June 2021
Buffalo Color

Remedial Investigation Alternatives Analysis for Buffalo Color Corporation Site Areas A and B Off-site: NYSDEC Site No. C915230A

Prepared for

Honeywell International Inc.

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ABBREVIATIONS

Anchor QEA	Anchor QEA Engineering, PLLC
AOC	Area of Concern
BCP	Brownfield Cleanup Program
CDF	Confined Disposal Facility
DMU	Dredge Management Unit
GLLA	Great Lakes Legacy Act
Honeywell	Honeywell International Inc.
H:V	horizontal to vertical
NYSDEC	New York State Department of Environmental Conservation
Off-site Area	Buffalo Color Corporation Site Areas A and B Off-site Area
RIAA	Remedial Investigation Alternatives Analysis
USACE	U.S. Army Corps of Engineers

1 Introduction

This Remedial Investigation Alternatives Analysis (RIAA) documents the evaluation of alternatives associated with the Buffalo Color Corporation Site Areas A and B Off-site Area (Off-site Area), New York State Department of Environmental Conservation (NYSDEC) Site No. C915230A. This RIAA has been prepared on behalf of Honeywell International Inc. (Honeywell) by Anchor QEA Engineering, PLLC (Anchor QEA) in accordance with the August 2016 Order on Consent (Order) and Administrative Settlement Index No. CO 9-20151109-133 under the NYSDEC State Superfund Program and Brownfield Cleanup Program (BCP). The evaluation process captured in this report summarizes the measures taken in evaluating the Off-site Area prior to the selected alternative being performed as part of the Great Lakes Legacy Act (GLLA) project for the Buffalo River Area of Concern (AOC). As the remedial activities for the Off-site Area have already occurred, this report documents the alternatives that were considered prior to conducting the work. The alternatives presented are based on existing information collected as part of the upland Buffalo Color Area A remediation, which was performed by South Buffalo Development under the New York State Brownfield Program, as well as in-river data collected for the GLLA Buffalo River AOC project. A Certificate of Completion for the uplands brownfield cleanup was issued by NYSDEC in December 2013.

2 Background

The brownfield cleanup associated with the upland Buffalo Color Area A site was completed in December 2013. This work included demolition of former dye plant buildings and associated manufacturing structures; installation of a groundwater cutoff wall, a groundwater pump and treatment system, and a soil cap and cover; and shoreline restoration.

As part of the Buffalo Color Area A cleanup process, a protective armored shoreline cover was installed along a 200-foot section of the property shoreline along the Buffalo River. The cover is comprised of a series of anchored marine mattresses, which provide both containment and erosion protection along the shoreline. The marine mattress sections are comprised of geo-composite grids filled with armor stone anchored at the top of slope and extending into the Buffalo River. In 2014, shoreline restoration, including turtle habitat, placement of planting soil and plantings, was implemented along the Area A riverbank portion of the site.

During the remedial design for the GLLA Buffalo River AOC project, riverbed areas adjacent to the Area A property shoreline were identified as areas requiring dredging, and the shoreline was identified as a “Critical Structure,” where a structure failure caused by remedial dredging operations could result in a safety hazard. This designation was primarily due to the installed groundwater cutoff wall that is a major element of the completed upland remedy. The groundwater cutoff wall alignment is near the river and parallels the shoreline. As a Critical Structure, a focused evaluation of the effects of dredging in front of the shoreline was completed to determine any potential detrimental effects from the dredging project. Removal of sediment and debris material from Buffalo River AOC project areas (referred to as Dredge Management Units [DMUs] 9 and 10) along the Area A shoreline was evaluated by several engineering firms, including Anchor QEA, AMEC Foster Wheeler (formerly MACTEC and currently Wood), and McMahon & Mann Consulting Engineers, as well as Watts Architecture & Engineering. Based on these analyses, it was determined that there was minimal effect from sediment removal along Area A shoreline areas up- and downstream of the marine mattresses due to the anticipated (and now completed) shoreline restoration, which incorporated removal of the former dye plant water intake and bulkhead structures and flattening the steeper shoreline slopes. Evaluation of the marine mattress segment indicated the slope was in stable condition, but the removal of sediments from the base of slope indicated the potential to create an unacceptable lowering of the global stability factor of safety. The limited area (approximately 0.45 acres), located near the toe of the marine mattress slope and within the extent of GLLA Buffalo River AOC DMUs 9 and 10, was identified as the Off-site Area requiring management under the BCP. Site location and site overview maps are provided as Figures 1 and 2, respectively.

Geotechnical investigations were performed to evaluate underlying soil and sediment conditions and determine the as-built locations of the marine mattress segments. In-water borings were completed at the approximate toe of the marine mattress slope in 2013, with three borings advanced to more than 20 feet. In April 2014, an updated multibeam bathymetric survey was completed to confirm existing bathymetry in the vicinity to inform the analysis. At the time of surveying, additional sediment probing was completed to determine the actual as-built location of the toe of the marine mattresses to confirm investigations performed manually by divers in 2013. Additional geotechnical evaluations, including upland borings and in-water soft sediment probing, were also performed in 2015. The combined data from these investigations were factored into the remedial alternatives evaluation for the Off-site Area (Buffalo River AOC DMUs 9 and 10).

3 Objectives

This evaluation of alternatives for the Off-site Area had the following primary objective:

- Identify and screen potential options for removal or management of sediment located in front of the Buffalo Color Corporation marine mattress within Buffalo River DMUs 9 and 10.

Based on engineering investigations and analyses, as well as discussions with NYSDEC, the following alternatives were evaluated:

- Alternative 1: Natural Recovery (i.e., dredging offset to center of channel)
- Alternative 2: In Situ Capping
- Alternative 3a: Dredging Proposed Prism (10-foot offset, 3 horizontal to 1 vertical [3H:1V] slope)
- Alternative 3b: Dredging Proposed Prism with Post-Dredging Sand Cover
- Alternative 4a: Dredging to Toe of the Marine Mattress
- Alternative 4b: Dredging to Toe Followed by Backfilling
- Alternative 4c: Dredging to Toe Following Installation of a Knee Wall
- Alternative 5: Marine Mattress Removal, Slope Layback, and Full Dredging

4 Alternatives

The following sections outline each of the five alternatives evaluated and summarize screening criteria that consider effectiveness, implementability, and relative cost. Schematics of the general remedial approaches that involve active remediation are provided in Appendix A.

4.1 Alternative 1: Natural Recovery

This alternative was evaluated as a standard baseline case for comparison. Alternative 1 would use natural recovery as a method of managing operations in the area. The natural recovery option would use a dredging offset from the marine mattress. Consistent with a standard approach used in GLLA remedies, including the Buffalo River AOC, this offset would restrict dredging to the center of the navigation channel adjacent to the marine mattress. Monitoring of the sediments would be included through the GLLA Year-2 and Year-5 required verification monitoring plans for the river, as well as the required Institutional Controls. The use of dredging offsets of varying distances were used for various GLLA Buffalo River AOC project DMUs including DMUs 1, 2, 5, 6a, 17, 18, 19, 28, and 29 to protect utility crossing, Critical Structures, or bridges.

4.1.1 Effectiveness

This alternative would have no change in existing sediment conditions at the toe of the marine mattress in the short term. However, future sedimentation may provide a natural cover over the sediments in the long term. In situ sediments would be left in place and be managed through Institutional Controls. Because no action would be taken during remediation, no hazards associated with the work would occur.

4.1.2 Implementability

Because no action would occur, only the placement of Institutional Controls, as part of this alternative, this is readily implementable.

4.1.3 Cost

Because no action would occur, costs associated with this alternative are minimal. Costs associated with monitoring and Institutional Controls are equivalent to those necessary for other evaluated alternatives.

4.1.4 Screening Result

Alternative 1 is removed from further consideration because it does not actively address the impacted sediments located in DMUs 9 and 10.

4.2 Alternative 2: In Situ Capping

This alternative would use an armored cap to protect sediments left in place. Similar to the application originally proposed for use in the Buffalo River City Ship Canal in front of the ADM/Pillsbury property (DMUs 1 and 2). An armored cap consisting of stone as the armoring component would be installed over sediments adjacent to the marine mattress to protect against erosion of the material. A single- or double-layer cap would be used, and armor stone size would be based on expected shear stress in the region as calculated by hydrodynamic modeling performed as part of the Buffalo River Feasibility Study. Figure A-1 in Appendix A shows this remedial approach.

Based on infrequent commercial size boat traffic in this upper section of the Buffalo River, assumed armor stone sizing would be primarily driven by river current flow-induced shear stress; further consideration during actual design would determine propwash and boat-wake effects on armor sizing. Evaluations would also determine the need for a filter layer based on the calculated armor stone size and the underlying sediment size. If armor stone is sufficiently small, only a single-layer installation would be required. Armoring extents would be expected across a footprint sufficient to protect the upland slope, similar in sizing to the footprint described further in Alternatives 3a and 3b.

Given the proximity of the toe of the marine mattress to the navigation channel, coordination with the U.S. Army Corps of Engineers (USACE) and approval to place capping materials within the federal navigation channel footprint and within authorized depths would be required for this option. Due to the permanent nature of this installation, a modification to the federal navigation channel restricting future dredging would also be necessary for protection of the armored cap.

