Date: 03/30/18

To: Gerardo Millan-Ramos; EPA Region 1 Remedial Project Manager

From: Denis McGrath, C.H.M.M., KGSNE JV, LLC.

Re: Mohawk Tannery Site - Removal Alternatives Update Technical Memorandum

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) requested that the KGSNE JV LLC (KGSNE) Superfund Technical Assessment and Response Team (START) provide technical assistance support for the Mohawk Tannery site (Site) in Nashua, New Hampshire. EPA tasked KGSNE to: update the cost for the removal alternative selected in the October 29, 2002 Non-Time-Critical Removal Action (NTCRA) Action Memorandum; perform effectiveness, implementability, and cost evaluations for two additional removal alternatives; develop a comparative analysis for the three alternatives; and present the evaluation results and conclusions in a technical memorandum.

This work was performed under Contract No. EP-S1-17-01. Tasks were conducted in accordance with the revised scope of work (SOW) provided by EPA on September 5, 2017 and revised on September 13, 2017, November 21, 2017, and November 30, 2017.

Background information used in the generation of this technical memorandum was provided by EPA as part of the SOW, a limited search of documents available through the New Hampshire Department of Environmental Services' (NHDES) "One-Stop" on-line data warehouse, and EPA's on-line administrative record for the Mohawk Tannery site.

BACKGROUND

The is located at the intersection of Fairmont Street and Warsaw Avenue in Nashua, New Hampshire. The Site formerly operated as a leather tanning facility between 1924 and 1984. The Site consists of two adjacent 15-acre parcels: the "Northern Parcel" containing the former manufacturing and waste management areas; and the "Southern Parcel" containing primarily undeveloped property. Both parcels border the Nashua River to the west and south. The Site is bordered by the Fimbel Door Company to the north, and residential parcels to the east and southeast.

In the 1960s, the Mohawk Tannery facility began treating its wastewater via two unlined lagoons located approximately 60 feet north of the adjacent Nashua River. These initial lagoons have since been referred to as Areas 1 and 2. These lagoons provided treatment by combining acidic and alkaline waste streams, and allowing the resulting solids to settle to the bottom of the lagoon. The resulting sludge was periodically removed and disposed of in several other areas on the Mohawk Tannery property. Sludge was encountered during construction in the 1970s, and was transferred to Areas 3, 4, 5, and 6. Area 7 resulted from the disposal of excavated hide scraps and other refuse resulting from additional construction.

During the 1980s, dried sludge from the tannery was placed into the adjacent Fimbel Door Company landfill (also referred to as the Fimbel Landfill). This landfill has since been capped and closed under New Hampshire regulations.

Several environmental investigations conducted by EPA, NHDES, and facility owner contractors concluded that at the time the tannery operated, hazardous substances including dioxin, chromium, pentachlorophenol, and 4-methylphenol were discharged directly to the Nashua River, and were deposited in the lagoons and waste disposal areas described previously.

The Site was proposed for listing on the National Priorities List (NPL) on May 11, 2000; however, to date, the Site remains proposed.

In July 2000, EPA prepared an Engineering Evaluation/Cost Analysis (EE/CA) Approval Memorandum to characterize the nature and extent of the contamination in the unlined lagoons and disposal areas, and to evaluate the removal options for the materials.

In January 2001, EPA conducted a time-critical removal action to remove and dispose of: drums and small containers of hazardous substances; asbestos-containing materials (ACM); and the contents of a clarifier tank. This removal action also improved access restrictions and erected warning signs.

The Final EE/CA was issued in July 2002. The EE/CA established the following removal objective:

- Prevent contact with, and control and contain the release of hazardous substances from the Site through source control measures.

The EE/CA evaluated three alternatives to address contamination in the lagoons and disposal areas including:

- Alternative 1 - Excavation and Off-Site Disposal;
- Alternative 2 - Consolidation into an On-Site Landfill; and
- Alternative 3 - Excavation, Off-Site Treatment, and Disposal.

The EE/CA recommended Alternative 1 be implemented for the NTCRA as it met the removal objectives and was the most implementable alternative. The NTCRA Action Memorandum proposed Alternative 1 be implemented due to the perceived benefits of Alternative 1 outweighing the cost advantages of Alternative 2 because the excavation and off-site disposal permanently removes the contaminants from the Site, and does not require long-term maintenance or monitoring. The 2002 EE/CA cost for the selected alternative was approximately $15 million.

The NTCRA was not implemented; however, a Remedial Investigation (RI) was performed to characterize the nature and extent of Site contamination not addressed by the NTCRA (e.g., outside of Areas 1 through 7). The RI was completed in 2005, which identified soil contamination outside of the lagoons and disposal areas.

In 2009, EPA retained Shaw Environmental, Inc. to perform a Solidification/Stabilization Bench-Scale Treatability Study. The result of this study identified that binders containing primarily Portland Cement (PC) with lesser quantities of blast-furnace slag and hydrated lime would meet Site geotechnical criteria and metals leaching standards; however, post-treatment samples indicated higher phenol concentrations.

Shaw recommended the use of absorbent additives to control this leaching. A 2016 treatability test performed by GeoInsight, Inc. evaluated the use of PC with organophilic clays and powdered activated carbon (PAC) absorbents. The 2016 testing recommended the use of 16% by weight PC for Areas 2, 3, 4, 6, and 7 with 3% by weight PAC added to the perimeter of the treatment areas, and a 25% by weight PC for Area 1 with 3% by weight PAC admixed in perimeter treatment areas.

In November 2016, GeoInsight, Inc. presented a Draft Remedial Action Plan (RAP) to implement a solidification/stabilization remedial approach for the sludge disposal areas and contaminated soil areas.

REMOVAL ACTION GOALS

The Removal Action Objectives (RAOs) for the project are identified in the 2002 EE/CA. They are as follows:

- Prevent, to the extent practicable, direct contact with, ingestion of, and inhalation of contaminants in tannery sludge/waste and associated soil at concentrations exceeding preliminary removal goals (PRGs);
- Prevent to the extent practicable, ecological receptor exposure to contaminants exceeding PRGs in tannery sludge/waste and associated soil;
- Prevent, to the extent practicable, migration of contaminants exceeding PRGs from tannery sludge/waste and associated soil to site groundwater and the Nashua River; and
- Address tannery sludge/waste and associated soil with contaminants exceeding PRGs to restore the Site to its intended residential use.

EPA Region 1 provided the following summary of PRGs and their NHDES Soil Remediation Standards (SRS) for inclusion in this technical memorandum.

Preliminary Remedial Goals (PRGs)		
Contaminant of Concern	**EE/CA PRG (mg/kg)**	**NHDES SRS (mg/kg)**
Benzo(a)pyrene	0.7	0.7
Pentachlorophenol	3.0	3.0
4-Methylphenol (p-cresol)	0.7	0.7
Dioxin - TCDD (expressed as toxicity equivalency [TEQ])	5.11E-05*	0.001
Antimony	9.0	9.0
Arsenic	11.0	11.0
Barium	1,000.0	1,000.0
Cadmium	33.0	33.0
Chromium total	1,000.0	1,000.0
Lead	200.0**	400.0
Manganese	1,000.0	1,000.0
Vanadium	393.0*	NA

Notes:
SRS = Soil Remediation Standards. SRSs are derived from New Hampshire Code of Administrative Rules Chapter Env-Or-606.19, Table 600-2 Soil Remediation Standards as-of 2017
EE/CA - Engineering Evaluation/Cost Analysis
NHDES - New Hampshire Department of Environmental Services
mg/kg- milligrams per kilogram
* The PRGs for Dioxin and Vanadium are based on an EPA Regional Screening Level (RSL) assuming a Hazard Quotient (HQ) = 1, expressed as mg/kg.
** The PRG for Lead is based on the EPA Region 1 Strategy Soil Screening Level
NA = Not Available

WASTE VOLUMES

Sludge Disposal Areas

The following table summarizes the sludge/waste disposal area volumes anticipated in the 2016 RAP. For the purposes of this evaluation, KGSNE will evaluate based on the larger of the two waste sludge volumes.

Waste Area	2016 RAP Volume (Cubic Yards)	2016 RAP Overlying Soil Volume (Cubic Yards)
Sludge Disposal Area 1	29,630	0
Sludge Disposal Area 2	29,630	8,889
Sludge Disposal Area 3	556	222
Sludge Disposal Area 4	800	400
Sludge Disposal Area 6	1,111	667
Sludge Disposal Area 7	4,459	2,230
TOTALS	66,186	12,407

Satellite Soil Contamination Areas

The 2016 RAP presented an argument to attribute arsenic contamination detected in previously collected soil samples to background conditions as the concentrations detected in soil samples was greater than that of sludge samples, which the RAP suggests represents waste source material. The highest reported arsenic in soil detection (39 milligrams per kilogram) was in the gravel pit, which the RPA indicates was not associated with the tannery operations. It bears noting that arsenic was also detected (69 milligrams per kilogram) in a residue sample collected from a trench within the floor slab of the former tannery building. Therefore, considering arsenic concentrations representative of background, the 2016 RAP identified several areas of contaminated soil requiring management. These areas are summarized below:

Area ID	Contaminated Soil Volume (Cubic Yards)	Contaminants
TP-01	15	Metals
TP-02	100	Metals and pentachlorophenol
TP-08 & -09	250	Metals and dioxin
TP-15	20	Metals
TP-21 and -22	750	Metals
TP-34	10	Metals
SS-124	5	Metals
TOTALS	1,150	

Building Slab and Trench Areas

Residue samples and sub-slab soil samples were collected during the 2005 RI from the main building floor slabs and drains/trenches. Elevated concentrations of several contaminants of concern were reported in the drain/trench residue samples; however, sub-slab soil samples identified only arsenic. For the purposes of this evaluation, KGSNE assumes that the volume of this residual material is low and inconsequential to the overall waste volumes. Based on the available data, and consistent with the 2016 RAP's conclusion that arsenic contamination in soil is representative of background conditions, sub-slab soil contamination is not included further in this evaluation.

Concrete samples from the floor slab and/or the trenches have not been collected; therefore, the reuse of the concrete cannot be conclusively determined. For the purpose of this evaluation, KGSNE assumes that such concrete could be reused on-site in a manner consistent with building code and engineering principles.

Southern Parcel Area

The September 26, 2013 technical memorandum evaluating the screening-level human health and ecological risk assessments for the southern parcel indicated that the risks to recreational users of the property do not exceed the 1E-04 excess cancer risk or a hazard quotient of 1. Risks to potential future residents exceed these thresholds. Possible ecological impacts are identified in the technical memorandum in surface soil and in wetlands; however, additional data and investigation would be required to further quantify this risk.

The memo indicates that the presence of asbestos fibers in surface soil may represent a risk to recreators, and would require further data to develop substantive conclusions. Additionally, only surface soil samples have been collected in the asbestos area, and an accurate estimate of impacted soil cannot be determined. Further data would be required. For this technical memorandum evaluation, KGSNE assumes that the lateral asbestos impacts are limited as presented in the technical memo, and is limited to the top foot of soil. This results in an estimated in-situ soil volume of 2,500 cubic yards (CY).

REMEDIAL ALTERNATIVE DESCRIPTIONS

Per the revised EPA SOW dated September 13, 2017, EPA requested that KGSNE provide a description of three removal alternatives: the NTCRA-preferred alternative (Alternative 1 – Excavation with Off-Site Disposal); Alternative 4 - On-Site Treatment (Solidification/Stabilization); and Alternative 5 – Encapsulation and Capping.

General assumptions for the three alternatives evaluated in this memorandum are summarized below.

NTCRA: KGSNE assumes that the removal action on this Site will be a NTCRA, and will be procured, performed, and managed in accordance with the Federal Acquisition Regulations (FARs).

Applicable or Relevant and Appropriate Regulations and Guidelines (ARARs): KGSNE assumes that the ARARs and guidelines identified in the 2002 EE/CA remain an accurate portrayal of the ARARs/guidelines in effect currently.

Floodplain Impacts: One notable alteration of an ARAR which the 2002 EE/CA identified as applicable is the Floodplain Management Executive Order (EO) 11988, and its implementation regulation located in 40 Code of Federal Regulations (CFR) 6.302(b) and Appendix A to Chapter 6. The significant change is that the flood hazard limits depicted in previous documents, including the 2016 RAP, do not portray the most current flood hazard evaluation as reflected in the Federal Emergency Management Agency's Letter of Map Revision Determination Document for Flood Insurance Rate Map Nos. 33011C0494D, 33011C0513D (which includes the Mohawk Tannery property), and 33011C0514E. The revised map presents a flood elevation of approximately 127.7 feet above mean sea level for the area between the Area 1 lagoon (which is not located within the 100-year floodplain), and the Area 2 lagoon (approximately half of which is).

Risk Evaluation: KGSNE assumes that the risk evaluation presented in the 2002 EE/CA remains an accurate portrayal of the human health and ecological risks for the Site.

Institutional Controls: KGSNE did not include a description or costs associated with any institutional controls that would potentially be required after completion of these alternatives.

Structural Considerations: Based on potential redevelopment proposals, buildings are proposed for construction over the former lagoons except Areas 1 and 2. In these areas, EPA instructed KGSNE to assume that the alternatives should be capable of supporting vegetation.

Construction Completion Report: KGSNE assumes that the development and submittal of a construction completion report or after-action report would be included in the engineering contingency costs.

The following sections describe each alternative.

Alternative 1 – Excavation with Off-Site Disposal

The 2002 EE/CA recommended selection of the excavation and off-site disposal alternative for the NTCRA. The Subsequent NTCRA Action Memorandum proposed this removal action. This Technical Memorandum updates costs to provide current cost comparison of this alternative to other alternatives being developed as part of a 2018 EE/CA.

Definable Features of Work & Costing Assumptions:

Site Access Road & Construction: Access road construction would initiate at the Broad Street Parkway entrance to the Fimbel Door Co. property, and would extend across a known asbestos

disposal site (ADS) and connect to an existing gravel/dirt road that accesses the Mohawk Tannery property northwest of Areas 1 and 2.

Building/Foundation Demolition: The structures formerly present on the Mohawk Tannery site have been razed and removed. The sole remaining remnants of these buildings are the concrete floor slabs and foundations. The concrete slabs around Area 6 will require removal and disposal. Based on available data, it does not appear that Area 6 sub-slab sample collection or concrete sample collection has been conducted to determine whether the concrete has been impacted by contamination. Testing may be required to determine this. Samples of residue within portions of the main building and associated out-building slabs have identified the presence of contaminants which exceed PRGs. Sub-slab soil samples collected from this area have also identified similar contaminants. However, no concrete samples have been collected to determine if the contaminants (which include polychlorinated biphenyls [PCBs]) detected in the residue and/or sub-slab soil are present in the concrete slabs as well, which may require waste management.

Haul Road Construction: Existing Site roads would be improved to allow unimpeded construction-related traffic. Improvements assumed include modifications to grading, placement and grading of gravel surfaces, and increased widths in some areas.

