed as part of the remedial alternatives. Instead, the sediment capping alternatives will include LUCs and an operations and maintenance (O&M) program that address the cap itself. The Navy would perform the required inspections and maintenance of a sediment cap and would respond to a release or potential release of the capped sediment through the O&M program. The Navy would repair any damage to the cap or could implement a modified remedy if site conditions change significantly such that the cap would no longer be protective of human health and the environment.

NAVSTA has stated that the dam may be modified in order to address issues with the stormwater discharge permit regarding the amount of suspended solids entering the bay during storm events. That work schedule remains to be determined, but is unlikely to occur until at least after next year. NAVFAC will work with NAVSTA to ensure any future modifications to the dam do not adversely impact the sediment cap. Alternatively, NAVFAC can modify the implemented cap construction to accommodate any changes which are determined to be necessary for the dam.

Specific Comment 80: Page 6-14, Cost Section: Cost calculation should include permanent maintenance of the pond dam.

Response: See the response to Specific Comment #77 above.

Specific Comment 89: Figure 4-2: Regarding the soil cover, please clarify if this cover will be designed as a low permeability cover and provide a permeability value if known at this time. This figure makes reference to the 100-year flood elevation regarding the armored slope for the soil cover toe termination. Please clarify how the 100-year flood elevation will be determined.

Response: The purpose of the soil cover is to (1) prevent incidental ingestion and direct contact with surface and subsurface soil and (2) prevent erosion of soil containing COCs to the stream/pond. Also, as described in the response to Specific Comment #38 above, no significant leachability concern has been identified for site soil. Therefore, a low permeability cover is not required.

Based on new FEMA mapping, Site 8 is located outside of the 100-year floodplain (Flood Insurance Rate Map for Newport County, Rhode Island, effective April 5, 2010). The appropriate height of any armor stone under Alternatives SO2 and SO3 will be determined during the Remedial Design phase. Figure 4-2 will be modified accordingly. Figure 4-2 also will be modified to reference Alternative SO3 only (Alternative SO2 does not include a geotextile layer across the whole excavation area).

New EPA Comments (August 11, 2011) on the Revised Draft Feasibility Study (July 2011):

General Comment 1: In EPA's December 24, 2009 Conditional Concurrence Letter on the Draft Final RI for NUSC Disposal Area, EPA listed issues that must be considered in the NUSC FS. The following issues that were identified in that letter are not adequately addressed in the Revised Draft FS:

- *For the South Meadow, evaluation of remedial alternatives will need to consider and address the finding that additional 55-gallon capacity drums likely exist in this area (refer to page 3-9 of Draft Final RI).*

- *For the Paved Gated Storage Area, the evaluation of remedial alternatives will need to consider and address the portion of the area where the Navy was unable to complete a geophysical survey to evaluate the area for the existence of subsurface anomalies.*

With respect to the South Meadow, the Navy must present a remedial alternative for soil that includes the removal of all remaining containers in the South Meadow. Where it is known that additional drums remain in this area, EPA would expect the selected remedy to include the removal of these and any other containers in the area.

With respect to the Paved Gated Storage Area where the existence of subsurface anomalies is unknown, EPA would expect a contingency remedy to address the following situations:

- If groundwater restoration goals are not achieved in a reasonable timeframe and there is reason to believe that continuing sources of contamination from this area may be inhibiting groundwater cleanup, Navy will need to complete follow-on geophysical investigations in this area and remove subsurface anomalies.
- If the use of the site is changed, including the transfer of the property outside the Navy or elimination of the active use of the Paved Gated Storage Area, Navy will need to complete follow-on geophysical investigations in this area and remove subsurface anomalies.

Response: As agreed during the September 21, 2011 and October 5, 2011 meetings, the FS will be revised to indicate removal of the buried drums in the South Meadow. Also, the soil LUCs will include provisions to address the third and fourth bullets in the comment. The third bullet will be incorporated as requested. The fourth bullet will be modified to indicate that the additional geophysical investigation would be conducted if site use changed such that the Paved Gated Storage Area was no longer operated as a Waste Management Unit.

General Comment 2: As discussed during the Supplemental RI effort, there is currently insufficient data to support a Monitored Natural Attenuation (MNA) remedy for this site. EPA has again scored the site using the data available, including data from the latest monitoring event (Appendix D.3), by completing the checklist available in the Biochlor model which evaluates the site based on a long list of indicator parameters relevant to MNA. The result for the North Meadow plume was a score of 9 which indicates that limited evidence exists for anaerobic biodegradation of chlorinated hydrocarbons (range 6 to 14). A score of 15 or higher is indicative of adequate evidence for MNA. Strong evidence requires a score greater than 20. EPA's MNA Guidance (*Use of MNA at Superfund, RCRA Corrective Action, and UST Sites*, April 1991) states: The efficacy of MNA "… *involves collection of site-specific data sufficient to estimate with an acceptable level of confidence both the rate of attenuation processes and the anticipated time required to achieve remediation objectives.*" Navy calculated the source attenuation rate (k point) based on the data available for monitoring location MW-03B which is comprised of four samples collected over eight years, three of which were collected within the past three years. Navy calculated an attenuation rate of 0.252, but has not provided any analysis as to the confidence inherent in that estimate for the rate. Because MW-03B was the only location where more than two samples have been collected, no other locations could be evaluated for comparative purposes. EPA requests that Navy provide an independent evaluation of the confidence level for the source attenuation rate and include the calculation in the FS. Please also provide confidence levels for estimates of the time to achieve the required cleanup goals.

Response: The source attenuation rate (k point) derived from MW-03B sampling data was used for the model applied to the North Meadow plume. A separate k point was calculated from MW-07B for use of the model in the Building 179 area. The k point values will be further evaluated when more groundwater sampling data are available (e.g., from source area wells with three or more rounds of data). As agreed during the September 21, 2011 meeting, further evaluation of confidence levels and uncertainties will not be performed until more MNA data are available over time. The MNA sampling schedule remains to be determined.

As also discussed during the September 21, 2011 meeting, the Navy anticipates that MNA will be used as a follow-up to active remediation of the most contaminated groundwater areas rather than as a stand-alone remedy for groundwater at Site 8. As such, uncertainties in the MNA model are of less concern under Alternatives GW3 and GW4 than they would be under Alternative GW2. The uncertainties associated with the model in Appendix D and the effectiveness of Alternative GW2 will be clarified in the FS.

Note that the Navy disagrees with use of the scoring method for MNA analyses and instead prefers to use a weight-of-evidence approach (see discussions from the March 2011 MNA sampling event).

General Comment 3: Both soil and sediment remedial alternatives will have varying levels of habitat impacts. The remedial alternatives developed should include a remedial component and associated costs for site restoration, as appropriate.

Response: Site restoration is already included in the soil and sediment alternatives. The FS will be clarified accordingly.

General Comment 4: If the extent of contamination depicted in Figure 2-6 is accurate, then Navy has an opportunity to minimize the area of the site that is restricted with LUCs. Only a relatively small area of subsurface contamination exists in the North Meadow and west of NUWC Pond. EPA requests that Navy consider another soil alternative that excavates all the contaminated subsurface soil from the north end of the site, so that portion of the site is available for unrestricted use and unencumbered by LUCs. This alternative could also have economic advantages in that the area could be restored without having to recreate the existing topography.

Response: LUCs would still be required due to groundwater contamination, thus unrestricted use is not achievable at this time. The identified remedial alternatives will support the continued industrial use of the site. However, it is agreed that some soil consolidation would be advantageous (e.g., discontinuous impact areas north and west of the pond) and the current remedial alternatives will be modified accordingly rather than creating a new alternative.

General Comment 5: Please include a figure in the FS that presents the wetland setback boundaries.

Response: Figure 3-14 from the RI will be incorporated into the FS.

Specific Comment 1: Page 1-35, Section 1.10.2, and Page 2-6, Section 2.2.1: Page 1-35 states: "*The chemicals in groundwater exceeding threshold values for the construction worker scenario were not selected as COCs for industrial groundwater because the representative site concentrations (95% UCL) did not exceed the calculated risk values.*" Page 2-6 states: "*Although the RI identified risks to construction workers from exposure to metals in groundwater, the screening steps conducted in Section 1.10 of this FS eliminated metals as COCs for the construction worker because the representative (95% UCL) site concentration in groundwater did not exceed the calculated target risk value.*" Clarify these statements. Provide a list of the constituents that these statements apply to. Is the Navy indicating that a qualitative risk analysis was done for the groundwater contaminants with levels exceeding screening values? If so, provide the analysis that supports these conclusions.

Response: As agreed during the September 21, 2011 meeting, the FS will be clarified to explain the COC refinement step conducted in Section 6 of the SRI. The HHRA conducted during the RI identified aluminum, beryllium, chromium, iron, and manganese in groundwater as a concern for the construction worker receptor. Upon further evaluation in Table 6-1 of the SRI in which representative site concentrations were compared to target risk levels, only chromium was retained as a COC to be addressed in the FS for the construction worker receptor (based on the conservative assumption that chromium is present as Cr^{+6} rather than Cr^{+3}).

Specific Comment 2: Page 2-10, Section 2.3.1, 5th Bullet: This RAO was revised from the August 2010 Draft FS. The August 2010 Draft FS included the RAO as: "*Prevent the migration of contamination to the surface water and sediment via groundwater transport.*" In EPA's October 18, 2010 Letter, Specific Comment 2, EPA offered comments on this RAO requesting that Navy establish how compliance with this RAO would be monitored and achieved and requesting that the Navy ensure that remedial alternatives proposed meet this RAO. The Revised Draft FS revises this RAO to: "*Prevent the migration of sediment COCs that could cause unacceptable ecological risk to pond and stream sediment via groundwater transport and overland runoff.*" This revised language is not appropriate, since sediment COCs are not the same as COCs in groundwater and soil. The RAO should be revised to: "*Prevent the migration of groundwater COCs and soil COCs to surface water and sediment at levels that could cause unacceptable ecological risks.*" In EPA's October 18, 2010 Letter, General Comment 7, EPA indicated that surface water and sediment impacts from migrating groundwater contamination were a concern and monitoring would be required. The Revised Draft FS does incorporate requirements for surface water and sediment monitoring. Once a monitoring plan is prepared for the site, the Navy will need to establish an acceptable monitoring program for surface water and sediment and establish appropriate comparison criteria for determining compliance with this RAO.

Response: As agreed by EPA (October 5, 2011 meeting and an email on September 16, 2011), the RAO does not need to be changed because the specific COCs have already been identified for sediment. The remedial alternatives developed for soil and groundwater will reduce COC migration to the stream and pond (i.e., the actions to be taken to address soil and groundwater will be protective of sediment at the site). Because risks to ecological receptors from chemicals in the surface water are already acceptable, actions taken to mitigate COCs in groundwater and soil will not adverse impact surface water. For that reason, the FS will be modified to delete the collection of surface water samples as part of the monitoring program.

Specific Comment 3: Page 2-11, Section 2.4: It is not apparent that the subsurface soil volumes presented in the table on this page are consistent with the description in the 3rd bullet on this page. Review and correct as appropriate or clarify why Navy believes they are consistent.

Response: The FS will be corrected.

Specific Comment 4: Section 2.2.2, Human Health PRGs, and Table 2-4: Regarding the selected PRG for total cPAHs expressed as benzo(a)pyrene equivalents, the value of 2.1 mg/kg for industrial PRG is based on 10^{-5} target cancer risk level. This selected PRG exceeds RIDEM Direct Exposure Criteria of 0.8 mg/kg for industrial scenario. Since RIDEM DECs are considered ARARs, they must be achieved as cleanup goals so RIDEM DEC should be selected as PRG in this scenario.

Response: As agreed at the September 21, 2011 meeting, Table 2-4 will be revised to present PRGs for the individual carcinogenic PAH COCs identified in Table 6-6 of the SRI rather than using a benzo(a)pyrene equivalent. The PAH PRGs will be selected from the lower of the calculated risk-based value and the RIDEM criteria.

Specific Comment 5: Section 2.2.2, Human Heath PRGs, and Table 2-5: The selected groundwater PRGs were set at either target cancer risk level of 10^{-5} or target hazard index of 1. The selected PRGs for chromium, carbon tetrachloride, tetrachlorethane, vinyl chloride, and arsenic exceed existing federal drinking water standards and are not acceptable. The PRGs should be selected as the lowest levels of MCL, non-zero MCLGs, or risk-based levels. Please revise PRGs for the COCs mentioned above.

Response: As agreed by EPA (email on September 16, 2011), the cited groundwater PRGs do not require modification. The selected PRGs for chromium, carbon tetrachloride, tetrachlorethane, vinyl chloride, and arsenic were set to equal the federal drinking water MCLs (see Table 2-5 of the revised draft FS). Consistent with EPA guidance, groundwater PRGs are to be based on the lower of MCLs and non-zero MCLGs (note that no non-zero MCLGs are available for the identified groundwater COCs). A risk-based PRG was developed for COCs which do not have a MCL or non-zero MCLG.

Specific Comment 6: Section 2.2.2, Ecological PRGs, and Table 2-6: Based on EPA's comments on the Supplemental RI, it was agreed that lead would be included as a COC for sediment in both stream and pond sediment. Table 2-6, however, does not include a PRG for lead for the pond. The Navy should establish a PRG for lead in sediment in the pond.

Response: The ecological-PRGs developed for pond sediment included a probable effects concentration quotient (PEC-Q), which incorporates lead into the calculation. During the April 14, 2011 technical meeting, the team agreed that an ecological PRG specific for only lead would not be developed for pond sediment because there was a poor relationship between lead concentrations and toxicity in the pond sediment samples.

Also note that, upon further review of the RI report, it is realized that lead in stream sediment should also be identified as a COC for human health (the revised draft FS only listed lead as an ecological-based COC in stream sediment). The stream sediment PRG for lead will be revised accordingly in Table 2-6 of the FS. Human health PRGs for lead in sediment for construction workers and industrial workers calculated using EPA's adult lead model would be 1,900 mg/kg and 2,200 mg/kg, respectively. The PRG for residential exposures would be 400 mg/kg; however, the current and planned future use of the site is industrial.

Specific Comment 7: Page 3-2, Section 3.1, Containment: The last sentence of this section should refer to both surface water and groundwater movement. Please edit the text accordingly.

Response: Agree. The text will be modified, as requested.

Specific Comment 8: Page 3-10, Section 3.3.3, Conclusion: The report states "*soil PRGs and groundwater conditions do not require mitigating COC leachability in soil.*" Subsurface vadose soil concentrations in the South Meadow exceed the RIDEM leachability criteria. Therefore, remedial alternatives must be designed to eliminate leaching in those areas where the criteria are exceeded.

Response: See the response to the 10/18/2010 Specific Comment #38 above.

Specific Comment 9: Page 3-16, Section 3.3.6, Conclusion: The conclusion that on-site consolidation has no significant advantages is not supported by the prior discussion of this technology. It appears that utilization of this technology could result in potentially significant cost advantages. EPA requests that Navy consider developing an additional soil alternative that incorporates on-site consolidation, which would reduce the off-site disposal cost for arsenic-impacted soil as compared to SO2, and would reduce the volume of imported soil as compared to SO3.

Response: See the response to August 11, 2011 General Comment #4 above.

Specific Comment 10: Page 3-19, Section 3.4.2, MNA: The report states: "*more data over time would be helpful for further evaluating the effectiveness of MNA at the site.*" It is EPA's understanding that Navy is committed to conduct additional rounds of MNA sampling. Please provide a schedule for the planned additional sampling program. See General Comment 2 above. It is likely that more data will be required to establish a reasonable confidence level for any MNA remedy component.

Response: The Navy plans to conduct additional rounds of MNA sampling; however, the schedule remains to be determined. See also the response to General Comment #2 above. It is acknowledged that the level of uncertainty in attenuation rates makes selection of a MNA-only alternative more difficult; however, the available information coupled with the conceptual site model (plumes are relatively diffuse and are contained by the stream/pond system) suggest that MNA can be a successful remedy component following active treatment of the highest COC concentrations in groundwater. The Biochlor model presented in the FS indicated that remediation goals can be achieved within a reasonable timeframe in this case.

Specific Comment 11: Page 3-20, Section 3.4.3, Hydraulic Containment: Please edit the 2nd and 3rd sentences of the description here to state: "*A hydraulic containment system is similar to an extraction well system but the purpose of the two systems differs somewhat. The wells used in a hydraulic containment system would be designed and situated to provide optimum efficiency in holding contaminated groundwater in place to minimize migration whereas an extraction system would be focused on maximizing the removal of contaminant mass.*"

Response: Agree. The text will be modified as requested.

Specific Comment 12: Page 3-21, Section 3.4.4, Extraction Wells: Consistent with the SC11, edit the 1st sentence of the description here by changing the word *identical* to *similar*.

Response: Agree. The text will be modified as requested.

Specific Comment 13: Page 3-29, Section 3.5.3, Consolidation and Cover System: The report limits consolidation options to only one that creates an upland area out of the existing pond area. EPA requests that Navy consider developing an additional sediment alternative that includes consolidation of sediments within the pond.

Response: As discussed during the October 5, 2011 meeting, the FS will be revised to include an additional alternative for sediment consolidation within the pond. Sediment would be consolidated into the deeper end of the pond although a certain volume of sediment would need to be removed in order to maintain the current flood capacity of the pond.

Specific Comment 14: Section 4: See comments 38 and 61 of EPA's October 18, 2010 comments (restated above). If leachability criteria are exceeded in vadose soil, then an impermeable cover would be required to limit leaching. The data suggest that the leachability criteria exceedances are limited to a small area in the South Meadow.

Response: See the response to October 2010 Specific Comment #38.

Specific Comment 15: Section 4.1.2 and 4.1.3, Removal of Anomolies, and Figures 4-1 and 4-3: These Sections indicate that "*soil/debris including geophysical survey anomalies, buried drums, and the paint can area near the site entrance would be excavated from the limits identified*" on Figures 4-1 and 4-3. However, elsewhere in the report, it is stated: "*The existing pavement over the Paved Storage Area would serve as a cap and soil/debris located within its limits would not be excavated.*" Confirm that all 4 anomolies depicted in Figures 4-1 and 4-3 will be excavated. In addition, in EPA's December 24, 2009 Conditional Concurrence Letter on the Draft Final RI for NUSC Disposal Area, EPA listed the following issue to be addressed in the NUSC FS:

- *For the Buried Container Area, evaluation of remedial alternatives will need to consider and address the finding that some unknown quantity of paint cans and associated soil lead contamination remain south of the excavated area and constitute a continuing source of contamination to the sediments in Deerfield Creek and NUWC Pond (see page 4-84 of the Draft Final RI).*

Confirm that the limits of the paint can area excavation depicted in Figures 4-1 and 4-3 adequately corresponds to the remaining paint cans and soil lead contamination referenced in the Draft Final RI.

Response: The four anomalies are planned for removal (selective excavation). The remainder of the paved storage area will not be excavated and will be a Waste Management Unit. See also the response to August 11, 2011 General Comment #1 above. The FS text/figures will also be clarified to indicate removal of the remaining paint can area.

Specific Comment 16: Section 4.1.2 and 4.1.3: Additional details on LUCs should be provided. What uses would be prohibited?

Response: The FS will be clarified regarding the specific restrictions to be included in the LUCs. Further details regarding the LUCs will be provided in the Land Use Control Remedial Design (LUC RD) following the ROD.

Specific Comment 17: Page 4-2, Section 4.1.2: In the discussion of LTTD, indicate the volume of soil to be treated.

Response: The FS will be clarified to indicate that the volume of soil to be treated using LTTD is approximately 4,300 cubic yards.

Specific Comment 18: Page 4-3, Section 4.1.2, Verification Sampling: The report indicates that verification samples will be used "*for comparison the industrial PRGs and for generating a post remedial action risk assessment.*" However, existing data shows that subsurface soils exceed industrial PRGs (e.g., Figure A-5), so what is the purpose of the verification sampling? If industrial PRGs are exceeded, will additional excavation be completed? In addition, what is the purpose of the post remedial action risk assessment? Will both existing subsurface soil data and the verification sampling be included in this risk assessment? The collection of sidewall samples will be important and should be collected every 25 feet of excavation perimeter. The report only refers to sidewall samples "*from the slope of the soil/debris that remains onsite below the Paved Storage Areas.*" Sampling of all sidewall areas will be needed.

Response: As discussed at the October 5, 2011 meeting, sampling of the exposed soil and the post-remedial action risk assessment will be deleted because the alternative is intended to provide for 2 feet of clean soil in support of continued industrial use of the site. Sampling of excavation sidewalls will be included to verify the proper extent of soil is removed. One verification sample collected from the bottom of each of the excavated anomaly areas may be collected for informational purposes.

Specific Comment 19: Section 4.2.2: This Section does not discuss the findings of the verification sampling and how that data will be used to demonstrate overall protection of human health and the environment and/or compliance with ARARs. If the verification sampling can support the demonstration of compliance with these evaluation criteria, it should be discussed here.

Response: The FS will be clarified accordingly. See also the response to Specific Comment #18 above.

Specific Comment 20: Page 4-9, Section 4.2.2, Long-Term Effectiveness and Permanence: The report states: "*Although not all of the…geophysical anomalies would be removed from the site*". The report must clarify what anomalies will remain and what additional risks these pose. See General Comment 1 and Specific Comment 15.

Response: The FS will be clarified accordingly. See the responses to General Comment #1 and Specific Comment #15 above.

Specific Comment 21: Page 4-10, Section 4.2.2, Implementability: What is the level of As that will be allowed in the PAH contaminated soil that is planned for LTTD treatment and reuse onsite? How significant is the impact of debris on the volume of soil that can be treated with LTTD?

Response: See Figures 2-3 and 4-1 of the FS. Soil containing arsenic above PRGs will not be treated using LTTD. Because only surface soil (0 to 2 feet) is planned for LTTD treatment, the impact of debris on the volume of soil is not expected to be significant.

Specific Comment 22: Page 4-11, Section 4.2.3: Please supplement the discussion of Alternative SO3 to describe to what extent, if any, it will reduce the flood capacity of the flood plain. Also, it is not feasible to install two feet of soil cover along the creek, the stream, and the pond perimeter as shown in Figure 4-3 without any excavation. This is not discussed in the alternative. However, it appears to be addressed in

the cost estimate by excavation and regrading to allow the placement of clean fill cover in these areas. Please confirm.

Response: Figure 4-3 will be modified to show that the soil cover does not include the creek. The soil cover will not reduce the flood plain capacity.

Specific Comment 23: Page 4-13, Section 4.2.3, Implementability: The text refers to "*removal of hot spot areas*" and "*backfilling for consolidation*". Please clarify.

Response: The text will be corrected to refer to "waste anomalies" (rather than "hot spots") and "backfilling" instead of "backfilling for consolidation".

Specific Comment 24: Page 4-15 Section 4.3: The cost comparison table on this page states that the annual O&M/LTM costs for alternatives SO2 and SO3 would be the same. However, there are 50% more wells to monitor for SO3. Please review and correct as appropriate. Address this same issue in Appendix C which bases O&M/LTM costs on 10 wells for both of these alternatives, which contradicts the text description of the alternatives.

Response: The inconsistency will be corrected.

Specific Comment 25: Section 5 and Table 5-3: Specific comments 67 and 68 of EPA's October 18, 2010 letter are only partially addressed in the revised draft. The report must be revised to include discussion of the mobilization of arsenic and manganese that can occur when reductive dechlorination remedies are employed. Navy needs to supplement the discussion throughout the FS to acknowledge this fact and discuss how this may result in levels of As and Mg *[sic]* above the elevated levels already present. In addition, the report provides remedial information and timeframes for CVOCs, but a comparable discussion on attenuation of metals and expected timeframes to achieve metals cleanup goals needs to be included. The report does include general statements such as *"(i)t is expected that as CVOCs contamination is depleted, these metals contaminants would also be subsequently attenuated through physical and chemical processes*" and "*metal contamination would be naturally attenuate over time*" and "*(e)levated concentrations of metal COCs…would also be attenuated through naturally-occurring processes after CVOCs are depleted in the subsurface*". However, Navy must include additional discussion to support that MNA would attenuate metals in groundwater and that remedial goals would be achieved in a reasonable timeframe. The report should explain that following depletion of CVOC contamination, the groundwater aquifer should re-establish aerobic conditions which would then provide for the binding of the metals to the aquifer solids. Reference to EPA's Guidance, *MNA of Inorganic Contaminants in Groundwater*, October 2007 (http://www.epa.gov/nrmrl/pubs/600R07139/600R07139.pdf) or literature studies could be provided as support.