4.2.1 Effectiveness

This alternative would reduce surface sediment ecological exposure concentrations at the toe of the marine mattress by creating a clean sediment surface overlying the targeted sediment. Existing sediments would remain in place, though potential for exposure would be reduced, and the sediments would be contained in place through erosion protection and armoring. Monitoring and potential for periodic maintenance would be required with the installation of a cap.

4.2.2 Implementability

Because in situ capping was used as a management method as part of the GLLA cleanup in the City Ship Canal, this alternative is readily implementable, pending necessary permitting. Local sourcing of different sized armor stone would be required, as well as coordination with a marine dredging contractor regarding placement.

4.2.3 Relative Cost

The cost for cap materials and placement would be comparable to the cost reduction associated without dredging the sediments along the toe of the slope. Costs associated with long-term monitoring and maintenance would be incurred and are assumed to be comparable to those for other GLLA project cover and cap placement areas.

4.2.4 Screening Result

Alternative 2 is not considered viable. Though readily implementable and used elsewhere as part of the GLLA project, this alternative presents logistical issues associated with placement of capping materials within or proximate to the federal navigation channel and within federal authorized depths. This alternative if implemented would require restrictions to future allowable dredging within the federal channel for long-term protection of the armored cap.

4.3 Alternative 3a: Dredging Proposed Prism

This alternative incorporates the removal of 97% of the targeted sediments within DMUs 9 and 10, with approximately 1,300 cubic yards of sediment remaining as natural support for the slope. The proposed dredge prism is based on the existing marine mattress toe alignment, a 10-foot offset, and a 3H:1V slope to protect the marine mattress and upland slope from a large vertical cut at the base of slope. The 10-foot offset is to protect the installed marine mattress from damage during the dredging. Figure A-2 in Appendix A shows this remedial approach.

Bathymetric surveying illustrated a varying toe alignment due to differing marine mattress panel segments. In addition, the observed horizontal accuracy of the completed GLLA dredging precludes a tight tolerance for dredging adjacent to the Buffalo Color Corp Critical Structure. Following the offset, an industry standard 3H:1V slope would be used down to the proposed design till elevation.

Monitoring of the sediments would be included through the established GLLA Year-2 and Year-5 monitoring plans for the river, as well as the Engineering and Institutional Controls established in the monitoring plans. This approach is similar to that used in other Buffalo River locations with Critical Structures where complete dredging did not occur.

4.3.1 Effectiveness

The dredging included as part of this alternative would remove most of the targeted sediment from DMUs 9 and 10, leaving a de minimis quantity of material necessary to ensure the bank remains stable. The use of an offset from the marine mattress is based on a standard industry practice and reduces the risk of damage to the marine mattress during construction; furthermore, the combined offset and slope reduce risks associated with the global stability of the slope.

Use of a narrower 5-foot offset was reviewed, but it was not considered adequately protective due to the irregularity of the marine mattress toe alignment and the greater risk of reduced factor of safety if the marine mattress became damaged during dredging. Additionally, due to the configuration of the slopes and the location of the mattress toe in proximity to the navigational channel, the 10-foot offset results in a similar quantity of material left in place (approximately 1,300 cubic yards) compared to the 5-foot offset while providing much greater protection for the marine mattress. This alternative uses an approach consistent with all Critical Structures and shorelines from the approved final GLLA remedy. All structures associated with the GLLA remedial dredging receive, at minimum, a 5-foot offset. A 10-foot offset is used for GLLA dredging at shorelines that include natural and stone slopes, grouted slope, cobble, gravel, and debris, in addition to riprap, as well as sloped stone gabion shorelines.

4.3.2 Implementability

Because dredging has been implemented in the river and a revised dredging template will be used here, this approach is readily implementable. However, this approach requires careful observation and supervision of the dredge operator during implementation and when in the proximity of DMUs 9 and 10.

4.3.3 Relative Cost

Costs would include the general dredging operations costs for removal, transport, and disposal at the permitted USACE Confined Disposal Facility (CDF) in the Buffalo Outer Harbor. Additional costs would also include those associated with monitoring and controls, which are equivalent to those necessary for other alternatives and future work associated with the main GLLA river remedy.

4.3.4 Screening Result

Alternative 3a is retained. It is readily implementable along the existing project schedule. This option follows the approved final design elements for other structures and shoreline types and leaves a minimal quantity of material in place, similar to shoreline locations along other stretches of the river. This approach removes the risk associated with operations or removal at the immediate toe of the marine mattress and reduces risk for the upland remedy. Material would be sampled for record purposes as part of an agreed upon sampling plan.

4.4 Alternative 3b: Dredging Proposed Prism with Post-Dredging Sand Cover

This alternative would proceed in the same manner as Alternative 3a with the addition of post-dredging sand cover. Because the proposed offset and slope would leave sediments in place that have been targeted for removal, this option would provide cover material to promote natural recovery within the benthic zone, thereby reducing the availability of contaminants from the sediments left in place. This approach is similar to the accepted approach for enhanced natural recovery outlined in the GLLA Year-2 and Year-5 monitoring plans, where added material would be placed to reach the remedial goals for surface concentrations. Figure A-3 in Appendix A shows this remedial approach.

4.4.1 Effectiveness

Similar to the results of Alternative 3a, the dredging included with this option removes the majority of targeted sediment from DMUs 9 and 10 while protecting the toe of the slope of the marine mattresses. The addition of clean backfill placement reduces the exposure of remaining targeted sediments.

4.4.2 Implementability

Dredging implementability is the same as described for Alternative 3a. Application of a sand cover material following dredging would require sourcing of the applicable sand material and coordination with the existing dredging contractor for placement and verification. Because the targeted sediment that would remain in place extends into the navigation channel, this option would require coordination with USACE, as well as approval to place material within the federal navigation channel footprint and within authorized depths. The sand cover material associated with this alternative is assumed to be for reestablishment of the river channel bottom and would not require changes to the federal navigation channel or authorized depths; it would only require coordination and permission for installation.

4.4.3 Relative Cost

Costs would include the general dredging operations costs for removal, transport, and disposal at the USACE CDF. Additional costs would be associated with the purchase and placement of sand, including potential remobilization costs or added schedule costs associated with this alternative.

4.4.4 Screening Result

Alternative 3b is retained. Though additional coordination would be required to source material and determine placement requirements, additional protection of the sediments to remain in place reduces risk associated with exposure. Coordination and permitting efforts for placement within the Federal navigation channel may limit acceptance of this alternative within a reasonable implementation schedule of 12 to 18 months.

4.5 Alternative 4a: Dredging to Toe of the Marine Mattress

This alternative would incorporate dredging all targeted sediments within DMUs 9 and 10 immediately adjacent to the toe of the marine mattress. No offset would be used from the structure, contrary to the approach used for the remainder of the remediation project and at other similar projects, nationally, where offsets are used to protect sensitive structures or shoreline features. No backfill or other shoring materials would be installed post-dredging. To conform to previous evaluations of slope stability, overdredge allowance restrictions would be necessary adjacent to the structure and limited to the original design allowance of 6 inches. Figure A-4 in Appendix A shows this remedial approach.

4.5.1 Effectiveness

This alternative would remove all targeted sediments as part of the remedial dredging if till elevations are as established in the final design. However, potential exists for the underlying native till to be at different elevations (either higher or lower), which would adjust the targeted removal quantity. Though all sediments would be removed, potential exists to destabilize the existing marine mattress slope due to the removal of approximately 5 to 10 feet of sediment from the toe of the slope, which would reduce the existing factor of safety of the slope.

If triggered, such processes have the potential to extend upland far enough to impact the identified Critical Structure, namely the installed cutoff wall (slag cement and bentonite wall). Given the irregular shape of the toe of the mattress due to the individual panels, as well as the horizontal accuracy shown from the GLLA dredging, potential to damage the existing mattress segments during dredging exists. Coordination with the property owner would be necessary, and the owner would have to agree to accept this future liability in writing.

4.5.2 Implementability

Because dredging would proceed with a revised dredging template associated with the overdredge allowance, this approach is readily implementable.

4.5.3 Relative Cost

Costs would include the general dredging operations costs for removal, transport, and disposal at the USACE CDF, including the additional material removed up to the toe of the mattress. Minor costs would also include those associated with monitoring and controls, which are equivalent to those necessary for other alternatives and future work associated with the main river remedy.

4.5.4 Screening Result

Alternative 4a is removed from consideration due to a decrease in the acceptable factor of safety and unacceptable levels of risk associated with the removal of material from the toe of the slope. The removal of the sediments at the toe of the slope would reduce the existing factor of safety of the slope, putting the marine mattress and shoreline geotechnical stability at risk of future failure. This could also impact the upland remedy through potential damage to the installed cutoff wall. Dredging immediately adjacent to the marine mattresses could also lead to damage to the mattresses themselves, thereby impacting the protection provided by the mattresses. Even after dredging is complete, the large, open-cut face would remain susceptible to erosion, potentially undermining the existing marine mattresses over time.

4.6 Alternative 4b: Dredging to Toe Followed by Backfilling

This alternative would proceed in a manner similar to Alternative 4a with the addition of backfilling following dredging to provide a buttress along the toe of the marine mattress. Under this alternative, backfill (sand or gravel) would be placed at a 3H:1V slope from the toe of the marine mattress to shore up the slope and limit the potential for erosion of the cut face. Figure A-5 in Appendix A shows this remedial approach.