Stockpile/Staging Area Prep: Stockpile areas established and maintained in Areas 5 and 6. Stockpiles would be underlain by a 12-inch thick layer of gravel over a 40-mil high density polyethylene (HDPE) liner and 6-inches of gravel. Gravel and liner would be graded to promote drainage to the perimeter of the stockpile, and bermed to prevent run-off or run-on during precipitation events.

Dewatering: Excavation dewatering would be required in Areas 1, 2, and 3 via three pumps discharging to a fractionation tank. A transfer pump would discharge settled water from the first fractionation tank to a second tank for additional settling prior to discharge to the publicly-owned treatment works (POTW). Routine discharge samples would be collected during the dewatering effort. An estimated 250,000 gallons of total dewatering volume is assumed.

Sludge/Waste/Soil Excavation: Excavate and stage overlying soil using a track-mounted excavator with a two-cubic-yard bucket and transport soil via two off-road dump trucks. Soil will be staged for later reuse. Excavation of waste/sludge material is assumed at a reduced rate of production due to moisture content and odor management considerations (see below). Sludge transported to stockpile staging area for moisture and odor management (mechanical mixing of agricultural lime). The SRS-exceeding contaminated soil (1,200 CY) would be removed from each of the nine areas. Approximately 2,500 CY of material from the southern parcel will also be excavated and transported for off-site disposal.

Dust and Odor Suppression: Routine water-bar spraying of access and haul roads. Foam odor/dust suppressant of work areas plus agricultural lime additive mixing to stockpiles at 10% by weight. Excavation perimeter surrounded by misting nozzles spraying odor reduction solutions. Solution mixed on-site in storage tank and delivered via diesel pumps.

Air Monitoring: Perimeter air monitoring would be required daily at two locations (up and down-wind) for the duration of the excavation. Air samples analyzed for the presence of sulfide and dioxin.

Excavation confirmation samples: Confirmation soil samples collected at a rate of one per 500 square feet of exposed excavation for laboratory analysis of dioxin, semi-volatile organic compounds (SVOCs), and metals. Waste characterization samples collected at a rate of one per 500 tons of sludge/waste for disposal. Sample analyses for volatile organic compounds (VOCs), SVOCs, and metals via the Toxicity Characteristic Leaching Procedure (TCLP), flashpoint, corrosivity, reactivity, and free-liquids.

Transportation and Disposal: Assumed 20 trucks loaded per day. The 2002 EE/CA stated that a RCRA Subtitle D landfill facility located in New Hampshire would accept non-hazardous wastes. KGSNE assumes that this acceptance remains in effect. The 2002 EE/CA assumed that a RCRA Subtitle C landfill located in upstate New York would accept the hazardous waste stream. However, as of September 2017, this landfill is no longer accepting wastes for land disposal. Therefore, trucking to a facility in the upper Midwest is assumed. If it is necessary to dispose of hazardous waste stream at a RCRA Subtitle C landfill, costs are expected to increase by approximately 40%.

Site Restoration: Excavations will be backfilled with the overlying soil previously excavated and staged, supplemented with off-site borrow material. Backfill will be placed in 6-inch lifts and compacted to original Site grades. A 4-inch layer of topsoil will be placed on impacted areas, and will be hydroseeded and mulched.

Site Staffing/Labor: Site management staff will require travel expenses; however, site labor and operators will be local.

Post-Removal Site Control (PRSC): These controls would include quarterly inspection and maintenance of the new vegetation, and erosion/sedimentation control features (as needed) would be required for two years.

Attachment A provides a conceptual layout of Alternative 1.

Alternative 4 – On-Site Treatment (Solidification/Stabilization)

The solidification/stabilization alternative is similar in scope and magnitude to the approach identified in the GeoInsight RAP. A conceptual layout of Alternative 4 is included in Attachment A.

Table 4-2 of the 2002 EE/CA eliminated the In-Situ Solidification/Stabilization process option due to it not being applicable to organic Site contaminants; being difficult to implement below the groundwater table; and that it may alter the flood storage capacity in Area 2 (due to the addition of bulking agents/solidification reagents). However, stabilization bench testing performed in 2009 and 2016 identified that PC and binders coupled with powdered activated carbon provided a suitably strong, minimally transmissive, stabilized material that did not present a leaching concern for organic constituents in the sludge. Therefore, this alternative is undergoing additional evaluation.

Significant Alternative-Specific Assumptions:

Building/Foundation Demolition: The structures formerly present on the Mohawk Tannery site have been razed and removed. The sole remaining remnants of these buildings are the concrete floor slabs and foundations. The concrete slabs around Area 6 will require removal and disposal. The remaining slabs will require management in accordance with redevelopment needs.

Floodplain Management EO Compliance: KGSNE assumes that EPA has performed a Floodplain Assessment, and that the assessment and reporting sufficiently demonstrates compliance with floodplain management criteria.

The On-Site Treatment (Solidification/Stabilization) alternative is comprised of the following definable features of work (DFOWs):

- Pre-Construction Activities;
- Project Management & Staffing;
- Mobilization, Site Preparation, Temporary Facilities;
- Project Controls;
- Excavation and Removal of Overlying Soil;
- Sludge Consolidation;
- Solidification/Stabilization of Soil/Sludge;
- Cap and Vent Construction;
- Backfill & Site Restoration;
- Decontamination, Temp Facility Removal, De-Mobilization; and
- PRSC Monitoring

Pre-Construction Activities

Pre-construction activities would include a pre-design investigation, engineering and removal designs and specifications, establishment of the contractor's performance and payment bonds, and preparation of project-specific plans.

Pre-design Investigation: The investigation would obtain alternative-specific design data including verification of moisture and odor control technology effectiveness, verification that overlying soil is suitable for reuse, and verification through additional bench testing that the selected solidification/stabilization technology remains effective below the groundwater level.

Engineering and Removal Designs and Specifications: The required engineering, designs, and specifications would be completed and approved prior to initiating construction work. At a minimum, this design will establish materials specifications, identify the limits of work, identify project controls locations, identify anticipated application rates, estimate excavation and swell volumes, establish quality assurance/quality control and materials testing requirements, and establish end-goals.

Project Bonding: Due to the estimated size of this project, KGSNE assumes that the Government would require performance and payment bonds (at 1% of construction costs).

Project-Specific Planning: Plans including a Construction Implementation Plan, a Health and Safety Plan, an Erosion and Sedimentation Control Plan, a Storm Water and Water Pollution Prevention Plan, a Construction Quality Assurance Project Plan, and an Analytical Quality Assurance Project Plan would be prepared and approve prior to mobilization.

Project Management and Staffing

A site-superintendent, a health and safety officer, a quality control officer, and an office administrator/cost reporter would be on-site for the duration of the construction (estimated at 12 months).

Mobilization, Site Preparation, and Temporary Facilities

Mobilization: Heavy equipment including tracked-excavators, wheeled-loader, low ground-pressure bulldozer, off-road dump trucks, mixing equipment, power mixers, tracked pressure feeders, and associated equipment would be mobilized to the Site as needed. Equipment resources will be scheduled and staged to minimize equipment down time.

Temporary Facilities: Temporary facilities would include an office trailer (for the contractor and government use); water (200 gallons per minute) service from Warsaw Ave, electricity (600 amp service) (from adjacent utility pole), phone and internet (from adjacent utility pole), steel storage containers; non-hazardous waste disposal, temporary security/dust control fencing, and temporary water management facilities (dewatering pumps, fractionation tanks for water settlement, water quality verification laboratory analyses, and discharge fees to the publicly-owned treatment works via sewer main).

Site Preparation: Site preparation would include establishment of erosion and sedimentation controls, clearing/grubbing of designated work areas, chipping of above-grade vegetation, disposal of below-grade vegetation, establishment of equipment and personnel decontamination facilities, establishment of construction-access roads (from Broad St. Parkway), improvement of on-site haul roads, establishment of a stable staging and stockpile management area, and relocation/manage the sewer utility located at the southwest corner of Area 2. Monitoring wells located within the treatment zone (Supply Well, GZ-09, GZ-10, SH-16S/D) would be abandoned consistent with state and local requirements. Other monitoring wells in the work area will be preserved to the extent practicable.

Building/Foundation Demolition: The structures formerly present on the Mohawk Tannery site have been razed and removed. The sole remaining remnants of these buildings are the concrete floor slabs and foundations. The concrete slabs around Area 6 will require removal and disposal. Based on available data, it does not appear that Area 6 sub-slab sample collection or concrete sample collection has been conducted to determine whether the concrete has been impacted by contamination. Testing may be required to determine this. Samples of residue within portions of the main building and associated out-building slabs have identified the presence of contaminants which exceed PRGs. Sub-slab soil samples collected from this area have also identified similar

contaminants. However, no concrete samples have been collected to determine if the contaminants (which include PCBs) detected in the residue and/or sub-slab soil are present in the concrete slabs as well, which may require waste management.

Project Controls

This DFOW would include purchase and use of health and safety equipment, personal protection equipment, dust control equipment and materials, odor control equipment and materials, perimeter odor controls, establishment of survey controls, and materials/quality assurance/quality control testing.

Excavation of Overlying Soil, NHDES SRS-Exceeding Soil, and Expansion Cell Soil

Excavation activities would initiate with the removal of the soil berms surrounding Area 1. This soil would be transported to the stockpile area for later reuse.

Excavation activities would progress to the excavation of a 6- to 12-foot-deep/16,000 CY expansion cell located adjacent to the Area 1 sludge lagoon. Excavation spoils would be transported to the stockpile area for stockpile and later reuse. This cell would accommodate sludge/soil swell volume due to the application of solidification/stabilization reagents.

From this point, excavation activities would alternate between sludge excavation and consolidation, and overlying soil/SRS-exceeding soil excavation and transfer. In general, the overlying soil from Areas 3, 4, 6, and 7 would be excavated and transported to the stockpile area for later reuse. The Area 2 cap/overlying soil would also be stripped and stockpiled for later reuse.

The SRS-exceeding contaminated soil (1,200 CY) would be removed from each of the nine areas and the southern parcel. This soil would be transferred to Area 2 (after the overlying cap soil has been removed) for subsequent stabilization/solidification (described below). Approximately 2,500 CY of material from the southern parcel will also be relocated to the Area 2 waste sludge area.

Sludge Consolidation

With the expansion cell excavated, sludge from Areas 3, 4, 6 and 7 as well as SRS-exceeding contaminated soil would be placed into the expansion cell along with the anticipated swell volume resulting from the application of stabilization/solidification reagents. The solidification/stabilization activities are described below.

Excavations in Areas 3, 4, 6, 7, and the areas from which SRS-exceeding contaminated soil was removed would be backfilled using previously excavated soil material staged in the stockpile area. Further descriptions of the backfill/site restoration activities are described below.

As noted above, the SRS-exceeding contaminated soil would be consolidated into the Area 2 sludge volume for solidification/stabilization treatment.

Solidification/Stabilization of Soil/Sludge

Two solidification/stabilization technologies would be employed to achieve design criteria: hollow-stem auger/mechanical mixing (for Area 1 and the Expansion Cell); and power-auger/blender with a hood (for Area 2). The rationale for the two techniques is due to the waste thicknesses. Area 1 thicknesses approach 20 feet, and Area 2 approaches 10 feet. The hollow-stem auger method is not depth-limited, while the power-auger method is limited by the reach of conventionally-available heavy equipment. Ten feet is well within the reach of conventional equipment.

To maximize optimal mixing weather, both solidification/stabilization methods would progress concurrently.

Each solidification/stabilization method would be demonstrated to be effective at mixing the materials in-situ prior to initiating full-scale operation.

Area 1: The Area 1 sludge lagoon would be surveyed and the approximate center of each treatment "cylinder" will be identified and staked.

A track-mounted multi-purpose drill would advance between 5- and 10-foot-diameter hollow-stem auger boreholes to the targeted depths at each cell. The solidification mixture will consist of the following materials: 25% by volume sand (from stockpiled reuse), 25% by weight Portland cement and binder material, and 3% by weight powdered activated carbon in perimeter regions. Due to the general lack of stability associated with the in-situ materials, weight dispersion equipment will likely be required to access more central portions of the lagoon. Additionally, an odor-controlling shroud would be placed over the borehole during and after mixing.

The solidification media is blended in a grout plant located near the drilling machine to the required slurry density/makeup. While the auger is turning, the slurry is pumped into the hollow-stem auger at sufficient pressure to effectively interact with the subsurface soil. Each treated soil mass "cylinder" would be overlapped slightly by adjacent treatment "cylinders" to promote effective reagent-soil contact, and minimize untreated areas. This process is repeated until the entirety of the sludge volume has received solidification/stabilization treatment.

The surface area of Area 1 is estimated to be 40,000 square feet. Each treatment "cylinder" is 10 feet in diameter with an assumed 20% perimeter overlap, which would increase the effective treatment area to 48,000 square feet. Based on this estimate, approximately 600 treatment "cylinders" would be required to account for the entire Area 1 sludge volume.

Stabilization/solidification progression would be tailored to maximize the cement curing time to generate sufficient material strength (10 pounds per square inch) to support the stabilization equipment within three days (with additional matting as needed).

Excess swell volume above grade in Area 1 would be removed and placed into the expansion cell. Excess swell volume above grade is not anticipated in the expansion cell.

Area 2 & Expansion Cell: The Area 2 sludge lagoon would be surveyed and the approximate center of each treatment "cell" will be identified and staked.

A tracked-excavator-mounted power auger and a 20-foot by 20-foot application hood would be used to provide Area 2 sludge treatment. This method applies dry-mixed cement/binders/powdered carbon (delivered/stored in a bulk tanker) to the application hood via compressed air. The air leaves the hood via ports fitted with particulate filters and odor suppressants, as needed, and deposits a targeted quantity of reagents to the 400-square foot treatment area. The hood is then removed, and initial rough mixing is performed using a standard tracked excavator and bucket. Finer mixing/blending is performed using the excavator-mounted power auger. Water is added to the mixture as needed to assist with in-situ material blending.

The process is repeated until each 400-square foot cell has been mixed/blended.

The surface area of the Expansion Cell is approximately 40,000 square feet. Therefore, approximately 100 treatment cells will be required.

Cap and Vent Construction

The solidified sludge areas would be covered with 16 inches of compacted well-draining common borrow (re-use material from overlying soil excavations/expansion cell construction) bisected by a 15-mil vapor barrier. The common borrow will be overlain by a 4-inch layer of topsoil and hydro-seeded. The vapor barrier would serve two purposes, to direct precipitation away from the solidified sludge and to promote capture of generated gases by a gas vent system. The system would consist of a series of lateral vent fingers converging on a central vent stack. The vent fingers would be installed in a 12-inch thick layer of 0.75-inch gravel. The stack would be capped by a wind-driven turbine to promote negative pressure within the system.

Backfill and Site Restoration

Excavations in Areas 3, 4, 6, 7, and the SRS-exceeding soil areas would be backfilled using re-use materials from previous removal action construction. This material would be transported to the fill areas, and dumped in-place. The material would be graded and compacted. The re-use soil would be overlain by approximately four inches of topsoil, which would not be compacted. The entire area, including the excavation and solidification/stabilization areas would be seeded at the same time.