Response: Reductive dechlorination of CVOCs can cause changes in pH and redox potential that mobilize metals bound to metal oxides (e.g., iron oxides and manganese oxides) in naturally-occurring minerals in soil and rock matrix via reductive dissolution or desorption. The fact that elevated levels of arsenic and manganese are present in site groundwater suggests this might be currently occurring. Active remediation by adding electron donor compounds to promote in-situ bioremediation (Alternative GW3) could potentially cause more mobilization of these metals and further increase their concentrations in groundwater. This issue has been briefly addressed in Sections 5.1.2 and 5.1.3 of the revised draft FS. Additional discussion will be included to elucidate the mechanisms of metal mobilization under reducing conditions caused by natural or enhanced biodegradation of CVOCs.

As suggested in EPA's comments, following the depletion of CVOC contamination and re-establishment of geochemical conditions in the aquifer that favor the binding of metals to aquifer solids, the elevated metal concentrations are expected to attenuate over time via adsorption or (co)precipitation. The FS will be revised to include additional discussion on the change of geochemical conditions and the mechanisms of immobilization of metals under such conditions.

As agreed by EPA during the November 16, 2011 meeting, accurately modeling timeframes for metal attenuation following the depletion of CVOC contamination is currently not feasible based on available information. The CVOC plumes have not been depleted at the site. In addition, no information on the mineral composition of the aquifer solids is available. More rounds of groundwater monitoring with detailed geochemical analysis would be needed to establish any temporal changes in metal concentrations and characterize the trend of CVOC depletion and change in geochemical conditions. Recharge from upgradient groundwater and infiltration would also need to be characterized to evaluate the extent and rate of metal attenuation after CVOC depletion. At this time, the FS can only include a rough estimate of the timeframe required for the additional metals attenuation, based on estimated aquifer replenishment rates.

The FS (and the ROD) will be clarified to indicate that additional cleanup time for the metals in groundwater will be necessary after CVOCs are remediated and that additional monitoring would be performed. This will be a follow-on approach to active remediation of the CVOC plumes. MNA for metals is a recognized remediation option and there is reason to believe that, following remediation of the CVOC plumes, the metals concentrations in groundwater resulting from the release of naturally occurring metals in site soil would be reduced over time due to the restored aquifer quality.

Specific Comment 26: Page 5-6, Section 5.1.3, and Page 5-8, Section 5.1.4: The report indicates that a pilot study would confirm well spacing and the application rate for treatment for GW3 or GW4. Please discuss how the pilot study would address bedrock contamination which is assumed to migrate via fractures and therefore presumably has inconsistent structural geology throughout the site.

Response: The FS will be revised to include additional discussion on the pilot study. A pilot study would be conducted at a selected location that is most representative of the heterogeneous condition in the fractured bedrock aquifer across the site. It would provide valuable information on typical conditions that may be encountered under certain fracture structures. Supplemented with understanding of the fracture characteristics across the site and by adding necessary safety factors into design parameters, the final design of Alternative GW3 or GW4 would be able to better address the concerns for uncertainty in the heterogeneity of the fractured rock aquifer.

Specific Comment 27: Page 5-13, Section 5.2.2, Short-Term Effectiveness: Clarify the discussion in the 2nd paragraph. The discussion apparently refers to two separate RAOs so edit the text to make it clear which RAOs are achieved when.

Response: The discussion will be clarified as follows to address specific RAOs:

> ***"The RAO to prevent the use of site groundwater for human consumption would be achieved immediately upon implementation of LUCs and monitoring. Alternative GW2 would attain the RAO to restore groundwater quality to its beneficial use once COCs reach the cleanup goals within an estimated 35 to 50 years for the attenuation of CVOCs plus the additional time needed for the attenuation of residual metals concentrations (e.g., to be determined based on future monitoring data trends)."***

Specific Comment 28: Page 5-14, Section 5.2.2: Correct the section number for GW-3; it should be 5.2.3.

Response: Agree. The section numbering will be corrected in Section 5 and the table of contents.

Specific Comment 29: Page 5-17, Section 5.2.3: Correct the section number for GW-4; it should be 5.2.4.

Response: Agree. The section numbering will be corrected in Section 5 and the table of contents.

Specific Comment 30: Page 5-22, Section 5.3: Edit the second full sentence on the page to read: "For Alternative *GW-4*, …."

Response: Agree. The text will be corrected.

Specific Comment 31: Section 6.0: Throughout the discussion of sediment remedies, the text indicates that: "*Damaged ecosystems are expected to recover within five years through repopulation from upstream sources.*" Similar statements occur in other sections of the document. However, these statements are not substantiated. There is no upstream pond from which seed stock for emergent and submerged vegetation could drift downstream to the pond. Therefore, it seems unlikely that there would be substantial rapid recovery if vegetation were eliminated from shallow areas of the pond. Provide support that upstream sources can provide adequate sources of flora and fauna for repopulation of the pond where remedies are proposed to excavate and/or cover/cap the existing biota.

Response: The FS will be clarified that the five year time frame for repopulation is a rough estimate, given that there is not a significant amount of aquatic vegetation in the pond, and most vegetation in the pond would have originated from upstream sources such as the wetland and associated stream. The vegetation in the shallow portion of the pond is just an extension of the adjacent wetland vegetation into the pond. Therefore, it is not necessary to have an upstream pond to provide vegetation to the NUWC Pond.

Specific Comment 32: Page 6-3, Section 6.1.2, ENR Sediment Cover: EPA would expect acoustic surveys to confirm cover placement. Revise the text discussion on acoustic surveys to: "*Acoustic surveys will be performed prior to and after placing the cover material to confirm that the required cover layer thickness has been achieved.*" What timeframe does Navy believe will be required to adequately augment the six inch applied cover with another six inches of natural cover? What is the basis for the sedimentation rate?

Response: The Navy does not have sedimentation rate data and does not know how long it would take for an additional six inches of sediment to deposit over six inches of applied material. However, as agreed during the October 5, 2011 meeting, the six inches of applied material would be sufficiently protective of benthic invertebrates because the biologically active zone is typically the top few inches, especially in ponds where the sediment can become anoxic. The FS will be clarified that any additional sediment that naturally deposits on top of applied sediment would just serve as extra protection, but it is really not necessary to be protective of ecological receptors.

The FS will be modified to include acoustic surveys to confirm proper remedy implementation.

Specific Comment 33: Section 6.1.3: Alternative SD3 includes the placement of a geotextile membrane as part of a cover system for contaminated sediments. However, a geotextile membrane was not included in the retained sediment process options provided in Section 3.5. In addition, EPA is concerned about the proposed use of geotextile fabric as an underlayment for a sediment cap. Using geotextile fabric would immediately smother any existing benthic organisms and would likely be more destructive to pond life than a gradually-applied sand or other cap. The geotextile might also become exposed (as often occurs on banks and in terrestrial settings) in which case it may become a more inhospitable substrate for life than the existing contaminated sediments. If the Navy has documentable reason to believe that geotextile fabric offers a substantial benefit, this needs to be explained further in the FS.

Response: As noted in Section 6.3, each of the sediment alternatives will have some degree of impact on the benthic population. As discussed during the October 5, 2011 meeting, the description of Alternative SD3 will be modified to indicate that the geotextile layer will serve three purposes: (1) to support the cover soils (cover stability); (2) to better separate the underlying sediment with the clean cover soil (prevent mixing); and (3) to act as an indicator layer in the event of cover erosion. Potential concerns with the use of a geotextile will also be further discussed (e.g., limited longevity in a pond, difficult to maintain, effect on existing benthic organisms). Sections 3.5 and 6.1.3 of the FS will be modified accordingly.

As also discussed during the October 5, 2011 meeting, the FS will be revised to discuss the wetland sources upstream of the pond which would serve to recolonize the plants and benthic organisms in the pond.

Specific Comment 34: Page 6-5, Section 6.1.3, Verification Sampling: Revise the text discussion on acoustic surveys to: "*Acoustic surveys will be performed prior to and after placing the cover material to confirm that the required cover layer thickness has been achieved.*"

Response: Agree. The text will be modified accordingly.

Specific Comment 35: Page 6-7, Section 6.1.4, and Page 6-16, Section 6.2.4: The text on page 6-7 states: "*the dewatering process is expected to be supplemented using filtration bags and an absorbent agent*" and "*sodium polyacrylate will be added to each truck…to absorb any additional free water…*" However, Page 6-16 states: "*This alternative does not provide any active treatment technologies…*" See EPA's October 18, 2010 letter, Specific Comment 4. The remedial elements noted on Page 6-7 for Alternative SD4 may partially meet the criterion for treatment and should be noted on Page 6-16.

Response: Agree. Section 6.2.4 will be revised to note the volume reduction and partial treatment of the dewatering process. (Note: It is assumed EPA meant to refer to Specific Comment 5 in the October 18, 2010 letter.)

Specific Comment 36: Page 6-9, Section 6.2.1, Cost: Correct the discount rate to 2.3 percent, which is the rate used for the soil and groundwater cost evaluations. 2.3 percent is the latest Office of Management and Budget real discount rate. Please make this same correction for all the sediment alternatives.

Response: The cost estimates provided in the revised draft FS are based on a 2.3 percent discount rate. The description in the text will be corrected.

Specific Comment 37: Page 6-11, Section 6.1.3, Short-Term Effectiveness: Clarify whether SD2 would be effective and protective once the initial 6-inch cover has been placed or whether it would not become effective and protective until after the natural enhancement has occurred resulting in a 12-inch cover.

Response: See the response to Specific Comment #32 above.

Specific Comment 38: Table 2-4: Please clarify why RIDEM's leachability criteria are not applicable for site soil. Benzo(a)pyrene concentrations far in excess of RIDEM's leachability criteria exist in subsurface vadose soil in the South Meadow (TP-15A and SB 110). The absence of significant PAH concentrations in groundwater does not obviate the need to satisfy the RIDEM leachability criteria.

Response: See the response to October 18, 2010 Specific Comment #38 above.

Specific Comment 39: Table 3-1, Page 3: Phytoremediation using ferns has been found to be a very effective treatment technology for remediating arsenic is soil. The screening comments need to be revised to acknowledge this. The existence of the paved area is not a valid reason to screen out this technology, as it could be applied in other areas that are not paved.

Response: Further discussion in the screening of phytoremediation will be included in Section 3 of the FS. Phytoremediation will not be retained for development into a remedial alternative in Section 4. As noted in Table 3-1, the types of contaminants and the presence of debris are also of concern. Other concerns include its uncertain full-scale effectiveness and the lesser protection against soil erosion to stream and pond sediment.

Specific Comment 40: Table 3-3, Page 2: The rationale for eliminating consolidation of sediment within the pond is that this would reduce the storage capacity of the pond. However, sediment consolidation

can be combined with some level of excavation in a way that would not reduce storage capacity of the pond. See Specific Comment 13. Such an alternative could require less cover material thus maintaining a greater storage capacity than alternatives that only cover existing sediment in place.

Response: See the response to Specific Comment #13 above.

Specific Comment 41: Figures 1-4, 1-5 and 1-6: In Figure 1-4, add the wells and borings that make up the cross-sections. The vertical datum for Figure 1-4 is NGVD 1929 whereas the vertical datum for the cross-sections, Figures 1-5 and 1-6, is said to be NGVD 1988. If correct, the elevations for the plan and cross-section figures will not coincide. Note that NGVD 1988 is an incorrect designation; it should be NAVD 1988. Please also confirm the datum used for the water level elevations shown on Figures 1-5 and 1-6. Please review and correct these figures as appropriate so that one consistent vertical datum is used throughout the FS.

Response: The datum and elevations will be checked and corrected as needed.

Specific Comment 42: Figure 2-3: The extent of surface soil contamination depicted in this figure is somewhat different from the extent of contamination depicted in Figures 4-1 and 4-3. Correct the inconsistencies, as appropriate.

Response: The figures will be corrected.

Specific Comment 43: Figure 2-10: This figure indicates that PRG exceedances were detected in the north end of Deerfield Creek. However, there is no figure showing which contaminants account for the PRG exceedances (lead and PCBs do not). Please add the appropriate figures to document why the north end of Deerfield Creek needs to be remediated.

Response: Sample location SD-111 contained 1,520 J mg/kg of lead which exceeds the lead PRG of 1,233 mg/kg. The proposed excavation area will be revised accordingly.

Specific Comment 44: Figure 4-1: It appears that some of the remediation work may occur within the wetland setback boundaries. Please edit the text of the FS to acknowledge this for each of the alternatives.

Response: The FS will be revised accordingly. Figures 4-1 and 4-3 also will be revised so that the generalized remediation areas exclude the streams (alternatives to address stream sediment are presented in Section 6).

Specific Comment 45: Figure 6-2: Please revise this figure to acknowledge the supplemental natural sedimentation cover that is a component of this remedy.

Response: Agree. The figure will be revised accordingly.

Specific Comment 46: Appendix B.1:

a. Page 1: The calculations state that the "*area of surface soil PAH contamination (industrial)*" is 173,181 sf and that the "*total area of surface soil exceeding industrial PRGs*" is 175,908 sf. Review of Figure 2-3, which shows the limits of surface soil contamination, indicates that the area of arsenic contamination without PAH contamination is much greater than the difference between the above referenced areas (which is only 2,727 sf). Please review and correct the calculations or the figure as appropriate.

Response: There are some overlaps in the areas exceeding PAH and arsenic PRGs on Figure 2-3. The calculations will be clarified or corrected as necessary.

b. Page 3: Regarding the number of verification samples required, please note that verification samples will be required in order to reuse the LTTD treated soil and sidewall verification samples will be required at the perimeter of the excavations.

Response: Verification samples for LTTD treated soil will be added to calculation sheet and cost estimate.

Specific Comment 47: Appendix B.2:

a. Page 2: The calculations for GW2 refer to 49 existing monitoring wells; however, Appendix B.1 notes that 25 monitoring wells will be abandoned to construct a soil remedy. Please adjust the costing to account for replacing the abandoned wells as necessary so that an appropriate monitoring network will be constructed. If necessary, adjust the monitoring costs for the groundwater alternatives.

Response: Appendix B.2 (Quantity Calculations for Groundwater Alternatives) will be clarified that the cost for replacing the abandoned wells has already been accounted for in soil alternatives SO2 and SO3. It would be redundant to include this cost in groundwater alternatives. For groundwater alternatives, it is assumed that 49 wells (both existing and newly constructed replacement) would be available for monitoring.

b. Page 3: The calculations refer to the Emulsified Oil Design Tool spreadsheets as the basis for the design values provided on this page. Provide copies of the spreadsheets, a list of the assumptions made, and the documentation that supports the adequacy of the design parameters used for costing.

Response: Copies of the Emulsified Oil Design Tool spreadsheets, including the assumptions used, selected design parameters, and output parameters, are provided in Attachment 1 of this response document. Note that some information in the Emulsified Oil Design Tool (e.g., life cycle analysis and net present value calculation) were not used to develop the quantities and cost in this FS. Documentation of the Emulsified Oil Design Tool can be found at the SERDP website http://www.serdp.org/Tools-and-Training/Environmental-Restoration/Perchlorate/Emulsion-Design-Tool-Kit.

c. Page 6: Please elaborate on the design basis and assumptions used to determine that 1,500 gallons of Fenton's reagent would be appropriate for groundwater treatment. What experience from other sites with contamination in bedrock groundwater is Navy relying on to establish the design parameters for this site?

Response: The challenge with using Fenton's reagent for ISCO at Site 8 will be the effective delivery of reactants to the right place in the fractures. The pilot study proposed in Section 5.1.4 would help determine the actual quantity of Fenton's reagent to be used. The 1,500 gallons of 12.5 percent Fenton's reagent used in the conceptual (FS-level) design for Alternative GW4 was based on application rate estimates from other projects. A preliminary quote for an overburden project at NWS Charleston was used to estimate the volume of reagent for the purposes of estimating the cost of the alternative. In addition, during a pilot study in bedrock at former NAS South Weymouth, some injection wells received 500 to 2,300 gallons of reagent. This amount of Fenton's reagent is equivalent to approximately 6 grams of oxidant per kilogram of media at the site, which is more than what is needed theoretically for degradation of CVOCs and 1,4-dioxane in groundwater of the target treatment zones. This dosage with optimized delivery rate from a pilot study should be able to account for uncertainties associated with delivery efficiency, the short life of radicals, and potential reactions with other constituents in aquifer solids and groundwater. Note that the median value of catalyzed hydrogen peroxide (Fenton's reagent) used in ISCO designs is 1.2 grams oxidant per kilogram of media based on an ISCO case study database (Siegrist et al., *In Situ Chemical Oxidation for Groundwater Remediation*, Springer, 2011).

d. Page 6: In the third last line on this page please correct the typo in the equation: it should be 2,800 hours/8 = 350 hours.

Response: Agree. The typo will be corrected.

Specific Comment 48: Appendix C:

a. SO2: The description of Line item 6.7 erroneously refers to treated soil. The volume of 10,447 tons for off-site disposal corresponds with the volume calculated in Appendix B.1 (7,050 CY = 10,4547 tons) so apparently none of the LTTD treated soil is assumed to require off-site disposal. Please correct the title of this line item.

Response: Agree. This line item in the cost sheet will be corrected.

b. SO2: For Site Restoration, please note that verification samples of the treated soil will be required before it can be reused at the site. Please account for that in the costs. Also, unless accounted for in the treatment cost line item, some analysis of the soil to be treated will likely be required to properly treat the contaminated soil. Please clarify this.

Response: Verification samples of the treated soil will be added to the calculation sheet and cost estimate. Also, the FS will be clarified to indicate that the additional soil samples are assumed to be part of the treatment cost line item.

c. SO3: For line item 6.4, it is likely that significantly more than four verification samples will be required because of the excavation that will be required along the creek, stream, and pond perimeter to allow the placement of the soil cover. Please review and adjust this assumption as appropriate.

Response: Such additional excavation prior to cover construction was not accounted for in the conceptual-level design of the FS. These details will be further developed in the Remedial Design phase. For purposes of the FS cost estimate at this time, additional verification samples will be included.

d. SO3: Line Item 6.6 requires 4 waste characterization samples for only 22 tons of soil destined for off-site disposal. Please review and correct or clarify.

Response: One sample was assumed for each of the four anomaly areas.

e. SO3: For Line Item 8, Monitoring Well Replacement, please correct the numbers used to correspond with the assumptions presented in Appendix B.1 (not the same as SO2).

Response: The cost estimate will be corrected.

f. SO3: For the recurring LTM costs, please correct the numbers used to correspond with the assumptions presented in Appendix B.1 (not the same as SO2).

Response: The cost estimate will be corrected.

g. GW2: Please clarify whether any of the 49 wells in the proposed monitoring network will need to be re-installed based on the abandonment of 25 wells as described in the soil alternatives. If so, please include the costs associated with installing the new wells. The same comment applies to alternatives GW3 and GW4.

Response: See the response to Comment #47a above.

h. SD2: For Line Item 7.3, please clarify that this cost is to install the six-inch cover in the pond, because significantly less than 2 acres of dredging will be required for this alternative. Sediment removal is likely to be a combination of excavation in the south end and dredging in the north end – are these costs reflected in this cost estimate?

Response: Line Item 7.3 will be clarified accordingly. The cost for excavation is accounted for in Section 6 of the capital cost sheet (will be clarified).

i. SD3: For Line Item 7.5, please clarify that this cost is to install the two six-inch cover layers in the pond because significantly less than 2 acres of dredging will be required for this alternative. Sediment removal is likely to be a combination of excavation in the south end and dredging in the north end – are these costs reflected in this cost estimate? Also, please clarify the difference in unit costs for this line item versus line item 7.3 in SD2 (this difference may indicate that both layers are applied in a single pass for SD3).

Response: Line Item 7.5 will be clarified accordingly. The cost for excavation is accounted for in Section 6 of the capital cost sheet (will be clarified). The difference in unit cost for hydraulic dredging between SD2 and SD3 reflects the difference in cost and time for equipment setting up and the time needed for placing the cover material(s) using hydraulic dredging. Note that SD2 would place a single 6-inch fine-grained sand or silty sand cover, while SD3 would place a 6-inch sand layer and a 6-inch granular layer on top of the geotextile.

j. SD4: Costs will be required to contain, collect, analyze, and treat the water removed from the sediment in the geotubes. Please include estimates for those costs for this alternative.

Response: The cost table will be clarified. It is assumed that the water generated from dewatering process would be treated (filtered) prior to discharging back to NUWC pond (see Section 6.1.4 on page 6-7). This would include the water removed from the sediment in the geotubes. The cost for dewatering and filtration is included in the overall cost of hydraulic dredging. Therefore, a separate cost for contain, collect, analyze, and treat the water removed from the sediment in the geotube is not needed.

Specific Comment 49: Appendix D.1:

General Response: EPA has provided several comments regarding the uncertainties and limitations of the available MNA data. These comments were discussed during the September 21, 2011 meeting, and the Navy anticipates that MNA will be used as a follow-up to active remediation of the most contaminated groundwater areas rather than as a stand-alone remedy for groundwater at Site 8. As such, uncertainties in the MNA model are of less concern under Alternatives GW3 and GW4 than they would be under Alternative GW2. The uncertainties associated with the model in Appendix D and the effectiveness of Alternative GW2 will be clarified in the FS.

a. No hydraulic conductivity testing was conducted within the footprint of the North Meadow plume. Navy used hydraulic conductivity data collected from the entire site and calculated a geometric mean value that was used for modeling. For reference, the geometric mean of the hydraulic conductivities for the three wells in the North Meadow is approximately one-half of the value used in Navy's modeling.

Response: Hydraulic conductivity was tested in the North Meadow in three wells: MW-114, MW-115 and MW-116. The geometric mean of the hydraulic conductivity tests in those three wells were used in the Biochlor model for the North Meadow. The mean value in the North Meadow bedrock is much higher than the mean value for the remainder of the site. Appropriate hydraulic conductivity values were used in both Biochlor models.

b. Other values used in the modeling such as effective porosity and fraction of organic carbon are estimated from literature values and may not accurately represent the site conditions. While it is

not inappropriate to use such values in the absence of field data, doing so increases the uncertainty for the results obtained from the modeling.

Response: Comment noted. These parameters were varied during modeling and it was found that the model is not very sensitive to these parameters.

c. Navy has estimated the effects of treatment by postulating residual plume shapes and contaminant concentrations to establish baseline conditions for MNA modeling following treatment. While this is not inappropriate, the baseline conditions are only a guess and therefore add considerable uncertainty to the modeling results. It is not known if the assumptions used are conservative.

Response: Comment noted. Several post-treatment plume configurations were considered and modeled. The configuration presented in the FS was considered to be the most reasonable estimate of the post-treatment plume based on the available information.

d. The source attenuation rate (k point) was calculated based on four data points from one well because no other well has more than two data points. The result is that a significant modeling parameter was calculated using a very limited data set which results in significant uncertainty as to the accuracy of the value calculated.

Response: See the response to General Comment #2 above. The attenuation rates will be further evaluated when more groundwater data are available.

e. For bio-treatment, the k point value was arbitrarily increased to 0.8 and the downgradient first-order decay coefficients (lamdas) were increased five-fold to simulate the effects of the bio-treatment. However, no supporting justification for a three- to four- fold increase in k point or a five-fold increase in lamda is presented in the FS. The accuracy of these estimates is unknown.

Response: Comment noted. Recommended values have not been found in the literature. The additional uncertainty will be noted.

f. The modeling performed by Navy assumes that MW-03B is the source of the TCE contamination. However, there may be reason to believe the source could be elsewhere. MW-117B is somewhat upgradient of MW-03B and had a TCE concentration in 2008 of 730 µg/L whereas MW-03B had a TCE concentration of 190 µg/L in 2008. If groundwater actually flows from MW-03B to MW-117B then that could account of the TCE concentrations observed otherwise MW-117B may be independent of MW-03B.

Response: Based upon measured groundwater levels -03B and -117B are essentially cross-gradient of each other. Therefore, there would be no advective flow/transport directly from MW-03B to MW-117B. However, contaminant transport in a cross-gradient direction and via dispersion from MW-03B to MW-117B occurs may account for the observation of plume migration in this direction. However, based on the results of the most recent sampling event, MW-03B was found to be the most appropriate assumption for use in the model. A summary of TCE concentrations in MW-03B and MW-117B over time is provided below. Further evaluation of source area attenuation can be conducted when more groundwater data are available (e.g., k point values at MW-03B and MW-117B).