Dredging operations would be restricted to "slot" dredging, proceeding with a limited length of shoreline followed by backfilling operations, and the process would continue. This would limit the time the larger open-face cut would be exposed and reduce the impact to the overall slope stability prior to the placement of the backfill. Although this method would increase the factor of safety over an open cut, a decrease in the existing factor of safety would still occur following excavation and backfill.

Given the proximity of the toe of the marine mattress to the navigation channel, coordination with USACE and approval to place materials within the federal navigation channel footprint and within authorized depths would be required for this option. Due to the permanent nature of this installation for long-term slope stability, a modification to the federal navigation channel restricting dredging may also be necessary for future protection of the slope. A modification to a federal navigation channel requires the approval of the USACE.

4.6.1 Effectiveness

This alternative would remove all targeted sediments as part of the remedial dredging assuming the native till elevations are located as established in the final design. However, potential exists for the till to be at different elevations (either higher or lower), thus changing the targeted removal quantity. Though the post-backfill factor of safety would show an improvement over the open-cut scenario, the existing factor of safety of the slope cannot be re-achieved under this scenario.

Considering the variance in strengths of underlying materials and the range of possible existing conditions cases, a potential risk still exists for destabilizing the slope during dredging and backfilling operations or under long-term conditions. Coordination with the property owner would be necessary, and the owner would have to agree to accept this liability in writing.

Ongoing monitoring and maintenance of this buttress would be necessary to ensure the slope remains stable, and observation following navigation dredging events would also likely be necessary and prudent.

4.6.2 Implementability

Dredging in slots, as previously described in this section, is a common practice used on some projects to limit impacts to adjacent slopes or structures. Dredging in this fashion would result in slower production rates as the limited slot length is dredged, after which operations switch to backfill. Operations in this Critical Structure area, with restricted dredging and necessary observation, would likely be required in daytime operations only, adding to the overall implementation schedule because typical 24-hour operations would not be allowed. Surveying and verification of removal would need to be coordinated to ensure targeted material is removed to design grades.

4.6.3 Relative Cost

Significant costs, relative to other alternatives evaluated, would be incurred using the slot dredging method. Reduced dredging production rates are to be expected, which would lengthen the schedule. Added costs for backfill purchase and placement would also be incurred. In addition to production and added materials costs, increased surveying requirements would add costs to this method. Frequent surveying to verify removal and backfill in multiple segments with quick turnaround times would be necessary as part of this operation and thereby increase associated costs for the work.

4.6.4 Screening Result

Alternative 4b is retained as an option pending logistical issues associated with placement of capping materials within a federal navigation channel and within federally authorized depths. However, the permitting process related to this option would be significant assuming a permit can be obtained because this approach would require placement of a fill in navigable waters of the United States and, particularly, in an active navigation channel. Additionally, it would be necessary to get the property owner’s consent to accept the increased liability associated with this option.

4.7 Alternative 4c: Dredging to Toe Following Installation of a Knee Wall

This alternative is similar to Alternative 4a because it would incorporate dredging the full quantity of targeted sediments within DMUs 9 and 10 immediately adjacent to the toe of the marine mattress. Alternative 4c would take the additional step of installing steel sheetpile sections driven to bedrock in a submerged wall configuration (called a knee wall) along the general alignment of the toe of the mattress sections. The knee wall would provide support for the removal of sediments in front of the wall and protect against future erosion concerns due to undercutting of the slope from the normal river currents. Following installation of the knee wall, dredging would be performed to remove the wedge of sediments at the toe of the slope, followed by installation of backfill to cover any remaining gap between the knee wall and the marine mattresses. The final configuration of the sheeting would leave the top of the wall approximately 12 feet below low-water conditions. Figure A-6 in Appendix A shows this remedial approach.

The knee wall would eliminate the need for an offset from the marine mattress structure during dredging and allow for significant additional sediment removal. To conform to previous evaluations of slope stability, overdredge allowance restrictions would still be necessary adjacent to the structure and limited to the original design allowance of 6 inches.

4.7.1 Effectiveness

As with Alternative 4a, this alternative would remove all targeted sediments as part of the remedial dredging, with the assumption that the applicable native till elevations are as established. However, potential exists for the till to be at different elevations (either higher or lower) and thus change the targeted removal quantity.

In contrast to Alternative 4a, installation of the knee wall would reduce the potential to destabilize the existing marine mattress and slope and decrease the potential to negatively impact the upland remedy that includes the installed cutoff wall.

4.7.2 Implementability

Installation of the knee wall is implementable. The sheetpile sections can be installed using a submersible vibratory hammer. To achieve installation of the knee wall to 12 feet below low-water conditions, the sheetpile sections would be driven twice. During the initial installation, individual sheets can be driven to bedrock and measured to determine the location at which the sheets would need to be cut off to achieve the final target depth. After measurement, the sheets can be partially extracted to cut the tops of the sheets to the final target length based on the bedrock installation measurement. After the sheets are cut, they can be re-driven to bedrock at the final design grade.

Once the knee wall has been installed, dredging along the toe of the slope can be readily implemented. Dredging would likely be slower rates near the knee wall. Surveying and verification of removal would need to be coordinated to ensure targeted material is removed to design grade. Following completion of dredging along the face of the knee wall, backfilling can be completed to cover the linear and narrow band of sediments located between the toe of the marine armor mattress system and the installed knee wall.

4.7.3 Relative Cost

Installation of the knee wall, followed by dredging to the toe of the slope and backfilling, is a relatively high-cost alternative compared to other alternatives to achieve the incrementally small targeted sediment removal quantity. In addition to the sheetpile materials, the installation costs would be significant due to the need to drive the sheets twice to achieve the target final depth. Added costs would also be seen through designing the knee wall, procuring necessary permits, and coordinating with the relevant agencies. Dredging adjacent to the installed knee wall would be low-production dredging due to the need to protect the newly installed knee wall from damage.

4.7.4 Screening Result

Alternative 4c is retained for further consideration. This alternative would improve both short- and long-term stability of the slope, both during and after construction, thereby reducing potential risk to the marine mattresses and the adjacent Critical Structure (the installed cutoff wall). This option achieves the removal of sediments to the toe of the slope and avoids placement of backfill materials within the federal channel. Installation of a knee wall would result in an increase in costs and has a longer schedule duration compared to the other alternatives due to the effort required for design, permitting, and installation.

4.8 Alternative 5: Marine Mattress Removal, Slope Layback, and Full Dredging

This alternative would incorporate removal of the installed marine mattress segments, removal of upland materials to reduce the steepness of the slope, and full dredging of targeted sediments from the final design. This option is being considered as a bookend to the no-action alternative; however, through the course of the project, full removal has been identified as detrimental to the adjacent Critical Structure (the completed shoreline restoration), as well as potential impacts to future upland development along the shoreline. Figure A-7 in Appendix A shows this remedial approach.

Removal of the marine mattresses would also require the removal of the installed brownfield shoreline restoration overlying the mattresses (including shoreline protection, added soil, and plantings), excavation and removal of the soil anchors installed to support the mattress segments, removal of the previously installed inclinometers used to monitor the slope, removal and dismantling of the mattresses themselves, and removal of upland soil to contour the slope to reduce overburden stresses on the global slope stability. Following slope contouring, shoreline protection and additional restoration would be required to replace the removed work required as part of the upland remediation settlement. Once mattress removal and slope contouring are completed, full dredging of targeted sediments in DMUs 9 and 10 would occur. Due to the proximity of the adjacent Critical Structure (cutoff wall), steps to protect the cutoff wall during excavation may be required.

4.8.1 Effectiveness

This alternative would remove all targeted sediments as part of the GLLA dredging on the assumption that native till elevations are identified and established in the final design. Potential exists to locate till at different elevations (either higher or lower) and thus change the targeted removal quantity. Because the slope would be reworked as part of this alternative, no structural support at the toe would be required, assuming a sufficiently stable factor of safety could be achieved.

Short-term risks associated with this alternative include potential impacts to the upland cutoff wall through the slope reconfiguration and anchor removal. Coordination with the property owner would be necessary, and the owner would have to agree to accept this liability in writing.

4.8.2 Implementability

Removal of the marine mattress and associated appurtenances presents a challenge to effectively and efficiently remove the restoration, dismantle the marine mattress, and reconfigure the slope while protecting the slope stability and the completed upland remedy, including the adjacent Critical Structure (cutoff wall).

Removal of anchors and other portions of the mattress, as well as slope reconfiguration work, have the potential to negatively impact the installed cutoff wall during the rework. Efforts that are part of this alternative would also remove recently installed brownfield restoration elements and require replacement following the work. Dredging would proceed as it did in other locations, with additional attention to the slope and potential restriction to overdredge based on the final slope configuration.

4.8.3 Relative Cost

Removal of the marine mattresses, reconfiguration of the slope, soils management, replacement of restoration elements, and full dredging would make Alternative 5 the costliest alternative. In addition to general construction costs, costs would be incurred by schedule impacts to the dredging (design of the mattress removal, slope reconfiguration, and associated slope stability analyses), and all necessary permitting and agency coordination would delay dredging beyond the anticipated removal date. This would lead to additional remobilization costs and potentially push implementation outside of the current dredging season.