Monitoring wells GZ-09, GZ-10, and SH-16S/D would be replaced in kind.

Decontamination, Temp Facility Removal, De-Mobilization

As equipment is demobilized from the Site, it would be thoroughly decontaminated and cleaned. Decontamination (predominantly water) fluids would be captured and transferred to the on-site fractionation tanks for settlement and disposal via the POTW.

After the construction is accepted as complete, the temporary facilities including utilities, trailers, storage containers, erosion controls (if the vegetation has sufficiently taken) would be removed disconnected/removed from the Site. The Site would be left in a clean and tidy state.

PRSC Monitoring

Initial PRSCs would include quarterly inspection and maintenance of the new vegetation and erosion/sedimentation control features (as needed). These controls would be required for a period of two years. Cap and vent monitoring will be required for an assumed 30 years.

In addition, although no New Hampshire Groundwater Management Permit (GMP) has been established for the Mohawk Tannery site, KGSNE assumes that groundwater monitoring would be required for some period of time following the placement of the cap (KGSNE conservatively estimates this at 30 years). EPA has informed KGSNE that either a GMP will be established per NHDES regulations or that a City ordinance prohibiting groundwater use will be issued. The GMP program allows for continual data evaluation to direct future monitoring; therefore, it is possible that the duration of the PRSC monitoring could be short. For the purpose of this evaluation, the monitoring program outlined in the 2016 RAP proposes bi-annual groundwater monitoring of up to eight monitoring wells. Sample analyses would include SVOCs and total/dissolved metals.

Annual cap/vent system inspections will be required during the PRSC period (30 years). The inspections will focus on the ability of the cap/vent to meet its design goals. Damage, erosion, settlement, or other evidence of cap/vent system failure will be investigated and remediated as-needed. Each inspection will be documented by a submitted inspection report.

Alternative 5 – Waste Encapsulation and Impermeable Capping

Table 4-2 of the 2002 EE/CA eliminated both vertical and horizontal barriers because they were not considered to be effective technology process options. The vertical barrier was eliminated because it was not considered to be effective at preventing the release of contaminants from unsaturated soil to the environment and because it would have limited effectiveness within a floodplain. The horizontal barrier was eliminated because it was considered to be ineffective at preventing the release of contaminants to the environment due to the presence of contaminants below groundwater, and because the barrier would potentially alter the floodplain. Considered separately, these process options would not likely be effective for the reasons stated above. However, EPA requested that KGSNE evaluate these two process options together.

The encapsulation alternative involves: consolidating contaminated soil and sludge waste from outside areas into Areas 1 and 2; enclosing the waste using vertical barriers; and capping the waste using an impermeable surface. The purpose of this alternative is to prevent direct contact with the waste and to minimize potential groundwater and surface water impacts.

Attachment A includes a conceptual layout of Alternative 5.

Impermeable capping will include a synthetic geomembrane installed with bedding and protection layers, and covered with vegetation. Several design options to accomplish vertical encapsulation of the waste are

available. This technical memorandum will discuss steel sheet-pile walls, slurry walls, and secant-pile walls.

Aside from the noted examples below, the pre-construction activities, project management and staffing, excavation and removal of overlying soil, sludge consolidation, backfill & site restoration, and decontamination/temporary facilities removal/de-mobilization tasks are essentially the same as Alternative 4, with differences due to scale and duration. The vertical encapsulation and impermeable cap construction tasks are unique to this alternative and are described below.

KGSNE assumes that a Floodplain Assessment has been performed, and that the selected alternative will address and manage potential flood impacts.

The encapsulation and capping alternative is comprised of the following DFOWs:

- Pre-Construction Activities;
- Project Management & Staffing;
- Mobilization, Site Preparation, Temporary Facilities;
- Project Controls;
- Building/Foundation Demolition;
- Excavation and Removal of Overlying Soil;
- Sludge Consolidation;
- Vertical Encapsulation;
- Impermeable Cap Construction;
- Backfill & Site Restoration; and
- Decontamination, Temp Facility Removal, De-Mobilization
- PRSC Monitoring

Definable Features of Work Descriptions and Assumptions

Excavation and Removal of Overlying Soil

The soil excavation volumes identified in Alternative 4 remain for Alternative 5, with the exception of the expansion cell. Under Alternative 5, the expansion cell would be slightly smaller as no material swell is anticipated for this alternative. However, some in-situ sludge in Area 2 would require excavation and relocation to the expansion cell to create sufficient vertical space to create a 2-foot thick cap, while maintaining the pre-construction grade (and therefore not modifying the flood storage capacity). Additionally, spoils from the cap construction (due to the construction of structural piles/piers) would also be placed in the expansion cell.

Sludge Consolidation

The sludge volumes and deposition locations for Areas 3, 4, 6, 7, and the SRS-exceeding soil remain the same as described in Alternative 4.

Vertical Encapsulation

Sheet-Piling

Under this option, the in-situ and consolidated waste would be encapsulated within a perimeter of steel sheet-piles to contain the sludge and prevent groundwater contamination from moving laterally to the adjacent Nashua River or other areas.

To accomplish this, a track-mounted excavator equipped with a sheet-pile hammer and hydraulic power pack would advance 22-foot long steel sheet-piles along the perimeter of Areas 1, 2, and an expansion area (to manage soil/sludge volumes needed to comply with floodplain criteria, and resulting from estimated cap installation-related excavation spoils). The sheeting will be securely installed into dense till material located above the bedrock surface. This sheet-pile length was assumed for cost estimating purposes.

The knuckle joints of each sheet-pile would be flushed clean of debris and pressure-sealed using a compatible sealant.

Slurry Wall

For the purpose of this evaluation, a soldier-pile tremie concrete slurry wall is evaluated. Wall construction would begin with the installation of a guide-wall to approximately four feet below grade along the proposed wall alignment. Adjustments may be made at this time. Steel H-piles would be driven to the bedrock surface on 8-foot centers. Soil would be excavated along the wall alignment and placed within the expansion cell. Slurry would be placed into the excavation and allowed to cure. The slurry would be allowed to dewater into a temporary holding lagoon. The resulting sludge would be excavated and transported to the expansion cell to be incorporated into the sludge materials.

Secant Wall

Secant wall construction would begin with the establishment of the wall's alignment. Adjustments may be made at this time. Several options for secant wall construction are available; however, final selection of the technical implementation methods and materials' details will be made after the remedial design has been performed. However, for the purpose of this evaluation, KGSNE assumes the following:

- A single secant-pile drilling rig will perform the work;
- Each 22-inch secant-pile will be installed by advancing a steel casing securely into till followed by auger excavation of the annulus;
- Assumed average soil thickness is 22 feet, and no bedrock embedment is needed;
- Excavation spoils will be placed beneath the cap and used to establish the subgrade;
- A low-strength cement-bentonite slurry (assumed to be 100 pounds-per square-inch strength) will be pumped into the annular space;

- Steel H-piles may be driven to the bedrock surface in every-other secant-pile to add lateral strength to the secant-pile wall (due to an assumed flood-water-related scour height of 10 feet); and
- Adjacent secant-piles will be advanced such that they intersect the prior pile by approximately 20% thus forming a continuous wall.

Significant design investigations including at a minimum floodway, scour, seepage, and stability analyses, would be required to design the slurry composition, admixtures, pile lengths, bedrock embedment, H-pile installation frequency, and other similar components.

Each encapsulation method would be designed and constructed to withstand flood-related challenges such as scouring and erosion/wall exposure that are anticipated and outlined in the basis of design.

As a demonstration of the concept and quality analysis, a section of a slurry or secant wall may be constructed to allow for evaluation of quality-control conformance.

Impermeable Cap Construction

The impermeable cap includes a geosynthetic cap and associated drainage, and protection layers. The components of the cap system will be determined during the design phase. However, the cap may include features such as: a geogrid to stabilize the cap system over the in-situ waste; a textured high-density geomembrane; a biplanar geocomposite material placed over the geomembrane to direct percolated precipitation from the geomembrane; a 12-inch layer of screened re-use soil over the geocomposite; and topsoil/hydroseeding at the surface. However, alternate impermeable cap designs will be evaluated during the design phase. Depending on storm water modeling results, surface drainage swales and underdrains may be required to collect and direct storm water. These swales would discharge to a detention system to be constructed on the Southern Parcel. Detained storm water would either be discharged to the Nashua River, or allowed to percolate into the groundwater.

A portion of the cap/cover system will be installed within the 100-year floodplain. Therefore, additional resilience features will be added to the cover system within the floodplain. These features may include placement of large-diameter armoring stone placed on a cushion of more finely graded aggregate materials. Additionally, the seaming and anchoring of the HDPE geomembrane will attempt to take advantage of the natural features such as the likely flood-flow direction and scouring potential.

Removal Action Estimated Durations

The following conceptual construction sequence and durations are approximations. The estimates are to plan and design the removal action, perform the removal action work, perform quality control verifications, comply with federal acquisition regulations, and evaluate performance.

Definable Feature	Duration – Sheet-Pile Wall (Weeks)	Duration – Slurry Wall (Weeks)	Duration – Secant Wall (Weeks)
Engineering & Removal Design	25	30	30
Subcontracting and Procurement	8	8	8
Mobilization	1	1	1
Site Preparation	3	3	3
Excavation and Consolidation	7	7	7
Wall Installation	11	33	50
Impermeable Cap & Vent Construction	6	6	6
Backfilling and Site Restoration	5	5	5
Demobilization	1	1	1
Total Pre-Construction Estimated Duration	33	38	38
Estimated Construction Duration	34	56	73

INDIVIDUAL ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The NTCRA guidance manual requires that alternatives be evaluated based on their effectiveness in achieving the removal objectives, the implementability of executing the alternative, and the cost of the alternative.

The effectiveness of the alternative is evaluated using the following criteria:

- Overall protection of public health and the environment;
- Compliance with ARARs and Other Criteria, Advisories, and Guidance;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment; and
- Short-term effectiveness.

The alternative's implementability of the alternative is evaluated using the following criteria:

- Technical feasibility;
- Administrative feasibility;
- Availability of Services and Materials;
- State Acceptance; and
- Community Acceptance.

The cost of each alternative is evaluated based on the present worth of the following cost elements:

- Direct capital costs;
- Indirect capital costs; and
- Annual PRSC costs.

The following sections provide an evaluation of each alternative using these criteria.

Alternative 1 – Excavation with Off-Site Disposal

The 2002 EE/CA presented the effectiveness, implementability, and cost analyses for Alternative 1. KGSNE has evaluated these analyses using the assumptions presented previously.

Effectiveness

The 2002 EE/CA concluded that this alternative met the removal action objectives by preventing direct contact with and ingestion of contaminated sludge/waste, preventing ecological exposure to contaminants, preventing the migration of contaminants to groundwater and surface water, and restoring the Site to a condition suitable for residential use. The following table summarizes the effectiveness evaluation for Alternative 1 based on the evaluation criteria.

Effectiveness Criteria	Capability of Meeting the Criteria	Comments
Overall protection of public health and the environment	✓	Excavation and off-site disposal removes the contaminants from the Site.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	✓	Alternative would be designed and implemented to comply with ARARs and other criteria. Significant additional ARARs are invoked if the waste is hazardous, and more ARARs would apply should the waste be a Dioxin-Containing Waste.
Long-term effectiveness and permanence	✓	Excavation and off-site disposal is a permanent solution.
Reduction of toxicity, mobility, or volume through treatment	■	The EE/CA assumed that the waste would be classified as non-hazardous, therefore no treatment would be required prior to land disposal. However, if this assumption proves incorrect, then waste treatment may be required to meet land-disposal restriction treatment requirements, which would satisfy this criterion.
Short-term effectiveness	✓	Short-term concerns such as air quality/dust/odors, and sedimentation/erosion would be mitigated through engineering controls. Once properly implemented, the removal action goals would be achieved immediately.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

Implementability

The 2002 EE/CA concluded that this alternative was implementable, but identified several implementation challenges. The following table summarizes the implementability evaluation for Alternative 1 based on the evaluation criteria.

Implementability Criteria	Capability of Meeting the Criteria	Comments
Technical feasibility	✓	Excavation, materials management, and waste disposal are well-understood remedial construction techniques. Technical implementation could become more complicated (and costly) should assumptions made regarding the waste classification, hydrogeological conditions, waste locations, and engineering controls prove not to be correct.
Administrative feasibility	✓	According to the 2002 NTCRA Action Memorandum, an exception from the NTCRA statutory limit of $2 million was requested. Whether this request was granted is not known. Additionally, this alternative would require the construction/ improvement of a temporary access road through the adjacent Fimbel Door Company property. Such access would require negotiation with the adjacent property owner.
Availability of Services and Materials	✓	Numerous remedial contractors are available locally to perform waste excavation, materials management, and waste transportation. Should the assumption that the waste is non-hazardous prove correct, several RCRA Subtitle D landfills are located relatively locally to the Site. However, should the material be classified as a hazardous waste, then additional pre-land disposal treatment may be necessary (either on-site or at the TSDF) to meet land disposal restriction treatment criteria. Suitable facilities are not local to the Site, and would require a large number of trucks (or a suitable off-site rail staging/loading area) or the availability of rail service to transport the waste within a reasonable timeframe. No facilities located within the United States can accept Dioxin-Containing Hazardous Wastes; therefore, export of such waste to Canada would be required. The EE/CA indicated that facilities in Canada are available to manage such wastes. Additionally, given the volume of wastes to be managed, individual facilities may be reluctant to accept 100% of the volume for fear of exceeding permitted capacities, therefore, more than one facility may be required to manage this waste volume.
State/Support Agency Acceptance	✓	The NHDES provided comments on the EE/CA, which EPA addressed in the Responsiveness Summary of the 2002 NTCRA Action Memorandum. The Action Memorandum indicates that the state generally accepts the proposed action.

Implementability Criteria	Capability of Meeting the Criteria	Comments
Community Acceptance	✓	Members of the public provided comments on the EE/CA, which EPA addressed in the Responsiveness Summary of the 2002 NTCRA Action Memorandum. The Action Memorandum indicates that the community generally accepts the proposed action.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

Cost

KGSNE updated the costs for Alternative 1 presented in the 2002 EE/CA using the Engineering News-Record (ENR) Construction Cost Index (CCI) for the Boston Area for August 2017 compared against the 2002 ENR CCI. The updated cost estimate is presented in Attachment B-1.

The cost update was calculated as follows:

$$\% \text{ Change} = [(CCI_{2017} - CCI_{2002}) \div CCI_{2002}] \times 100\%$$

$$\text{Updated Cost} = \text{Unit Cost} \times \% \text{ Change}$$

where:
CCI_{2002} = Construction cost index for 2002 (7042.39)
CCI_{2017} = Construction cost index for 2017 (13797.06)

$$[(13797.06 - 7042.39) \div 7042.39] \times 100\% = 95.91\%$$

The total present worth costs Alternative 1 (assuming all waste is disposed of in a domestic RCRA Subtitle D landfill) is approximately $32,600,000.