	TCE CONCENTRATIONS (ug/L)			
	MW-03B (screen 4-24 ft)	**MW-117B**	**MW-117B-D1 (screen 19-29 ft)**	**MW-117B-D2 (screen 29-39 ft)**
2003	1500	--	--	--
2008	190	730	--	--
2010	150	--	140	130
2011	340	--	16	--

g. No geophysical data has been collected from the wells within the footprint of the North Meadow plume. Of the North Meadow wells, only MW-114B and MW-115B have geophysical data. Therefore, the bedrock structure in the plume footprint is at this point uncharacterized adding uncertainty to the modeling results presented.

Response: Bedrock structure in the North Meadow has been characterized from the data from MW-114B and MW-115B, as well as the observations made during drilling/well installation.

Specific Comment 50: Appendix D.2: Comments provided for Appendix D.1 generally also apply to the modeling performed for the South Meadow and Building 179 plume.

Response: Comment noted. See the responses to Specific Comments 49a through 49g above.

Specific Comment 51: Appendix E, Sustainable Evaluation of Remedial Alternatives: EPA did not complete a detailed technical evaluation of the analysis presented in Appendix E. In general, EPA supports Navy's efforts to evaluate the sustainability of planned remediation efforts and identify opportunities to mitigate environmental impacts of the remediation. EPA agrees that these considerations can be evaluated under the short-term effectiveness criteria. In addition, EPA agrees with Navy's statement here that *"(t)he results presented …are provided with the intention of giving more information in order to make a more intelligent decision on which treatment to use*". Further, EPA suggests that a valuable use of the results presented here will be in the design of the selected remedy to ensure that the drivers of any significant impacts are considered and that those environmental impacts are mitigated to the extent practicable. The Navy's efforts should be consistent with EPA Region 1's Clean and Green Policy issued on February 18, 2010 (http://www.clu-in.org/greenremediation/docs/R1GRPolicy.pdf). In addition, EPA has developed a number of Green Remediation Fact Sheets that provide best management practices (BMPs) for a number of common remediation processes. Navy should consider these as they move forward with the remediation of the NUSC site: excavation and surface restoration (http://www.clu-in.org/greenremediation/docs/GR_Quick_Ref_FS_exc_rest.pdf), bio-remediation (http://www.clu-in.org/greenremediation/docs/GR_factsheet_biorem_32410.pdf), and clean fuel and emission technology (http://www.clu-in.org/greenremediation/docs/Clean_FuelEmis_GR_fact_sheet_8-31-10.pdf). Review of these BMP fact sheets may provide additional recommendations for reducing the environmental footprint of the remedies that could be added to the Recommendations Section of this analysis.

Response: As noted in Appendix E and during the October 5, 2011 meeting, the Navy is following DOD policy and DON guidance documents for evaluating and implementing sustainable remediation practices. EPA's Clean and Green Policy and Green Remediation Fact Sheets also would be considered during the remedy development process, particularly during the Remedial Design.

SEPTEMBER 8, 2011 COMMENT LETTER

Responses to EPA's comments dated September 8, 2011 are provided below. The comment numbering from the EPA's original letter was retained. EPA also provided revised ARAR tables for the FS.

Response: The Navy has revised the ARAR tables provided by EPA in accordance with the other responses provided herein (see Attachment 2).

New EPA Comments (September 8, 2011) on the Revised Draft Feasibility Study (July 2011):

General Comment 1: Throughout the FS, it is unclear where the Navy intends to allow "limited recreation" (page 2-9, Section 2.3.1). If limited recreation is to be allowed in any area where soil contamination is present, the LUCs need to identify the allowed recreational uses and where recreational use will not be permitted.

Response: As agreed during the November 16, 2011 meeting, the FS will be modified to indicate that recreational use does not occur at the site. The current and anticipated future use of the site is industrial. Occasional use of the property by Navy employees for walking, jogging, and picnicking does not constitute recreational use. This type of limited worker exposure is already covered in the risk assessment as part of the industrial use scenario. Site 8 is a restricted access area with security enforced by both NUWC and NAVSTA and public recreational use will not occur. Although the HHRA evaluated fishing as a potential exposure scenario, the pond is not used for fishing and, as noted in the RI, could not support subsistence-level fishing in any case.

Also, as agreed during the November 16, 2011 meeting, the FS will be clarified to indicate that the crushed-stone roadway (used for walking/jogging along the northeastern site perimeter) is not part of Site 8. The site boundary will be drawn at the west edge of the road.

General Comment 2: With respect to LUCs for groundwater, the FS should address whether groundwater uses beyond consumption need to be considered in the LUCs. EPA would expect that the groundwater LUCs would prevent all uses of groundwater (e.g., consumption, irrigation, etc.) or show that other uses do not pose an unacceptable risk. The FS should include a discussion of how groundwater LUCs may impact adjacent property owners and how that will be addressed in the LUC RD.

Response: As agreed by EPA (email on November 16, 2011), the FS will be modified to indicate that groundwater LUCs would prohibit the installation of groundwater supply (extraction) wells, including public and private drinking water wells and irrigation wells in addition to prohibiting any use of groundwater as potable. Section 5 of the FS (e.g., last paragraph on page 5-4) will be modified to indicate that the Navy will coordinate with the adjacent property owner and state agencies (e.g., Department of Public Health and RIDEM) to prevent the installation of a groundwater extraction well by Site 8.

Specific Comment 1: Page ES-2: Revise the RAOs to be consistent with the RAOs listed in Section 2.3.1.

Response: Agree. The listing of RAOs in the Executive Summary will be corrected to match those in Section 2.3.1 of the FS.

Specific Comment 2: Page 2-4, Section 2.1.4.1, Groundwater: In the first sentence change: "Federal MCLs and non-zero Maximum Contaminant Level Goals (MCLGs) for drinking water" to "Federal MCLs, non-zero Maximum Contaminant Level Goals (MCLGs), and federal risk-based standards for drinking water."

Response: Agree. The sentence will be modified as requested.

Specific Comment 3: Page 2-4, Section 2.1.4.1, Groundwater: Replace the last sentence with: "As discussed in EPA groundwater remediation guidance, in State's without an EPA-approved CSGWPP, CERLCA groundwater remediation must meet federal MCLs and risk-based standards."

Response: The text will be modified to read as follows:

> **"As per EPA groundwater remediation guidance, in states without an EPA-approved CSGWPP, CERLCA groundwater remediation must meet federal MCLs and risk-based standards, unless the water is non-potable."**

Specific Comment 4: Page 2-4, Section 2.1.4.2: Remove the third sentence since floodplain standards would apply if the remedial action (even if not in a mapped floodplain) could cause downstream flooding (for instance through management of water levels at the dam) and the federal/state coastal zone for the base extends across the operable unit.

Response: Disagree. Site 8 is located outside of the 100-year floodplain per FEMA mapping and is outside of the 200-foot coastal zone delineation. The site wetlands are under the jurisdiction of RIDEM, not the Coastal Resources Management Council (source: Freshwater Wetlands Jurisdictional Boundary: Middletown, Rhode Island, April 2001, http://www.dem.ri.gov/maps/wetjuris.htm). Also, the pond sediment will be remediated through either capping or dredging options which will not impact downstream areas. Potential impacts during construction activities would be addressed through ARARs related to dredging and erosion and sediment controls. The design of the sediment remedy will be such that there is no net loss of water storage capacity in the pond (i.e., capping would be combined with dredging). And as noted in the response to 10/18/2010 Specific Comment #77, the dam is not part of the remedial alternatives. Management of water levels at the dam is not currently performed by NAVSTA and is not proposed in the FS remedial alternatives. If a sediment cap option is selected, then a pre-design investigation would be conducted to verify that the cap design will be sufficient to withstand the flow through the pond (e.g., armoring would be provided if needed). The pre-design investigation would include flow measurements and sediment transport evaluations.

[On November 16, 2011, EPA provided the following follow-up comment:]
The RI Freshwater Regulations would be the relevant ARAR for wetland issues.

Rhode Island Freshwater Wetlands Laws (RIGL 2-1-18 et seq.)	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other freshwater wetlands in the state. Actions required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction to a wetland.

Regarding the November 16 follow-up comment, the RIDEM regulation will be cited rather than the law (see Attachment 2 of this response document).

Specific Comment 5: Page 3-16, Section 3.3.6, Onsite Landfilling, Implementability: Add at the end of the third sentence: "or the RI Remediation Regulations, depending on the characteristics of the waste and the regulatory status of the disposal area."

Response: Agree. The text will be modified, as requested.

Specific Comment 6: Page 3-42 – 3-43, Section 3.7.1, Reduction of Toxicity: Remove all references to recycling meeting this criterion.

Response: Agree. The text will be modified, as requested.

Specific Comment 7: Page 4-7, Section 4.2.1, Long Term Effectiveness: Add at the end of the last sentence: "(following federal TBC risk guidances) and exceeding RI Remediation Regulation criteria."

Response: It is assumed that this comment refers to the previous subsection on page 4-7 entitled "Compliance with ARARs". The text will be modified, as requested.

Specific Comment 8: Page 4-9, Section 4.2.2, Compliance with ARARs: If PCB levels in the soil exceed 1 ppm, the Navy needs a separate EPA finding under TSCA that the proposed alternative will not pose an unreasonable risk of injury to health or the environment.

[Note: EPA provided the following additional comment in an e-mail on 10/31/11:]

One of EPA's follow-up actions from our conference call on 10/11/11 regarding the ARARs comments and responses was to clarify the EPA's position on the applicability of the TSCA regulations and the need for the EPA finding regarding risk under TSCA. Dave Peterson and I have reviewed the PCB data in the RI and SRI and held discussions with the EPA risk assessor and the EPA project manager for TSCA. Our position on the applicability of TSCA is clarified below:

EPA's reference to PCB levels of above 1 ppm was a general guideline for triggering the question of whether TSCA is applicable. If a PCB-contaminated material meets the definition of a PCB remediation waste as defined under 40 CFR Section 761.3, it is regulated for cleanup and disposal under the federal PCB regulations at 40 CFR Part 761.

Under this definition, if a PCB source with greater than or equal to 50 ppm was present at the Site in or after 1978/1979, which could have caused or contributed to PCB contamination, TSCA would apply. The burden is on the generator to provide justification for why PCB contaminated material is not regulated for cleanup and disposal under TSCA. Since NUSC is a former disposal area and PCB sources exist or existed at the base, EPA does not believe that Navy will be able to reliably support that the PCB contamination in soils and sediment at NUSC did not result from a PCB release from a regulated PCB source.

Therefore, without reliable justification that it is not regulated, we conservatively assume that it is regulated. This does not impact the risk assessment conclusions or the remedial alternatives being evaluated. TSCA provides for the use of CERCLA risk assessment guidance for evaluation of risk from PCBs. Therefore, the risk assessment completed in the RI for PCBs for soils and sediment is valid. However, TSCA does need to be included as an ARAR for the reasoning noted above.

Furthermore, consistent with TSCA requirements, EPA will need to make a finding under TSCA 761.61(c) that the proposed alternative will not pose an unreasonable risk of injury to health or the environment. As such, EPA requests that the Navy consider this, as appropriate, in the FS and EPA proposes that the following language be incorporated into the proposed plan:

> "Human Health and Ecological Risk Evaluations were conducted using CERCLA risk assessment methods and guidance. The assessments concluded that leaving PCBs in-place (disposal) at the present concentrations does not pose an unreasonable risk to public health or the environment based on current and proposed future use. The remedy does include [provide general details of selected remedial components for soils and sediments; e.g., placement of a cap (e.g. clean soil, asphalt, etc)], which would provide additional protection to Site receptors. Accordingly and based on the provisions of 40 CFR § 761.61(c), EPA has determined that in-place management of PCB-contaminated soils and sediments will not pose an unreasonable risk to public health or the environment."

The only unresolved issue for us on this matter is the question of recreational use of the site. EPA's comments on recreational use were discussed at the 10/11/11 conference call and Navy committed to clarify where recreational uses would be allowed and whether any recreational uses would be allowed within the NUSC boundaries that are the subject of the planned remedial actions. If recreational uses will be allowed on the NUSC property following the remedial actions, EPA will need to consider those uses and whether the finding under TSCA for the selected remedy is still acceptable.

Response: Regarding recreational use, see the response to General Comment #1 from September 8, 2011 above.

As discussed during the RPM Meeting on November 16, 2011, the Navy disagrees that TSCA is an ARAR for Site 8. Per EPA guidance documents, TSCA requirements do not apply to PCBs at concentrations less than 50 parts per million (ppm). The guidance does not limit the 50 ppm to

disposal scenarios, but rather indicates that this is the level at which TSCA "applies." At Site 8, the maximum detected PCB concentrations are 5 ppm in soil and 3 ppm in sediment. In an e-mail sent to EPA on December 1, 2011, the Navy cited the following references used in establishing this position:

(1) Guidance on Remedial Actions for Superfund Sites with PCB contamination, (EPA/540/G-90/007, August 1990)

- **Page 11, Section 2.2 (TSCA PCB Regulations), 2nd paragraph: "TSCA requirements do not apply to PCBs at concentrations less than 50 ppm;…"**
- **Page 11, Section 2.2 (TSCA PCB Regulations), 3rd paragraph: "In selecting response action strategies and cleanup levels under CERCLA, EPA should evaluate the form and concentration of the PCB contamination "as found" at the site, […] Cleanup levels and technologies should not be selected based on the form and concentration of the original PCB material spilled or disposed of at the site prior to EPA's involvement…"**
- **Table 2-1 (Remediation Options for PCB Waste under TSCA): Under the column heading of "PCB Concentration (ppm)", there are no values shown below 50 ppm except for PCB container, which is not the case for Site 8.**

(2) RCRA, Superfund, and EPCRA Monthly Hotline Report, September 1997 (EPA530-R-97-005i SUB-9224-97-009)

- **CERCLA, 3. PCBs at CERCLA Sites, 2nd and 3rd paragraphs: "The 50 ppm concentration level applies to the PCB-contaminated material "as found" at a CERCLA site not "as generated." At site cleanups not under CERCLA authority the PCB anti-dilution provision provides that response action strategies and cleanup levels be based on the form and concentration of the original PCB material spilled or disposed of at the site..... EPA should evaluate the form and concentration of the PCB contamination "as found" at a CERCLA site when selecting response action strategies and cleanup levels (Guidance on Remedial Action for Superfund Sites with PCB Contamination, OSWER Dir 9355.4-01, PB91-921206). At a CERCLA site, if a transformer containing PCB-material at 100 ppm were to leak into the soil, contaminating the soils with PCBs, the response action strategies and cleanup levels would be based on the concentration of the PCBs found in the soil rather than the concentration of the original PCB material contained in the transformer. Thus, if the concentration of PCBs in the soil is less than 50 ppm when excavated, then TSCA requirements would not be applicable...."**

(3) Revisions to the PCB Q and A Manual, January 2009 <http://www.epa.gov.osw/hazard/tsd/pcbs/pubs/qacombined.pdf>

- **Page 48, (for §761.50(b)(3)(i) "Pre-'78 waste"): "Question 9: If a pre-1978 release resulted in PCB soil levels <50 ppm (so that soil would not meet the definition of "remediation waste"), can the Regional Administrator require cleanup pursuant up TSCA? Answer: No. Under §761.50(b)(3)(i)(A), the Regional Administrator can require cleanup based on a finding of unreasonable risk only if the PCB concentration as found at the site is ≥50 ppm."**

Based on these specific references, the Navy's position is that TSCA is not an ARAR for Site 8 because the as-found PCB concentrations are well below 50 ppm. It is clear from these references that TSCA was not intended to deal with CERCLA sites where details regarding the original release are relatively unknown, thus, the guidance allows you to use the "as-found" concentrations instead.

Specific Comment 9: Page 6-8, Section 6.2.1, Compliance with ARARs: In the last sentence change: "from state and federal regulations" to "from federal regulations and risk-based standards derived from federal TBC guidances."

Response: Agree. The text will be modified, as requested.

Specific Comment 10: Page 6-10, Section 6.2.2 and Page 6-13, Section 6.2.3; Compliance with ARARs: The alternatives only meet ARARs if the remedial actions can meet EPA sediment remediation guidance standards and federal ecological risk-based standards for freshwater sediments. The Navy needs a separate EPA finding under TSCA that the proposed PCB cleanup standard is protective and the remediation process (including management and dewatering of excavated sediments containing PCBs) will not pose an unreasonable risk of injury to health or the environment. To satisfy federal and State wetland and floodplain standards, the alternative needs to included mitigation to replace alteration of wetland resources and lost flood storage capacity (or show that filling in the shoreline of the alteration of waterways and waterbodies will not increase the risk of downstream flooding). The alternative needs to identify mitigation measures that will be taken.

Response: The sediment standards were developed using EPA guidance documents. The Contaminated Sediment Remediation Guidance for Hazardous Waste Sites document will be added to the ARAR tables as a TBC. Sediment exceeding the developed PRGs will be addressed through dredging and capping.

The FS will be clarified to discuss mitigation measures that may be required if wetlands are permanently lost, but mitigation would not be required for wetlands that are temporarily impacted if a portion of the pond is dredged. The sediment capping alternatives will also incorporate some dredging in order to prevent lost flood storage capacity. However, note that the original purpose of the pond was to provide irrigation water, not to prevent downstream flooding.

Regarding TSCA, see the response to Specific Comment #8 above.

Specific Comment 11: Page 6-15, Section 6.2.4, Compliance with ARARs: The Navy needs a separate EPA finding under TSCA that the proposed PCB cleanup standard for the stream and pond sediments is protective and that the remediation process (including management and dewatering of excavated sediments containing PCBs) will not pose an unreasonable risk of injury to health or the environment. To satisfy federal and State wetland standards the alternative needs to include mitigation to replace alternation of wetland/aquatic habitat resources. The alternative needs to identify mitigation measures that will be taken.

Response: See the response to Specific Comment #10 above.

Specific Comment 12: Table 2-1: Refer to EPA's November 22, 2010 comments on the August 2010 Draft FS, Comment 1. Revise Table 2-1 to address this ARARs comment. The "consideration" text proposed in the original comment can be revised, as appropriate, to reflect the Navy's remedial plan for restoring groundwater throughout the site (i.e., not using the waste management area designation). [The language in the "consideration" text for "National Primary Drinking Water Regulations", page 2 of 2, is acceptable.] The VI Guidance, noted as a TBC in the November 22, 2010 Comment 1, does not need to be included. In addition, remove the last line of the Table (Water Quality Regulations).

Response: Agree, except it is noted that NRWQC were not used to develop PRGs. Also note that the Paved Storage Area is being handled as a waste management unit.

Specific Comment 13: Table 2-2, Page 1: Although the "Floodplain Management" ARARs text is consistent with EPA's November 22, 2011 Comment 3, EPA requests that the "Floodplain Management" ARAR be replaced with the following to be consistent with more recent ARARs decision documents:

Floodplain Management and Protection of Wetlands, 44 C.F.R. 9	Relevant and Appropriate	Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.	The effects the remedial action, particularly in regard to the sediment and soil alternatives, on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by sediment remediation, monitoring, or other remedial activities will be mitigated in accordance with requirements. The site is upstream of coastal flood zone. Remedial actions that involve remedial activities that may affect downstream floodplain areas will include all practicable means to minimize harm to and preserve beneficial values of floodplains. The Navy will solicit public comment regarding proposed impacts to wetlands and floodplains in the Proposed Plan. The comments received will be addressed in the Responsiveness Summary in the ROD for this operable unit.

Response: Partly agree. The requirement of solicitation from the public is an administrative requirement. In any case, public comment will be obtained when the Proposed Plan is presented, including comments on the wetlands and floodplains. No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects of this ARAR do not need to be considered (see also the response to September 8, 2011 Specific Comment #4 above). Methods to minimize impacts on wetlands and mitigation methods will be identified during the Remedial Design phase of the selected alternative. See also the updated ARAR Tables in Attachment 2.

In addition, add the Federal Coastal Zone Management ARAR noted in EPA's November 22, 2011 letter, Comment 3.

Response: Disagree. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of Rhode Island Coastal Resources Management Council (CRMC) jurisdiction. Wetlands in the vicinity of the site are under the jurisdiction of RIDEM, not the Rhode Island CRMC.

If there are potential historic or archeological resources within the operable unit area (e.g., the dam or any structure more than 50 years old), add appropriate federal and state historic preservation ARARs.

Response: The ARARs will be added (see Attachment 2 of this response document), although at this time there are no anticipated impacts to potential historic or archeological resources.

Specific Comment 14: Table 2-2: Refer to EPA's November 22, 2010 comments on the August 2010 Draft FS, Comment 4. Revise Table 2-2 to address the ARARs revisions outlined in this comment.

Response: Disagree. As noted above, the site is not within the Rhode Island CZMA. The dam is a feature/component of the pond and not a component of the remedial alternatives. The Dam Safety regulations will not be included as ARARs. See also the response to EPA's 10/18/2010 Specific Comment #77 above.

Specific Comment 15: Table 2-3, Page 1: Although the "TSCA" ARARs text is consistent with EPA's November 22, 2010 Comment 6 proposed language, the "synopsis" and "consideration" text should be revised to the following for clarity. [Although PCBs are not a COC for soil, PCBs were found in soils above screening criteria.]

Toxic Substances Control Act (TSCA); PCB Remediation Waste, 40 C.F.R.761.61(c)	Applicable	This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in-situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.	All sediment and soil exceeding identified PCB cleanup levels will either be removed, dewatered (if required) and disposed of off-site or will be placed under a cover system that meets TSCA protectiveness standards. The dredging, transportation/dewatering, and management of PCB contaminated media will be performed in a manner to comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's sediment and soil PCB cleanup levels, along with the dredging, dewatering, and management of the contaminated media will not pose an unreasonable risk to human health or the environment.

Response: Disagree. See the response to Specific Comment #8 above.

Specific Comment 16: Table 2-3: EPA's November 22, 2010 letter, Comment 6, included proposed revisions to Table 2-3. Some of the proposed revisions are addressed in the Revised Draft FS, Table 2-3. However, not all proposed revisions were made and some of the ARARs included in the August 2010 Draft FS version were deleted and need to be re-incorporated into Table 2-3. To address these inconsistencies, add these additional federal action-specific ARARs:

Safe Drinking Water Act (42 U.S.C. §300f et seq.); National primary drinking water regulations (40 C.F.R. 141, Subparts B and G) **Agree. Even though these are cited in the chemical-specific tables they will be included here for clarity in their use during the monitoring and LUC program. As EPA**	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved.

provided on November 16, 2011, the ARAR "consideration" text will be revised to read "These are monitoring standards used to ensure contaminated groundwater does not migrate beyond the compliance zone for areas where waste is managed in place."			
Safe Drinking Water Act (42 U.S.C. §300f *et seq.*); National primary drinking water regulations (40 C.F.R. 141, Subpart F) **Agree. Even though these are cited in the chemical-specific tables they will be included here for clarity in their use during the monitoring and LUC program. However, MCLGs set at zero will not be included. As EPA provided on November 16, 2011, the ARAR "consideration" text will be revised to read "These are monitoring standards used to ensure contaminated groundwater does not migrate beyond the compliance zone for areas where waste is managed in place."**	Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered.	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved.
Health Advisories (EPA Office of Drinking Water) **Agree. Even though these are cited in the chemical-**	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used	Groundwater within the Site must achieve this standard. Groundwater use restrictions will be maintained until the standard is achieved.

specific tables they will be included here for clarity in their use during the monitoring and LUC program. As EPA provided on November 16, 2011, the ARAR "consideration" text will be revised to read "These are monitoring standards used to ensure contaminated groundwater does not migrate beyond the compliance zone for areas where waste is managed in place."		for drinking water. The risk-based standard for manganese is 0.3 mg/L.	
CWA National Recommended Water Quality Criteria (NRWQC), 40 CFR 122.44) **Agree, for monitoring activities during sediment remediation. See also Attachment 2.**	Relevant and Appropriate	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments	Water quality standards used to develop monitoring standards sediment and soil remedial alternatives at the Site.
Clean Water Act - National Pollutant Discharge Elimination System (NPDES), 40 CFR Parts 122 and 125 **Agree. This will be included although the State has NPDES authority.**	Applicable	Establishes the specifications for discharging pollutants from any point source into the waters of the U.S. Includes stormwater standards for activities disturbing more than one acre.	Any water discharged to surface water bodies during remedial activities will comply with this regulation. Best management practices will be used to meet stormwater standards during the remedial action.
Toxic Pollutant Effluent Standards, 40 CFR 129 **As agreed by EPA during the November 16, 2011 meeting, this regulation will be deleted. See also Attachment 2.**	Applicable	Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.	Any water discharged to surface water bodies will meet the standards identified in this regulation.

Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs), 42 U.S.C. 7411, 7412; 40 C.F.R. Part 61 **Disagree. See below for explanation.**	Applicable	NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.	If remedial activities include thermal treatment these emissions standards will be met. In addition excavation, standards for particulate matter will be met during excavation and handling of contaminated sediments. Activities during construction will include measures to suppress dust.
Generation of investigation derived waste USEPA OSWER Publication 9345.3-03 FS, January 1992 **As agreed during the November 16, 2011 meeting, this TBC will be deleted. See also Attachment 2.**	To Be Considered	Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.	IDW will be managed in a manner to protect human health and the environment.
EPA Groundwater Protection Strategy (August 1984; NCP Preamble, Vol 55, No. 46, March 8, 1990, 40 CFR Part 300, p. 8733); Guidelines for Ground-Water Classification (November 1986) **Agree; however, the "consideration" column text will be modified to be consistent with the examples provided in Attachment 2 of this response document.**	To Be Considered	The Groundwater Protection Strategy provides a common reference for preserving clean groundwater and protecting the public health against the effects of past contamination. Guidelines for consistency in groundwater protection programs focus on the highest beneficial use of a groundwater aquifer and define three classes of groundwater. These documents defined Class I, II and III groundwaters.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved.
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA-540-R-05-012 OSWER 9355.0-85 December 2005) **Agree.**	To Be Considered	Guidance for making remedy decisions for contaminated sediment sites.	This guidance will be considered in addressing contaminated sediment alternatives involving Monitored Natural Recovery, Thin Layer Capping, Dredging, and/or Cover/Capping. The guidance also addresses dewatering, and disposal of the contaminated sediments.
Clean Water Act; General Pretreatment Regulations for Existing	Applicable	Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.

and New Sources of Pollution, 33 U.S.C. § 1251 et seq. 40 CFR. Part 403 **Agree. This will be included for the sediment alternatives although the State has NPDES authority.**			
Thermal Treatment, 40 C.F.R. Part 265, Subpart P **Disagree. As discussed during the November 16, 2011 meeting, no hazardous waste will be treated by a thermal process and the system is not a TSDF. Soil that may be hazardous would be hazardous due to the TCLP characteristic for lead. This material will not be treated by LTTD. In addition, this regulation is part of the RI regulations, by reference.**	Relevant and Appropriate	Standards for air emissions and other operating standards for thermal treatment units.	These standards will apply for alternatives that include thermal treatment.
Management of Undesirable Plants on Federal Lands, 7 U.S.C. 2814 **Agree; however, the description will be modified to note that the responsibility will be transitioned to NAVSTA after (1) the remedy is in place and (2) NAVSTA develops their base-wide program for controlling undesirable plants.**	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site.

In addition, add these State ARARs:

Clean Air Act - Emissions Detrimental to Persons or Property **Agree.**	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during remedial activities will be used to assess compliance with these standards if threshold levels are reached
Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells **Agree.**	RIGL 46-13..2 *et seq.*	Applicable	Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).	Under these standards drinking water wells are prohibited within areas of contamination and monitoring wells used will be properly decommissioned when no longer needed.

Response: See the above responses shown after each ARAR citation.

Regarding NESHAPs, the Navy disagrees that NESHAPs are to be ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.

See also Attachment 2 for other revised ARAR tables.

Specific Comment 17: Table 2-3, State Solid Waste ARARs: All of the State Solid Waste Regulations cited in the OFFTA ROD should be cited in this FS, since both set standards for soil/pavement covers over contaminated soils (14 sections were cited in OFFTA, but only 6 in this FS). The "consideration" text for all of the State Solid Waste ARARs should match the language negotiated with the Navy that was used in the OFFTA ROD (Table A-3, "Action To Be Taken" text).

Response: The OFFTA State Solid Waste Citations will be included, except as follows:

- **Rhode Island Solid Waste Regulations - Monitoring Wells (DEM OWM-SW0401, 2.1.08 (a) (8)) - part of monitoring well requirements and will be included with the groundwater alternatives.**

- **Rhode Island Solid Waste Regulations - Monitoring Wells (DEM OWM-SW0401, 2.3.11) - part of monitoring well requirements and will be included with the groundwater alternatives.**

- **Rhode Island Solid Waste Regulations (DEM OWM-SW0401, 2.1.08 (c) – Long-term Monitoring - part of monitoring requirements and will be included with the groundwater alternatives.**

Also, the text will be revised to reflect the Paved Area rather than the entire "site".

Specific Comment 18: Table 2-3, Page 6: For the first line change the "consideration" text to: "These regulations would apply to the management of any contaminated media that, after testing, is determined to exceed hazardous waste thresholds."

Response: The text will be modified, as requested.

Specific Comment 19: Table 2-5: EPA's risk-based standard for manganese, as identified in EPA's Health Advisory, is 300 ug/L and should be used as the PRG/Performance Standard. EPA's November 22, 2010, Comment 12, requested this be addressed.

Response: Table 2-5 will be revised to use the health advisory for manganese. As discussed during the September 21, 2011 meeting, this will not change the remedial alternatives except to increase the timeframe for LUCs and monitoring.

Specific Comment 20: Tables 4-4 – 4-9, Tables 5-4 – 5-12, and Tables 6-4 – 6-12: Make revisions to the alternative specific ARARs tables to ensure that they are consistent with the revisions required to address comments on the Section 2 ARARs tables above and consistent with the ARARs tables in the OFFTA ROD, Appendix A. In addition, in many cases, the information provided in the "Action to be Taken to Attain the ARAR" column is inadequate throughout these ARARs table. Revise the tables to specify how each alternative will achieve the cited ARARs. For the location-specific ARARs Tables, if there are potential historic or archeological resources within the operable unit area (e.g., the dam or any structure more than 50 years old), add appropriate federal and state historic preservation ARARs.

Response: See Attachment 2 for the revised ARAR tables.

Specific Comment 21: Table 5-5, Table 5-8 and Table 5-11: There are location-specific ARARs relating to the installation and O&M of monitoring wells. These ARARs should be included in these tables.

Response: ARARs related to installation and maintenance of monitoring wells are included under the action-specific ARARs.

ATTACHMENT 1

Emulsified Oil Design Tool Spreadsheets

Site Data - Aquifer Description

TTZ ID: A

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW118B, MW128B, MW117B, and MW03B Area Tre
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	22.5	ft	6.75	m
b	Depth to top of injection zone	25	ft	7.50	m
c	Depth to bottom of injection zone	45	ft	13.50	m
d	Hydraulic Gradient	0.297	ft/ft	0.297	m/m
e	Hydraulic Conductivity	7.83	ft/day	2.76E-03	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	116.28	ft/day	4.10E-02	cm/s
		42440.6	ft/yr	12935.88	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: A

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4		165.8	8	
b	Trichloroethene (TCE), C_2HCl_3	328	131.4	6	1.50E-05
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	5	96.9	4	1.92E-07
d	Vinyl Chloride (VC), C_2H_3Cl	1	62.5	2	2.75E-08
e	Carbon tetrachloride, CCl_4	1	153.8	8	6.76E-08
f	Chloroform, $CHCl_3$	1	119.4	6	2.64E-08
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	1	133.4	6	4.95E-08
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	1	99.0	4	2.63E-08
j	Chloroethane, C_2H_5Cl	2	64.9	2	7.09E-08
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	1.54E-05	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: A

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	1.4	32.0	4	1.75E-04
b	Background Nitrate (mg/L as N)	0.28	14.0	5	1.00E-04
c	Background Sulfate (mg/L)	22.25	96.1	8	1.85E-03
d	Estimated methane produced (mg/L)	0.0013	16.0	8	6.50E-07
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	6.23			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	2.13E-03	e- equiv/L	**2.14E-03**

Site Data - Substrates and Reagents

TTZ ID: A

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

TTZ ID: A

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	25	ft	7.62	m			
b	Bottom of Screened Interval	45	ft	13.72	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1350	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,250**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	8.4	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information **TTZ ID: A**

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	300	ft	90.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

TTZ ID: A

Area Treatment Using a Series of Barriers - Capital Cost Analysis

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***									
a	Minimum Well Spacing (ft)	5	1.50	m						
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m						
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25
d	Number of Wells per Row	60	40	30	24	20	18	15	14	12
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25
f	Number of Rows	8	6	4	4	3	3	2	2	2
g	Number of Wells	480	240	120	96	60	54	30	28	24
2	***Fixed Costs***									
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500
3	***Well Installation***									
a	Well Installation Costs	$1,080,000	$540,000	$270,000	$216,000	$135,000	$121,500	$67,500	$63,000	$54,000
4	***Injection Information***									
a	Hours of injection per day	9								
b	Maximum number of wells to inject at one time	10								
c	Percentage of total wells to inject at one time	50%								
d	Actual number of wells injected at one time	10	10	10	10	10	10	10	10	10
e	Required total water supply rate (gpm)	30	30	30	30	30	30	30	30	30
5	***Injection***									
a	Injection Volume per well (gal/well)	30	60	120	150	239	266	479	513	598
b	Total Injection Volume (gallons)	14,363	14,363	14,363	14,363	14,363	14,363	14,363	14,363	14,363
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1
d	Total days of injection required (days)	48	24	12	10	6	6	3	3	3
e	Labor Cost for Injection	$136,800	$68,400	$34,200	$28,500	$17,100	$17,100	$8,550	$8,550	$8,550
5	***Substrate***									
a	Mass of Oil Injected per well (lbs/well)	98	195	390	488	780	867	1,560	1,671	1,950
b	Total Mass of Oil Injected (lbs)	46,800	46,800	46,800	46,800	46,800	46,800	46,800	46,800	46,800
c	Substrate Costs	$156,000	$156,000	$156,000	$156,000	$156,000	$156,000	$156,000	$156,000	$156,000
6	***Total Installation and Injection Costs***									
a	Total Installation and Injection Costs	$1,381,300	$772,900	$468,700	$409,000	$316,600	$303,100	$240,550	$236,050	$227,050

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: A

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW118B, MW128B, MW117B, and MW03B Area	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	30	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	120	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	46,800	lbs	21,228	kg
b	Total Injection Volume	14,363	gallons	54,368	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	10	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$270,000
c	Injection Costs	$34,200
d	Substrate Costs	$156,000
e	Total Installation and Injection Costs	$468,700

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$34,200
d	Substrate Costs	$156,000
e	Total Installation and Injection Costs	$198,700

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$1,236,139
d	Project Life NPV	$1,236,139

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Site Data - Aquifer Description

TTZ ID: B

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW04B, MW105B, and MW104B Area Treatment
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	15.2	ft	4.56	m
b	Depth to top of injection zone	25	ft	7.50	m
c	Depth to bottom of injection zone	45	ft	13.50	m
d	Hydraulic Gradient	0.063	ft/ft	0.063	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	1.37	ft/day	4.82E-04	cm/s
		499.0	ft/yr	152.09	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: B

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	2	165.8	8	1.18E-07
b	Trichloroethene (TCE), C_2HCl_3	3	131.4	6	1.59E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	5	96.9	4	2.00E-07
d	Vinyl Chloride (VC), C_2H_3Cl	1	62.5	2	2.75E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	4	133.4	6	1.57E-07
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	125	99.0	4	5.05E-06
j	Chloroethane, C_2H_5Cl	2	64.9	2	7.09E-08
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	5.78E-06	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: B

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.385	32.0	4	4.81E-05
b	Background Nitrate (mg/L as N)	0.025	14.0	5	8.93E-06
c	Background Sulfate (mg/L)	21.5	96.1	8	1.79E-03
d	Estimated methane produced (mg/L)	0.019	16.0	8	9.50E-06
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	7			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	1.86E-03	e- equiv/L	**1.86E-03**

Site Data - Substrates and Reagents

TTZ ID: B

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

TTZ ID: B

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	25	ft	7.62	m			
b	Bottom of Screened Interval	45	ft	13.72	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1350	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,250**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.4	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information

TTZ ID: B

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	100	ft	30.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Area Treatment Using a Series of Barriers - Capital Cost Analysis

TTZ ID: B

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***										
a	Minimum Well Spacing (ft)	5	1.50	m							
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m							
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25	
d	Number of Wells per Row	20	14	10	8	7	6	5	5	4	
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25	
f	Number of Rows	8	6	4	4	3	3	2	2	2	
g	Number of Wells	160	84	40	32	21	18	10	10	8	
2	***Fixed Costs***										
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0	
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
3	***Well Installation***										
a	Well Installation Costs	$360,000	$189,000	$90,000	$72,000	$47,250	$40,500	$22,500	$22,500	$18,000	
4	***Injection Information***										
a	Hours of injection per day	9									
b	Maximum number of wells to inject at one time	10									
c	Percentage of total wells to inject at one time	50%									
d	Actual number of wells injected at one time	10	10	10	10	10	9	5	5	4	
e	Required total water supply rate (gpm)	30	30	30	30	30	27	15	15	12	
5	***Injection***										
a	Injection Volume per well (gal/well)	30	57	120	150	228	266	479	479	598	
b	Total Injection Volume (gallons)	4,788	4,788	4,788	4,788	4,788	4,788	4,788	4,788	4,788	
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1	
d	Total days of injection required (days)	16	9	4	4	3	2	2	2	2	
e	Labor Cost for Injection	$45,600	$25,650	$11,400	$11,400	$8,550	$5,700	$5,700	$5,700	$5,700	
5	***Substrate***										
a	Mass of Oil Injected per well (lbs/well)	98	186	390	488	743	867	1,560	1,560	1,950	
b	Total Mass of Oil Injected (lbs)	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	
c	Substrate Costs	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	
6	***Total Installation and Injection Costs***										
a	Total Installation and Injection Costs	$466,100	$275,150	$161,900	$143,900	$116,300	$106,700	$88,700	$88,700	$84,200	

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: B

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW04B, MW105B, and MW104B Area Treatment	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	10	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	40	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	15,600	lbs	7,076	kg
b	Total Injection Volume	4,788	gallons	18,123	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	10	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$90,000
c	Injection Costs	$11,400
d	Substrate Costs	$52,000
e	Total Installation and Injection Costs	$161,900

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$11,400
d	Substrate Costs	$52,000
e	Total Installation and Injection Costs	$71,900

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$439,600
d	Project Life NPV	$439,600

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Site Data - Aquifer Description

TTZ ID: C

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW103B Area Treatment
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	17	ft	5.10	m
b	Depth to top of injection zone	30	ft	9.00	m
c	Depth to bottom of injection zone	50	ft	15.00	m
d	Hydraulic Gradient	0.05	ft/ft	0.05	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	1.09	ft/day	3.83E-04	cm/s
		396.0	ft/yr	120.71	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: C

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4		165.8	8	
b	Trichloroethene (TCE), C_2HCl_3	13	131.4	6	5.94E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	18	96.9	4	7.43E-07
d	Vinyl Chloride (VC), C_2H_3Cl	2	62.5	2	7.68E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	8	133.4	6	3.42E-07
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	180	99.0	4	7.27E-06
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	9.03E-06	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: C

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.22	32.0	4	2.75E-05
b	Background Nitrate (mg/L as N)		14.0	5	
c	Background Sulfate (mg/L)	8.4	96.1	8	6.99E-04
d	Estimated methane produced (mg/L)	0.12	16.0	8	6.00E-05
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	6.99			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	7.87E-04	e- equiv/L	**7.96E-04**

Site Data - Substrates and Reagents

TTZ ID: C

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

TTZ ID: C

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	30	ft	9.14	m			
b	Bottom of Screened Interval	50	ft	15.24	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1500	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,400**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.4	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information

TTZ ID: C

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	40	ft	12.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Area Treatment Using a Series of Barriers - Capital Cost Analysis

TTZ ID: C

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***										
a	Minimum Well Spacing (ft)	5	1.50	m							
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m							
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25	
d	Number of Wells per Row	8	6	4	4	3	3	2	2	2	
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25	
f	Number of Rows	8	6	4	4	3	3	2	2	2	
g	Number of Wells	64	36	16	16	9	9	4	4	4	
2	***Fixed Costs***										
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0	
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
3	***Well Installation***										
a	Well Installation Costs	$153,600	$86,400	$38,400	$38,400	$21,600	$21,600	$9,600	$9,600	$9,600	
4	***Injection Information***										
a	Hours of injection per day	9									
b	Maximum number of wells to inject at one time	10									
c	Percentage of total wells to inject at one time	50%									
d	Actual number of wells injected at one time	10	10	8	8	5	5	2	2	2	
e	Required total water supply rate (gpm)	30	30	24	24	15	15	6	6	6	
5	***Injection***										
a	Injection Volume per well (gal/well)	30	53	120	120	213	213	479	479	479	
b	Total Injection Volume (gallons)	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1	
d	Total days of injection required (days)	7	4	2	2	2	2	2	2	2	
e	Labor Cost for Injection	$19,950	$11,400	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	
5	***Substrate***										
a	Mass of Oil Injected per well (lbs/well)	98	173	390	390	693	693	1,560	1,560	1,560	
b	Total Mass of Oil Injected (lbs)	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	
c	Substrate Costs	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	
6	***Total Installation and Injection Costs***										
a	Total Installation and Injection Costs	$202,850	$127,100	$73,400	$73,400	$56,600	$56,600	$44,600	$44,600	$44,600	

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: C

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW103B Area Treatment	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	4	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	16	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	6,240	lbs	2,830	kg
b	Total Injection Volume	1,915	gallons	7,249	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$38,400
c	Injection Costs	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$73,400

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$35,000

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$208,581
d	Project Life NPV	$208,581

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Site Data - Aquifer Description

TTZ ID: D

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW100B Area Treatment
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	9.3	ft	2.79	m
b	Depth to top of injection zone	25	ft	7.50	m
c	Depth to bottom of injection zone	45	ft	13.50	m
d	Hydraulic Gradient	0.05	ft/ft	0.05	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	1.09	ft/day	3.83E-04	cm/s
		396.0	ft/yr	120.71	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: D

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4		165.8	8	
b	Trichloroethene (TCE), C_2HCl_3		131.4	6	
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$		96.9	4	
d	Vinyl Chloride (VC), C_2H_3Cl		62.5	2	
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	310	99.0	4	1.25E-05
j	Chloroethane, C_2H_5Cl	130	64.9	2	4.01E-06
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	1.65E-05	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: D

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.3	32.0	4	3.75E-05
b	Background Nitrate (mg/L as N)		14.0	5	
c	Background Sulfate (mg/L)	13	96.1	8	1.08E-03
d	Estimated methane produced (mg/L)	0.25	16.0	8	1.25E-04
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	7.24			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	1.24E-03	e- equiv/L	**1.26E-03**

Site Data - Substrates and Reagents

TTZ ID: D

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

TTZ ID: D

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	25	ft	7.62	m			
b	Bottom of Screened Interval	45	ft	13.72	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1350	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,250**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.3	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information

TTZ ID: D

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	40	ft	12.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Area Treatment Using a Series of Barriers - Capital Cost Analysis

TTZ ID: D

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***										
a	Minimum Well Spacing (ft)	5	1.50	m							
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m							
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25	
d	Number of Wells per Row	8	6	4	4	3	3	2	2	2	
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25	
f	Number of Rows	8	6	4	4	3	3	2	2	2	
g	Number of Wells	64	36	16	16	9	9	4	4	4	
2	***Fixed Costs***										
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0	
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
3	***Well Installation***										
a	Well Installation Costs	$144,000	$81,000	$36,000	$36,000	$20,250	$20,250	$9,000	$9,000	$9,000	
4	***Injection Information***										
a	Hours of injection per day	9									
b	Maximum number of wells to inject at one time	10									
c	Percentage of total wells to inject at one time	50%									
d	Actual number of wells injected at one time	10	10	8	8	5	5	2	2	2	
e	Required total water supply rate (gpm)	30	30	24	24	15	15	6	6	6	
5	***Injection***										
a	Injection Volume per well (gal/well)	30	53	120	120	213	213	479	479	479	
b	Total Injection Volume (gallons)	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1	
d	Total days of injection required (days)	7	4	2	2	2	2	2	2	2	
e	Labor Cost for Injection	$19,950	$11,400	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	
5	***Substrate***										
a	Mass of Oil Injected per well (lbs/well)	98	173	390	390	693	693	1,560	1,560	1,560	
b	Total Mass of Oil Injected (lbs)	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	
c	Substrate Costs	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	
6	***Total Installation and Injection Costs***										
a	Total Installation and Injection Costs	$193,250	$121,700	$71,000	$71,000	$55,250	$55,250	$44,000	$44,000	$44,000	

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: D

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW100B Area Treatment	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	4	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	16	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	6,240	lbs	2,830	kg
b	Total Injection Volume	1,915	gallons	7,249	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$36,000
c	Injection Costs	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$71,000

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$35,000

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$206,181
d	Project Life NPV	$206,181

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Site Data - Aquifer Description

TTZ ID: E

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW101B Area Treatment
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	12.5	ft	3.75	m
b	Depth to top of injection zone	30	ft	9.00	m
c	Depth to bottom of injection zone	50	ft	15.00	m
d	Hydraulic Gradient	0.05	ft/ft	0.05	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	1.09	ft/day	3.83E-04	cm/s
		396.0	ft/yr	120.71	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: E

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4		165.8	8	
b	Trichloroethene (TCE), C_2HCl_3	4	131.4	6	1.74E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	0	96.9	4	1.69E-08
d	Vinyl Chloride (VC), C_2H_3Cl	2	62.5	2	4.80E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	76	133.4	6	3.42E-06
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	540	99.0	4	2.18E-05
j	Chloroethane, C_2H_5Cl	110	64.9	2	3.39E-06
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	2.89E-05	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: E

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.68	32.0	4	8.50E-05
b	Background Nitrate (mg/L as N)		14.0	5	
c	Background Sulfate (mg/L)	13	96.1	8	1.08E-03
d	Estimated methane produced (mg/L)	0.25	16.0	8	1.25E-04
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	7.48			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	1.29E-03	e- equiv/L	**1.32E-03**

Site Data - Substrates and Reagents

TTZ ID: E

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

TTZ ID: E

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	30	ft	9.14	m		
b	Bottom of Screened Interval	50	ft	15.24	m		
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1500	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,400**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.4	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information

TTZ ID: E

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	40	ft	12.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Area Treatment Using a Series of Barriers - Capital Cost Analysis

TTZ ID: E

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***										
a	Minimum Well Spacing (ft)	5	1.50	m							
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m							
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25	
d	Number of Wells per Row	8	6	4	4	3	3	2	2	2	
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25	
f	Number of Rows	8	6	4	4	3	3	2	2	2	
g	Number of Wells	64	36	16	16	9	9	4	4	4	
2	***Fixed Costs***										
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0	
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	
3	***Well Installation***										
a	Well Installation Costs	$153,600	$86,400	$38,400	$38,400	$21,600	$21,600	$9,600	$9,600	$9,600	
4	***Injection Information***										
a	Hours of injection per day	9									
b	Maximum number of wells to inject at one time	10									
c	Percentage of total wells to inject at one time	50%									
d	Actual number of wells injected at one time	10	10	8	8	5	5	2	2	2	
e	Required total water supply rate (gpm)	30	30	24	24	15	15	6	6	6	
5	***Injection***										
a	Injection Volume per well (gal/well)	30	53	120	120	213	213	479	479	479	
b	Total Injection Volume (gallons)	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1	
d	Total days of injection required (days)	7	4	2	2	2	2	2	2	2	
e	Labor Cost for Injection	$19,950	$11,400	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	
5	***Substrate***										
a	Mass of Oil Injected per well (lbs/well)	98	173	390	390	693	693	1,560	1,560	1,560	
b	Total Mass of Oil Injected (lbs)	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	
c	Substrate Costs	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	$20,800	
6	***Total Installation and Injection Costs***										
a	Total Installation and Injection Costs	$202,850	$127,100	$73,400	$73,400	$56,600	$56,600	$44,600	$44,600	$44,600	