4.8.4 Screening Result

Alternative 5 is removed from consideration due to complete removal of the installed shoreline restoration and potential damage to the installed upland Critical Structure. Alternative 5 is also the costliest alternative for a small increment of additional targeted sediment removal. Removal of the mattress to access dredge material along the toe of the mattress, as well as to avoid the need for an offset or other in-place approaches described in this document, provides a minimal positive impact on long-term risk reduction but greatly increases short-term risks. Although the additional river sediment removal could slightly reduce exposure risk in the river, potential for risk associated with damaging the completed shoreline restoration and the upland remedy reduces the overall benefits of this alternative. Therefore, it has been removed from consideration.

5 Screening Summary and Other Considerations

5.1 Screening Summary

All of the alternatives were evaluated (as discussed in the previous section), and a comparative analysis was performed. A summary of the screening results is provided in Table 1.

Based on the analysis, Alternative 4c (Dredging to Toe following Installation of a Knee Wall) was selected as the most appropriate remedial technology for the site. Cost estimates for both the knee wall installation and the dredging components of this alternative are provided in Appendix B.

5.2 Future Monitoring and Follow-Up Actions

Following implementation of recommended Alternative 4c, dredging at the toe of the slope would be completed to the final design dredge template. Future monitoring of this portion of the river (DMUs 9 and 10) would be completed in accordance with the monitoring program for the GLLA Buffalo River Remediation project. In addition, there is ongoing annual monitoring for the Buffalo Color Site Areas A and B as a component of the Site Management Plans for those areas (AMEC 2015). Post-remedy monitoring could be included as a component of the Areas A and B annual monitoring in the future.

6 References

AMEC (AMEC Environment and Infrastructure, Inc), 2015. Former Buffalo Color Corporation Site – Areas a and B Site Management Plan. NYSDEC Site Number: C915230. May 2015.

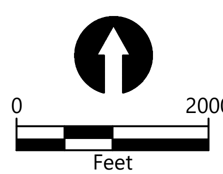
Table

Table 1
Screening Summary

Alternative	Description	Effectiveness Screening	Implementability Screening	Relative Cost Screening	Screening Result (Retained/ Removed)	General Comments
1	Natural Recovery (dredging offset to center of channel)	Not effective in the short term; may improve in the long term, but remedy is dependent on sedimentation rates which are variable	Implementable; no action is needed	Lowest cost	Removed	Failure to address impacted sediments; increases material left in place compared to other alternatives
2	In Situ Capping	Effective in the short term; does not provide additional removal of targeted sediments	Implementable; comparable capping was performed elsewhere in the river as a component of GLLA Project	Lower cost	Removed	Logistical issues associated with placement of in situ capping materials in federal channel; required changes to federal channel restricting dredging
3a	Dredging Proposed Prism (10-foot offset, 3H:1V slope)	Effective in removing most targeted sediments	Implementable; comparable dredging was performed elsewhere in the river as a component of GLLA Project	Lower cost	Retained	Readily implementable within project schedule; follows approved final design elements for other Critical Structures and shorelines; removes risk associated with slope stability
3b	Dredging Proposed Prism with Post-Dredging Sand Cover	Effective in the short term and would provide protection longer than Alternative 3a through cover placement	Implementable; comparable to Alternative 3a	Moderate cost	Retained	Added cover of sediments and residuals reduces risk of exposure beyond that of Alternative 3a; permitting concerns associated with materials placed in federal channel
4a	Dredging to Toe of the Marine Mattress	Effective in the short term; potential long-term issues related to slope stability	Implementable; elsewhere in the river, more conservative offsets from Critical Structures were employed during GLLA Project dredging	Moderate cost	Removed	Reduces factor of safety of slope; unacceptable increase in risk due to potential for damage to existing marine mattress protection
4b	Dredging to Toe Followed by Backfilling	Effective in the short term; longer term slope stability concerns exist but improved relative to to Alternative 3a due to backfill	Implementable; specific dredging and backfilling techniques such as slot dredging would be required that would complicate constructability	Higher cost	Retained	Introduces greater risk for reduced slope stability and damage to existing marine mattress; logistical issues associated with placement of materials in federal channel; requires changes to federal channel that would restrict dredging
4c	Dredging to Toe Following Installation of a Knee Wall	Effective in the short term; would provide full removal of targeted sediments and would improve slope stability	Implementable; dredging would occur following installation of the knee wall	Higher cost	Retained and Selected	Improves stability of slope, during and after construction; achieves removal of sediments to toe of the slope; avoids placement of backfill materials in the federal channel
5	Marine Mattress Removal, Slope Layback, and Full Dredging	Effective in the short term at addressing the targeted sediments but would require disturbance of other upland engineering controls	Implementable; highly challenging construction sequencing	Highest cost	Removed	Potential for impacts to installed upland remedy; unacceptable increase in risk due to removal of installed shoreline stability elements; removes shoreline restoration elements

Figures

SOURCE: Aerial Imagery from Bing Maps.
HORIZONTAL DATUM: New York State Plane West, NAD83, U.S. Feet.
VERTICAL DATUM: International Great Lake Datum of 1985



Publish Date: 2018/06/22 3:24 PM | User: bhurry
Filepath: K:\Projects\0287-Honeywell International Inc\Buffalo River Site Strategy & Eng Sup\0287-RP-019 (Surface XS_20140604).dwg Site Loc Areas A and B

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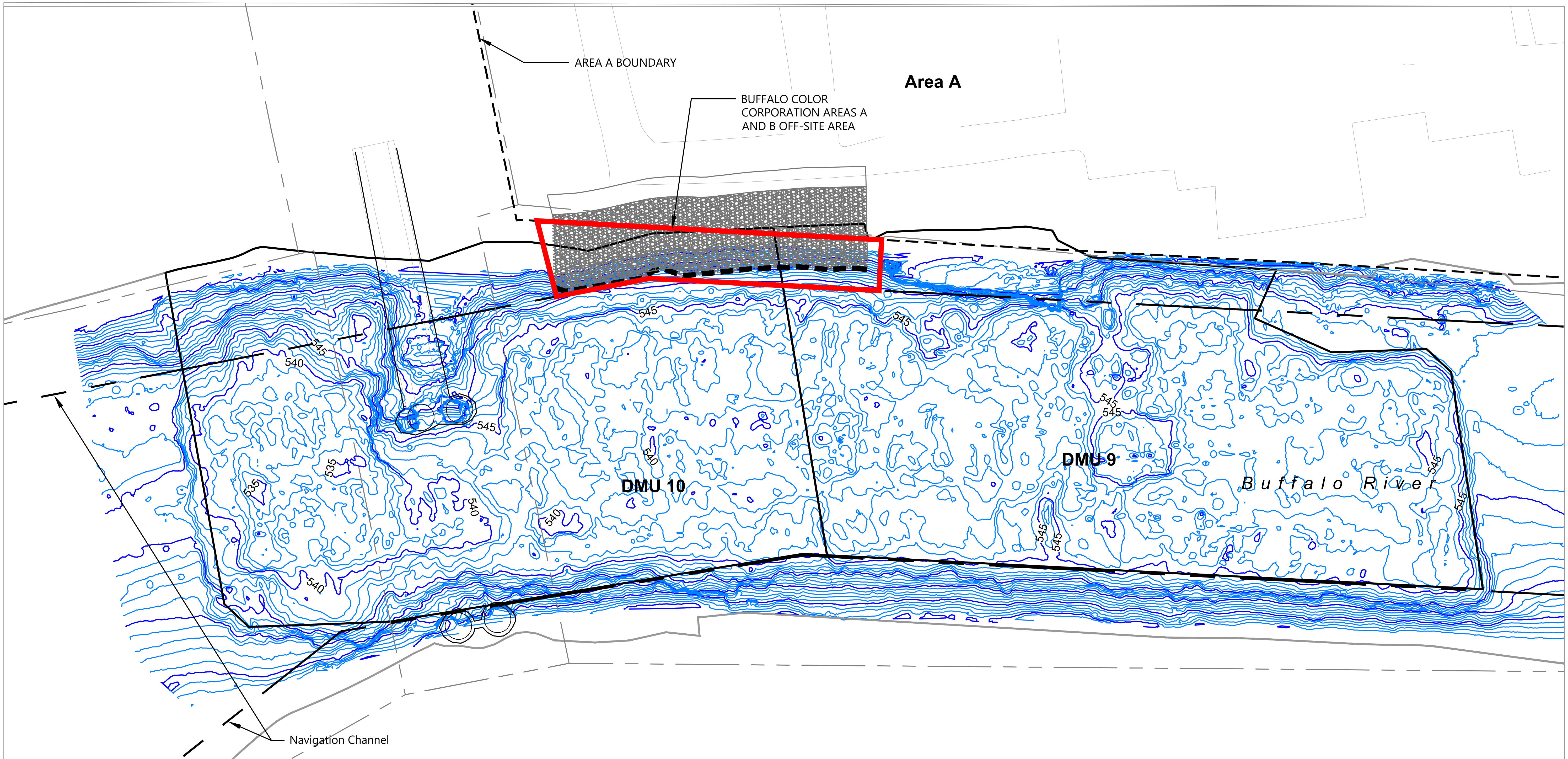
Figure 1
Site Location

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



SOURCE: Basemap prepared from CH2MHILL drawings, titled 'Existing Conditions' and 'Dredging Operations'. Bathymetry from AECOM, dated October 2014.
HORIZONTAL DATUM: New York State Plane West, NAD83, U.S. Feet.
VERTICAL DATUM: International Great Lakes Datum of 1985 (IGLD85)
NOTES:

1. Base map information including navigation channel, in-water structure and 90% Design toe of marine mattress is shown as indicated in the Basis of Design Report prepared by CH2MHill/Ecology and Environment (March, 2013)
2. Actual toe of marine mattress is based on May 28, 2013 diver survey and probing conducted by OSI (April 2014).