As detailed in Attachment B-1, at least half of the alternative's cost reside in the transportation and off-site disposal of the excavated sludge/wastes.

Alternative 4 – On-Site Treatment (Solidification/Stabilization)

Effectiveness

The following table summarizes the effectiveness evaluation of Alternative 4 based on the evaluation criteria.

Effectiveness Criteria	Capability of Meeting the Criteria	Comments
Overall protection of public health and the environment	✓	Solidification and stabilization coupled with a soil cover and venting system would mitigate the risk to public health by reducing the ability of receptors to contact the stabilized material. The technology also transforms contaminants into less toxic and/or a less mobile form and decreases the permeability of the treated media, reducing the potential for contaminant release. This approach was successfully applied at the Pownal Tannery Superfund site in Pownal, Vermont.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	✓	The solidification/stabilization alternative would be constructed to comply with ARARs. Of particular note is the ARAR relating to floodplain impact avoidance. If unavoidable impacts to the 100-year floodplain are encountered, additional public notifications may be required.
Long-term effectiveness and permanence	✓	Solidification/stabilization technologies are generally permanent, and with maintenance should be effective in the long-term. Previous bench testing using site-specific materials suggests that this alternative would effectively achieve the desired removal goals with some exceptions (leaching of some non-COC substances occurred). Additional pre-design investigations would be needed to assess other aspects of effectiveness such as odor/moisture control technologies and the extent of soil suitable for on-site reuse.
Reduction of toxicity, mobility, or volume through treatment	✓	Although the waste volume would increase, the solidification and stabilization technology generally reduces the mobility of contaminants, and may also reduce the toxicity of the contaminants.

Effectiveness Criteria	Capability of Meeting the Criteria	Comments
Short-term effectiveness	✓	Outside of risks typical of a construction project, the solidification/stabilization alternative has relatively few short-term risks to the public/site workers. Work would be performed by properly trained and competent personnel. Rigorous work area and perimeter air monitoring coupled with odor and dust suppression and other odor-controlling methods would support the short-term effectiveness of the alternative. A pre-design investigation would be performed to verify and potentially customize odor control technology effectiveness. Increased use of local roadways may be required to achieve the construction goals; however, the route would be carefully selected and traffic control planning would be coordinated with community officials. Erosion and sedimentation concerns would be mitigated by readily available control measures.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

With careful design, evaluation, and execution, the solidification/stabilization alternative would meet each of the effectiveness criteria.

Implementability

The following table summarizes the implementability evaluation for Alternative 4 based on the evaluation criteria.

Implementability Criteria	Capability of Meeting the Criteria	Comments
Technical feasibility	✓	Numerous complexities exist for in-situ stabilization/solidification such as establishing and metering the reagent dosage rates; achieving sufficient mixing; demonstrating compliance with design criteria; and water management. These complexities can be overcome during the design or implementation stage.

Implementability Criteria	Capability of Meeting the Criteria	Comments
Administrative feasibility	✓	An exception from the NTCRA statutory limit of $2 million will be required. Additionally, this alternative would require the construction/improvement of a temporary access road through the adjacent Fimbel Door Company property. Such access would require negotiation with the adjacent property owner. If access to the Broad Street Parkway (a limited access road) is needed, then coordination with the Federal Highway Administration (FHA) would likely be required. Each of these concerns could be addressed with coordination.
Availability of Services and Materials	✓	Stabilization and solidification equipment is readily available. Some customized media-application equipment fabrication may be required to control odors and solidification medial delivery. A similar solidification/stabilization project was completed at the Pownal Tannery Superfund site in Pownal, Vermont.
State/Support Agency Acceptance	N/A	The State/Support Agency support for this alternative will be determined during the comment process.
Community Acceptance	N/A	Community support for this alternative will be determined during the comment process.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

N/A – Capability of this alternative to meet the criteria cannot be determined or is not applicable.

Implementing the solidification/stabilization alternative is technically feasible, and capable contractors and proper equipment are available to complete the work. However, design and execution challenges exist which could impact the duration of implementation, and increase the technical complexity of the removal action. Minimizing community concerns, particularly with construction traffic, would be paramount during design and implementation. One alternative to potentially mitigate this would be accessing the work area from a limited-access road (Broad Street Parkway), where impacts to residential neighborhoods would be minimized. Granting of such access would require coordination with the FHA, and state and local officials.

State and community acceptance has not yet been determined, and cannot be assessed at this time.

Cost

Based on the previously stated assumptions along with those included in Attachment B-4, the present worth costs for Alternative 4 are estimated to be approximately $18,700,000. The construction would require approximately one year to execute (at a capital cost of approximately $18,400,000), therefore no present worth adjustment is necessary for the construction costs. Post-construction vegetation and erosion

inspections and monitoring and 30 years of groundwater monitoring result in a present-value of operations and maintenance (O&M) of approximately $300,000. Pursuant to the June 1993 OSWER directive No. 9355.3-20, a 7% discount rate was used in calculating the present worth of long-term O&M costs. EPA had requested that KGSNE conduct a sensitivity analysis of this discount rate; however, with such comparably low PRSC costs, no notable difference in present value is encountered when using a lower discount rate.

Alternative 5 – Waste Encapsulation and Impermeable Capping

Effectiveness

The following table summarizes the effectiveness evaluation of Alternative 5 based on the evaluation criteria.

Effectiveness Criteria	Capability of Meeting the Criteria	Comments
Overall protection of public health and the environment	✓	Capping and physical isolation of the waste from the surrounding (lateral) environment would be consistent with the removal objectives. Encapsulation has been successfully implemented at numerous waste disposal sites.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	✓	Modification to the 100-year floodplain may be necessary in parts of the Site in order to accommodate the cap. EPA will perform these analyses, and issue its findings.
Long-term effectiveness and permanence	✓	A well-maintained encapsulation system should function effectively. See additional Long-Term Effectiveness discussions below.
Reduction of toxicity, mobility, or volume through treatment	✗	No treatment of the waste will occur with this alternative.

Effectiveness Criteria	Capability of Meeting the Criteria	Comments
Short-term effectiveness	✓	Outside of risks typical of a construction project, the waste encapsulation and capping alternative has relatively few short-term risks to the public/site workers. Work would be performed by properly trained and competent personnel. Depending on the method selected for vertical encapsulation wall installations, this could be a loud activity. Rigorous work area and perimeter air monitoring coupled with odor and dust suppression and other odor-controlling methods would support the short-term effectiveness of the alternative. A pre-design investigation would be performed to verify and potentially customize odor control technology effectiveness. Increased use of local roadways may be required to achieve the construction goals; however, the route would be carefully selected and traffic control planning would be coordinated with community officials. Erosion and sedimentation concerns would be mitigated by readily available control measures.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

The three vertical encapsulation methods evaluated in this memorandum: steel sheet-pile walls, soldier-pile cement tremie slurry walls, and secant walls are each effective at encapsulating wastes to minimize contaminant migration.

Properly installed steel sheet-piles in which the seams have been sealed to the extent practicable coupled with an impermeable horizontal barrier (cap) would serve to minimize groundwater discharge from the containment area. Vertical joints are located approximately every two feet; therefore, there is some potential for leakage. Additionally, the knuckle joints may not remain interlocked along the entirety of the sheet-pile. Un-coated sheets may also degrade under oxidative conditions. The groundwater in and around the waste sludge areas exhibits an acidic pH and relatively oxidative conditions. Although sheet-piles are expected to be effective in the long-term, without a chemically resistant coating, or the use of polyethylene sheets, degradation may be anticipated. Such degradation may result in leakage of groundwater through the barrier. Should this barrier option be selected, materials compatibility analyses should be completed as part of the design process, as well as a design-life determination.

Slurry walls are considered a standard vertical barrier technology. Wall types and installation methods are varied (e.g., single-pass construction, soldier-pile construction, bucket excavation/fill construction). These walls may be constructed using a variety of materials including cement, bentonite, soil, and/or polymers;

and with or without steel reinforcement. Each wall type and material type has disadvantages. For this evaluation, a soldier-pile tremie cement-bentonite slurry wall was evaluated due to its structural stability (when faced with a significant erosion of 10 feet of exposed wall). Faster and less-complicated/costly wall types/installation methods may be equally effective in managing groundwater transference when compared to the soldier-pile tremie wall; however, strength of structure may be lessened. Should this alternative be selected, such evaluations should be included in the design documents.

Soldier-pile tremie cement-bentonite slurry walls exhibit relatively high shear strength, low compressibility, and permeabilities in the 1E-06 centimeters per second range (assuming good bonding to the reinforcing steel). A slurry wall can be expected to effectively minimize transfer of groundwater. However, some limitations to the effectiveness of the method include: difficulty in verifying that the slurry wall is contiguous (panel-to-panel continuity, sluffing of debris/soil into the trench); more permeability through the barrier than anticipated; degradation due to the presence of highly-ionic substances, sulfates, and/or acids/bases, and scaling/cracking of the wall itself. Admixtures can be added to the slurry to improve barrier performance. If this barrier option is selected, the design should evaluate material compatibilities, as well as the potential admixtures which may be beneficial to the barrier.

Similar to slurry walls, secant-pile walls are also constructed of a slurry with a similar composition to the slurry wall. The primary difference between slurry walls and secant-pile walls is the means of construction. Secant-pile walls have been used as cut-off barriers for dams, deep excavation support/walls, and for the prevention of water intrusion/flow.

Soldier-pile tremie slurry walls have fewer seams between panels/joints compared to a secant-pile wall, but must bind/adhere to the steel soldier-piles to minimize groundwater flow. Therefore, the potential for groundwater transfer through the seams are present. However, the controls on construction for each pile is greater than that of the slurry wall because each pile is cased to the target depth. Limitations to the effectiveness of the secant-pile barrier option are similar to those of the slurry wall option. Additionally, admixtures or amendments may also be added to the slurry to enhance performance. Steel reinforcement may be required to add additional strength to the piles. Such an addition would be based on the potential exposed height of the piles above grade. These considerations should be evaluated as part of the design. Additionally, the need for, and spacing of reinforcing steel would be evaluated as part of the remedial design.

Implementability

Implementability Criteria	Capability of Meeting the Criteria	Comments
Technical feasibility	✓	Numerous complexities exist for encapsulation and capping alternative. However, with sufficient data collected during a pre-design investigation and/or pilot/demonstration testing, these complexities can be overcome during the design and/or implementation stage.

Implementability Criteria	Capability of Meeting the Criteria	Comments
Administrative feasibility	✓	An exception from the NTCRA statutory limit of $2 million will be required. Additionally, this alternative would require the construction/improvement of a temporary access road through the adjacent Fimbel Door Company property. Such access would require negotiation with the adjacent property owner. If access to the Broad Street Parkway (a limited access road) is needed, then coordination with the FHA would likely be required. Each of these concerns should be addressed with coordination.
Availability of Services and Materials	✓	Numerous specialty contractors are capable of installing the encapsulation walls and cap system. The materials required for this alternative are readily available.
State/Support Agency Acceptance	N/A	The State/Support Agency support for this alternative will be determined during the comment process.
Community Acceptance	N/A	Community support for this alternative will be determined during the comment process.

Notes:

✓ - Generally meets this criterion

✘ - Generally will not meet this criterion

■ - May not fully meet this criterion

N/A – Capability of this alternative to meet the criteria cannot be determined or is not applicable.

Implementing each of the vertical encapsulation options coupled with an impermeable barrier are technically feasible, and capable contractors and proper equipment are available to complete the work. However, design and execution challenges exist which could impact the duration of implementation and the technical complexity of the removal action. Minimizing community concerns, particularly with construction traffic, would be paramount during design and implementation. One alternative to potentially mitigate this concern would be accessing the work area from a limited-access road (Broad Street Parkway) to minimize impacts to residential neighborhoods in the vicinity of the site. Granting of such access would require coordination with the FHA, and state and local officials.

State and community acceptance has not yet been determined, and cannot be assessed at this time.

Cost

The following table presents summarized costs for the encapsulation methods. Please refer to Attachment B for more detailed cost estimates.

Cost Element	Sheet-Pile Wall	Slurry Wall	Secant Wall
Approx. Estimated Capital Costs – Present Value	$7,600,000	$13,800,000	$13,800,000
Approx. Estimated PRSC Costs – Present Value	$400,000	$400,000	$400,000
Total Costs – Present Value	$8,000,000	$14,200,000	$14,200,000

Post-construction vegetation and erosion inspections and monitoring and 30 years of groundwater monitoring result in a present value of O&M of approximately $270,000. Pursuant to the June 1993 OSWER directive No. 9355.3-20, a 7% discount rate was used in calculating the present worth. EPA had requested that KGSNE conduct a sensitivity analysis of this discount rate; however, with such comparably low PRSC costs, no notable difference in present value is encountered when using a lower discount rate.

COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

As part of the analysis of alternatives, the removal action alternatives evaluated individually in the previous section were compared to each other to identify differences between the alternatives and to analyze their comparative benefits and drawbacks. The three alternatives are all implementable and capable of achieving the removal action objectives, but each alternative takes a different approach to risk mitigation and therefore offers slightly different levels of long-term effectiveness and permanence with a wide range of costs. Alternative 1 would be the most permanent, resulting in the complete removal of contaminated media, but at a relatively high cost. Alternatives 4 and 5 are containment strategies that do not remove contaminated media from the Site, but instead encapsulate/stabilize it and establish engineering and institutional controls to prevent direct contact with and migration of contaminants. Even with long-term costs included, Alternatives 4 and 5 are significantly less expensive than Alternative 1 due to the extremely high cost of off-site transportation and disposal. The solidification/stabilization of sludge material under Alternative 4 makes it more permanent (and therefore more effective in the long term) than Alternative 5. A more detailed summary of the comparative analysis of alternatives is provided in the following sub-sections.

Effectiveness

The following is a comparative analysis of the effectiveness of the three removal action alternatives evaluated in this technical memorandum.

Overall Protection of Human Health and the Environment

All three alternatives would meet the removal action objectives because all of the contaminated media that exceeds the NHDES SES would be removed, contained, or treated. All three alternatives could meet the objective of supporting future residential site use (assuming that such residential units are not within the waste disposal areas).

Compliance with ARARs

All three alternatives could be designed to comply with ARARs. Compliance with ARARs would be more complicated for Alternatives 4 and 5 due to the proposed construction of a cap or cover system within a delineated floodplain. Additional engineering and flood storage mitigation may be required for these alternatives, whereas Alternative 1 may not require such considerations.

Long-Term Effectiveness and Permanence

Alternative 1 would be effective in the long term and would be permanent because all contaminated media exceeding the NHDES SRS would be removed from the Site. No residual risks would remain associated with this waste material.

Alternative 4 converts the sludge and soil wastes into a solidified/stabilized mass that is covered by clean backfill. A combination of the solidified mass and cover system mitigates the residual direct exposure risks, and renders the contaminants immobile. Bench testing of the solidification methods has demonstrated that this alternative effectively reduces the majority of leachable substances; however, some solidification formulations continued to leach substances. This condition may be controlled using additives (such as activated carbon). The solidified mass significantly reduced the matrix permeability, preventing significant groundwater flow through the mass.