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: E

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW101B Area Treatment	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	4	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	16	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	6,240	lbs	2,830	kg
b	Total Injection Volume	1,915	gallons	7,249	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$38,400
c	Injection Costs	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$73,400

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$5,700
d	Substrate Costs	$20,800
e	Total Installation and Injection Costs	$35,000

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$208,581
d	Project Life NPV	$208,581

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Site Data - Aquifer Description

TTZ ID: F

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW9B Downgradient Barrier
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	12	ft	3.60	m
b	Depth to top of injection zone	30	ft	9.00	m
c	Depth to bottom of injection zone	50	ft	15.00	m
d	Hydraulic Gradient	0.05	ft/ft	0.05	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	1.09	ft/day	3.83E-04	cm/s
		396.0	ft/yr	120.71	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: F

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4		165.8	8	
b	Trichloroethene (TCE), C_2HCl_3	1	131.4	6	5.48E-08
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$		96.9	4	
d	Vinyl Chloride (VC), C_2H_3Cl	0	62.5	2	1.18E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	41	133.4	6	1.84E-06
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	82	99.0	4	3.31E-06
j	Chloroethane, C_2H_5Cl	24	64.9	2	7.40E-07
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	5.96E-06	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: F

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.75	32.0	4	9.38E-05
b	Background Nitrate (mg/L as N)	0.018	14.0	5	6.43E-06
c	Background Sulfate (mg/L)	1.1	96.1	8	9.16E-05
d	Estimated methane produced (mg/L)	6	16.0	8	3.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	7.26			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	3.19E-03	e- equiv/L	**3.20E-03**

Site Data - Substrates and Reagents

TTZ ID: F

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.00	$/lb
k	Cost per pound of oil	3.33	$/lb

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

TTZ ID: F

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	30	ft	9.14	m			
b	Bottom of Screened Interval	50	ft	15.24	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Hollow Stem Auger			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1500	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,400**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.4	gpm/well
d	Injection rate to be used in Design	3	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Single Permeable Reactive Barrier - Design Information

TTZ ID: F

Design criteria for installation of a single permeable reactive barrier is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	90	ft	27.00	m
b	Treatment Zone Thickness	20	ft	6.00	m
c	Percentage of injection zone that transmits most flow	80%			
d	Effective Treatment Zone Thickness	16	ft	4.80	m
e	Seepage Velocity	1.09	ft/day	3.8E-04	cm/s
f	Groundwater Flux through Treatment Zone	85,313	gal/yr	322,911	L/yr

2 *Treatment Zone Contact Time*

A minimum contact time of 2 to 4 months is typically required for effective treatment of chlorinated solvents in emulsified oil barriers. Longer contact times may be needed for difficult to degrade contaminants, with higher contaminant concentrations, and/or high concentrations of competing electron acceptors. Shorter contact times may be acceptable for easily treated contaminants (e.g. nitrate or perchlorate) or when only partial treatment is required.

a	Minimum Allowable Contact time	55	days

3 *Targeted Carbon Released*

Emulsified oil barriers release dissolved organic carbon (DOC) over the life of the barrier. This DOC released is in excess of that required for contaminant biodegradation and consumption of competing electron acceptors. Field monitoring data indicates that DOC released from barriers declines from hundreds mg/L shortly after emulsion injection to tens of mg/L near the end of the operating life. Long-term average DOC concentrations are typically in the range of 40 - 100 mg/L.

a	Average Amount of DOC Released	75	mg/L		
b	DOC Released per year	53	lb	24	kg

4 *Design Life*

The design tool estimates reinjection frequency based on amount of substrate injected, the annual substrate consumption rate, and fraction of initial substrate consumed when when treatment performance declines. However, users may specify a maximum time between reinjections. The design tool will then use the smaller of these two values. Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Total Project Life (Max of 30 years)	30	years
b	Subtrate Scaling Factor (typically 0.3 to 0.6)	0.5	
c	Maximum Time between Reinjections	5.0	years

5 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and flow contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.5)	0.8		
b	Mass Scaling Factor (0.1 to 1.5)	0.6		
c	Estimated Contact Efficiency for Injection	74%	to	87%

Single Permeable Reactive Barrier - Capital Cost Analysis

TTZ ID: F

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***									
a	Minimum Well Spacing (ft)	5	1.50	m						
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m						
c	Well Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25
d	Number of Wells per Row	18	12	9	8	6	6	5	4	4
e	Number of Rows	12	8	6	5	4	4	3	3	3
f	Contact Time per Row (days)	4.5833333	6.875	9.1666667	11	13.75	13.75	18.333333	18.333333	18.333333
g	Total Number of Wells	216	96	54	40	24	24	15	12	12
2	***Fixed Costs***									
a	Planning, Engineering, and Permitting	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500
c	Total Fixed Costs	$23,500	$23,500	$23,500	$23,500	$23,500	$23,500	$23,500	$23,500	$23,500
3	***Well Installation***									
a	Well Installation Costs	$518,400	$230,400	$129,600	$96,000	$57,600	$57,600	$36,000	$28,800	$28,800
4	***Injection Information***									
a	Hours of injection per day	9								
b	Maximum number of wells to inject at one time	10								
c	Percentage of total wells to inject at one time	50%								
d	Actual number of wells injected at one time	10	10	10	10	10	10	8	6	6
e	Required total water supply rate (gpm)	30	30	30	30	30	30	24	18	18
5	***Injection Costs***									
a	Injection Volume per well (gal/well)	38	85	150	235	338	461	602	761	940
b	Total Injection Volume (gallons)	8,122	8,122	8,122	9,400	8,122	11,055	9,024	9,137	11,280
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1
d	Total days of injection required (days)	22	10	6	4	3	3	2	2	2
e	Labor Cost for Injection	$62,700	$28,500	$17,100	$11,400	$8,550	$8,550	$5,700	$5,700	$5,700
6	***Substrate***									
a	Mass of Oil Injected per well (lbs/well)	92	207	368	574	827	1,126	1,470	1,861	2,297
b	Total Mass of Oil Injected (lbs)	19,849	19,849	19,849	22,973	19,849	27,016	22,054	22,330	27,567
c	Oil Demand (lbs/yr)	80	80	80	80	80	80	80	80	80
d	Effective Life of Single Injection (yrs)	248.7	248.7	248.7	287.8	248.7	338.5	276.3	279.8	345.4
e	Reinjection Interval (yrs)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
f	Substrate Costs	$66,162	$66,162	$66,162	$76,576	$66,162	$90,054	$73,513	$74,432	$91,892
6	***Total Installation and Injection Costs***									
a	Total Installation and Injection Costs	$670,762	$348,562	$236,362	$207,476	$155,812	$179,704	$138,713	$132,432	$149,892

Single Permeable Reactive Barrier - Selected Design

TTZ ID: F

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW9B Downgradient Barrier	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Design Information*

a	Reinjection Interval	5	years
b	Total Project Life	30	years
c	Minimum Allowable Contact time	55	days

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Rows	6	rows		
c	Total Number of Wells	54	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	19,849	lbs	9,003	kg
b	Total Injection Volume	8,122	gallons	30,744	L
c	Total Injection Volume per well	150	gal/well	569	L/well
d	Estimated Injection Rate	3.0	gpm/well		
e	Number of wells injected simultaneously	10	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (engineering and installation)	$23,500
b	Well Installation Costs	$129,600
c	Labor Cost for Injection	$17,100
d	Substrate Costs	$66,162
e	Total Installation and Injection Costs	$236,362

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$13,500
b	Well Rehabilitation and/or Installation Costs	$25,920
c	Labor Cost for Injection	$17,100
d	Substrate Costs	$66,162
e	Total Installation and Injection Costs	$122,682

7 *Total Life Cycle Costs*

a	Annual Interest Rate	4%
b	Monitoring and Reporting	$129,690
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$628,034
d	Project Life NPV	$757,724

8 *Design Parameters*

a	Substrate Scaling Factor	0.5		
b	Volume Scaling Factor	0.8		
c	Mass Scaling Factor	0.6		
d	Estimated Contact Efficiency for Injection	74%	to	87%

Site Data - Aquifer Description

TTZ ID: G

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	MW7A/7B Area Treatment
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation
c	Location	Newport Site 8

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	30	ft	9.00	m
c	Depth to bottom of injection zone	50	ft	15.00	m
d	Hydraulic Gradient	0.015	ft/ft	0.015	m/m
e	Hydraulic Conductivity	0.434	ft/day	1.53E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	0.33	ft/day	1.15E-04	cm/s
		118.8	ft/yr	36.21	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	fractured bedrock			
b	Bulk Density	162.5	lbs/ft^3	2.6	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

TTZ ID: G

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	12	165.8	8	5.79E-07
b	Trichloroethene (TCE), C_2HCl_3	4	131.4	6	1.87E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	5	96.9	4	1.98E-07
d	Vinyl Chloride (VC), C_2H_3Cl	1	62.5	2	3.36E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*- tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3	450	133.4	6	2.02E-05
i	1,1-Dichloroethane (DCA), CH_2CHCl_2	590	99.0	4	2.38E-05
j	Chloroethane, C_2H_5Cl	6	64.9	2	1.88E-07
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	4.53E-05	e- equiv/L

Site Data - Biogeochemical Characterization

TTZ ID: G

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.365	32.0	4	4.56E-05
b	Background Nitrate (mg/L as N)	0.0097	14.0	5	3.46E-06
c	Background Sulfate (mg/L)	7.875	96.1	8	6.56E-04
d	Estimated methane produced (mg/L)	0.19	16.0	8	9.50E-05
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)		54.9	2	
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)		55.8	1	
i	pH (not used in calculation)	6.93			
j	Alkalinity (mg/L) (not used in calculation)				

				Total e- equiv demand (e- equiv/L)
k	e- equiv demand from biogeochemical characterizeation	8.00E-04	e- equiv/L	**8.45E-04**

Site Data - Substrates and Reagents

TTZ ID: G

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID	TBD	
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))	C56H100O6	
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	60%	percent
i	Electron equivalents per Kg raw product	217.75	e-/Kg
j	Cost per pound of product including shipping	2.10	$/lb
k	Cost per pound of oil	3.50	$/lb

Installation and Injection Costs for:
Well Installation by Conventional Drilling followed by Emulsion Injection

TTZ ID: G

Information on the labor and materials required for conventional well installation and emulsion injection is entered on this page. This approach assumes that temporary or permanent wells are installed first using conventional drilling equipment. Well installation is assumed to be by a subcontract driller with supervision by the prime contractor. Once the wells are installed, multiple wells are manifolded together for emulsion injection. Results of this analysis are summarized as: a) total fixed cost; b) cost per boring; and c) cost per gallon of fluid injected.

1 *Well Information*

a	Top of Screened Interval	30	ft	9.14	m			
b	Bottom of Screened Interval	50	ft	15.24	m			
c	Well Screen Diameter (Typical range is 1 to 2 inches)	2	inch	0.17	ft	0.051	m	
d	Effective Diameter of Sand Pack (1 to 3.75 inches)	2.5	inch	0.21	ft	0.064	m	

2 *Well Installation Costs for Conventional Drilling*

a	Drilling Equipment to be used	Rosonic			
b	Cost for well installation (and abandonment if required)	30	$/ft	98.4	$/m
c	Drilling well installation costs	1500	$/well		
d	Wells installed per day	3	wells/day		
e	Additional material and IDW costs per well	250	$/well		
f	Subcontractor mobilization	0	$		
g	Number of supervising personnel on-site each day	2	person(s)		
h	Average labor rate of personnel	85	$/hr		
i	Supervision Hours billed per person per day	9	hr/person/day		
j	Additional costs (consumables, H&S, and equipment rental)	200	$/day		
k	**Total cost per well**	**2,400**	**$/well**		

This approach assumes that one or more wells will be injected at the same time. Costs are included to cover: a) fixed costs associated with initial site mobilization and equipment setup; b) costs that are proportionate to the time required for injection.

3 *Injection Information*

a	Injection pressure	10	psi
b	Well loss coefficient (typically 5 to 20) Due to clogging around well screens	5	
c	Theoretical estimate of injection rate per well	0.3	gpm/well
d	Injection rate to be used in Design	5	gpm/well

4 *Fixed Costs*

a	Mobilization	2500	$
b	Water Supply	0	$
c	Piping and other equipment for emulsion preparation and injection	1500	$
d	Time required for equipment setup and removal	45	hr
e	Labor rate for equipment setup and removal	100	$/hr
f	Labor cost for setup and removal	4500	$
g	**Total fixed cost**	**8,500**	**$**

5 *Injection Costs*

a	Number of personnel on-site each day of injection	2	person(s)
b	Average labor rate of personnel	85	$/hr
c	Hours billed per person per day	9	hr/person/day
d	Per Diem (e.g., meals, travel)	40	$/person/day
e	Vehicle rental	0	$/day
f	Lodging	70	$/person/day
g	Injection equipment costs (pumps, tanks, hoses, etc.)	1000	$/day
h	Additional costs (consumables, H&S, and equipment rental)	100	$/day
i			$/day
j			$/day
k			$/day
l	**Injection costs per day**	**2,850**	**$/day**

Area Treatment - Design Information

TTZ ID: G

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	40	ft	12.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	(●) 1 to 1 ( ) 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	80%			
f	Effective Treatment Zone Thickness	16	ft	4.80	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	30	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.5		
b	Mass Scaling Factor (0.1 to 1.0)	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

Area Treatment Using a Series of Barriers - Capital Cost Analysis

TTZ ID: G

The page shows the effect of injection well spacing on capital costs to install the a permeable reactive barrier. Results of this analysis are used in later pages to calculate life cycle costs. Users must enter a minimum injection point spacing and injection point increment.

1	***Well Layout***									
a	Minimum Well Spacing (ft)	5	1.50	m						
b	Incremental Increase in Well Spacing (ft)	2.5	0.75	m						
c	Well Spacing (ft)	5	8	10	13	15	18	20	23	25
d	Number of Wells per Row	8	6	4	4	3	3	2	2	2
e	Row Spacing (ft)	5	7.5	10	12.5	15	17.5	20	22.5	25
f	Number of Rows	8	6	4	4	3	3	2	2	2
g	Number of Wells	64	36	16	16	9	9	4	4	4
2	***Fixed Costs***									
a	Planning, Engineering, and Permitting	$0	$0	$0	$0	$0	$0	$0	$0	$0
b	Fixed Costs from Installation and Injection	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500
c	Total Fixed Costs	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500	$8,500
3	***Well Installation***									
a	Well Installation Costs	$153,600	$86,400	$38,400	$38,400	$21,600	$21,600	$9,600	$9,600	$9,600
4	***Injection Information***									
a	Hours of injection per day	9								
b	Maximum number of wells to inject at one time	10								
c	Percentage of total wells to inject at one time	50%								
d	Actual number of wells injected at one time	10	10	8	8	5	5	2	2	2
e	Required total water supply rate (gpm)	50	50	40	40	25	25	10	10	10
5	***Injection***									
a	Injection Volume per well (gal/well)	30	53	120	120	213	213	479	479	479
b	Total Injection Volume (gallons)	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915	1,915
c	Injection Time per set of wells (days)	1	1	1	1	1	1	1	1	1
d	Total days of injection required (days)	7	4	2	2	2	2	2	2	2
e	Labor Cost for Injection	$19,950	$11,400	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700	$5,700
5	***Substrate***									
a	Mass of Oil Injected per well (lbs/well)	98	173	390	390	693	693	1,560	1,560	1,560
b	Total Mass of Oil Injected (lbs)	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240	6,240
c	Substrate Costs	$21,840	$21,840	$21,840	$21,840	$21,840	$21,840	$21,840	$21,840	$21,840
6	***Total Installation and Injection Costs***									
a	Total Installation and Injection Costs	$203,890	$128,140	$74,440	$74,440	$57,640	$57,640	$45,640	$45,640	$45,640

Area Treatment Using a Series of Barriers - Selected Design

TTZ ID: G

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	MW7A/7B Area Treatment	
b	Description (e.g., project number)	GW2 Enhanced In-Situ Bioremediation	
c	Location	Newport Site 8	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	30	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	4	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	16	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	6,240	lbs	2,830	kg
b	Total Injection Volume	1,915	gallons	7,249	L
c	Total Injection Volume per well	120	gal/well	453	L/well
d	Estimated Injection Rate	5.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

Not Used

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$8,500
b	Well Installation Costs	$38,400
c	Injection Costs	$5,700
d	Substrate Costs	$21,840
e	Total Installation and Injection Costs	$74,440

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$8,500
b	Well Rehabilitation and/or Installation Costs	$0
c	Labor Cost for Injection	$5,700
d	Substrate Costs	$21,840
e	Total Installation and Injection Costs	$36,040

7 *Total Life Cycle Costs*

a	Annual Interest Rate	3%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	$213,637
d	Project Life NPV	$213,637

8 *Design Parameters*

a	Volume Scaling Factor	0.5		
b	Mass Scaling Factor	0.5		
c	Estimated Contact Efficiency for Injection	40%	to	54%

ATTACHMENT 2

Revised ARAR Tables

Navy Responses (December 8, 2011) to
EPA's Proposed Revisions to ARARs Tables from the
Revised Draft Feasibility Study (July 2011) for
Site 8 – NUSC Disposal Area
Naval Station Newport

NOTES ON EDITS:

- The EPA file was used as the base file.
- Text that will not be used is shown as struck.
- New text is shown in red font.
- Explanatory notes are bracketed and are shown in green font. The bracketed text will be removed from the tables when presented in the FS report.

Table 4-4: Chemical-specific

Federal ARARs

EPA Carcinogenicity Slope Factor	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed through remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.
EPA Risk Reference Dose (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed through remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens assessed through this guidance will be addressed through remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.

Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks to children assessed through this guidance will be addressed through remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.
Recommendations of the Technical Review Workgroup for Lead for an approach to Assessing Risks Associated with Adult Exposure to Lead In Soil	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA Guidance for evaluating risks posed by lead in soil.	Risks from lead assessed under this guidance will be addressed through remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.

Modify the RI Remediation Regulation

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001; DEM-DSR-01-93, sections 8.01 and 8.02	Applicable	These regulations set remediation standards for direct contact and leachability for contaminated soil at NPL sites when they are more stringent than federal standards.	These standards were used to develop soil PRGs. Remediation to industrial cleanup levels based on excavation of the top 2 feet of contaminated soil, backfilling with 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), ex-situ treatment of PAH contaminated soil, off-site disposal of the remaining excavated soil, removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area meets the regulations' requirements for permitting industrial use and leachability standards in areas where pavement will be maintained.

Table 4-5: Location-Specific
Federal ARARs

Fish and Wildlife Coordination Act	16 U.S.C.. §661 *et seq*.	Applicable	Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted, in particular regarding remedial measures for contaminated soil that will impact streams, wetlands, and downstream water bodies.
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management)~~ Implements Executive Order 11990 (Protection of Wetlands). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of soil remedial actions on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by soil remediation, will be mitigated in accordance with requirements. ~~Remedial work adjacent to Site water bodies/waterways has the potential to negatively alter downstream floodplain. Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered. Removal of contaminated soil prevents introduction of contaminants to floodplain.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.~~ Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Alternatives may involve discharge of dredged material and/or excavation. Soil remediation or other remedial actions that include dredging or filling in wetlands will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource, as required. The Navy has determined that this alternative **[is][is not]** the Least Damaging Practicable Alternative to protect wetland resources because it **[provides][does not provide]** the best balance of addressing contaminated soil within and adjacent to wetlands and waterways with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site. The CERCLA criteria will be used to select the alternative. [Determination of the LEDPA will be made prior to finalizing the FS, and this text will be revised accordingly at that time.]
Endangered Species Act	16 U.S.C. 1531 *et seq.*; 50 C.F.R. parts 200 and 402	Applicable	Regulates activities affecting federally listed endangered or threatened species or their habitat. The federally-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate federal agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]
National Historic Landmarks (Historic Sites Act)	16 USC §461 et seq.; 36 CFR Part 65	Applicable	The purpose of the National Historic Landmarks program is to identify and designate National Historic Landmarks, and encourage the long range preservation of nationally significant properties that illustrate or commemorate the history and prehistory of the United States.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact historical properties/structures determined to be protected by this standard, activities will be coordinated with the Department of the Interior.

Protection of Historic Properties (National Historic Preservation Act)	16 USC §470 et seq., 36 CFR Part 800	Applicable	Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact properties/structures determined to be protected by this standard, activities will be coordinated with the Advisory Council on Historic Preservation.

State ARARs

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State-jurisdictional wetlands and water bodies.~~ [Deleted. This was deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
Rhode Island Endangered Species Act	RIGL 20-37-1 *et seq.*	Relevant and Appropriate	Regulates activities affecting State-listed endangered or threatened species or their habitat. The State-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate State agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
Rhode Island Historical Preservation Act	RIGL 42-45 et seq.	Applicable	Requires action to take into account effects on properties included on or eligible for the National register of Historic Places and minimizes harm to National Historic Landmarks.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact properties/structures determined to be protected by this standard, activities will be coordinated with the State Agency.
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Excavation activities will be conducted to minimize the disturbance of wetlands.

Table 4-6: Action-Specific

Federal ARARs

~~Toxic Substances Control Act (TSCA); PCB Remediation Waste,~~	~~40 C.F.R. 761.61(c)~~	~~Applicable~~	~~This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.~~	~~All soil exceeding identified PCB cleanup levels will be either be removed, dewatered (if required) and disposed of off-site or will be placed under a cover system that meets TSCA protectiveness standards. The excavation, transportation/dewatering, and management of PCB contaminated media will be performed in a manner to comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's soil PCB cleanup levels, along with the excavation, dewatering, and management of the contaminated media will not pose an unreasonable risk to human health or the environment.~~ [Deleted because TSCA should not be an ARAR. Per EPA's "Guidance on Remedial Actions for Superfund Sites with PCB Contamination," TSCA requirements "do not apply to PCBs at concentrations less than 50 ppm." The guidance does not limit the 50 ppm to disposal scenarios, but rather indicates that this is the level at which TSCA "applies." The maximum concentration detected for soil is 5 ppm, and 3 ppm for sediment. As such, the 1 ppm action level for residential land use and the 10-25 ppm action level for industrial land use would not be applicable.]
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	MCLGs were considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.

Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	The HA for manganese was considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.
~~CWA National Recommended Water Quality Criteria (NRWQC)~~	~~40 CFR 122.44)~~	~~Relevant and Appropriate~~	~~Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standards may be used to develop cleanup standards for sediments.~~	~~*Water quality standards used to develop monitoring standards both during the active remedial period and for long-term monitoring of the protectiveness of the waste management area that will be established under this alternative.*~~ [Deleted because NRWQC were not used to develop PRGs.]
Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable	~~Establishes the specifications for discharging pollutants from any point source into the waters of the U.S.~~ Includes stormwater standards for activities disturbing more than one acre.	~~Any water discharged to surface water bodies during remedial activities will comply with this regulation.~~ Best management practices will be used to meet stormwater standards during the remedial action.
~~Toxic Pollutant Effluent Standards~~	~~40 CFR 129~~	~~Applicable~~	~~Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.~~	~~Any water discharged to surface water bodies as part of this alternative will meet the standards identified in this regulation.~~ [Deleted because this regulation is applies to handlers of pure PCBs, such as manufacturers of PCBs and PCB capacitors. The regulation applies to process and non-process waste water that is potentially in contact with pure PCBs. The effluent standard uses specific language, for example, "PCBs are prohibited in any discharge from any PCB manufacturer." The language of this standard is not relevant for the site. In any case, there is no discharge.]

~~Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)~~	~~42 U.S.C. 7411, 7412; 40 C.F.R. Part 61~~	~~Applicable~~	~~NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.~~	~~Ex-situ treatment under this Alternative will meet air emissions standards under these NESHAPs. In addition, excavation standards for particulate matter will be met during excavation and handling of contaminated soils. Activities during construction will include measures to suppress dust.~~ [Deleted. NESHAPs are not ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.]
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]
~~Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution~~	~~33 U.S.C. § 1251 et seq. 40 CFR. Part 403~~	~~Applicable~~	~~Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).~~	~~These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.~~ [Deleted because there is no discharge.]
~~Thermal Treatment,~~	~~40 C.F.R. Part 265, Subpart P~~	~~Relevant and Appropriate~~	~~Standards for air emissions and other operating standards for thermal treatment units.~~	~~These standards will apply to the alternative's ex-situ thermal treatment.~~ [Deleted because no hazardous waste is being treated by a thermal process, and the operation is not a TSDF. Soil that may be hazardous will be hazardous due to the TCLP characteristic for lead. This material will not be treated by LTTD. In addition, this regulation was deleted because it is part of the RI regulations, by reference.]