LEGEND:

- 550 Existing Contours (October 2014, 1' and 5' Interval)
- Toe of Marine Mattress (May 2013 and April 2014)
- DMU Boundary
- Marine Mattress Design Footprint (Mactec)
- Parcels

0 100
Feet

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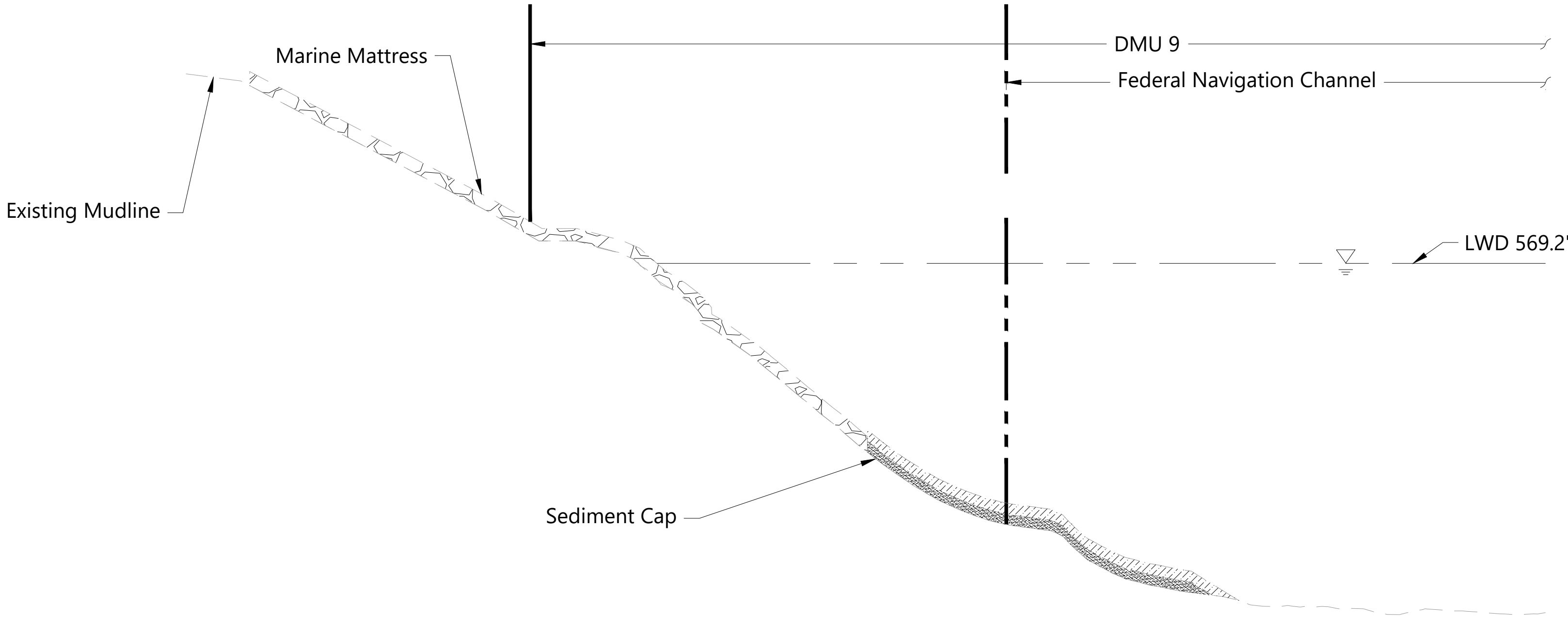
Figure 2
Site Location Map
Buffalo Color Corporation Areas A and B Off-Site
Buffalo, New York

Appendix A
Remedial Alternative Figures



In Situ Capping

Not to Scale

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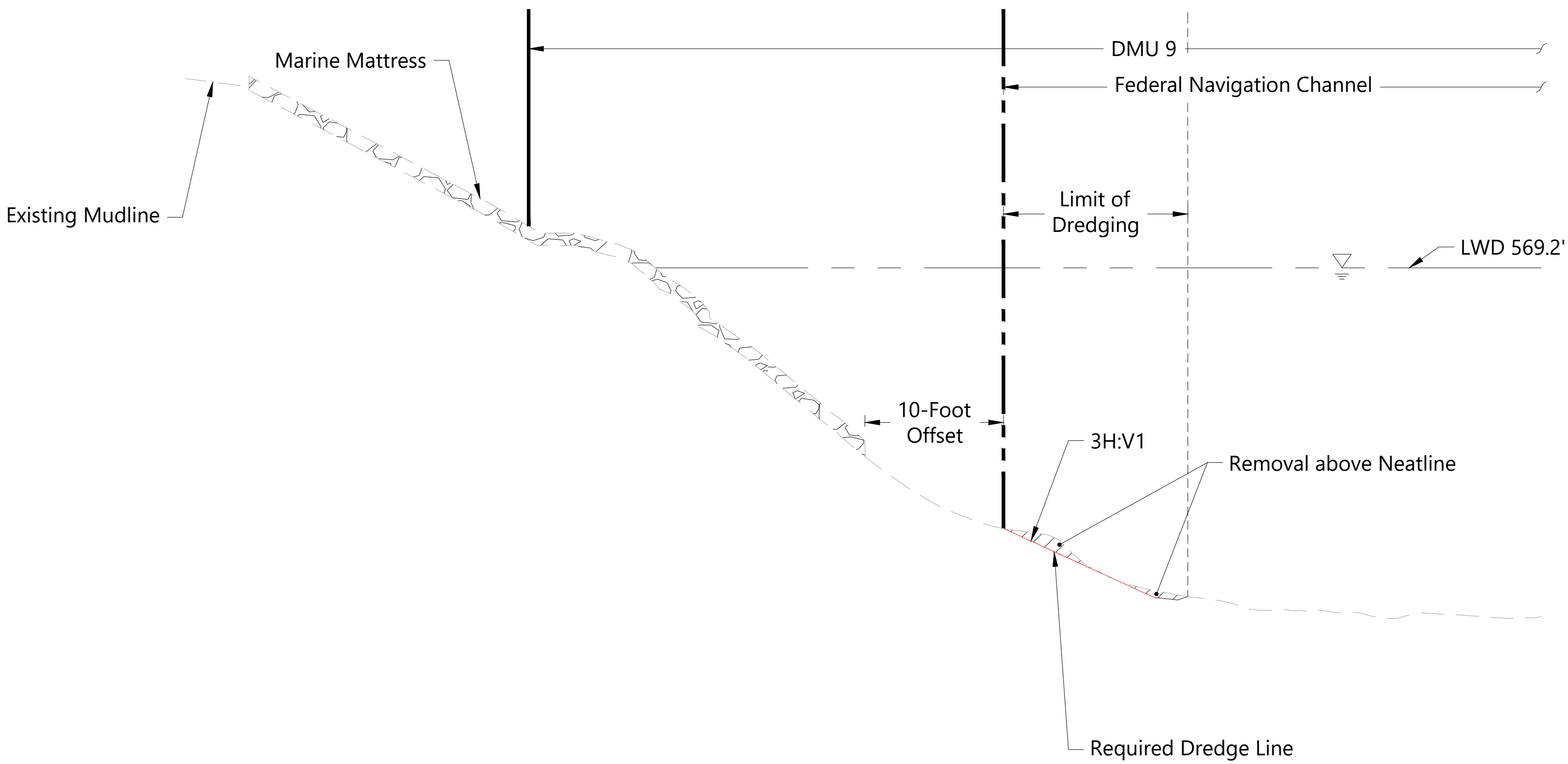
Figure A-1
Alternative 2

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Dredging Proposed Prism (10-foot Offset, 3 Horizontal to 1 Vertical (3H:1V))

Not to Scale

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Filepath: K:\Projects\0287-Honeywell International Inc\Buffalo River Site Strategy & Eng Sup\0287-RP-085 (DMU 9 AND DMU 10 - DEC REPORT 20210614.dwg Figure A-2