Alternative 4 is effective in the long term and would be essentially permanent, provided that the solidified mass is not allowed to erode. Long-term monitoring of groundwater would evaluate the long-term effectiveness of the solidification alternative. Erosion of the solidified mass could result in a release via storm water transport or wind action. However, repairing or re-stabilizing the solidified mass would be complicated and difficult as the contaminated mass would be a cemented block.

The physical barriers included in Alternative 5 are effective long-term solutions, but they are not permanent. As presented above, each of the encapsulation options effectively prevents direct human contact with the contaminants. None of the encapsulation options completely block groundwater flow; however, they all reduce the flow significantly, thus achieving the limitation of contaminant migration objectives. Each encapsulation system will require regular maintenance and monitoring (such as vegetation monitoring, groundwater monitoring, etc.) to maximize long-term effectiveness. The longevity of Alternative 5 may vary based on the encapsulation option selected. However, encapsulation system repairs are possible should degradation be encountered.

Alternative 1 is the most effective alternative because it removes the contaminants from the Site. The long-term effectiveness of Alternatives 4 and 5 are similar, each attains the removal objectives to the extent practicable. However, due to the solidified nature of the waste, failures and/or degradation of the Alternative 4 components would be more difficult to address/repair than that of the Alternative 5 components, which are more modular.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 4 includes a treatment step that would reduce the toxicity and mobility of contaminants, although the volume of contaminated media would increase due to bulking from the treatment process. Alternatives 1 and 5 do not include treatment.

Short-Term Effectiveness

When disturbed, the waste material has historically been odorous. Alternative 1 proposes to remove all wastes from the Site. This alternative will disturb all wastes, which may result in significant odors. Odor suppressants and perimeter air misters may assist in reducing the potential for fugitive odor-related

impacts to on-site personnel and the nearby community, but this alternative exhibits the highest potential to result in fugitive odors. This alternative results in significant truck and construction-related traffic, which could impact the nearby community with noise, dust, and odor. The quantity of exposed waste/earth associated with Alternative 1 increases the potential for environmental impacts if erosion/sedimentation controls are insufficient. Therefore, of all the alternatives, Alternative 1 exhibits the lowest short-term effectiveness.

Alternative 4 also directly impacts all the waste materials via in-situ mixing. As with Alternative 1, the generation of fugitive odors potentially impacting site workers and the nearby community is possible as the mixing is conducted and as it cures. Odor suppressants and perimeter air misters may assist in reducing the potential for fugitive odor-related impacts to on-site personnel and the nearby community. A relatively minor amount of construction-related traffic is expected in association with Alternative 4. Contaminated wastes will not be transported off-site under this alternative, and the active working areas will be relatively limited and controlled such that it is unlikely to result in environmental impacts.

Alternative 5 directly impacts relatively little of the waste materials. Therefore, of the three alternatives, Alternative 5 exhibits the lowest potential for fugitive emission generation. As with Alternative 4, Alternative 5 results in a small amount of construction-related traffic, which may impact the nearby community. However, depending on vertical encapsulation option selected, noise concerns may be present (due to the use of a hydraulic sheet-pile driver). Relatively little earth disturbance is expected as part of Alternative 5, which would reduce the potential for environmental impacts.

Alternatives 1 and 5 would achieve the project's goals at the completion of construction. Alternative 4 may be delayed slightly as the solidification matrix cures.

Based on the above, Alternative 5 exhibits the greatest amount of short-term effectiveness, whereas Alternative 1 exhibits the least amount.

Implementability

The following is a comparative analysis of the implementability of the three removal action alternatives evaluated in this technical memorandum.

Technical Feasibility

All three alternatives can be constructed. However, some technical challenges are expected for each.

Significant excavation challenges exist for Alternative 1 due to the limited-access excavation of soft sludge materials below the water table that could result in difficult site management conditions and schedule delays. Significant dewatering efforts would likely reduce this risk, but would not eliminate it. Similarly, the implementation schedule for Alternative 4 is predicated upon the sludge (including the sludge below the groundwater) solidifying to a sufficient strength to support the solidification equipment within several days of mixing. Bench testing of several mix formulations suggest that it is possible to achieve sufficient strength; however, the heterogeneity of the in-situ materials may be more significant than anticipated.

The constructability of the vertical encapsulation component of Alternative 5, regardless of the encapsulation option selected, has been implemented many times in traditional construction, at a minimum. Typical construction challenges associated with vertical encapsulation include subsurface debris/boulders, subsurface heterogeneity, and challenging alignments/access limitations. Each of these can be addressed without significant delays or costs. The cap system over the wastes may be challenging to construct due to the soft saturated wastes, particularly in Area 1. Methods to mitigate this risk may include the use of low-ground-pressure equipment, weight dispersion matting, and geotechnical fabrics/matting.

Each of the Alternatives have been successfully and reliably implemented at CERCLA sites located throughout Region 1.

As mentioned previously, additional remediation/repairs are possible for Alternatives 1 and 5; however, additional remediation/repairs would be difficult to conduct due to the solid nature of the materials.

Administrative Feasibility

Actual permits would not be required for on-site work if implemented under CERCLA, but the substantive requirements of ARARs would be addressed and met for work performed under the alternatives. However, administrative approvals would be required for the off-site transportation and disposal (and potential treatment) of contaminated media (Alternative 1). Alternatives 4 and 5 would require coordination with municipal departments and NHDES to satisfy construction requirements.

Administrative issues such as gaining access to the adjacent Fimbel Landfill property to construct an access road or utilizing the Broad Street Parkway for truck traffic would be similar for each alternative, but likely more difficult for Alternative 1 because of the volume of truck traffic anticipated.

As much of the work area lies within a 100-year floodplain, measures will be taken to evaluate, manage, and mitigate as-needed impacts to the floodway/flood-storage that may arise from constructing the cap/cover systems associated with the alternatives.

Availability of Services and Materials

Qualified contractors with trained personnel, equipment, and hazardous waste site experience would be readily available to perform all of the on-site services that would be required for all three alternatives. Some specialty equipment would be required to implement Alternatives 4 and 5, so these alternatives would be slightly less implementable than Alternative 1 in this respect. However, the availability and capacity of off-site disposal facilities permitted to receive the volume of wastes contemplated for off-site disposal under Alternative 1 may be limited. This would not be a concern for Alternatives 4 and 5.

State Acceptance

The State of New Hampshire support for any of these removal actions will be determined during the public comment process.

Community Acceptance

The community support for any of these removal actions will be determined during the public comment process.

Based on the above, Alternative 1 is considered the least implementable, and Alternatives 4 and 5 are considered to be somewhat equally implementable.

Cost

A summary of costs for each alternative is presented in the table below. Attachment B includes the detailed cost estimates for each of the alternatives.

Alternative	Capital Cost	Present Worth of O&M	Present Worth of Alternative
1	$32,600,000	<$10,000	$32,600,000
4	$18,400,000	$270,000	$18,700,000
5	$7,600,000 - $13,800,000	$400,000	$8,000,000 - $14,200,000

As shown in the table above, Alternative 1 would be the most expensive of the alternatives evaluated, and is at least approximately $14,000,000 more expensive than Alternatives 4 and 5. The cost for Alternative 1 is driven primarily by the fees associated with transportation and off-site disposal of contaminated media.

Alternative 4 is less expensive than Alternative 1, but more expensive than any of the Alternative 5 encapsulation options. Alternative 5 costs vary by as much as $6,200,000 with the different vertical encapsulation options.

RECOMMENDED REMOVAL ACTION ALTERANTIVE

Based on the comparison of Alternatives 1, 4, and 5, Alternative 5 – Waste Encapsulation and Capping was selected as the recommended removal action alternative.

Each of the alternatives effectively addressed the removal action objections. However, the balance between long-term and short-term effectiveness, when coupled with implementability and costs, favored Alternative 5. Alternative 5 is expected to present the fewest and least complicated implementation challenges of the three alternatives.

Alternative 5 effectively achieves the removal goals, is implementable, and appears to be the most cost-effective alternative presented regardless of the encapsulation method selected.

Attachment B-1 - Table 1-PW
Present Worth for Alternatives 1A, 1B, and 1C
Mohawk Tannery Site
Nashua, New Hampshire

Alternative 1 - Disposal of 100% of Sludge/Waste at U.S. RCRA D Landfill

Present Worth Analysis				
Year	**Present Worth Factor (1)**	**Capital Costs ($)**	**O&M Costs ($)**	**Present Worth ($)**
0	1.000	$ 32,564,467.46	$ -	$ 32,564,467.46
1	0.935		$ 3,144.00	$ 2,938.32
2	0.873		$ 3,144.00	$ 2,746.09
			TOTAL	**$ 32,570,151.87**

Alternative 1B - Disposal of Area 1 Sludge at U.S. RCRA C Landfill, Remainder to U.S. RCRA D Landfill

Attachment B-1 - Table 1A-CC
Capital Costs for Alternative 1A - Excavation and Off-Site Disposal (Subtitle D)
Mohawk Tannery Site
Nashua, New Hampshire

				2017 Unit Cost ($)				2017 Total Cost ($)				2017 Total Direct Cost ($)	Comments/Reference
Item No.	Item	Qty.	Unit	Sub.	Mat.	Labor	Equip	Sub.	Mat.	Labor	Equip	1.951	ENR 2002-2017 Multiplier
01 - TEMPORARY FACILITIES & MOBILIZATIONDEMOBILIZATION													
01-001	Temp. Fac/Equip. Mobe/Demobe	1	LS	$ 45,165.65	$ -	$ -	$ -	$ 45,165.65	$ -	$ -	$ -	$ 45,165.65	CCI Updated
01-002	Office Trailer (1 each)	11	MO	$ -	$ -	$ -	$ 751.14	$ -	$ -	$ -	$ 8,262.49	$ 8,262.49	CCI Updated
01-003	Storage Container (1 each)	11	MO	$ -	$ -	$ -	$ 146.33	$ -	$ -	$ -	$ 1,609.58	$ 1,609.58	CCI Updated
01-004	Portable Comm. Equip.	11	MO	$ -	$ -	$ -	$ 585.30	$ -	$ -	$ -	$ 6,438.30	$ 6,438.30	CCI Updated
01-005	Site Utilities	11	MO	$ 390.20	$ -	$ -	$ -	$ 4,292.20	$ -	$ -	$ -	$ 4,292.20	CCI Updated
01-006	Sanitary Facilities	11	MO	$ 204.86	$ -	$ -	$ -	$ 2,253.41	$ -	$ -	$ -	$ 2,253.41	CCI Updated
01-007	Site Security	11	MO	$ 11,706.00	$ -	$ -	$ -	$ 128,766.00	$ -	$ -	$ -	$ 128,766.00	CCI Updated
01-008	Sampling Equipment	11	MO	$ -	$ -	$ -	$ 3,902.00	$ -	$ -	$ -	$ 42,922.00	$ 42,922.00	CCI Updated
01-009	Dumpster/MSW Disposal	11	MO	$ 448.73	$ -	$ -	$ -	$ 4,936.03	$ -	$ -	$ -	$ 4,936.03	CCI Updated
02 - DECONTAMINATION FACILITIES & SERVICES													
02-001	Vehicle Decontamination												
02-001a	Gravel Base Delivered and Placed	15	CY	$ -	$ 23.41	$ 3.00	$ 3.41	$ -	$ 351.18	$ 45.07	$ 51.21	$ 447.46	CCI Updated
02-001b	40-mil HDPE Liner Delivered and Placed	800	SF	$ -	$ 0.66	$ 0.06	$ -	$ -	$ 530.67	$ 46.82	$ -	$ 577.50	CCI Updated
02-001c	Stone Drainage Layer Delivered and Placed	10	CY	$ -	$ 23.41	$ 4.88	$ 2.36	$ -	$ 234.12	$ 48.78	$ 23.61	$ 306.50	CCI Updated
02-001d	Splash Guard Placed	800	SF	$ -	$ 2.44	$ 1.95	$ -	$ -	$ 1,951.00	$ 1,560.80	$ -	$ 3,511.80	CCI Updated
02-002	Decontamination												
02-002a	Pressure Washer	2	Ea	$ -	$ -	$ -	$ 5,612.81	$ -	$ -	$ -	$ 11,225.62	$ 11,225.62	CCI Updated
02-002b	Decontamination Labor	300	HR	$ -	$ 15.30	$ 57.71	$ -	$ -	$ 4,588.75	$ 17,313.17	$ -	$ 21,901.93	CCI Updated
02-003	Personnel Decontamination												
02-003a	Gravel Base Delivered and Placed	2	CY	$ -	$ 23.41	$ 3.00	$ 3.41	$ -	$ 46.82	$ 6.01	$ 6.83	$ 59.66	CCI Updated
02-003b	40-mil HDPE Liner Delivered and Placed	100	SF	$ -	$ 0.66	$ 0.06	$ -	$ -	$ 66.33	$ 5.85	$ -	$ 72.19	CCI Updated
02-003c	Stone Drainage Layer Delivered and Placed	2	CY	$ -	$ 23.41	$ 4.88	$ 2.36	$ -	$ 46.82	$ 9.76	$ 4.72	$ 61.30	CCI Updated
02-004	Water Storage Tanks (clean and contaminated)	22	MO	$ -	$ 877.95	$ -	$ -	$ -	$ 19,314.90	$ -	$ -	$ 19,314.90	CCI Updated
03 - SITE PREPARATION													
03-001	Access Road Construction												
03-001a	Clearing	1	AC	$ -	$ -	$ 2,800.00	$ 2,400.00	$ -	$ -	$ 2,800.00	$ 2,400.00	$ 5,200.00	Project experience
03-001b	Gravel Delivered	1100	CY	$ -	$ 23.41	$ 3.10	$ 3.30	$ -	$ 25,753.20	$ 3,412.30	$ 3,626.91	$ 32,792.41	CCI Updated
03-001c	Gravel Spread, Grade, Compact	3300	SY	$ -	$ -	$ 0.51	$ 0.96	$ -	$ -	$ 1,673.96	$ 3,154.77	$ 4,828.73	CCI Updated
03-002	Building/Foundation Demolition												
03-002a	Foundation Removal	750	CY	$ -	$ -	$ 1.68	$ 2.17	$ -	$ -	$ 1,258.40	$ 1,624.21	$ 2,882.60	CCI Updated
03-002b	Foundation Debris Transportation & Disposal	1200	Ton	$ 136.57	$ -	$ -	$ -	$ 163,884.00	$ -	$ -	$ -	$ 163,884.00	CCI Updated
03-002c	Clarifier Tank Evacuation/Removal	1	Ea	$ 1,814.43	$ -	$ 942.57	$ 760.48	$ 1,814.43	$ -	$ 942.57	$ 760.48	$ 3,517.48	CCI Updated
03-002d	Wood-Frame Building Demolition	0	CF	$ -	$ -	$ 0.10	$ 0.16	$ -	$ -	$ -	$ -	$ -	Demolition completed
03-002e	Building Debris Transportation & Disposal	0	CY	$ -	$ -	$ 9.46	$ 14.11	$ -	$ -	$ -	$ -	$ -	Demolition completed
03-003	Clear Medium Trees	10	AC	$ -	$ -	$ 2,800.00	$ 2,400.00	$ -	$ -	$ 28,000.00	$ 24,000.00	$ 52,000.00	Project experience
03-004	Erosion Controls												
03-004a	Silt Fence	2500	LF	$ -	$ 1.23	$ 2.46	$ -	$ -	$ 3,072.83	$ 6,145.65	$ -	$ 9,218.48	CCI Updated
03-004b	Hay Bales	20	Ton	$ -	$ 107.11	$ 357.75	$ 119.97	$ -	$ 2,142.20	$ 7,155.10	$ 2,399.34	$ 11,696.64	CCI Updated
03-005	Haul Road Construction												
03-005a	Gravel Delivered	2200	CY	$ -	$ 23.41	$ 3.10	$ 3.30	$ -	$ 51,506.40	$ 6,824.60	$ 7,253.82	$ 65,584.82	CCI Updated
03-005b	Gravel Spread, Grade, Compact	6667	SY	$ -	$ -	$ 0.51	$ 0.96	$ -	$ -	$ 3,381.90	$ 6,373.59	$ 9,755.49	CCI Updated
03-006	Prepare Stockpile/Staging Areas												
03-006a	Rough Grade	1850	SY	$ -	$ -	$ 1.66	$ 4.88	$ -	$ -	$ 3,067.95	$ 9,023.38	$ 12,091.32	CCI Updated
03-006b	Sand/Gravel Delivered	910	CY	$ -	$ 23.41	$ 3.10	$ 3.30	$ -	$ 21,304.92	$ 2,822.90	$ 3,000.44	$ 27,128.26	CCI Updated
03-006c	40-mil HDPE Liner Delivered and Placed	16400	SF	$ -	$ 0.66	$ 0.06	$ -	$ -	$ 10,878.78	$ 959.89	$ -	$ 11,838.67	CCI Updated
03-006d	Erosion & Sediment Controls	750	LF	$ -	$ 3.32	$ 9.36	$ 2.15	$ -	$ 2,487.53	$ 7,023.60	$ 1,609.58	$ 11,120.70	CCI Updated
03-007	Dust Suppression (Water Spray)	48400	SY	$ -	$ -	$ -	$ 0.02	$ -	$ -	$ -	$ 944.28	$ 944.28	CCI Updated