Management of Undesirable Plants on Federal Lands	7 U.S.C. 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site. The responsibility of control will be transitioned to NAVSTA after (1) the remedy is in place, and (2) NAVSTA develops a base-wide program for controlling undesirable plants.

State ARARs

Clean Air Act -Emissions Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during excavation/cover installation and ex-situ treatment will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act –Air Toxics	RIGL 23-23 *et seq.*; CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Monitoring of air emissions during excavation/cover installation and ex-situ treatment will be used to assess compliance with these standards if threshold levels are reached.
Water Pollution Control - Pollution Discharge Elimination Systems	RIGL 42-16 *et seq.*; CRIR 12-190-003, Rule 31	Applicable	~~Contains discharge limitations, monitoring requirements and best management practices. Substantive requirements under NPDES are written such that state and federal national recommended water quality criteria (NRWQC) are met. Permits are required for off-site discharges, RI Standards apply to POTWs.~~ Includes storm water requirements for construction projects that disturb over one acre.	~~Discharge of any contaminated groundwater during soil excavation or during O&M of the remedy into surface waters or POTW will meet applicable standards.~~ Stormwater standards for construction projects over one acre will ~~also~~ be met.
~~Water Pollution Control - Water Quality~~	~~RIGL 42-16 *et seq.*; CRIR 12-190-001~~	~~Applicable~~	~~Establishes water use classification and water quality criteria for waters of the state.~~	~~Water quality standards used to develop monitoring standards both during the active remedial period and for *long-term monitoring of the protectiveness of the waste management area that will be established under this alternative.*~~ [Deleted because there are no discharges.]
~~Pretreatment Regulations~~	~~RIGL 46-12, 4217.1, 42-45~~	~~Applicable~~	~~Rhode Island standards for discharge to POTWs.~~	~~These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.~~ [Deleted because there are no discharges.]

Rules and Regulations for Dredging and Management of Dredge Materials	DEM-OWR-DR-0203	Applicable	Addresses dredging activities and disposal of dredge spoils.	Any dredging of wetland soils and backfilling with cover material that is required under this alternative must comply with the requirements of the regulations.
~~Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells~~	~~RIGL 46-13..2 et seq.~~	~~Applicable~~	~~Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).~~	~~*Under these standards drinking water wells are prohibited within the waste management area that will be established under this alternative and monitoring wells used will be properly decommissioned when no longer needed.*~~ [Deleted because these activities would be covered under the groundwater alternatives.]
~~Rules and Regulations for Groundwater Quality – Appendix 1~~		~~Applicable~~	~~Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.~~	~~*Under this alternative, wells installed for monitoring the waste management area will be installed and abandoned according to these standards.*~~ [Deleted because these activities would be covered under the groundwater alternatives.]
The two lines citing the RI Hazardous Waste Regulations should be retained as drafted. [Agree]				
Rhode Island Solid Waste Regulations – Closure	DEM OWM-SW0401, 1.7.14(b)	Relevant and Appropriate	Regulation states that an approved closure plan must be implemented.	Under this alternative the Paved Storage Area will be closed under a plan developed in accordance with the substantive requirements of this section of the regulations (to be incorporated into the remedial design (RD) and the Operations and Maintenance Plan (O&M) (including a monitoring plan). Contaminated soil beneath the Paved Storage Area will be left in place as a waste management unit.
Rhode Island Solid Waste Regulations – Dust Control	DEM OWM-SW0401, 1.7.10	Relevant and Appropriate	Requires dust control.	Dust must be controlled at the site during cover construction and during maintenance activities.
Rhode Island Solid Waste Regulations – Health and Safety	DEM OWM-SW0401, 1.7.12 (a)	Relevant and Appropriate	Requires solid waste management facilities be designed and maintained to protect the health and safety of personnel at the facility and persons in close proximity.	Under this subsection health and safety of construction workers and persons in the proximity of the site would be maintained during construction and maintenance activities.

Rhode Island Solid Waste Regulations – Groundwater Monitoring and Closure	DEM OWM-SW0401, 1.8.01 (a) and 1.8.01 (b)	Relevant and Appropriate	Requires facilities to monitor groundwater and to meet closure requirements	The substantive requirements of this section of the regulations will be met by monitoring groundwater and meeting closure requirements. Because contaminants will be left in place at the Paved Storage Area, the Paved Storage Area will be closed as a waste management unit, and undergo long term monitoring. The remedial design (RD), remedial action work plan (RAWP), operations and monitoring plan (O&M) (including the long term monitoring plan [LTMP]) developed for this cleanup will contain the specific monitoring and closure requirements for the waste management unit that will comply with the substantive requirements.
Rhode Island Solid Waste Regulations – Sedimentation and Erosion Control	DEM OWM-SW0401, 2.1.04	Relevant and Appropriate	Requires a "Sedimentation and Erosion Control Plan" be developed.	An erosion and sediment control plan will be developed for this site in accordance with the substantive requirements of this section. The RD and the RAWP, to be developed for this cleanup, will contain the specific erosion and sediment controls requirements for the remedial construction.
~~Rhode Island Solid Waste Regulations – Monitoring Wells~~	~~DEM OWM-SW0401, 2.1.08 (a) (8)~~	~~Relevant and Appropriate~~	~~Contains requirements for construction of monitoring wells to monitor a solid waste landfill.~~	~~The substantive requirements of this section of the regulations will be met for construction of new monitoring wells.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
~~Rhode Island Solid Waste Regulations – Long-term Monitoring~~	~~DEM OWM-SW0401, 2.1.08 (c)~~	~~Relevant and Appropriate~~	~~Contains requirements for monitoring wells.~~	~~The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site. *Because this remedy leaves contamination in place*, it will be supported with a Long-Term Monitoring Plan (LTMP) for groundwater. The LTMP will be directed by a work plan that will contain the specific monitoring requirements.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
Rhode Island Solid Waste Regulations – Cover Systems	DEM OWM-SW0401, 2.2.12 (d) (1) and 2.2.12 (d) (2) (ii)(iii) and (v).	Relevant and Appropriate	Contains requirements for maintenance of the vegetative cover final cover system.	Existing cover at the Paved Storage Area will be maintained in compliance with these standards.

Rhode Island Solid Waste Regulations – Cover Permeability	DEM OWM-SW0401, 2.3.04(e), (f)	Relevant and Appropriate	Outlines the requirements for the maintenance and permeability of cover material	The substantive requirements of this section of the regulations will be met by the existing asphalt cover at the Paved Storage Area that has been determined to provide an adequate barrier for specific areas to be used for industrial use, and has been determined to provide an adequate barrier for the remainder of the land as a waste management area.
Rhode Island Solid Waste Regulations – Compliance Boundaries	DEM OWM-SW0401, 2.3.05	Relevant and Appropriate	Establishes requirement for compliance boundary for pollution of ground waters or surface waters.	The substantive requirements of this section of the regulations will be met by the requirement that no contamination of groundwater be permitted outside the boundary of the Paved Storage Area. Because this remedy leaves contamination in place, groundwater monitoring will be conducted to assure that no contaminants are transported to the groundwater beyond the boundary of the waste management area.
Rhode Island Solid Waste Regulations – Surface Water Drainage	DEM OWM-SW0401, 2.3.10	Relevant and Appropriate	Contains requirements for surface water drainage.	The substantive requirements of this section of the regulations will be met through the surface drainage of the Paved Storage Area. The cover system would be prevents erosion, sedimentation, and standing water on the cover.
~~Rhode Island Solid Waste Regulations – Monitoring Wells~~	~~DEM OWM-SW0401, 2.3.11~~	~~Relevant and Appropriate~~	~~Contains requirements for monitoring wells.~~	~~The substantive requirements of this section of the regulations will be met by having and maintaining monitoring wells for the purpose of monitoring groundwater conditions. *Because this remedy leaves contaminants in place*, it will be supported with a Long Term Monitoring Plan (LTMP) for groundwater. The LTMP will be directed by a work plan that will contain the specific monitoring well requirements.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
Rhode Island Solid Waste Regulations – Siting in and Adjacent to Wetlands and Floodplains	DEM OWM-SW0401, 2.3.14	Relevant and Appropriate	Provides requirements for new solid waste landfill units and expansions that impact wetlands and coastal wetlands, coastal flood zones, etc.	This alternative will involve alteration of land within wetlands ~~and flood zones~~. The substantive requirements of this section of the regulations will be met by protecting wetland ~~and downstream floodplain~~ resources during construction and maintenance of a ~~soil~~ cover over soil containing residual contamination. The RD, RAWP, and the LTMP will be developed and provide specific requirements, to meet the substantive requirements of this section

Rhode Island Solid Waste Regulations – Closure in "Unstable Areas"	DEM OWM-SW0401, 2.3.23	Relevant and Appropriate	Provides requirements for closure of solid waste units in "unstable areas", interpreted to include wetland and floodplains.	This alternative establishes a waste management area adjacent to "unstable areas." The substantive requirements of this section of the regulations will be met through the closure of the waste management area. This alternative meets the intent because the waste management area will be covered in a manner that prevents the release of contaminants during a 100 year flood event.

Table 4-7: Chemical-specific

Federal ARARs

EPA Carcinogenicity Slope Factor	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed through remediation to industrial cleanup levels based on installing a cover over areas of contaminated soil (except in areas where an existing pavement cover will be maintained), removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.
EPA Risk Reference Dose (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed through remediation to industrial cleanup levels based on installing a cover over areas of contaminated soil (except in areas where an existing pavement cover will be maintained), removal of anomalies, LUCs and long-term monitoring of the *established waste management area.*
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens assessed through this guidance will be addressed through remediation to industrial cleanup levels based on installing a cover over areas of contaminated soil (except in areas where an existing pavement cover will be maintained), removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks to children assessed through this guidance will be addressed through remediation to industrial cleanup levels based on installing a cover over areas of contaminated soil (except in areas where an existing pavement cover will be maintained), removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.

Recommendations of the Technical Review Workgroup for Lead for an approach to Assessing Risks Associated with Adult Exposure to Lead In Soil	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA Guidance for evaluating risks posed by lead in soil.	Risks from lead assessed under this guidance will be addressed through remediation to industrial cleanup levels based on installing a cover over areas of contaminated soil (except in areas where an existing pavement cover will be maintained), removal of anomalies, LUCs and long-term monitoring of the Paved Storage Area.

State ARARs

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001; DEM-DSR-01-93, sections 8.01 and 8.02	Applicable	These regulations set remediation standards for direct contact and leachability for contaminated soil at NPL sites when they are more stringent than federal standards.	These standards were used to develop soil PRGs. Remediation to industrial cleanup levels based on placement of 2 feet of clean permeable cover material (except in areas where an existing pavement cover will be maintained), removal and off-site disposal of anomalies, LUCs and long-term monitoring of the Paved Storage Area meets the regulations' requirements for permitting industrial use and leachability standards in areas where pavement will be maintained.

Table 4-8: Location-Specific
Federal ARARs

Fish and Wildlife Coordination Act	16 U.S.C.. §661 *et seq*.	Applicable	Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted, in particular regarding remedial measures for contaminated soil that will impact streams, wetlands, and downstream water bodies.
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management)~~ Implements Executive Order 11990 (Protection of Wetlands). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of soil remedial actions on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by soil remediation, will be mitigated in accordance with requirements. ~~Remedial work adjacent to Site water bodies/waterways has the potential to negatively alter downstream floodplain. Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered. Cover on contaminated soil prevents introduction of contaminants to the floodplain.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.~~ Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Alternatives may involve discharge of dredged material and/or excavation. Soil remediation or other remedial actions that include dredging or filling in wetlands will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource as required. The Navy has determined that this alternative **[is][is not]** the Least Damaging Practicable Alternative to protect wetland resources because it **[provides][does not provide]** the best balance of addressing contaminated soil within and adjacent to wetlands and waterways with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site. The CERCLA criteria will be used to select the alternative. [Determination of the LEDPA will be made prior to finalizing the FS, and this text will be revised accordingly at that time.]
Endangered Species Act	16 U.S.C. 1531 *et seq.*; 50 C.F.R. parts 200 and 402	Applicable	Regulates activities affecting federally listed endangered or threatened species or their habitat. The federally-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate federal agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]

National Historic Landmarks (Historic Sites Act)	16 USC §461 et seq.; 36 CFR Part 65	Applicable	The purpose of the National Historic Landmarks program is to identify and designate National Historic Landmarks, and encourage the long range preservation of nationally significant properties that illustrate or commemorate the history and prehistory of the United States.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact historical properties/structures determined to be protected by this standard, activities will be coordinated with the Department of the Interior.
Protection of Historic Properties (National Historic Preservation Act)	16 USC §470 et seq., 36 CFR Part 800	Applicable	Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact properties/structures determined to be protected by this standard, activities will be coordinated with the Advisory Council on Historic Preservation.

State ARARs

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State jurisdictional wetlands and water bodies.~~ [Deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
Rhode Island Endangered Species Act	RIGL 20-37-1 *et seq.*	~~Applicable~~ Relevant and Appropriate	Regulates activities affecting State-listed endangered or threatened species or their habitat. The State-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate State agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
Rhode Island Historical Preservation Act	RIGL 42-45 et seq.	Applicable	Requires action to take into account effects on properties included on or eligible for the National register of Historic Places and minimizes harm to National Historic Landmarks.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact properties/structures determined to be protected by this standard, activities will be coordinated with the State Agency.
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Cover installation and excavation activities will be conducted to minimize the disturbance of wetlands.

Table 4-9: Action-Specific

Federal ARARs

~~Toxic Substances Control Act (TSCA); PCB Remediation Waste,~~	~~40 C.F.R. 761.61(c)~~	~~Applicable~~	~~This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.~~	~~All soil exceeding identified PCB cleanup levels will be placed under a cover system that meets TSCA protectiveness standards. The management of PCB contaminated media will be performed in a manner to comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's soil PCB PRG, along with the covering of the contaminated media, will not pose an unreasonable risk to human health or the environment.~~ [Deleted because TSCA should not be an ARAR. Per EPA's "Guidance on Remedial Actions for Superfund Sites with PCB Contamination," TSCA requirements "do not apply to PCBs at concentrations less than 50 ppm." The guidance does not limit the 50 ppm to disposal scenarios, but rather indicates that this is the level at which TSCA "applies." The maximum concentration detected for soil is 5 ppm, and 3 ppm for sediment. As such, the 1 ppm action level for residential land use and the 10-25 ppm action level for industrial land use would not be applicable.]
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	MCLGs were considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.

Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	The HA for manganese was considered in development of PRGs. The PRGs will be used to determine whether contamination has migrated outside of the compliance zone of the Paved Storage Area to ensure the protectiveness of the remedy, or if contamination levels have been reduced enough and that no site risk remains and monitoring can be ended.
~~CWA National Recommended Water Quality Criteria (NRWQC)~~	~~40 CFR 122.44)~~	~~Relevant and Appropriate~~	~~Federal NRWQC are health-based and ecologically-based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments~~	~~Water quality standards used to develop monitoring standards both during the active remedial period and for long-term monitoring of the protectiveness of *the waste management area that will be established under this alternative.*~~ [Deleted because NRWQC were not used to develop PRGs.]
Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable	~~Establishes the specifications for discharging pollutants from any point source into the waters of the U.S.~~ Includes stormwater standards for activities disturbing more than one acre.	~~Any water discharged to surface water bodies during remedial activities will comply with this regulation.~~ Best management practices will be used to meet stormwater standards during the remedial action.
~~Toxic Pollutant Effluent Standards~~	~~40 CFR 129~~	~~Applicable~~	~~Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.~~	~~Any water discharged to surface water bodies as part of this alternative will meet the standards identified in this regulation.~~ [Deleted because this regulation is applies to handlers of pure PCBs, such as manufacturers of PCBs and PCB capacitors. The regulation applies to process and non-process waste water that is potentially in contact with pure PCBs. The effluent standard uses specific language, for example, "PCBs are prohibited in any discharge from any PCB manufacturer." The language of this standard is not relevant for the site. In any case, there is no discharge.]

~~Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)~~	~~42 U.S.C. 7411, 7412; 40 C.F.R. Part 61~~	~~Applicable~~	~~NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.~~	~~Activities during construction and O&M of the cover will include measures to suppress dust that may contain contaminants.~~ [Deleted. NESHAPs are not ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.]
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]
~~Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution~~	~~33 U.S.C. § 1251 et seq. 40 CFR. Part 403~~	~~Applicable~~	~~Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).~~	~~These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.~~ [Deleted because there is no discharge.]
Management of Undesirable Plants on Federal Lands	7 U.S.C. 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site. The responsibility of control will be transitioned to NAVSTA after (1) the remedy is in place, and (2) NAVSTA develops a base-wide program for controlling undesirable plants.

State ARARs

Clean Air Act -Emissions Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during cover installation and O&M will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act –Air Toxics	RIGL 23-23 *et seq.*; CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Monitoring of air emissions during cover installation and O&M will be used to assess compliance with these standards if threshold levels are reached.
Water Pollution Control - Pollution Discharge Elimination Systems	RIGL 42-16 *et seq.*; CRIR 12-190-003 Rule 31	Applicable	~~Contains discharge limitations, monitoring requirements and best management practices. Substantive requirements under NPDES are written such that state and federal national recommended water quality criteria (NRWQC) are met. Permits are required for off-site discharges, RI Standards apply to POTWs.~~ Includes storm water requirements for construction projects that disturb over one acre.	~~Discharge of any contaminated groundwater during cover installation or during O&M of the remedy into surface waters or a POTW will meet applicable standards.~~ Stormwater standards for construction projects over one acre will ~~also~~ be met.
~~Water Pollution Control - Water Quality~~	~~RIGL 42-16 *et seq.*; CRIR 12-190-001~~	~~Applicable~~	~~Establishes water use classification and water quality criteria for waters of the state.~~	~~Water quality standards used to develop monitoring standards both during the active remedial period and for long-term monitoring of the protectiveness of the *waste management area that will be established under this alternative.*~~ [Deleted because there are no discharges.]
~~Pretreatment Regulations~~	~~RIGL 46-12, 4217.1, 42-45~~	~~Applicable~~	~~Rhode Island standards for discharge to POTWs.~~	~~These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.~~ [Deleted because there are no discharges.]
Rules and Regulations for Dredging and Management of Dredge Materials	DEM-OWR-DR-0203	Applicable	Addresses dredging activities and disposal of dredge spoils.	Any dredging of wetland soils and backfilling with cover material that is required while implementing the alternative must comply with the requirements of the regulations.
~~Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells~~	~~RIGL 46-13..2 et seq.~~	~~Applicable~~	~~Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).~~	~~*Under these standards drinking water wells are prohibited within the waste management area that will be established under this alternative and monitoring wells used will be properly decommissioned when no longer needed.*~~ [Deleted because these activities would be covered under the groundwater alternatives.]

~~Rules and Regulations for Groundwater Quality – Appendix I~~		~~Applicable~~	~~Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.~~	~~Under this alternative, wells installed *for monitoring the waste management area* will be installed and abandoned according to these standards.~~ [Deleted because these activities would be covered under the groundwater alternatives.]
The two lines citing the RI Hazardous Waste Regulations should be retained as drafted. [Agree]				
Rhode Island Solid Waste Regulations – Closure	DEM OWM-SW0401, 1.7.14(b)	Relevant and Appropriate	Regulation states that an approved closure plan must be implemented.	Under this alternative the Paved Storage Area will be closed under a plan developed in accordance with the substantive requirements of this section of the regulations (to be incorporated into the remedial design (RD) and the Operations and Maintenance Plan (O&M) (including a monitoring plan). Contaminated soil beneath the Paved Storage Area will be left in place as a waste management unit.
Rhode Island Solid Waste Regulations – Dust Control	DEM OWM-SW0401, 1.7.10	Relevant and Appropriate	Requires dust control.	Dust must be controlled at the site during cover construction and during maintenance activities.
Rhode Island Solid Waste Regulations – Health and Safety	DEM OWM-SW0401, 1.7.12 (a)	Relevant and Appropriate	Requires solid waste management facilities be designed and maintained to protect the health and safety of personnel at the facility and persons in close proximity.	Under this subsection health and safety of construction workers and persons in the proximity of the site would be maintained during construction and maintenance activities.
Rhode Island Solid Waste Regulations – Groundwater Monitoring and Closure	DEM OWM-SW0401, 1.8.01 (a) and 1.8.01 (b)	Relevant and Appropriate	Requires facilities to monitor groundwater and to meet closure requirements	The substantive requirements of this section of the regulations will be met by monitoring groundwater and meeting closure requirements. Because contaminants will be left in place at the Paved Storage Area, the Paved Storage Area will be closed as a waste management unit, and undergo long term monitoring. The remedial design (RD), remedial action work plan (RAWP), operations and monitoring plan (O&M) (including the long term monitoring plan [LTMP]) developed for this cleanup will contain the specific monitoring and closure requirements for the waste management unit that will comply with the substantive requirements.
Rhode Island Solid Waste Regulations – Sedimentation and Erosion Control	DEM OWM-SW0401, 2.1.04	Relevant and Appropriate	Requires a "Sedimentation and Erosion Control Plan" be developed.	An erosion and sediment control plan will be developed for this site in accordance with the substantive requirements of this section. The RD and the RAWP, to be developed for this cleanup, will contain the specific erosion and sediment controls requirements for the remedial construction.

~~Rhode Island Solid Waste Regulations – Monitoring Wells~~	~~DEM OWM-SW0401, 2.1.08 (a) (8)~~	~~Relevant and Appropriate~~	~~Contains requirements for construction of monitoring wells to monitor a solid waste landfill.~~	~~The substantive requirements of this section of the regulations will be met for construction of new monitoring wells.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
~~Rhode Island Solid Waste Regulations – Long-term Monitoring~~	~~DEM OWM-SW0401, 2.1.08 (c)~~	~~Relevant and Appropriate~~	~~Contains requirements for monitoring wells.~~	~~The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site. *Because this remedy leaves contamination in place*, it will be supported with a Long Term Monitoring Plan (LTMP) for groundwater. The LTMP will be directed by a work plan that will contain the specific monitoring requirements.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
Rhode Island Solid Waste Regulations – Cover Systems	DEM OWM-SW0401, 2.2.12 (d) (1) and 2.2.12 (d) (2) (ii)(iii) and (v).	Relevant and Appropriate	Contains requirements for construction and maintenance of the vegetative cover final cover system.	Existing cover at the Paved Storage Area will be maintained in compliance with these standards.
Rhode Island Solid Waste Regulations – Cover Permeability	DEM OWM-SW0401, 2.3.04(e), (f)	Relevant and Appropriate	Outlines the requirements for the maintenance and permeability of cover material.	The substantive requirements of this section of the regulations will be met by the existing asphalt cover at the Paved Storage Area that has been determined to provide an adequate barrier for specific areas to be used for industrial use, and has been determined to provide an adequate barrier for the remainder of the land as a waste management area.
Rhode Island Solid Waste Regulations – Compliance Boundaries	DEM OWM-SW0401, 2.3.05	Relevant and Appropriate	Establishes requirement for compliance boundary for pollution of ground waters or surface waters.	The substantive requirements of this section of the regulations will be met by the requirement that no contamination of groundwater be permitted outside the boundary of the Paved Storage Area. Because this remedy leaves contamination in place, groundwater monitoring will be conducted to assure that no contaminants are transported to the groundwater beyond the boundary of the waste management area.
Rhode Island Solid Waste Regulations – Surface Water Drainage	DEM OWM-SW0401, 2.3.10	Relevant and Appropriate	Contains requirements for surface water drainage.	The substantive requirements of this section of the regulations will be met through the surface drainage of the Paved Storage Area. The cover system would be prevents erosion, sedimentation, and standing water on the cover.