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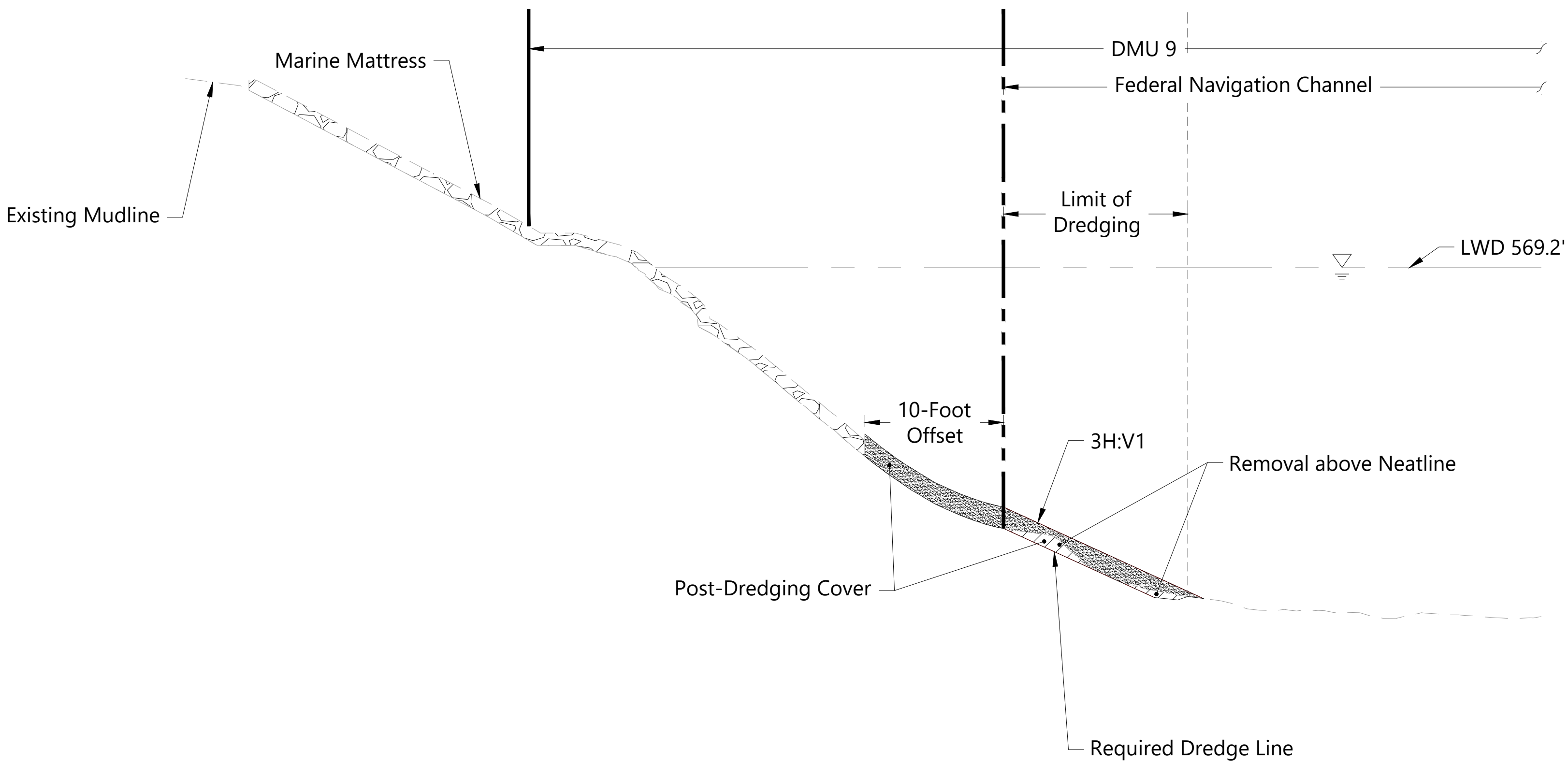
Figure A-2
Alternative 3a

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Dredging Proposed Prism with
Post-Dredging Sand Cover

Not to Scale

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Filepath: K:\Projects\0287-Honeywell International Inc\Buffalo River Site Strategy & Eng Sup\0287-RP-085 (DMU 9 AND DMU 10 - DEC REPORT 20210614.dwg Figure A-3

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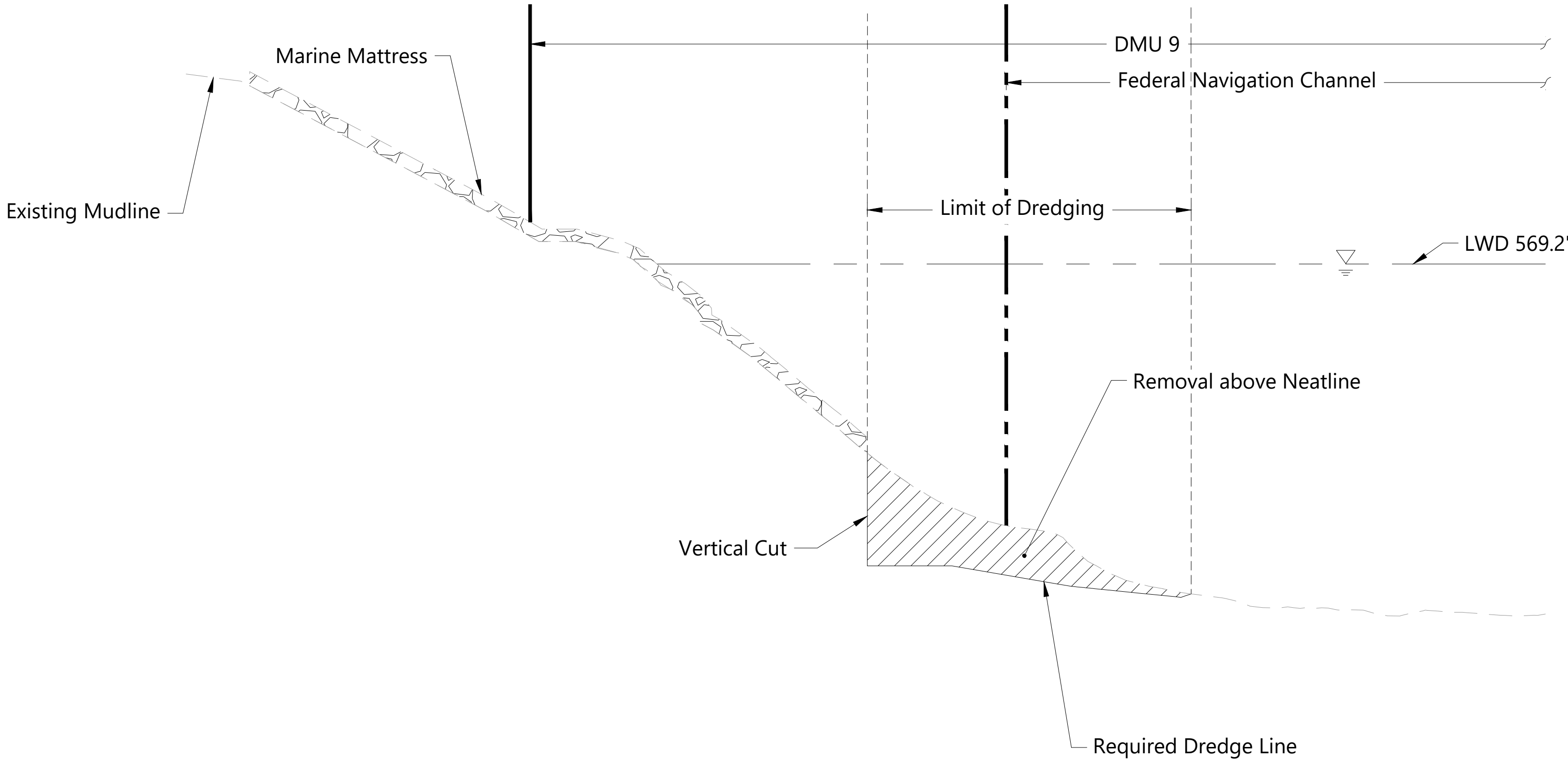
Figure A-3
Alternative 3b

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Dredging to Toe of Marine Mattress

Not to Scale

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Filepath: K:\Projects\0287-Honeywell International Inc\Buffalo River Site Strategy & Eng Sup\0287-RP-085 (DMU 9 AND DMU 10 - DEC REPORT 20210614.dwg Figure A-4