Attachment B-1 - Table 1A-CC
Capital Costs for Alternative 1A - Excavation and Off-Site Disposal (Subtitle D)
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	2017 Unit Cost ($) Sub.	Mat.	Labor	Equip	2017 Total Cost ($) Sub.	Mat.	Labor	Equip	2017 Total Direct Cost ($) 1.951	Comments/Reference ENR 2002-2017 Multiplier
04 - DEWATERING (Areas 1 and 2)													
04-001	Rental Pumps (3 ea)	60	Wk	$ -	$ 474.09	$ -	$ -	$ -	$ 28,445.58	$ -	$ -	$ 28,445.58	CCI Updated
04-002	3-inch Discharge Hose	1000	LF	$ -	$ -	$ -	$ 7.80	$ -	$ -	$ -	$ 7,804.00	$ 7,804.00	CCI Updated
04-003	Fractionation Tanks (2 each at 11 months)	22	MO	$ -	$ -	$ -	$ 1,755.90	$ -	$ -	$ -	$ 38,629.80	$ 38,629.80	CCI Updated
04-004	Analytical Samples	10	Ea	$ 975.50	$ -	$ -	$ -	$ 9,755.00	$ -	$ -	$ -	$ 9,755.00	CCI Updated
04-005	Waste Disposal Fees	250	Kgal	$ 3.90	$ -	$ -	$ -	$ 975.50	$ -	$ -	$ -	$ 975.50	CCI Updated
05 - SLUDGE/WASTE/SOIL EXCAVATION													
05-001	Excavate & Load Overlying Soil	12400	CY	$ -	$ -	$ 1.42	$ 3.47	$ -	$ -	$ 17,660.45	$ 43,062.47	$ 60,722.92	CCI Updated
05-002	Excavate & Load Sludge/Waste	68900	CY	$ -	$ -	$ 2.15	$ 5.21	$ -	$ -	$ 147,866.29	$ 358,911.81	$ 506,778.10	CCI Updated
05-003	Transport to Stockpile Areas	3445	Hr	$ -	$ -	$ 24.78	$ 65.22	$ -	$ -	$ 85,359.18	$ 224,689.55	$ 310,048.73	CCI Updated
05-004	Dust Suppression	300	Ac	$ -	$ 4.99	$ 40.72	$ 51.56	$ -	$ 1,498.37	$ 12,215.21	$ 15,469.48	$ 29,183.06	CCI Updated
05-005	Odor Control	1	LS	$ 273,140.00	$ -	$ -	$ -	$ 273,140.00	$ -	$ -	$ -	$ 273,140.00	CCI Updated
05-006	Air Monitoring	300	Ea	$ 1,951.00	$ -	$ -	$ -	$ 585,300.00	$ -	$ -	$ -	$ 585,300.00	CCI Updated
06 - SLUDGE/WASTE STOCKPILING AND HANDLING													
06-001	Odor/Moisture Control (Lime)	9900	Ton	$ -	$ 30.00	$ -	$ -	$ -	$ 297,000.00	$ -	$ -	$ 297,000.00	Project experience
06-002	Sludge Dewatering/Moisture Control	1300	Hr	$ -	$ -	$ 28.02	$ 146.33	$ -	$ -	$ 36,421.27	$ 190,222.50	$ 226,643.77	CCI Updated
06-003	Stockpile Maintenance	1300	Hr	$ -	$ -	$ -	$ 146.33	$ -	$ -	$ -	$ 190,222.50	$ 190,222.50	CCI Updated
07 - SAMPLE ANALYSES													
07-001	Sample Shipping	150	Ea	$ 80.00	$ -	$ -	$ -	$ 12,000.00	$ -	$ -	$ -	$ 12,000.00	Project experience
07-002	Confirmation Analytical Costs (Dioxin/SVOCs/Metals)	250	Ea	$ 750.00	$ -	$ -	$ -	$ 187,500.00	$ -	$ -	$ -	$ 187,500.00	Project experience
07-003	Waste Characterization Samples	200	Ea	$ 1,463.25	$ -	$ -	$ -	$ 292,650.00	$ -	$ -	$ -	$ 292,650.00	CCI Updated
08 - OFFSITE DISPOSAL OF SLUDGE/WASTE													
08-001	Load Dump Trucks	75790	CY	$ -	$ -	$ 1.42	$ 3.47	$ -	$ -	$ 107,942.39	$ 263,202.00	$ 371,144.39	CCI Updated
08-002	Transportation & Disposal	123537.7	Ton	$ 156.08	$ -	$ -	$ -	$ 19,281,764.22	$ -	$ -	$ -	$ 19,281,764.22	CCI Updated
09 - SITE RESTORATION													
09-001	Backfill Placement & Compaction												
09-001a	Use Overlying Soil	9500	CY	$ -	$ 0.60	$ 3.24	$ 9.27	$ -	$ 5,745.70	$ 30,767.27	$ 88,038.88	$ 124,551.84	CCI Updated
09-001b	Use Off-Site Borrow	72000	CY	$ -	$ 10.32	$ 1.76	$ 4.04	$ -	$ 743,096.88	$ 126,424.80	$ 290,777.04	$ 1,160,298.72	CCI Updated
09-002	Place Topsoil (4")	2500	CY	$ -	$ 35.37	$ 7.10	$ 7.39	$ -	$ 88,429.08	$ 17,754.10	$ 18,485.73	$ 124,668.90	CCI Updated
09-003	Revegetate	4.5	AC	$ -	$ 664.04	$ 130.68	$ 179.63	$ -	$ 2,988.19	$ 588.05	$ 808.33	$ 4,384.57	CCI Updated
10 - SITE STAFFING													
10-001	Site Supervisor	11	MO	$ -	$ -	$ 6,243.20	$ -	$ -	$ -	$ 68,675.20	$ -	$ 68,675.20	CCI Updated
10-002	Site Engineer	11	MO	$ -	$ -	$ 6,243.20	$ -	$ -	$ -	$ 68,675.20	$ -	$ 68,675.20	CCI Updated
10-003	Site Sampler/Safety Officer	11	MO	$ -	$ -	$ 4,682.40	$ -	$ -	$ -	$ 51,506.40	$ -	$ 51,506.40	CCI Updated
10-004	Site Sampler/Field Technician	11	MO	$ -	$ -	$ 4,682.40	$ -	$ -	$ -	$ 51,506.40	$ -	$ 51,506.40	CCI Updated
10-005	Travel Expenses	210	Days	$ -	$ -	$ 959.89	$ -	$ -	$ -	$ 201,577.32	$ -	$ 201,577.32	CCI Updated
							SUBTOTAL DIRECT COST	$ 20,994,196.43	$ 1,311,480.24	$ 1,119,444.60	$ 1,867,039.22	$ 25,292,160.48	

	TOTAL COST ($) Sub.	Mat.	Labor	Equip	Total Cost ($)	Comments
Subtotal Direct Cost	$ 20,994,196.43	$ 1,311,480.24	$ 1,119,444.60	$ 1,867,039.22	$ 25,292,160.48	
Direct Cost Adjustments						
Health and Safety on Labor and Equipment (5%)	$ -	$ -	$ 55,972.23	$ 93,351.96	$ 149,324.19	
Subtotal	*$ 20,994,196.43*	*$ 1,311,480.24*	*$ 1,175,416.83*	*$ 1,960,391.18*	$ 25,441,484.67	
Indirect Cost Adjustments						
Tax on Materials (7%)	$ -	$ 91,803.62	$ -	$ -	$ 91,803.62	
G&A @10% of Equipment, Material, and Labor	$ -	$ 140,328.39	$ 117,541.68	$ 196,039.12	$ 453,909.19	
Subcontract Fee @ 4%	$ 839,767.86	$ -	$ -	$ -	$ 839,767.86	
Labor OH @60%	$ -	$ -	$ 671,666.76	$ -	$ 671,666.76	
Subtotal Direct & Indirect	*$ 21,833,964.29*	*$ 1,543,612.24*	*$ 1,964,625.27*	*$ 2,156,430.30*	$ 27,498,632.09	
Other Costs						
Profit @ 10% of Subtotal Direct & Indirect	$ 2,183,396.43	$ 154,361.22	$ 196,462.53	$ 215,643.03	$ 2,749,863.21	
Engineering Contingency at 6% of Construction Cost and 2% of T&D Cost					$ 1,491,013.20	
Office Support @ 3% Direct & Indirect	$ 655,018.93	$ 46,308.37	$ 58,938.76	$ 64,692.91	$ 824,958.96	
				TOTAL COST	**$ 32,564,467.46**	

Attachment B-1 - Table 2-PRSC
Post-Removal Site Control Costs for Alternative 1 - Excavation with Off-Site Disposal
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Post-Construction Monitoring						
01-001	Vegetation/Erosion Verification	8	Event	$ 786.00	$ 6,288.00	Previous project experience. Mobilize to the site quarterly for 2 years, document cap conditions, document deficiencies, prepare/issue inspection report.
				SUBTOTAL COST	**$ 6,288.00**	

Attachment B-4 - Table 2-PW
Present Worth for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Alternative 4 - In-Situ Solidification/Stabilization

Present Worth Analysis				
Year	**Present Worth Factor (1)**	**Capital Costs ($)**	**O&M Costs ($)**	**Present Worth ($)**
0	1.000	$ 18,414,466.15	$ -	$ 18,414,466.15
1	0.935	$ -	$ 24,344.00	$ 22,751.40
2	0.873	$ -	$ 24,344.00	$ 21,262.99
3	0.816	$ -	$ 21,200.00	$ 17,305.51
4	0.763	$ -	$ 21,200.00	$ 16,173.38
5	0.713	$ -	$ 21,200.00	$ 15,115.31
6	0.666	$ -	$ 21,200.00	$ 14,126.46
7	0.623	$ -	$ 21,200.00	$ 13,202.29
8	0.582	$ -	$ 21,200.00	$ 12,338.59
9	0.544	$ -	$ 21,200.00	$ 11,531.40
10	0.508	$ -	$ 21,200.00	$ 10,777.00
11	0.475	$ -	$ 21,200.00	$ 10,071.97
12	0.444	$ -	$ 21,200.00	$ 9,413.05
13	0.415	$ -	$ 21,200.00	$ 8,797.25
14	0.388	$ -	$ 21,200.00	$ 8,221.73
15	0.362	$ -	$ 21,200.00	$ 7,683.86
16	0.339	$ -	$ 21,200.00	$ 7,181.17
17	0.317	$ -	$ 21,200.00	$ 6,711.38
18	0.296	$ -	$ 21,200.00	$ 6,272.32
19	0.277	$ -	$ 21,200.00	$ 5,861.98
20	0.258	$ -	$ 21,200.00	$ 5,478.48
21	0.242	$ -	$ 21,200.00	$ 5,120.08
22	0.226	$ -	$ 21,200.00	$ 4,785.12
23	0.211	$ -	$ 21,200.00	$ 4,472.07
24	0.197	$ -	$ 21,200.00	$ 4,179.51
25	0.184	$ -	$ 21,200.00	$ 3,906.08
26	0.172	$ -	$ 21,200.00	$ 3,650.54
27	0.161	$ -	$ 21,200.00	$ 3,411.72
28	0.150	$ -	$ 21,200.00	$ 3,188.53
29	0.141	$ -	$ 21,200.00	$ 2,979.93
30	0.131	$ -	$ 21,200.00	$ 2,784.98
			TOTAL	**$ 18,683,222.23**

Notes:

1 - Discount rate of 7% per OSWER Directive

Attachment B-4 - Table 2-CC
Capital Costs for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Pre-Construction Work						
01-001	Pre-Design Investigation					
01-001a	Test-Pit Sample Collection & Extent Verification	5	DAY	$ 7,500.00	$ 37,500.00	Previous Project Experience - Excavate/delineate to the edge of the sludge in each area. Collect treatability samples.
01-001b	Stabilization Bench Testing	1	LS	$ 20,000.00	$ 20,000.00	Previous Project Experience - Bench samples to replicate previous work & verify adequacy below groundwater.
01-001c	Odor control verification testing	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience - Verify selected foam will provide adequate temporary odor control
01-002	Engineering & Removal Designs and Specifications	1	LS	$ 779,205.00	$ 779,205.00	Assume 6% of physical construction capital cost in accordance with costing guidance manual EPA 540-R-00-002
01-003	Project Bonding	1	LS	$ 140,000.00	$ 140,000.00	Industry-Based Estimate (1% of physical construction capital costs)
01-004	Project Planning & Submittals					
01-004a	Construction Work Plan and Schedule	1	LS	$ 20,000.00	$ 20,000.00	Previous Project Experience
01-004b	Health and Safety Plan	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004c	Erosion/Sediment Control Plan	1	LS	$ 10,000.00	$ 10,000.00	Previous Project Experience
01-004d	Storm water and water control plan	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience
01-004e	Construction QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004f	Analytical QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
02 - Project Management and Staffing						
02-001	Site Superintendent	9	MO	$ 20,000.00	$ 180,000.00	Vendor Estimate
02-002	Health & Safety Manager	9	MO	$ 15,000.00	$ 135,000.00	Vendor Estimate
02-003	Contractor QC Manager	9	MO	$ 12,000.00	$ 108,000.00	Vendor Estimate
02-004	Office & Accounting Support	9	MO	$ 3,000.00	$ 27,000.00	Vendor Estimate
03 - Mobilization, Site Preparation, and Temp Facilities						
03-001	Mobilization	1	LS	$ 200,000.00	$ 200,000.00	Vendor Estimate
03-002	Temporary Facilities			$ 8,000.00		
03-002a	Temporary Facilities - Trailer; Storage containers; Phone; Internet; Site Staff Travel Expenses	9	MO	$ 7,500.00	$ 67,500.00	1 Trailer, 1 Storage Container, Phone, Internet, Site Management Travel Expenses
03-002b	Temporary Facilities - Electric; water	9	MO	$ 7,500.00	$ 67,500.00	600-Amp service for the life of the project, includes installation of a power drop and meter establishment
03-002c	Temporary Facilities - MSW Disposal	500	TON	$ 100.00	$ 50,000.00	Weekly pickup at the site
03-002d	Temporary Facilities - Fencing/Dust Screens	2500	LF	$ 15.00	$ 37,500.00	6' secured panel fencing, wind screen, dust fabric
03-002e	Water Management Facilities (tanks, pumps, hose)	9	MO	$ 10,000.00	$ 90,000.00	2 Fractionation tanks, Suction pumps; Transfer pumps; hoses; in-line meter; tank cleanout
03-002f	Water discharge to PTOW	150,000	GAL	$ 0.05	$ 7,500.00	Vendor Estimate; based on known water levels
03-003	Site Preparation					
03-003a	Site Prep. Install/Maintain E&S Controls	3500	LF	$ 8.00	$ 28,000.00	Silt fencing & straw wattles around entire work area. Double silt fence along the Nashua River
03-003b	Clearing/Chipping/Grubbing Work Areas	7	Ac	$ 15,000.00	$ 105,000.00	Medium-thickness clearing to 6" above grade. Off-site recycling.

Attachment B-4 - Table 2-CC
Capital Costs for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
03-003c	Disposal of below-grade vegetation	400	TON	$ 100.00	$ 40,000.00	Grub stumps from cleared areas; Remove soil/sludge to the extent practicable. Size for off-site disposal
03-003d	Decontamination Facilities	4	Ea	$ 5,000.00	$ 20,000.00	1 Stabilized construction entrance; 3 equipment/personnel decontamination stations located on-site
03-003e	Access Road Construction/Improvement	1	LS	$ 36,000.00	$ 36,000.00	1,000 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric. Installed to access Broad Street Parkway
03-003f	On-site Haul Road Improvement	1	LS	$ 27,000.00	$ 27,000.00	750 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric for on-site access roads.
03-003g	Stockpile/Staging Area Preparation	1	LS	$ 25,000.00	$ 25,000.00	Graded 100'X100' pad with soil berms, water collection sump, and bedded with a 40-mil liner over crushed stone
03-003h	By-Pass/Remove/Replace Sewer	350	LF	$ 300.00	$ 105,000.00	Locate and protect 48-inch RCP during construction.
03-003I	Abandon Monitoring Wells	5	Ea	$ 2,000.00	$ 10,000.00	Abandon GZ-9, GZ-10, SH-16S/D, and the supply well
04 - Project Controls						
04-001	Health and Safety Equipment Purchase/Maintenance	9	MO	$ 13,000.00	$ 117,000.00	Purchase, store, and use Tyvek suits, full-face respirators, respirator cartridges, PIDs, Multi-gas meters, ammonia meters, perimeter air monitoring equipment
04-002	Dust Control Equipment	9	MO	$ 5,000.00	$ 45,000.00	Air misting equipment, water truck with water bar/sprayer, multiple layers of ballasted polyethylene sheeting over stockpiles
04-003	Work Area Odor Control Equipment and Materials					
04-003a	Odor Foam Machines	9	MO	$ 5,000.00	$ 45,000.00	Purchase and operate two Rusmar foam disperser pumps
04-003b	Odor Foam 40 drums per month	360	DRUMS	$ 550.00	$ 198,000.00	Delivery and store Rusmar anti-odor foam
04-003c	Hood/Shroud Over Stabilization Working Zones	2	Ea	$ 62,000.00	$ 124,000.00	Steel, plastic, and filter fabric shrouds for each solidification method
04-004	Perimeter Odor Control Equipment and Materials	9	MO	$ 7,500.00	$ 67,500.00	Air-misting equipment at the site perimeter with the neighborhood with anti-odor scents
04-005	Establishment of Survey Controls	1	LS	$ 100,000.00	$ 100,000.00	Surveys for the following: pre-construction, post-construction, performance & progress payments, post-stabilization, post-cap/as-builts.
04-006	Materials/QC Testing	1	LS	$ 100,000.00	$ 100,000.00	Materials QC testing, strength testing, permeability testing, compaction testing, and engineering submittal testing
05 - Excavation of Overlying Soil, SRS-Exceeding Soil, and Expansion Cell Soil						
05-001	Area 1 -Excavate Soil Berms, Transport, Stockpile	1500	CY	$ 20.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-002	Area 2 - Excavate 3 feet, Transport, Stockpile	9000	CY	$ 20.00	$ 180,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-003	Area 3 - Excavate 2 feet, Transport, Stockpile	225	CY	$ 25.00	$ 5,625.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-004	Area 4 - Excavate 3 feet, Transport, Stockpile	400	CY	$ 25.00	$ 10,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer

Attachment B-4 - Table 2-CC
Capital Costs for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
05-005	Area 6 - Excavate 3 feet, Transport, Stockpile	675	CY	$ 25.00	$ 16,875.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-006	Area 7 - Excavate 4 feet, Transport, Stockpile	2250	CY	$ 20.00	$ 45,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-007	SRS-Exceeding Soil, Transport to Area 2	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-008	Southern Parcel - Excavate 1 foot, Transport to Area 2	2500	CY	$ 25.00	$ 62,500.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-008	Expansion Cell Excavation - Sloped Sidewalls	16000	CY	$ 20.00	$ 320,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
06 - Sludge Consolidation						
06-001	Area 3 - Excavate 5 feet Transport to Ex. Cell	550	CY	$ 25.00	$ 13,750.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-002	Area 4 - Excavate 6 feet Transport to Ex. Cell	800	CY	$ 25.00	$ 20,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-003	Area 6 - Excavate 5 feet Transport to Ex. Cell	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-004	Area 7 - Excavate 8 feet Transport to Ex. Cell	4500	CY	$ 20.00	$ 90,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
07 - Solidification/Stabilization						
07-001	Deliver and Store Portland Cement	16000	TON	$ 150.00	$ 2,400,000.00	Vendor estimate
07-002	Deliver and Store Powdered Activated Carbon	200	TON	$ 1,100.00	$ 220,000.00	Vendor estimate
07-003	Debris Removal During Stabilization	100	TON	$ 750.00	$ 75,000.00	Vendor estimate. Extraction using a long-arm excavator and grapple.
07-004	Debris Disposal (non-haz)	100	TON	$ 100.00	$ 10,000.00	Vendor Estimate
07-005	Auger Stabilization Method Demonstration	5	DAY	$ 10,000.00	$ 50,000.00	Subcontractor-led demonstration
07-006	Area 1 Stabilization - 25% vol Sand; 25% wt Cement	23560	CY	$ 160.00	$ 3,769,600.00	Vendor estimate - assumed approximately 200 CY of stabilization insitu per-day
07-007	Area 2 Stabilization Method Demonstration	5	DAY	$ 10,000.00	$ 50,000.00	Vendor estimate
07-007	Area 2 Stabilization - 16% wt Cement	33330	CY	$ 40.00	$ 1,333,200.00	Vendor estimate - assumed approximately 500 CY of stabilization insitu per-day
07-008	Expansion Cell Stabilization - 16% wt Cement	16000	CY	$ 40.00	$ 640,000.00	Vendor estimate - assumed approximately 500 CY of stabilization insitu per-day
07-009	Solidification/Stabilization Swell Management	6000	CY	$ 20.00	$ 120,000.00	Vendor estimate - On-going activity to use expansion cell as an overflow for swell volume
08 - Cap & Vent System Construction						
08-001	Place Reuse Soil Over Stabilized Materials	6000	CY	$ 20.00	$ 120,000.00	Vendor estimate - assumes up to 3 feet of fill over the 17,500 SY area.
08-002	Deliver and Install 12-Inches of 3/4-Inch Vent Stone	1300	TON	$ 60.00	$ 78,000.00	Vendor estimate - assumes 3' wide, 1' thick pipe trenches.
08-003	Furnish and Install 6-Inch Multi-Flow Vent Strip	7500	LF	$ 15.00	$ 112,500.00	Vendor estimate
08-004	Furnish and Install Vent Risers	15	EA	$ 7,500.00	$ 112,500.00	Vendor estimate along a 25-foot center
08-005	Furnish and Install 15-Mil Vapor Barrier	17500	SY	$ 7.50	$ 131,250.00	Vendor estimate - overlapping barrier
08-006	Deliver and Place 8-Inches of Well-Draining Sand	7000	CY	$ 45.00	$ 315,000.00	Vendor estimate - imported DOT-spec materials
08-007	Fine-Grading/Compaction	17500	SY	$ 3.00	$ 52,500.00	Vendor estimate - Promote positive water-shedding off the stabilization area

Attachment B-4 - Table 2-CC
Capital Costs for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
08-008	Deliver 4-Inches of Topsoil	1500	CY	$ 45.00	$ 67,500.00	Vendor estimate - Deliver and transfer topsoil to work area
08-009	Fine-Grade Topsoil	17500	SY	$ 2.00	$ 35,000.00	Vendor estimate to fine-grade and track-harrow topsoil to promote seed stabilization
08-010	Hydroseed Cap Area	17500	SY	$ 3.00	$ 52,500.00	Vendor estimate - Hydroseed and mulch the stabilized area.
09 - Backfill & Site Restoration						
09-001	Place Reuse Soil Into Areas 6 and 7	8600	CY	$ 20.00	$ 172,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-002	Fine-Grade/Compact Areas 6 and 7	2000	SY	$ 3.00	$ 6,000.00	Vendor estimate - Fine-grade and compact top lifts
09-003	Deliver and Place 4-Inches of Topsoil - Areas 6 and 7	200	CY	$ 45.00	$ 9,000.00	Vendor estimate - Deliver and transfer topsoil to work area
09-004	Place Reuse Soil Into Areas 3 and 4	2000	CY	$ 20.00	$ 40,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-005	Fine-Grade/Compact Areas 3 and 4	800	SY	$ 3.00	$ 2,400.00	Vendor estimate - Fine-grade and compact top lifts
09-006	Deliver and Place 4-Inches of Topsoil - Areas 3 and 4	70	CY	$ 45.00	$ 3,150.00	Vendor estimate - Deliver and transfer topsoil to work area
09-007	Place Reuse Soil Into Southern Parcel	2500	CY	$ 20.00	$ 50,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-008	Fine-Grade/Compact Southern Parcel	7500	SY	$ 3.00	$ 22,500.00	Vendor estimate - Fine-grade and compact top lifts
09-007	Hydroseed Areas 3, 4, 6, 7, Southern Parcel	10300	SY	$ 3.00	$ 30,900.00	Vendor estimate - Hydroseed and mulch the stabilized area.
09-008	Replace Abandoned Monitoring Wells	4	Ea	$ 2,500.00	$ 10,000.00	Previous project experience. Install 4 replacement wells (GZ-09, GZ-10, SH-16S/D) supply well will not be re-drilled
09-010	Place/grade remaining re-use soil	15500	CY	$ 20.00	$ 310,000.00	
10 - Decontamination, Temp. Facilities Removal & Demobilization						
10-001	Decontaminate Equipment	20	Ea	$ 1,500.00	$ 30,000.00	Vendor estimate - decontaminate all heavy equipment, hand tools, subcontractor equipment and tools
10-002	Remove Temporary Facilities and E&S Controls	1	LS	$ 40,000.00	$ 40,000.00	Vendor estimate
10-003	Demobilize Equipment	1	LS	$ 150,000.00	$ 150,000.00	Vendor estimate
				SUBTOTAL COST	**$ 14,677,455.00**	

Attachment B-4 - Table 2-PRSC
Post-Removal Site Control Costs for Alternative 4 - Stabilization/Solidification
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Post-Construction Monitoring						
01-001	Vegetation/Erosion Verification	8	Event	$ 786.00	$ 6,288.00	Previous project experience. Mobilize to the site quarterly for 2 years, document cap conditions, document deficiencies, prepare/issue inspection report.
01-002	Groundwater Monitoring	60	Event	$ 8,300.00	$ 498,000.00	Previous project experience. Biannual groundwater monitoring of 8 monitoring wells using standard sampling methods. Estimate assumes dedicated sampling equipment for each sampling round, and two field personnel. Assumes 30 years of monitoring, submittal of a data report for each sampling event, and an annual groundwater monitoring report.
01-003	Annual Groundwater Reporting	30	Year	$ 4,600.00	$ 138,000.00	Previous project experience. Biannual groundwater monitoring of 8 monitoring wells using standard sampling methods. Estimate assumes dedicated sampling equipment for each sampling round, and two field personnel. Assumes 30 years of monitoring, submittal of a data report for each sampling event, and an annual groundwater monitoring report.
01-004	Annual Cap Inspection	30	Year	$ 4,600.00	$ 138,000.00	Previous project experience. Assumes annual inspections and simplified inspection report submittals. For an assumed period of 30 years.
			SUBTOTAL COST		**$ 780,288.00**	

Attachment B-5 - Table 3-PW
Present Worth for Alternative 5 - Encapsulation/Capping
Mohawk Tannery Site
Nashua, New Hampshire

Alternative 5a - Encapsulation (Sheet Piling) and Capping (Geosynthetics)