~~Rhode Island Solid Waste Regulations – Monitoring Wells~~	~~DEM OWM-SW0401, 2.3.11~~	~~Relevant and Appropriate~~	~~Contains requirements for monitoring wells.~~	~~The substantive requirements of this section of the regulations will be met by having and maintaining monitoring wells for the purpose of monitoring groundwater conditions. *Because this remedy leaves contaminants in place*, it will be supported with a Long Term Monitoring Plan (LTMP) for groundwater. The LTMP will be directed by a work plan that will contain the specific monitoring well requirements.~~ [Deleted because monitoring well installation and maintenance will be included under the groundwater alternatives.]
Rhode Island Solid Waste Regulations – Siting in and Adjacent to Wetlands and Floodplains	DEM OWM-SW0401, 2.3.14	Relevant and Appropriate	Provides requirements for new solid waste landfill units and expansions that impact wetlands and coastal wetlands, coastal flood zones, etc.	This alternative will involve alteration of land within wetlands ~~and flood zones~~. The substantive requirements of this section of the regulations will be met by protecting wetland ~~and downstream floodplain~~ resources during construction and maintenance of a ~~soil~~ cover over soil containing residual contamination. The RD, RAWP, and the LTMP will be developed and provide specific requirements, to meet the substantive requirements of this section.
Rhode Island Solid Waste Regulations – Closure in "Unstable Areas"	DEM OWM-SW0401, 2.3.23	Relevant and Appropriate	Provides requirements for closure of solid waste units in "unstable areas", interpreted to include wetland and floodplains.	This alternative establishes a waste management area within and/or adjacent to "unstable areas." The substantive requirements of this section of the regulations will be met through the closure of the waste management area. This alternative meets the intent because the waste management area will be covered in a manner that prevents the release of contaminants during a 100 year flood event.

Table 5-4: Chemical-specific

Federal ARARs

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Non-zero MCLGs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Health Advisory was considered in development of PRG for manganese. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
EPA Carcinogenicity Slope Factor		To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. *LUCs* within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
EPA Risk Reference Dose (RfDs)		To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Modify the RI Remediation Regulation citation:

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001; DEM-DSR-01-93, sections 8.01 and 8.03	Applicable	These regulations set remediation standards for groundwater at NPL sites when they are more stringent than federal standards.	These standards were used to develop groundwater PRGs. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Remove the line for the RI Water Quality Regulations (not chemical-specific standards). **[Agree]**

Table 5-5 and Table 5-8 and Table 5-11: Location-specific
Federal ARARs

~~Fish and Wildlife Coordination Act~~	~~16 U.S.C.. §661 *et seq*.~~	~~Applicable~~	~~Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.~~	~~Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted; in particular regarding remedial measures install or maintain monitoring wells that could impact streams, wetlands, and downstream water bodies.~~ [Deleted. No activities in the streams.]
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management) and~~ Implements Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of installing and maintaining monitoring wells on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by well installation and maintenance will be mitigated in accordance with requirements. ~~Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [Deleted. No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.~~ Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Alternatives may involve discharge of dredged material and/or excavation. Installation or maintenance of monitoring wells that include dredging or filling in wetlands will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource as required.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]

State ARARs

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State-jurisdictional wetlands and water bodies that may be affected by monitoring well installation and maintenance.~~ [Deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Injection well installation, injection, and monitoring activities will be conducted to minimize the disturbance of wetlands.

Table 5-6: Action-specific
Federal ARARs

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	Groundwater within the compliance boundary of the Paved Storage Area ~~boundary for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Groundwater within the compliance boundary the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards. ~~to ensure contaminated groundwater does not migrate beyond the compliance boundary.~~ Exceedances of these standards (particularly for manganese) within the compliance boundary will be addressed by LUCs.
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,	OSWER Directive 9200.4-17P (April 21, 1999)	To Be Considered	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard through monitored attenuation would be comparable to that which could be achieved through active restoration.	This guidance will be used to determine success of monitored natural attenuation component of any alternative to attain all groundwater cleanup standards within a reasonable time frame.
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]

EPA Groundwater Protection Strategy (August 1984); NCP Preamble; Guidelines for Ground-Water Classification (November 1986)	Federal Register Vol 55, No. 46, March 8, 1990, p. 8733 (NCP Preamble)	To Be Considered	The Groundwater Protection Strategy provides a common reference for preserving clean groundwater and protecting the public health against the effects of past contamination. Guidelines for consistency in groundwater protection programs focus on the highest beneficial use of a groundwater aquifer and define three classes of groundwater. These documents defined Class I, II and III groundwaters.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved. Groundwater outside of the compliance boundary for the Paved Storage Area established at the Site needs to attain federal drinking water and risk-based standards. Groundwater monitoring using these standards will be used to make sure groundwater exceeding these standards does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary is a basis for establishing prohibitions on the use of groundwater within the compliance boundary. An additional buffer zone beyond the compliance boundary to prevent groundwater wells from being installed that would draw contaminated groundwater beyond the compliance boundary may also be established, if required.

State ARARs (the two listed state hazardous waste regulation citations to be retained) [Agree].

~~Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells~~	~~RIGL 46-13..2 *et seq.*~~	~~Applicable~~	~~Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).~~	~~Under these standards, non-public drinking water wells are prohibited within areas of contamination, and monitoring wells used will be properly decommissioned when no longer needed.~~ [Deleted because installation and maintenance of monitoring wells are addressed by solid waste regulations for monitoring wells.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.1.08 (a) (8)	Relevant and Appropriate	Contains requirements for construction of monitoring wells to monitor a solid waste landfill.	The substantive requirements of this section of the regulations will be met for construction of new monitoring wells and maintenance of all monitoring wells. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]

Rhode Island Solid Waste Regulations – Long-term Monitoring	DEM OWM-SW0401, 2.1.08 (c)	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.3.11	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rules and Regulations for Groundwater Quality – Appendix 1		Applicable	Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.	Wells installed for monitoring will be installed and abandoned according to these standards.

Table 5-7: Chemical-specific

Federal ARARs

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Non-zero MCLGs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Health Advisory was considered in development of PRG for manganese. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
EPA Carcinogenicity Slope Factor		To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
EPA Risk Reference Dose (RfDs)		To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Modify the RI Remediation Regulation citation:

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001; DEM-DSR-01-93, sections 8.01 and 8.03	Applicable	These regulations set remediation standards for groundwater at NPL sites when they are more stringent than federal standards.	These standards were used to develop groundwater PRGs. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through bioremediation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Remove the line for the RI Water Quality Regulations (not chemical-specific standards) **[Agree]**.

Table 5-9: Action-specific

Federal ARARs (keep the federal underground injection control citation) **[Agree]**.

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards. ~~to ensure contaminated groundwater does not migrate beyond the compliance boundary.~~ Exceedances of these standards (particularly for manganese) within the compliance boundary will be addressed by LUCs.
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,	OSWER Directive 9200.4-17P (April 21, 1999)	To Be Considered	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard though monitored attenuation would be comparable to that which could be achieved through active restoration.	Bioremediation and MNA can attain federal drinking water and risk standards as defined by this guidance within a reasonable time frame outside of the compliance boundary for the waste management area.
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]

EPA Groundwater Protection Strategy (August 1984); NCP Preamble; Guidelines for Ground-Water Classification (November 1986)	Federal Register Vol 55, No. 46, March 8, 1990, p. 8733 (NCP Preamble)	To Be Considered	The Groundwater Protection Strategy provides a common reference for preserving clean groundwater and protecting the public health against the effects of past contamination. Guidelines for consistency in groundwater protection programs focus on the highest beneficial use of a groundwater aquifer and define three classes of groundwater. These documents defined Class I, II and III groundwaters.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved. Groundwater outside of the compliance boundary for the Paved Storage Area established at the Site needs to attain federal drinking water and risk-based standards. Groundwater monitoring using these standards will be used to make sure groundwater exceeding these standards does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary is a basis for establishing prohibitions on the use of groundwater within the compliance boundary. An additional buffer zone beyond the compliance boundary to prevent groundwater wells from being installed that would draw contaminated groundwater beyond the compliance boundary may also be established, if required.

State ARARs (the two listed state hazardous waste regulation and the state underground injection citations should be retained) [Agree]

~~Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells~~	~~RIGL 46-13..2 *et seq*.~~	~~Applicable~~	~~Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).~~	~~Under these standards drinking water wells are prohibited within areas of contamination and monitoring wells used will be properly decommissioned when no longer needed.~~ [Deleted because installation and maintenance of monitoring wells are addressed by solid waste regulations for monitoring wells.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.1.08 (a) (8)	Relevant and Appropriate	Contains requirements for construction of monitoring wells to monitor a solid waste landfill.	The substantive requirements of this section of the regulations will be met for construction of new monitoring wells and maintenance of all monitoring wells. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]

Rhode Island Solid Waste Regulations – Long-term Monitoring	DEM OWM-SW0401, 2.1.08 (c)	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.3.11	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rules and Regulations for Groundwater Quality – Appendix 1		Applicable	Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.	Wells installed for monitoring and in-situ treatment will be installed and abandoned according to these standards.

Table 5-10: Chemical-specific

Federal ARARs

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Non-zero MCLGs were considered in development of PRGs. Outside of the compliance boundary of the Paved Storage Area, PRGs would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Health Advisory was considered in development of PRG for manganese. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards..
EPA Carcinogenicity Slope Factor		To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
EPA Risk Reference Dose (RfDs)		To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in groundwater for COCs without MCLs, non-zero MCLGs, or Health Advisory values. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Modify the RI Remediation Regulation citation:

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001; DEM-DSR-01-93, sections 8.01 and 8.03	Applicable	These regulations set remediation standards for groundwater at NPL sites when they are more stringent than federal standards.	These standards were used to develop groundwater PRGs. Outside of the compliance boundary of the Paved Storage Area, PRG would be met through chemical oxidation and natural attenuation. LUCs within the compliance boundary of the Paved Storage Area will prevent use of contaminated groundwater that exceeds these standards.

Remove the line for the RI Water Quality Regulations (not chemical-specific standards) [Agree].

Table 5-12: Action-specific

Federal ARARs (keep the federal underground injection control citation) [Agree].

Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subparts B and G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Safe Drinking Water Act; National primary drinking water regulations	42 U.S.C. §300f *et seq.*; 40 C.F.R. 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; ~~MCLGs set as zero are To Be Considered.~~	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Groundwater within the compliance boundary of the Paved Storage ~~Area for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards to ensure contaminated groundwater does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary will be addressed by LUCs.
Health Advisories (EPA Office of Drinking Water)		To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water. The risk-based standard for manganese is 0.3 mg/L.	Groundwater within the compliance boundary of the Paved Storage Area ~~for any waste management area established for the soil or sediment components of the remedy~~ will be monitored using the standards ~~to ensure contaminated groundwater does not migrate beyond the compliance boundary.~~ Exceedances of these standards (particularly for manganese) within the compliance boundary will be addressed by LUCs.
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,	OSWER Directive 9200.4-17P (April 21, 1999)	To Be Considered	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard though monitored attenuation would be comparable to that which could be achieved through active restoration.	Chemical oxidation and MNA can attain federal drinking water and risk standards as defined by this guidance within a reasonable time frame outside of the compliance boundary for the waste management area.
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]

EPA Groundwater Protection Strategy (August 1984); NCP Preamble; Guidelines for Ground-Water Classification (November 1986)	Federal Register Vol 55, No. 46, March 8, 1990, p. 8733 (NCP Preamble)	To Be Considered	The Groundwater Protection Strategy provides a common reference for preserving clean groundwater and protecting the public health against the effects of past contamination. Guidelines for consistency in groundwater protection programs focus on the highest beneficial use of a groundwater aquifer and define three classes of groundwater. These documents defined Class I, II and III groundwaters.	Under federal standards, groundwater within the Site is considered a potential drinking water source; therefore, groundwater must achieve these standards. Groundwater use restrictions will be maintained until these standards are achieved. Groundwater outside of the compliance boundary for the Paved Storage Area established at the Site needs to attain federal drinking water and risk-based standards. Groundwater monitoring using these standards will be used to make sure groundwater exceeding these standards does not migrate beyond the compliance boundary. Exceedances of these standards within the compliance boundary is a basis for establishing prohibitions on the use of groundwater within the compliance boundary. An additional buffer zone beyond the compliance boundary to prevent groundwater wells from being installed that would draw contaminated groundwater beyond the compliance boundary may also be established, if required.

State ARARs (the two listed state hazardous waste regulation and the state underground injection citations should be retained) [Agree]

~~Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells~~	~~RIGL 46-13..2 *et seq.*~~	~~Applicable~~	~~Prohibits installing drinking water wells in contaminated aquifers. Establishes standards for decommissioning monitoring wells (Rule 9.03).~~	~~Under these standards drinking water wells are prohibited within areas of contamination and monitoring wells used will be properly decommissioned when no longer needed.~~ [Deleted because installation and maintenance of monitoring wells are addressed by solid waste regulations for monitoring wells.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.1.08 (a) (8)	Relevant and Appropriate	Contains requirements for construction of monitoring wells to monitor a solid waste landfill.	The substantive requirements of this section of the regulations will be met for construction of new monitoring wells and maintenance of all monitoring wells. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]

Rhode Island Solid Waste Regulations – Long-term Monitoring	DEM OWM-SW0401, 2.1.08 (c)	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rhode Island Solid Waste Regulations - Monitoring Wells	DEM OWM-SW0401, 2.3.11	Relevant and Appropriate	Contains requirements for monitoring wells.	The substantive requirements of this section of the regulations will be met by maintaining monitoring wells for the purpose of monitoring groundwater conditions at the site, including monitoring for soil contamination left in place. Groundwater monitoring for alternatives for all media will be addressed through a monitoring program under the selected groundwater alternative. [Added to address installation and maintenance of all wells. Groundwater monitoring for all alternatives will be addressed through a monitoring program under the selected groundwater alternative.]
Rules and Regulations for Groundwater Quality – Appendix 1		Applicable	Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.	Wells installed for monitoring and in-situ treatment will be installed and abandoned according to these standards.

Table 6-4: Chemical Specific

Federal ARARs

~~EPA Risk Reference Dose (RfDs)~~		~~To Be Considered~~	~~RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the ENR of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~EPA Carcinogenicity Slope Factor~~		~~To Be Considered~~	~~Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the ENR of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~Guidelines for Carcinogen Risk Assessment~~	~~EPA/630/P-03/001F (March 2005)~~	~~To Be Considered~~	~~Guidance for assessing cancer risk.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the ENR of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens~~	~~EPA/630/R-03/003F (March 2005)~~	~~To Be Considered~~	~~Guidance of assessing cancer risks to children.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the ENR of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~U.S. DOE, Office of Environmental Management, Secondary Chronic Values (SCVs) (Jones et al., 1997)~~		~~To Be Considered~~	~~The SCVs are toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota.~~	~~[It is unclear whether ecological risks at the Site identified using this guidance will be addressed by limited excavation and ENR.]~~ [Deleted because these screening values are only used for initial evaluation.]
~~U.S. EPA Sediment Quality Criterion (SQC) and Sediment Quality Benchmarks (SQBs) (USEPA, 1996)~~		~~To Be Considered~~	~~SQCs and SQBs were established to provide screening toxicity thresholds.~~	~~[It is unclear whether ecological risks at the Site identified using this guidance will be addressed by limited excavation and ENR.]~~ [Deleted because these screening values are only used for initial evaluation.]
~~NOAA Screening Quick Reference Tables, Threshold Effects Level (TEL) (Buchman, 1999)~~		~~To Be Considered~~	~~TELs represent the concentration below which adverse effects are expected to occur only rarely.~~	~~[It is unclear whether ecological risks at the Site identified using this guidance will be addressed by limited excavation and ENR.]~~ [Deleted because these screening values are only used for initial evaluation.]

~~Ontario Ministry of Environment and Energy (OMEE) Lowest Effect Levels (LELs) for Freshwater Sediments (Persaud et al., 1993)~~		~~To Be Considered~~	~~The LEL value is the concentration at which the majority of the sediment-dwelling organisms are not affected.~~	~~[It is unclear whether ecological risks at the Site identified using this guidance will be addressed by limited excavation and ENR.]~~ [Deleted because these screening values are only used for initial evaluation.]
Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Probable Effects Concentrations (PECs) (MacDonald et al., 2000)		To Be Considered	The PEC value is the concentration above which the adverse effects on sediment-dwelling organisms are likely to occur.	~~[It is unclear whether ecological risks at the Site identified using this guidance will be addressed by limited excavation and ENR.]~~ Limited sediment removal and ENR will prevent exposure to COCs at concentrations greater than PRGs calculated through the use of PECs.
~~CWA National Recommended Water Quality Criteria (NRWQC)~~	~~40 CFR 122.44~~	~~Relevant and Appropriate~~	~~Federal NRWQC are health-based and ecologically-based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments~~	~~[It is unclear whether sediment cleanup standards at the Site can be achieved by limited excavation and ENR.]~~ [Deleted because water quality criteria were not used to calculate sediment cleanup standards.]

Remove the State Water Quality citation. [Agree]

Table 6-5: Location-specific
Federal ARARs

Fish and Wildlife Coordination Act	16 U.S.C.. §661 *et seq*.	Applicable	Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted, in particular regarding remedial measures for contaminated sediment that will impact streams, wetlands, and downstream water bodies.
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management) and~~ Implements Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of sediment remedial actions on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by sediment remediation will be mitigated in accordance with requirements. ~~Remedial work within Site water bodies/waterways (as well as long-term maintenance of the NUSC Pond dam) has the potential to negatively alter downstream floodplain. Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered. Cover would be designed to maintain sediment in place.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems~~. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Sediment remediation or other remedial actions that include dredging or filling in wetlands will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource as required. The Navy has determined that this alternative **[is][is not]** the Least Damaging Practicable Alternative to protect wetland resources because it **[provides][does not provide]** the best balance of addressing contaminated sediment within and adjacent to wetlands and waterways with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site. The CERCLA criteria will be used to select the alternative. [Determination of the LEDPA will be made prior to finalizing the FS, and this text will be revised accordingly at that time.]
Endangered Species Act	16 U.S.C. 1531 *et seq.*; 50 C.F.R. parts 200 and 402	Applicable	Regulates activities affecting federally listed endangered or threatened species or their habitat. The federally-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate federal agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]

State ARARs

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State-jurisdictional wetlands and water bodies.~~ [Deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
Rhode Island Endangered Species Act	RIGL 20-37-1 *et seq.*	~~Applicable~~ Relevant and Appropriate	Regulates activities affecting State-listed endangered or threatened species or their habitat. The State-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate State agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Inspection of Dams and Reservoirs; Rules and Regulations for Dam Safety~~	~~RIGL 46-19~~	~~Applicable~~	~~Sets standards for inspecting and maintaining dams in the State.~~	~~LUCs and O&M of the NUSC Pond dam is required as part of the remedial action to prevent contaminated sediment that is being managed in place under this alternative from migrating downstream of the dam.~~ [Deleted because the dam is not part of the remedy. The dam is maintained by the base. Sediment downstream of dam may be analyzed if needed (e.g., if the cap is damaged) to evaluate the potential loss of contaminants from sediment behind dam.]
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Sediment removal and ENR cover installation activities will be conducted to minimize the disturbance of wetlands.

Table 6-6: Action-specific
Federal ARARs

Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	EPA-540-R-05-012 OSWER 9355.0-85 (December 2005)	To Be Considered	Guidance for making remedy decisions for contaminated sediment sites. Some of the relevant sections of the guidance address Remedial Investigations (Ch. 2), FS Considerations (including LUCs)(Ch. 3), MNR (Ch. 4), Capping (Ch. 5), Dredging and Excavation (Ch. 6), and Long-Term Monitoring (Ch. 8).	ENR and selective sediment removal, along with dewatering and off-site disposal under this alternative meets guidance standards for addressing contaminated sediments in the wetlands/waterway (as long as habitat restoration requirements can be met).
~~Toxic Substances Control Act (TSCA); PCB Remediation Waste,~~	~~40 C.F.R. 761.61(c)~~	~~Applicable~~	~~This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in-situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.~~	~~All sediment exceeding identified PCB cleanup levels will be either be removed, dewatered (if required) and disposed of off-site or will be placed under the ENR cover system. [It is unclear whether the ENR cover meets TSCA protectiveness standards (depending on PCB concentrations exposed after the proposed excavation).] The excavation, transportation/ dewatering, and management of PCB contaminated media must comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's sediment PCB cleanup levels, along with the excavation, dewatering, and ENR system for the PCB-contaminated sediment will not pose an unreasonable risk to human health or the environment.~~ [Deleted because TSCA should not be an ARAR. Per EPA's "Guidance on Remedial Actions for Superfund Sites with PCB Contamination," TSCA requirements "do not apply to PCBs at concentrations less than 50 ppm." The guidance does not limit the 50 ppm to disposal scenarios, but rather indicates that this is the level at which TSCA "applies." The maximum concentration detected for soil is 5 ppm, and 3 ppm for sediment. As such, the 1 ppm action level for residential land use and the 10-25 ppm action level for industrial land use would not be applicable.]
CWA National Recommended Water Quality Criteria (NRWQC)	40 CFR 122.44)	Relevant and Appropriate	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standards may be used to develop cleanup standards for sediments.	Water quality standards will be used to develop monitoring standards both during the active dredging/excavation and cover placement and for long-term monitoring ~~of the protectiveness of the waste management area that will be established under this alternative~~.

Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable	Establishes the specifications for discharging pollutants from any point source into the waters of the U.S. Includes stormwater standards for activities disturbing more than one acre.	Any water discharged to surface water bodies during remedial activities, such as sediment dewatering will comply with this regulation. Best management practices will be used to meet stormwater standards during the remedial action.
~~Toxic Pollutant Effluent Standards~~	~~40 CFR 129~~	~~Applicable~~	~~Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.~~	~~Any water discharged to surface water bodies as part of this alternative will meet the standards identified in this regulation.~~ [Deleted because this regulation is applies to handlers of pure PCBs, such as manufacturers of PCBs and PCB capacitors. The regulation applies to process and non-process waste water that is potentially in contact with pure PCBs. The effluent standard uses specific language, for example, "PCBs are prohibited in any discharge from any PCB manufacturer." The language of this standard is not relevant for the site.]
~~Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)~~	~~42 U.S.C. 7411, 7412; 40 C.F.R. Part 61~~	~~Applicable~~	~~NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.~~	~~Standards for controlling particulate matter will be met during dredging/excavation and handling of contaminated sediments. Activities during sediment handling will include measures to suppress dust.~~ [Deleted. NESHAPs are not ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.]
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]

Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 U.S.C. § 1251 et seq. 40 CFR. Part 403	Applicable	Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Management of Undesirable Plants on Federal Lands	7 U.S.C. 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site. The responsibility of control will be transitioned to NAVSTA after (1) the remedy is in place, and (2) NAVSTA develops a base-wide program for controlling undesirable plants.

State ARARs

Clean Air Act -Emissions Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during excavation/dredging and cover installation will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act –Air Toxics	RIGL 23-23 *et seq.*; CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Monitoring of air emissions during excavation/dredging and cover installation will be used to assess compliance with these standards if threshold levels are reached.
Water Pollution Control - Pollution Discharge Elimination Systems	RIGL 42-16 *et seq.*; CRIR 12-190-003	Applicable	Contains discharge limitations, monitoring requirements and best management practices. Substantive requirements under NPDES are written such that state and federal national recommended water quality criteria (NRWQC) are met. Permits are required for off-site discharges, RI Standards apply to POTWs. Includes storm water requirements for construction projects that disturb over one acre.	Discharge of any water from remedial activities during sediment excavation/dredging into surface waters or POTW will meet applicable standards. Stormwater standards for construction projects over one acre will also be met.
Water Pollution Control - Water Quality	RIGL 42-16 *et seq.*; CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Water quality standards will be used to develop monitoring standards ~~both~~ during the active remedial activities, such as dredging or cover placement. ~~period~~. ~~and for long-term monitoring of the protectiveness of the waste management area that will be established under this alternative.~~

Pretreatment Regulations	RIGL 46-12, 4217.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
The two lines citing the RI Hazardous Waste Regulations should be retained as drafted. [Agree]				
Rules and Regulations for Dredging and Management of Dredge Materials	DEM-OWR-DR-0203	Applicable	Addresses dredging activities and disposal of dredge spoils.	Any dredging/excavation of sediment and backfilling with cover material that is required implementing the alternative must comply with the requirements of the regulations.