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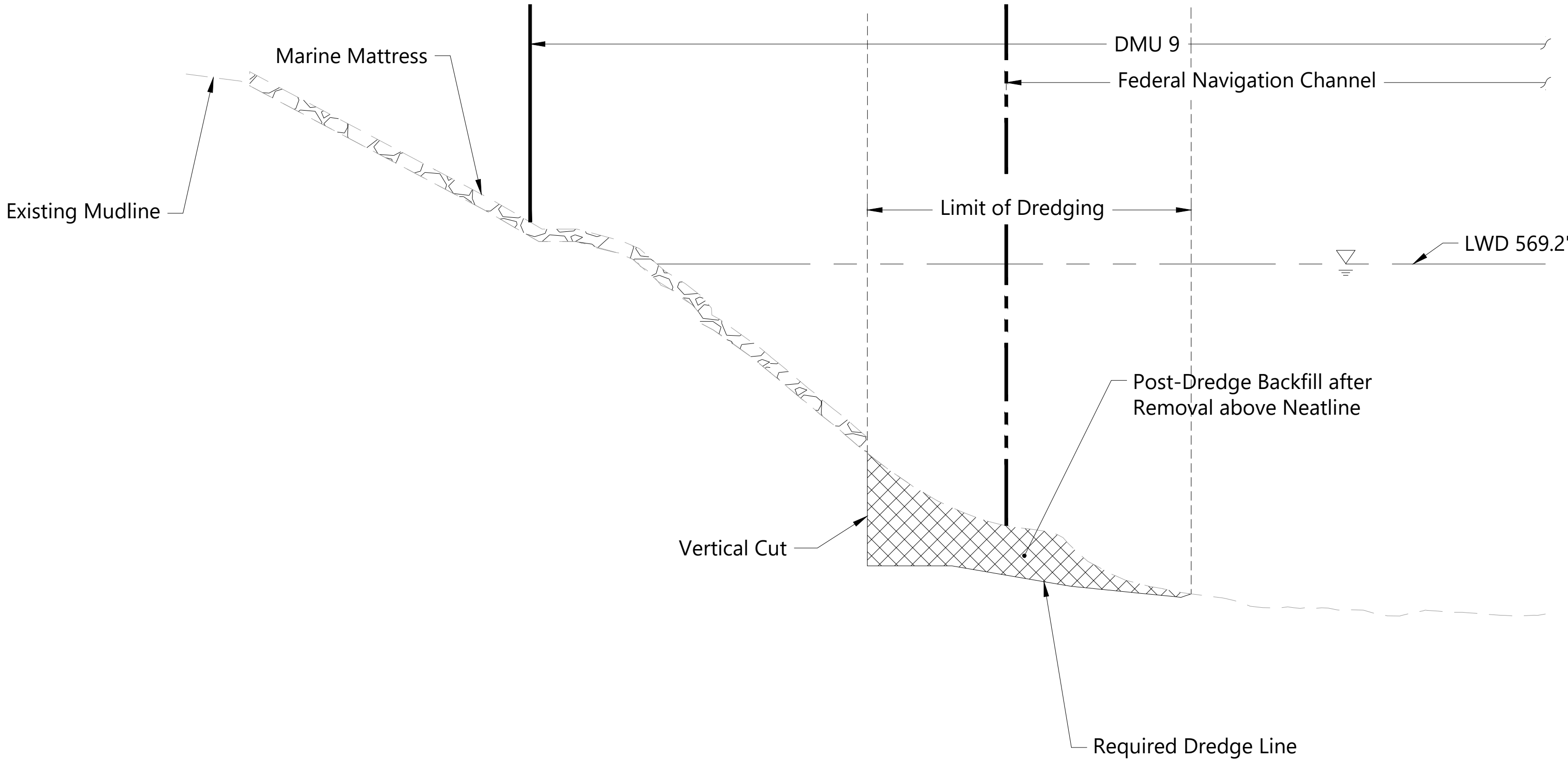
Figure A-4
Alternative 4a

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Dredging to Toe Followed by Backfill

Not to Scale

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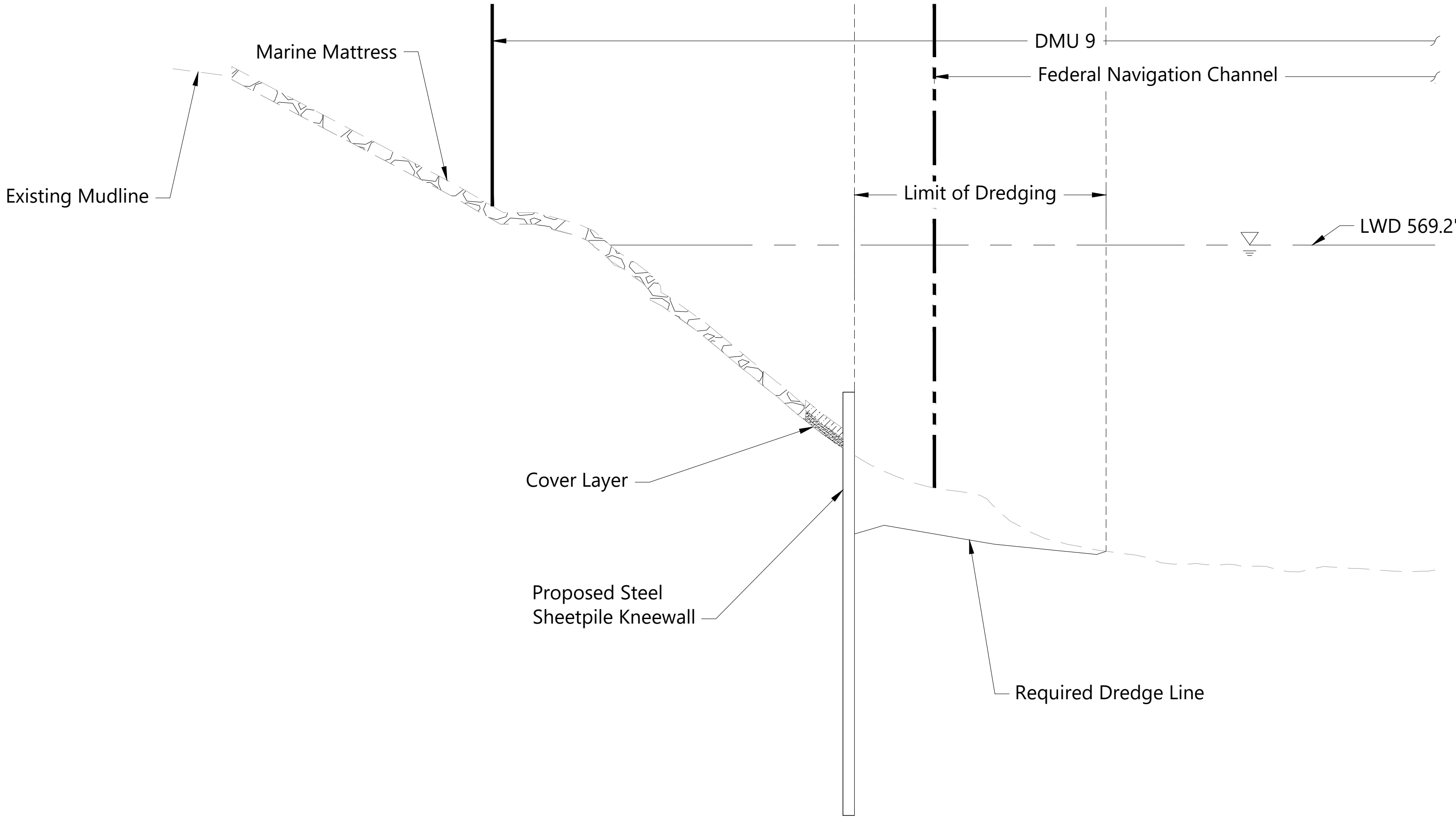
Figure A-5
Alternative 4b

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Dredging to Toe Following
Installation of a Knee Wall
Not to Scale

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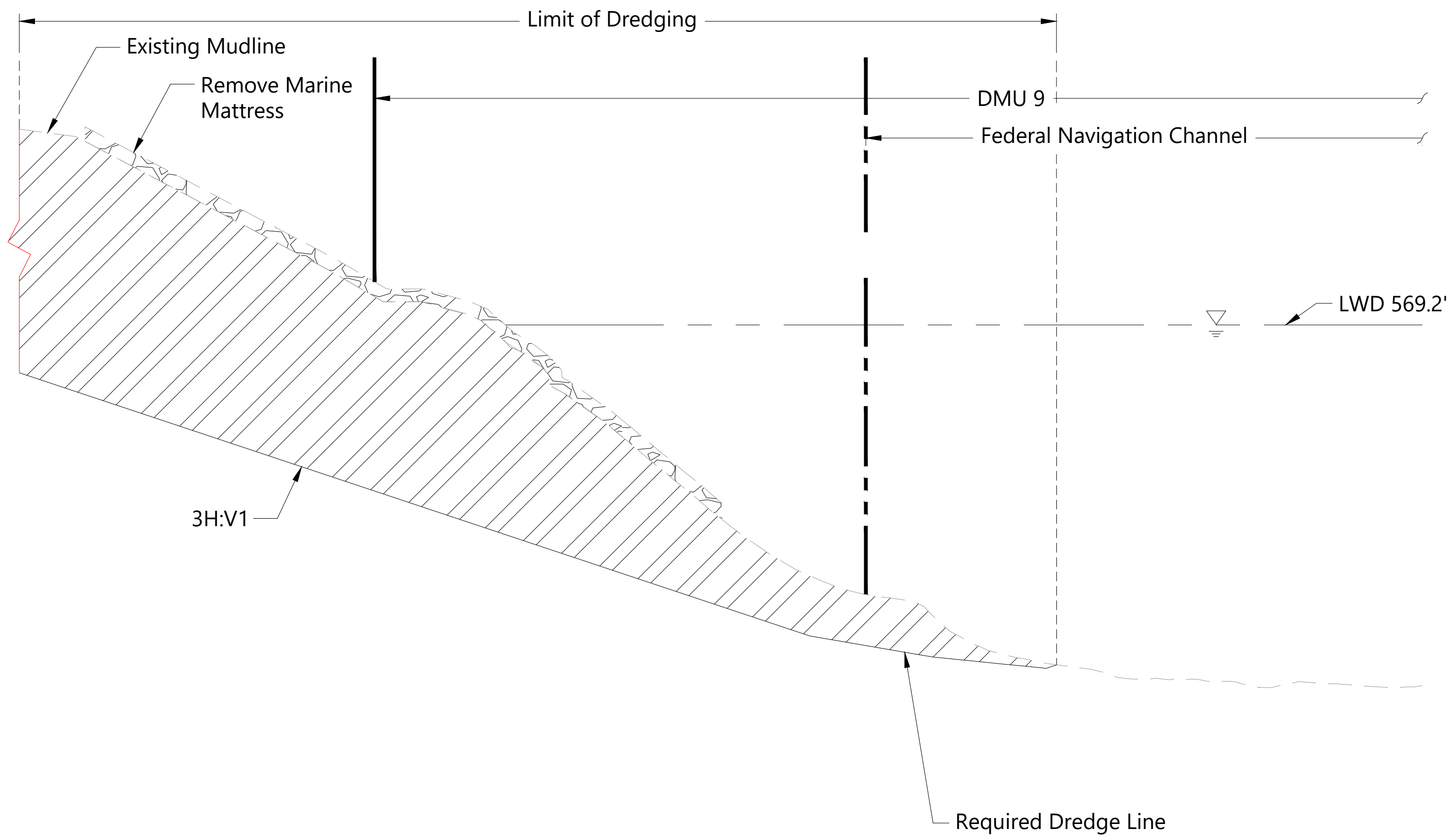
Figure A-6
Alternative 4c