Table 6-7: Chemical-specific

Federal ARARs

~~EPA Risk Reference Dose (RfDs)~~		~~To Be Considered~~	~~RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the capping of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~EPA Carcinogenicity Slope Factor~~		~~To Be Considered~~	~~Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the capping of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~Guidelines for Carcinogen Risk Assessment~~	~~EPA/630/P-03/001F (March 2005)~~	~~To Be Considered~~	~~Guidance for assessing cancer risk.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the capping of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]

~~Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens~~	~~EPA/630/R-03/003F (March 2005)~~	~~To Be Considered~~	~~Guidance of assessing cancer risks to children.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation and during the capping of the remaining sediments will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~U.S. DOE, Office of Environmental Management, Secondary Chronic Values (SCVs) (Jones et al., 1997)~~		~~To Be Considered~~	~~The SCVs are toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota.~~	~~Ecological risks at the Site identified using this guidance will be addressed by limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ [Deleted because these screening values are only used for initial evaluation.]
~~U.S. EPA Sediment Quality Criterion (SQC) and Sediment Quality Benchmarks (SQBs) (USEPA, 1996)~~		~~To Be Considered~~	~~SQCs and SQBs were established to provide screening toxicity thresholds.~~	~~Ecological risks at the Site identified using this guidance will be addressed by limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ [Deleted because these screening values are only used for initial evaluation.]
~~NOAA Screening Quick Reference Tables, Threshold Effects Level (TEL) (Buchman, 1999)~~		~~To Be Considered~~	~~TELs represent the concentration below which adverse effects are expected to occur only rarely.~~	~~Ecological risks at the Site identified using this guidance will be addressed by limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ [Deleted because these screening values are only used for initial evaluation.]
~~Ontario Ministry of Environment and Energy (OMEE) Lowest Effect Levels (LELs) for Freshwater Sediments (Persaud et al., 1993)~~		~~To Be Considered~~	~~The LEL value is the concentration at which the majority of the sediment-dwelling organisms are not affected.~~	~~Ecological risks at the Site identified using this guidance will be addressed by limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ [Deleted because these screening values are only used for initial evaluation.]
Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Probable Effects Concentrations (PECs) (MacDonald et al., 2000)		To Be Considered	The PEC value is the concentration above which the adverse effects on sediment-dwelling organisms are likely to occur.	~~Ecological risks at the Site identified using this guidance will be addressed by limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ Sediment and cover will prevent exposure to COCs at concentrations greater than PRGs calculated through the use of PECs.
~~CWA National Recommended Water Quality Criteria (NRWQC)~~	~~40 CFR 122.44~~	~~Relevant and Appropriate~~	~~Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments~~	~~The sediment cleanup standards developed using the NRWQC for the Site will be achieved through limited removal and capping, along with LUCs and Long-term Monitoring to ensure the protectiveness of the cap.~~ [Deleted because water quality criteria were not used to calculate sediment cleanup PRGs.]

Remove the State Water Quality citation. [Agree].

Table 6-8: Location-specific
Federal ARARs

Fish and Wildlife Coordination Act	16 U.S.C.. §661 *et seq*.	Applicable	Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted, in particular regarding remedial measures for contaminated sediment that will impact streams, wetlands, and downstream water bodies.
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management) and~~ Implements Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of sediment remedial actions on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by sediment remediation, will be mitigated in accordance with requirements. ~~Remedial work within Site water bodies/waterways (as well as long-term maintenance of the NUSC Pond dam) has the potential to negatively alter downstream floodplain. Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered. Cover would be designed to maintain sediment in place.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.~~ Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Sediment remediation or other remedial actions that include dredging or filling in wetlands will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource as required. Raising the Pond bottom with the cap may have significant impacts by converting aquatic habitats to upland/wetland and altering in-water aquatic habitats requiring replacement wetlands/aquatic habitats to be created elsewhere. The Navy has determined that this alternative **[is][is not]** the Least Damaging Practicable Alternative to protect wetland resources because it **[provides][does not provide]** the best balance of addressing contaminated sediment within and adjacent to wetlands and waterways with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site. The CERCLA criteria will be used to select the alternative. [Determination of the LEDPA will be made prior to finalizing the FS, and this text will be revised accordingly at that time.]
Endangered Species Act	16 U.S.C. 1531 *et seq.*; 50 C.F.R. parts 200 and 402	Applicable	Regulates activities affecting federally listed endangered or threatened species or their habitat. The federally-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate federal agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]

State ARARs:

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State-jurisdictional wetlands and water bodies.~~ [Deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
~~Inspection of Dams and Reservoirs; Rules and Regulations for Dam Safety~~	~~RIGL 46-19~~	~~Applicable~~	~~Sets standards for inspecting and maintaining dams in the State.~~	~~O&M of the NUSC Pond dam, along with LUCs, is required as part of the remedial action to prevent contaminated sediment that is being managed in place under this alternative from migrating downstream of the dam.~~ [Deleted because the dam is not part of the remedy. The dam is maintained by the base. Sediment downstream of dam may be analyzed if needed (e.g., if the cap is damaged) to evaluate the potential loss of contaminants from sediment behind dam.]
Rhode Island Endangered Species Act	RIGL 20-37-1 *et seq.*	~~Applicable~~ Relevant and Appropriate	Regulates activities affecting State-listed endangered or threatened species or their habitat. The State-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate State agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Sediment removal and cover placement activities will be conducted to minimize the disturbance of wetlands.

Table 6-9: Action-specific
Federal ARARs

Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	EPA-540-R-05-012 OSWER 9355.0-85 (December 2005)	To Be Considered	Guidance for making remedy decisions for contaminated sediment sites. Some of the relevant sections of the guidance address Remedial Investigations (Ch. 2), FS Considerations (including LUCs)(Ch. 3), Capping (Ch. 5), Dredging and Excavation (Ch. 6), and Long-Term Monitoring (Ch. 8).	Limited removal and capping under this alternative meets guidance standards for addressing contaminated sediments in the wetlands/waterway (as long as habitat restoration requirements can be met).
~~Toxic Substances Control Act (TSCA); PCB Remediation Waste,~~	~~40 C.F.R. 761.61(c)~~	~~Applicable~~	~~This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.~~	~~All sediment exceeding identified PCB cleanup levels will be either be removed, dewatered (if required) and disposed of off-site or will be placed under the cap. The excavation, transportation/ dewatering, and management of PCB contaminated media must comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's sediment PCB cleanup levels, along with the excavation, dewatering, and capping for the PCB-contaminated sediment will not pose an unreasonable risk to human health or the environment.~~ [Deleted because TSCA should not be an ARAR. Per EPA's "Guidance on Remedial Actions for Superfund Sites with PCB Contamination," TSCA requirements "do not apply to PCBs at concentrations less than 50 ppm." The guidance does not limit the 50 ppm to disposal scenarios, but rather indicates that this is the level at which TSCA "applies." The maximum concentration detected for soil is 5 ppm, and 3 ppm for sediment. As such, the 1 ppm action level for residential land use and the 10-25 ppm action level for industrial land use would not be applicable.]
CWA National Recommended Water Quality Criteria (NRWQC)	40 CFR 122.44)	Relevant and Appropriate	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments	Water quality standards will be used to develop monitoring standards both during the active dredging/excavation and cover placement and for long-term monitoring. ~~The sediment cleanup standards developed using the NRWQC for the Site will be achieved through removal and covering, along with LUCs and Long-term Monitoring to ensure the protectiveness of the remedy.~~

Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable	Establishes the specifications for discharging pollutants from any point source into the waters of the U.S. Includes stormwater standards for activities disturbing more than one acre.	Any water discharged to surface water bodies during remedial activities such as sediment dewatering will comply with this regulation. Best management practices will be used to meet stormwater standards during the remedial action.
~~Toxic Pollutant Effluent Standards~~	~~40 CFR 129~~	~~Applicable~~	~~Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.~~	~~Any water discharged to surface water bodies as part of this alternative will meet the standards identified in this regulation.~~ [Deleted because this regulation is applies to handlers of pure PCBs, such as manufacturers of PCBs and PCB capacitors. The regulation applies to process and non-process waste water that is potentially in contact with pure PCBs. The effluent standard uses specific language, for example, "PCBs are prohibited in any discharge from any PCB manufacturer." The language of this standard is not relevant for the site.]
~~Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)~~	~~42 U.S.C. 7411, 7412; 40 C.F.R. Part 61~~	~~Applicable~~	~~NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.~~	~~Standards for controlling particulate matter will be met during dredging/excavation and handling of contaminated sediments. Activities during sediment handling will include measures to suppress dust.~~ [Deleted. NESHAPs are not ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.]
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]

Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 U.S.C. § 1251 et seq. 40 CFR. Part 403	Applicable	Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Management of Undesirable Plants on Federal Lands	7 U.S.C. 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site. The responsibility of control will be transitioned to NAVSTA after (1) the remedy is in place, and (2) NAVSTA develops a base-wide program for controlling undesirable plants.

State ARARs

Clean Air Act -Emissions Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during excavation/dredging and cap installation will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act –Air Toxics	RIGL 23-23 *et seq.*; CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Monitoring of air emissions during excavation/dredging and cap installation will be used to assess compliance with these standards if threshold levels are reached.
Water Pollution Control - Pollution Discharge Elimination Systems	RIGL 42-16 *et seq.*; CRIR 12-190-003	Applicable	Contains discharge limitations, monitoring requirements and best management practices. Substantive requirements under NPDES are written such that state and federal national recommended water quality criteria (NRWQC) are met. Permits are required for off-site discharges, RI Standards apply to POTWs. Includes storm water requirements for construction projects that disturb over one acre.	Discharge of any water from remedial activities during sediment excavation/dredging into surface waters or POTW will meet applicable standards. Stormwater standards for construction projects over one acre will also be met.
Water Pollution Control - Water Quality	RIGL 42-16 *et seq.*; CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Water quality standards will be used to develop monitoring standards ~~both~~ during the active remedial activities, such as dredging or cap placement. ~~period~~. ~~and for long-term monitoring of the protectiveness of the waste management area that will be established under this alternative.~~
Pretreatment Regulations	RIGL 46-12, 4217.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.

The two lines citing the RI Hazardous Waste Regulations should be retained as drafted. [Agree]				
Rules and Regulations for Dredging and Management of Dredge Materials	DEM-OWR-DR-0203	Applicable	Addresses dredging activities and disposal of dredge spoils.	Any dredging/excavation of sediment and backfilling with cap material that is required implementing the alternative must comply with the requirements of the regulations.

Table 6-10: Chemical-specific

Federal ARARs

~~EPA Risk Reference Dose (RfDs)~~		~~To Be Considered~~	~~RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~EPA Carcinogenicity Slope Factor~~		~~To Be Considered~~	~~Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~Guidelines for Carcinogen Risk Assessment~~	~~EPA/630/P-03/001F (March 2005)~~	~~To Be Considered~~	~~Guidance for assessing cancer risk.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens~~	~~EPA/630/R-03/003F (March 2005)~~	~~To Be Considered~~	~~Guidance of assessing cancer risks to children.~~	~~Although to date, no sediments exceeding these risk-based human health standards have been identified, sampling of the sediments during the sediment excavation will ensure that no contaminants are present exceeding these standards.~~ [Deleted because there is no human health risk.]
~~U.S. DOE, Office of Environmental Management, Secondary Chronic Values (SCVs) (Jones et al., 1997)~~		~~To Be Considered~~	~~The SCVs are toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota.~~	~~Ecological risks at the Site identified using this guidance will be addressed by removing all sediment exceeding identified risk levels.~~ [Deleted because these screening values are only used for initial evaluation.]
~~U.S. EPA Sediment Quality Criterion (SQC) and Sediment Quality Benchmarks (SQBs) (USEPA, 1996)~~		~~To Be Considered~~	~~SQCs and SQBs were established to provide screening toxicity thresholds.~~	~~Ecological risks at the Site identified using this guidance will be addressed by removing all sediment exceeding identified risk levels.~~ [Deleted because these screening values are only used for initial evaluation.]
~~NOAA Screening Quick Reference Tables, Threshold Effects Level (TEL) (Buchman, 1999)~~		~~To Be Considered~~	~~TELs represent the concentration below which adverse effects are expected to occur only rarely.~~	~~Ecological risks at the Site identified using this guidance will be addressed by removing all sediment exceeding identified risk levels.~~ [Deleted because these screening values are only used for initial evaluation.]

~~Ontario Ministry of Environment and Energy (OMEE) Lowest Effect Levels (LELs) for Freshwater Sediments (Persaud et al., 1993)~~		~~To Be Considered~~	~~The LEL value is the concentration at which the majority of the sediment-dwelling organisms are not affected.~~	~~Ecological risks at the Site identified using this guidance will be addressed by removing all sediment exceeding identified risk levels.~~ [Deleted because these screening values are only used for initial evaluation.]
Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Probable Effects Concentrations (PECs) (MacDonald et al., 2000)		To Be Considered	The PEC value is the concentration above which the adverse effects on sediment-dwelling organisms are likely to occur.	~~Ecological risks at the Site identified using this guidance will be addressed by removing all sediment exceeding identified risk levels.~~ Sediment and cover will prevent exposure to COCs at concentrations greater than PRGs calculated through the use of PECs.
~~CWA National Recommended Water Quality Criteria (NRWQC)~~	~~40 CFR 122.44~~	~~Relevant and Appropriate~~	~~Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments~~	~~The sediment cleanup standards developed using the NRWQC for the Site will be achieved through removal of all sediment exceeding the standards.~~ [Deleted because water quality criteria were not used to calculate sediment cleanup PRGs.]

Remove the State Water Quality citation. [Agree].

Table 6-11: Location-specific
Federal ARARs

Fish and Wildlife Coordination Act	16 U.S.C.. §661 *et seq*.	Applicable	Requires Federal agencies involved in actions that will result in the control of structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project related impacts to fish and wildlife resources will be taken, if determined necessary. The appropriate federal and state resource agencies will be consulted, in particular regarding remedial measures for contaminated sediment that will impact streams, wetlands, and downstream water bodies.
~~Floodplain Management and~~ Protection of Wetlands	44 C.F.R. 9	Relevant and Appropriate	~~Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgate requirements under Executive Order 11988 (Floodplain Management) and~~ Implements Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. ~~Requires soliciting public comment on any disturbance of floodplains or federally-regulated wetlands.~~	During the remedial design stage the effects of sediment remedial actions on federal jurisdictional wetlands will be evaluated. All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by sediment remediation, will be mitigated in accordance with requirements. ~~Remedial work within Site water bodies/waterways has the potential to negatively alter downstream floodplain. Remedial actions will include all practicable means to minimize harm to and preserve beneficial values of downstream floodplains.~~ Public comment ~~regarding proposed impacts to wetlands and floodplains~~ will be solicited in the Proposed Plan. ~~The comments received will be addressed in the Responsiveness Summary for the ROD for this operable unit.~~ [No effects on the floodplain downstream are anticipated for any of the alternatives and the flow of flood waters would not be affected, so the floodplain aspects for this ARAR do not need to be considered. Removal of contaminated sediment will prevent introduction of contaminants into the floodplain.]

Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 U.S.C. § 1344; 40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. ~~Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.~~ Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Sediment remediation or other remedial actions that include dredging in wetlands/waterways will be implemented to meet these requirements, including mitigation of altered wetland/aquatic resource as required. The Navy has determined that this alternative **[is][is not]** the Least Damaging Practicable Alternative to protect wetland resources because it **[provides][does not provide]** the best balance of addressing contaminated sediment within and adjacent to wetlands and waterways with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site. The CERCLA criteria will be used to select the alternative. [Determination of the LEDPA will be made prior to finalizing the FS, and this text will be revised accordingly at that time.]
Endangered Species Act	16 U.S.C. 1531 *et seq.*; 50 C.F.R. parts 200 and 402	Applicable	Regulates activities affecting federally listed endangered or threatened species or their habitat. The federally-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate federal agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
~~Coastal Zone Management Act~~	~~16 USC Parts 1451 *et. seq.*~~	~~Applicable~~	~~Requires that any actions must be conducted in a manner consistent with state-approved management programs.~~	~~The site is located within a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.~~ [Deleted. The federal CZMA is implemented through the State Program. Rhode Island's coastal zone encompasses the entire state, although the inland extent of the Coastal Program's regulatory authority is generally 200 feet inland from any coastal feature. The federal CZMA was deleted because the site is outside of RI CRMC jurisdiction.]

State ARARs:

~~Coastal Resources Management~~	~~RIGL 46-23-1 *et seq*~~	~~Applicable~~	~~Sets standards for management and protection of coastal resources. Sec. 100.4 addresses freshwater wetlands in the vicinity of the coast and extends jurisdiction to land with 50 feet of wetlands, riverbanks and floodplain.~~	~~The entire site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed, particularly those pertaining to protecting State-jurisdictional wetlands and water bodies.~~ [Deleted because site is outside of 200 feet distance from coastal features. Freshwater wetlands near site are not in CRMC jurisdiction.]
~~Inspection of Dams and Reservoirs; Rules and Regulations for Dam Safety~~	~~RIGL 46-19~~	~~Applicable~~	~~Sets standards for inspecting and maintaining dams in the State.~~	~~The Navy needs to ensure that the dam stability is not compromised during dredging/excavation of the contaminated sediment.~~ [Deleted because the dam is not part of the remedy. Alternative SD4 specifies the removal of contaminated sediment.]
Rhode Island Endangered Species Act	RIGL 20-37-1 *et seq.*	~~Applicable~~ Relevant and Appropriate	Regulates activities affecting State-listed endangered or threatened species or their habitat. The State-listed loggerhead turtle and Kemps-Ridley turtle occur in the water of Narragansett Bay.	Appropriate State agencies will be consulted to ensure that remedial measure taken under this alternative will prevent site contamination from migrating downstream to the Bay.
Fresh Water Wetlands Act	Rules and Regulations Governing the Administration and Enforcement of the Fresh Water Wetlands Act	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other fresh water wetlands in the state. Actions are required to prevent the undesirable drainage, excavation, filling, alteration, encroachment or any other form of disturbance or destruction of a wetland.	Sediment removal activities will be conducted to minimize the disturbance of wetlands.

Table 6-12: Action-specific
Federal ARARs

Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	EPA-540-R-05-012 OSWER 9355.0-85 (December 2005)	To Be Considered	Guidance for making remedy decisions for contaminated sediment sites. Some of the relevant sections of the guidance address Remedial Investigations (Ch. 2), FS Considerations (Ch. 3), and Dredging and Excavation (Ch. 6).	Removal of all contaminated sediment, along with dewatering and off-site disposal under this alternative meets guidance standards for addressing contaminated sediments in the wetlands/waterway (as long as habitat restoration requirements can be met).
~~Toxic Substances Control Act (TSCA); PCB Remediation Waste,~~	~~40 C.F.R. 761.61(c)~~	~~Applicable~~	~~This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the *in-situ* concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, U.S. Environmental Protection Agency (USEPA) Region 1.~~	~~All sediment exceeding identified PCB cleanup levels will be removed, dewatered (if required) and disposed of off-site. The excavation, transportation/ dewatering, and management of PCB-contaminated media must comply with TSCA, including air and surface water monitoring during remedial activities. The Navy will obtain a finding by the Director, Office of Site Remediation and Restoration, EPA Region 1, that the remedy's sediment PCB cleanup levels, along with the excavation, dewatering, and management for the PCB-contaminated sediment will not pose an unreasonable risk to human health or the environment.~~ [Deleted because TSCA should not be an ARAR. Per EPA's "Guidance on Remedial Actions for Superfund Sites with PCB Contamination," TSCA requirements "do not apply to PCBs at concentrations less than 50 ppm." The guidance does not limit the 50 ppm to disposal scenarios, but rather indicates that this is the level at which TSCA "applies." The maximum concentration detected for soil is 5 ppm, and 3 ppm for sediment. As such, the 1 ppm action level for residential land use and the 10-25 ppm action level for industrial land use would not be applicable.]
CWA National Recommended Water Quality Criteria (NRWQC)	40 CFR 122.44)	Relevant and Appropriate	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds. These standard may be used to develop cleanup standards for sediments	Water quality standards used to develop monitoring standards both during the active dredging. ~~The sediment cleanup standards developed using the NRWQC for the Site will be achieved through removal of all sediment exceeding the standards.~~
Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable	Establishes the specifications for discharging pollutants from any point source into the waters of the U.S. Includes stormwater standards for activities disturbing more than one acre.	Any water discharged to surface water bodies during remedial activities such as sediment dewatering will comply with this regulation. Best management practices will be used to meet stormwater standards during the remedial action.

~~Toxic Pollutant Effluent Standards~~	~~40 CFR 129~~	~~Applicable~~	~~Regulates surface water discharges of specific toxic pollutants, namely aldrin, dieldrin, DDT, endrin, toxaphene, benzidine, and PCBs.~~	~~Any water discharged to surface water bodies as part of this alternative will meet the standards identified in this regulation.~~ [Deleted because this regulation is applies to handlers of pure PCBs, such as manufacturers of PCBs and PCB capacitors. The regulation applies to process and non-process waste water that is potentially in contact with pure PCBs. The effluent standard uses specific language, for example, "PCBs are prohibited in any discharge from any PCB manufacturer." The language of this standard is not relevant for the site.]
~~Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs)~~	~~42 U.S.C. 7411, 7412; 40 C.F.R. Part 61~~	~~Applicable~~	~~NESHAPS are a set of emission standards for specific chemicals, including naphthalene, arsenic, cadmium, chromium, lead, mercury, nickel, PCBs, DDE, and hexachlorobenzene. Certain activities are regulated including site remediation.~~	~~Standards for controlling particulate matter will be met during dredging/excavation and handling of contaminated sediments. Activities during sediment handling will include measures to suppress dust.~~ [Deleted. NESHAPs are not ARARs for this cleanup. NESHAPs are promulgated for emissions of particular air pollutants from specific sources. Per EPA's "CERCLA Compliance with Other Laws Manual: Part II - Clean Air Act and Other Environmental Statutes and State Requirements", NESHAPs are not generally applicable to Superfund remedial activities because CERCLA sites do not usually contain one of the specific source categories regulated. EPA's guidance also noted that "NESHAPs as a whole are generally not relevant and appropriate because the standards of control are intended for the specific type of source regulated and not all sources of that pollutant." Part of a NESHAP may be relevant and appropriate to a CERCLA site, but only if it involves the specific source category regulated by the NESHAP.]
~~Generation of investigation derived waste~~	~~USEPA OSWER Publication 9345.3-03 FS, January 1992~~	~~To Be Considered~~	~~Management of Investigation-Derived Waste (IDW) must ensure protection of human health and the environment.~~	~~IDW will be managed in a manner to protect human health and the environment.~~ [Deleted because at this stage of investigation, the IDW characteristics are well known. No IDW has been hazardous, so the guidance in this document, which is primarily covers addressing hazardous IDW within RCRA, does not provide anything. In any case, if methods in the guidance were needed, then the RCRA sections would still need to be cited as separate ARARs.]
Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 U.S.C. § 1251 et seq. 40 CFR. Part 403	Applicable	Standards for direct discharge of waste water into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.

Management of Undesirable Plants on Federal Lands	7 U.S.C. 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, purple loosestrife or other invasive plants within all remediated areas. An invasive species control plan will be developed as part of the long-term O&M for this site. The responsibility of control will be transitioned to NAVSTA after (1) the remedy is in place, and (2) NAVSTA develops a base-wide program for controlling undesirable plants.

State ARARs

Clean Air Act -Emissions Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during excavation/dredging and dewatering will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act –Air Toxics	RIGL 23-23 *et seq.*; CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Monitoring of air emissions during excavation/dredging and dewatering will be used to assess compliance with these standards if threshold levels are reached.
Water Pollution Control - Pollution Discharge Elimination Systems	RIGL 42-16 *et seq.*; CRIR 12-190-003	Applicable	Contains discharge limitations, monitoring requirements and best management practices. Substantive requirements under NPDES are written such that state and federal national recommended water quality criteria (NRWQC) are met. Permits are required for off-site discharges, RI Standards apply to POTWs. Includes storm water requirements for construction projects that disturb over one acre.	Discharge of any water from remedial activities during sediment excavation/dredging into surface waters or POTW will meet applicable standards. Stormwater standards for construction projects over one acre will also be met.
Water Pollution Control - Water Quality	RIGL 42-16 *et seq.*; CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Water quality standards will be used to develop monitoring standards during the sediment excavation/dredging and dewatering.
Pretreatment Regulations	RIGL 46-12, 4217.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
The two lines citing the RI Hazardous Waste Regulations should be retained as drafted. [Agree]				

Rules and Regulations for Dredging and Management of Dredge Materials	DEM-OWR-DR-0203	Applicable	Addresses dredging activities and disposal of dredge spoils.	Any dredging/excavation of sediment and dewatering will comply with the requirements of the regulations.