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York



Marine Mattress Removal, Slope Layback, and Full Dredging

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Figure A-7
Alternative 4c

Buffalo Color Corporation Areas A and B Off-site
Buffalo, New York

Appendix B
Cost Estimates for Selected Remedial Alternative

BUFFALO RIVER AOC 2015 ADDITIONAL DREDGING, BUFFALO, NY
DRAFT CONSTRUCTION COST ESTIMATE
HONEYWELL SCOPE OF WORK - DMU 9 and 10 Knee Wall

Revision Date **9/18/2015**
Current Date 9/18/2015

GENERAL CONSTRUCTION SUPPORT COSTS

Item		Quantity	Units	Unit Cost	Total Cost	Comment
1.0 General Construction Support Items					**$76,000**	
1.01	Mobilization	1	LS	$25,650	$25,650	Mobilization cost assumed to be 10% of Items 2.02 and 2.03 (Not applied to steel purchase cost)
1.02	Demobilization	1	LS	$12,825	$12,830	Demobilization cost assumed to be 5% of Items 2.03 and 2.03 (Not applied to steel purchase cost)
1.03	Site Staging and Restoration	1	LS	$12,825	$12,825	Site staging and restoration assumed to be 5% of Items 2.02 and 2.03 (Not applied to steel purchase cost)
1.04	Surveying	1	LS	$24,000	$24,000	Vendor Supplied Cost (2015); Assumes part time topographic surveying (50%) of steel installation duration and Multi-beam bathymetric survey as-built

DIRECT CONSTRUCTION COSTS

Item		Quantity	Units	Unit Cost	Total Cost	Comment
2.0 Steel Sheetpile Knee Wall Installation					**$513,000**	
2.01	Steel Sheetpile Purchase Cost	10,800	SF	$24	$255,900	Assumes PZ 27 sheeting. Vendor Supplied Cost. Surface Area assumes 240 LF wall with 50% of sheets of 55' length (terminating above surface of water) and 50% of sheets of 35' length (terminating approximately 2.5' above surface of existing mudline). Assumes 10% markup for delivery.
2.02	Sheetpile Installation Equipment and Labor	10,800	SF	$16	$172,500	Assumes knee wall is installed from water based equipment including crane, spud platform and associated equipment. Assumes submersible pile driver is utilized. Assumes 20 LF installed per day, totaling 12 day installation duration of sheeting.
2.03	Diver Assisted Cutoff of Excess Sheeting Material	240	LF	$350	$84,000	Assumes underwater cutoff of excess sheeting along length of wall. Dive team supported by water based equipment including excavator and spud platform. Dive team costs provided by local Vendor Quote (2014). Assumes 40 LF cut and removed per day.

Total General Construction Support Costs (Item 1)		**$76,000**	
Total Direct Construction Costs (Item 2)		**$513,000**	
Contractor Overhead and Profit (15% of Items 1 through 2)		**$88,000**	Contractor O&P assumed to equal 15% of General Construction Support Items and Direct Construction Costs
SUBTOTAL		**$677,000**	
Contingency (10% SUBTOTAL)		**$68,000**	
	TOTAL	**$745,000**	

General Notes:
1. Operations conducted under this estimate include installation of steel sheetpile knee wall as part of the Buffalo River AOC GLLA Project, Buffalo, NY.
2. Estimate includes installation of steel sheeting, associated surveying, site staging, and additional project related costs.
3. Cost estimate developed based on sheeting configuration, alignment, and specifications provided by Barton & Loguidice, D.P.C.
4. Estimated costs assume 6, 10 hour work days per week.
5. Costs for DMU 9 and 10 dredging and installation of backfill cover behind sheeting are not included in this estimate and are covered under separate scope.
6. Costs and volumes are rounded off as appropriate.
7. All cost estimates include material, labor, and taxes unless otherwise noted.
8. Unit Costs are estimated using standard estimating guides (e.g. Means Site Work and Landscape Cost Data), vendors, professional judgment, and experience from similar projects.
9. Costs do not include property costs (where applicable), access costs, legal fees, Agency oversight, or public relations efforts.
10. The estimates presented are developed using current and generally accepted engineering cost estimation methods. Note that these estimates are based on assumptions concerning future events and actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic and business conditions, site conditions that were unknown to Anchor QEA, LLC at the time the estimates were performed, future changes in site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates and such variations may be material. Anchor QEA, LLC is not licensed as accountants or securities attorneys and, therefore, make no representations that these costs form an appropriate basis for complying with financial reporting requirements for such costs.

BUFFALO RIVER AOC 2015 ADDITIONAL DREDGING, BUFFALO, NY
DRAFT CONSTRUCTION COST ESTIMATE
HONEYWELL SCOPE OF WORK - DMU 9 and 10 DREDGING AND BACKFILL

AQ 9/2/15 HW Scope Estimate

GENERAL CONSTRUCTION SUPPORT COSTS

Item		Quantity	Units	Unit Cost		Total Cost	Comment
1.0	**General Construction Support Items**					**$54,000**	
1.01	Mobilization	1	LS	$10,300		$10,300	Mobilization cost assumed to be 10% of Items 2 through 5
1.02	Demobilization	1	LS	$10,300		$10,300	Demobilization cost assumed to be 10% of Items 2 through 5
1.03	Bathymetric Surveys	2	LS	$7,500		$15,000	Assumes Multibeam pre- and post-dredge surveys for each area
1.04	Site Facilities	0.5	Mo	$35,000		$17,500	Assumes costs for contractor site facilities

DIRECT CONSTRUCTION COSTS

Item		Quantity	Units	Unit Cost		Total Cost	Comment
2.0	**Dredging**					**$58,000**	Daily rate cost accounts for equipment and labor; Assumes mechanical dredging with crane equipped with 6 CY environmental clamshell bucket
2.01	DMU 9 AND 10	1,136	CY	$29		$32,900	Volume includes 1 FT overdredge and additional 5% to account for sloughing beyond design dredge limits
2.02	Turbidity Curtain Purchase and Insta	1	LS	$24,600		$24,600	Resuspension controls includes materials and labor for installation and maintenance of the mobile resuspension control system.
3.0	**Dredged Material Unloading and CDF Placement**					**$16,000**	Assumes hydraulic unloading from scows into CDF
3.01	DMU 9 AND 10	1,136	CY	$8		$9,100	
3.02	Debris Material	1	day	$6,210		$6,300	Assumes mechanical unloading from scows into CDF; 1 week assumed
4.0	**CDF #4 Tipping Fees**					**$9,000**	Cost represents 2013 EPA MOA
4.01	DMU 9 AND 10	1,136	CY	$7.66		$8,800	
5.0	**Post-Dredge Cover Placement**					**$20,000**	
5.01	DMU 9 and 10 Cover	30	CY	$31		$1,000	Vendor supplied cost, Assumes 1.5 T/CY for cover material
5.02	DMU 9 and 10 Cover Placement	1	day	$18,300		$18,300	Total Cost assumes minimum of 1 day effort for entire equipment suite and labor
	Total General Construction Support Costs (Item 1)					**$54,000**	
	Total Direct Construction Costs (Items 2 through 5)					**$103,000**	
	Contractor Overhead and Profit (18% of Items 1 through 5)				18%	**$28,000**	Contractor O&P assumed to equal 18% of General Construction Support Items and Direct Construction Costs
	SUBTOTAL					**$185,000**	
	Contingency (20% SUBTOTAL)					**$37,000**	
				TOTAL		**$222,000**	

General Notes:

1. Operations conducted under this estimate include mechanical dredging of sediments from DMU 9 and 10 followed by placement of a cover as part of the Buffalo River AOC GLLA Project, Buffalo, NY.
2. Estimate includes mechanical dredging, offloading of materials into CDF #4 through coordination with USACE Contractor, placement of post dredging cover, and additional project related costs
3. Estimated costs assume 6, 12 hour work days per week.
4. Costs for DMU 9 and 10 kneewall are not included in this estimate.
5. Costs and volumes are rounded off as appropriate.
6. All cost estimates include material, labor, and taxes unless otherwise noted.
7. Unit Costs are estimated using standard estimating guides (e.g. Means Site Work and Landscape Cost Data), vendors, professional judgment, and experience from similar projects.
8. Costs do not include property costs (where applicable), access costs, legal fees, Agency oversight, or public relations efforts.
9. The estimates presented are developed using current and generally accepted engineering cost estimation methods. Note that these estimates are based on assumptions concerning future events and actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic and business conditions, site conditions that were unknown to Anchor QEA, LLC at the time the estimates were performed, future changes in site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates and such variations may be material. Anchor QEA, LLC is not licensed as accountants or securities attorneys and, therefore, make no representations that these costs form an appropriate basis for complying with financial reporting requirements for such costs.