Present Worth Analysis				
Year	**Present Worth Factor (1)**	**Capital Costs ($)**	**O&M Costs ($)**	**Present Worth ($)**
0	1.000	$ 6,434,587.32	$ -	$ 6,434,587.32
1	0.935	$ -	$ 35,344.00	$ 33,031.78
2	0.873	$ -	$ 35,344.00	$ 30,870.82
3	0.816	$ -	$ 32,200.00	$ 26,284.79
4	0.763	$ -	$ 32,200.00	$ 24,565.23
5	0.713	$ -	$ 32,200.00	$ 22,958.15
6	0.666	$ -	$ 32,200.00	$ 21,456.22
7	0.623	$ -	$ 32,200.00	$ 20,052.54
8	0.582	$ -	$ 32,200.00	$ 18,740.69
9	0.544	$ -	$ 32,200.00	$ 17,514.67
10	0.508	$ -	$ 32,200.00	$ 16,368.85
11	0.475	$ -	$ 32,200.00	$ 15,297.99
12	0.444	$ -	$ 32,200.00	$ 14,297.19
13	0.415	$ -	$ 32,200.00	$ 13,361.86
14	0.388	$ -	$ 32,200.00	$ 12,487.72
15	0.362	$ -	$ 32,200.00	$ 11,670.76
16	0.339	$ -	$ 32,200.00	$ 10,907.25
17	0.317	$ -	$ 32,200.00	$ 10,193.70
18	0.296	$ -	$ 32,200.00	$ 9,526.82
19	0.277	$ -	$ 32,200.00	$ 8,903.57
20	0.258	$ -	$ 32,200.00	$ 8,321.09
21	0.242	$ -	$ 32,200.00	$ 7,776.72
22	0.226	$ -	$ 32,200.00	$ 7,267.96
23	0.211	$ -	$ 32,200.00	$ 6,792.49
24	0.197	$ -	$ 32,200.00	$ 6,348.12
25	0.184	$ -	$ 32,200.00	$ 5,932.82
26	0.172	$ -	$ 32,200.00	$ 5,544.69
27	0.161	$ -	$ 32,200.00	$ 5,181.96
28	0.150	$ -	$ 32,200.00	$ 4,842.95
29	0.141	$ -	$ 32,200.00	$ 4,526.12
30	0.131	$ -	$ 32,200.00	$ 4,230.02
			TOTAL	**$ 6,839,842.86**

Notes:

1 - Discount rate of 7% per OSWER Directive

Attachment B-5 - Table 3-PW
Present Worth for Alternative 5 - Encapsulation/Capping
Mohawk Tannery Site
Nashua, New Hampshire

Alternative 5b - Encapsulation (Slurry Wall) and Impervious Capping

Present Worth Analysis				
Year	**Present Worth Factor (1)**	**Capital Costs ($)**	**O&M Costs ($)**	**Present Worth ($)**
0	1.000	$ 11,750,362.32	$ -	$ 11,750,362.32
1	0.935	$ -	$ 35,344.00	$ 33,031.78
2	0.873	$ -	$ 35,344.00	$ 30,870.82
3	0.816	$ -	$ 32,200.00	$ 26,284.79
4	0.763	$ -	$ 32,200.00	$ 24,565.23
5	0.713	$ -	$ 32,200.00	$ 22,958.15
6	0.666	$ -	$ 32,200.00	$ 21,456.22
7	0.623	$ -	$ 32,200.00	$ 20,052.54
8	0.582	$ -	$ 32,200.00	$ 18,740.69
9	0.544	$ -	$ 32,200.00	$ 17,514.67
10	0.508	$ -	$ 32,200.00	$ 16,368.85
11	0.475	$ -	$ 32,200.00	$ 15,297.99
12	0.444	$ -	$ 32,200.00	$ 14,297.19
13	0.415	$ -	$ 32,200.00	$ 13,361.86
14	0.388	$ -	$ 32,200.00	$ 12,487.72
15	0.362	$ -	$ 32,200.00	$ 11,670.76
16	0.339	$ -	$ 32,200.00	$ 10,907.25
17	0.317	$ -	$ 32,200.00	$ 10,193.70
18	0.296	$ -	$ 32,200.00	$ 9,526.82
19	0.277	$ -	$ 32,200.00	$ 8,903.57
20	0.258	$ -	$ 32,200.00	$ 8,321.09
21	0.242	$ -	$ 32,200.00	$ 7,776.72
22	0.226	$ -	$ 32,200.00	$ 7,267.96
23	0.211	$ -	$ 32,200.00	$ 6,792.49
24	0.197	$ -	$ 32,200.00	$ 6,348.12
25	0.184	$ -	$ 32,200.00	$ 5,932.82
26	0.172	$ -	$ 32,200.00	$ 5,544.69
27	0.161	$ -	$ 32,200.00	$ 5,181.96
28	0.150	$ -	$ 32,200.00	$ 4,842.95
29	0.141	$ -	$ 32,200.00	$ 4,526.12
30	0.131	$ -	$ 32,200.00	$ 4,230.02
			TOTAL	**$ 12,155,617.86**

Notes:

1 - Discount rate of 7% per OSWER Directive

Attachment B-5 - Table 3-PW
Present Worth for Alternative 5 - Encapsulation/Capping
Mohawk Tannery Site
Nashua, New Hampshire

Alternative 5c - Encapsulation (Secant Wall) and Imperveous Capping

Present Worth Analysis				
Year	**Present Worth Factor (1)**	**Capital Costs ($)**	**O&M Costs ($)**	**Present Worth ($)**
0	1.000	$ 6,597,872.36	$ -	$ 6,597,872.36
1	0.935	$ 6,597,872.36	$ 35,344.00	$ 6,199,267.63
2	0.873	$ -	$ 35,344.00	$ 30,870.82
3	0.816	$ -	$ 32,200.00	$ 26,284.79
4	0.763	$ -	$ 32,200.00	$ 24,565.23
5	0.713	$ -	$ 32,200.00	$ 22,958.15
6	0.666	$ -	$ 32,200.00	$ 21,456.22
7	0.623	$ -	$ 32,200.00	$ 20,052.54
8	0.582	$ -	$ 32,200.00	$ 18,740.69
9	0.544	$ -	$ 32,200.00	$ 17,514.67
10	0.508	$ -	$ 32,200.00	$ 16,368.85
11	0.475	$ -	$ 32,200.00	$ 15,297.99
12	0.444	$ -	$ 32,200.00	$ 14,297.19
13	0.415	$ -	$ 32,200.00	$ 13,361.86
14	0.388	$ -	$ 32,200.00	$ 12,487.72
15	0.362	$ -	$ 32,200.00	$ 11,670.76
16	0.339	$ -	$ 32,200.00	$ 10,907.25
17	0.317	$ -	$ 32,200.00	$ 10,193.70
18	0.296	$ -	$ 32,200.00	$ 9,526.82
19	0.277	$ -	$ 32,200.00	$ 8,903.57
20	0.258	$ -	$ 32,200.00	$ 8,321.09
21	0.242	$ -	$ 32,200.00	$ 7,776.72
22	0.226	$ -	$ 32,200.00	$ 7,267.96
23	0.211	$ -	$ 32,200.00	$ 6,792.49
24	0.197	$ -	$ 32,200.00	$ 6,348.12
25	0.184	$ -	$ 32,200.00	$ 5,932.82
26	0.172	$ -	$ 32,200.00	$ 5,544.69
27	0.161	$ -	$ 32,200.00	$ 5,181.96
28	0.150	$ -	$ 32,200.00	$ 4,842.95
29	0.141	$ -	$ 32,200.00	$ 4,526.12
30	0.131	$ -	$ 32,200.00	$ 4,230.02
			TOTAL	**$ 13,169,363.75**

Notes:

1 - Discount rate of 7% per OSWER Directive

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Sheet Pile)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Pre-Construction Work						
01-001	Pre-Design Investigation					
01-001a	Test-Pit Sample Collection & Extent Verification & Engineering Parameter Samples	1	LS	$ 75,000.00	$ 75,000.00	Previous Project Experience - Excavate/delineate to the edge of the sludge in each area. Collect engineering parameter samples for preload and parking surface design.
01-001c	Odor control verification testing	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience - Verify selected foam will provide adequate temporary odor control
01-002	Engineering & Removal Designs and Specifications	1	LS	$ 347,144.00	$ 347,144.00	Assume 8% of physical construction capital cost in accordance with costing guidance manual EPA 540-R-00-002
01-003	Project Bonding	1	LS	$ 50,000.00	$ 50,000.00	Industry-Based Estimate (1% of physical construction capital costs)
01-004	Project Planning & Submittals					
01-004a	Construction Work Plan and Schedule	1	LS	$ 20,000.00	$ 20,000.00	Previous Project Experience
01-004b	Health and Safety Plan	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004c	Erosion/Sediment Control Plan	1	LS	$ 10,000.00	$ 10,000.00	Previous Project Experience
01-004d	Storm water and water control plan	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience
01-004e	Construction QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004f	Analytical QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
02 - Project Management and Staffing						
02-001	Site Superintendent	7	MO	$ 20,000.00	$ 140,000.00	Vendor Estimate
02-002	Health & Safety Manager	7	MO	$ 15,000.00	$ 105,000.00	Vendor Estimate
02-003	Contractor QC Manager	7	MO	$ 7,500.00	$ 52,500.00	Vendor Estimate
02-004	Office & Accounting Support	7	MO	$ 3,000.00	$ 21,000.00	Vendor Estimate
03 - Mobilization, Site Preparation, and Temp Facilities						
03-001	Mobilization	1	LS	$ 50,000.00	$ 50,000.00	Vendor Estimate
03-002	Temporary Facilities					
03-002a	Temporary Facilities - Trailer; Storage containers; Phone; Internet; Site Staff Travel Expenses	13	MO	$ 4,500.00	$ 58,500.00	1 Trailer, 1 Storage Container, Phone, Internet, Site Management Travel Expenses
03-002b	Temporary Facilities - Electric; water	13	MO	$ 4,000.00	$ 52,000.00	600-Amp service for the life of the project, includes installation of a power drop and meter establishment
03-002c	Temporary Facilities - MSW Disposal	500	TON	$ 100.00	$ 50,000.00	Weekly pickup at the site
03-002d	Temporary Facilities - Fencing/Dust Screens	2500	LF	$ 15.00	$ 37,500.00	6' secured panel fencing, wind screen, dust fabric
03-002e	Water Management Facilities (tanks, pumps, hose)	5	MO	$ 10,000.00	$ 50,000.00	2 Fractionation tanks, Suction pumps; Transfer pumps; hoses; in-line meter; tank cleanout
03-002f	Water discharge to PTOW	150,000	GAL	$ 0.05	$ 7,500.00	Vendor Estimate; based on known water levels
03-003	Site Preparation					
03-003a	Site Prep. Install/Maintain E&S Controls	3500	LF	$ 8.00	$ 28,000.00	Silt fencing & straw wattles around entire work area. Double silt fence along the Nashua River
03-003b	Clearing/Chipping/Grubbing Work Areas	5	Ac	$ 15,000.00	$ 75,000.00	Medium-thickness clearing to 6" above grade. Off-site recycling.
03-003c	Disposal of below-grade vegetation	250	TON	$ 100.00	$ 25,000.00	Grub stumps from cleared areas; Remove soil/sludge to the extent practicable. Size for off-site disposal

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Sheet Pile)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
03-003d	Decontamination Facilities	4	Ea	$ 5,000.00	$ 20,000.00	1 Stabilized construction entrance; 3 equipment/personnel decontamination stations located on-site
03-003e	Access Road Construction/Improvement	1	LS	$ 36,000.00	$ 36,000.00	1,000 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric. Installed to access Broad Street Parkway
03-003f	On-site Haul Road Improvement	1	LS	$ 27,000.00	$ 27,000.00	750 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric for on-site access roads.
03-003g	Stockpile/Staging Area Preparation	1	LS	$ 20,000.00	$ 20,000.00	Graded 100'X100' pad with soil berms, water collection sump, and bedded with a nonwoven geotextile over crushed stone
03-003h	By-Pass/Remove/Replace Sewer	350	LF	$ 300.00	$ 105,000.00	Locate and protect 48-inch RCP during construction.
03-003I	Abandon Monitoring Wells	3	Ea	$ 2,000.00	$ 6,000.00	Abandon GZ-9, GZ-10, and the supply well
04 - Project Controls						
04-001	Health and Safety Equipment Purchase/Maintenance	7	MO	$ 4,500.00	$ 31,500.00	Purchase, store, and use Tyvek suits, full-face respirators, respirator cartridges, PIDs, Multi-gas meters, ammonia meters, perimeter air monitoring equipment
04-002	Dust Control Equipment	7	MO	$ 5,000.00	$ 35,000.00	Air misting equipment, water truck with water bar/sprayer, multiple layers of ballasted polyethylene sheeting over stockpiles
04-003	Work Area Odor Control Equipment and Materials					
04-003a	Odor Foam Machines	7	MO	$ 5,000.00	$ 35,000.00	Purchase and operate two Rusmar foam disperser pumps
04-003b	Odor Foam 40 drums per month	140	DRUMS	$ 550.00	$ 77,000.00	Delivery and store Rusmar anti-odor foam
04-004	Perimeter Odor Control Equipment and Materials	7	MO	$ 7,500.00	$ 52,500.00	Air-misting equipment at the site perimeter with the neighborhood with anti-odor scents
04-005	Establishment of Survey Controls	1	LS	$ 50,000.00	$ 50,000.00	Surveys for the following: pre-construction, post-construction, performance & progress payments
04-006	Materials/QC Testing	1	LS	$ 25,000.00	$ 25,000.00	Materials QC testing, strength testing, permeability testing, compaction testing, and engineering submittal testing
05 - Excavation of Overlying Soil and SRS-Exceeding Soil						
05-001	Area 1 -Excavate Soil Berms, Transport, Stockpile	1500	CY	$ 20.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-002	Area 3 - Excavate 2 feet, Transport, Stockpile	225	CY	$ 25.00	$ 5,625.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-003	Area 4 - Excavate 3 feet, Transport, Stockpile	400	CY	$ 25.00	$ 10,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-004	Area 6 - Excavate 3 feet, Transport, Stockpile	675	CY	$ 25.00	$ 16,875.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-005	Area 7 - Excavate 4 feet, Transport, Stockpile	2250	CY	$ 20.00	$ 45,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-006	SRS-Exceeding Soil, Transport to Area 1	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Sheet Pile)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
05-006	Southern Parcel - Excavate, containment wedge	1100	CY	$ 25.00	$ 27,500.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
06 - Sludge Consolidation						
06-001	Area 3 - Excavate 5 feet Transport to Area 1/2	550	CY	$ 25.00	$ 13,750.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-002	Area 4 - Excavate 6 feet Transport to Area 1/2	800	CY	$ 25.00	$ 20,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-003	Area 6 - Excavate 5 feet Transport to Area 1/2	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-004	Area 7 - Excavate 8 feet Transport to Area 1/2	4500	CY	$ 20.00	$ 90,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
07 - Sheetpile Wall Vertical Encapsulation						
07-001	Deliver and Store 22-foot steel sheets	951000	LBS	$ 0.80	$ 760,800.00	Vendor estimate. 2000 feet of 22-foot-long sheets delivered and staged.
07-002	Install Sheet Piles	35200	SF	$ 18.00	$ 633,600.00	Vendor estimate. Install and connect 2000 linear feet of 22-foot-long sheet pile
07-003	Flush sheet pile knuckle-joints	18000	LF	$ 2.00	$ 36,000.00	Vendor estimate. Clean the sheet pile joints and prepare for sealing
07-004	Install water-tight sealant in knuckle-joints	18000	LF	$ 2.00	$ 36,000.00	Vendor estimate. Install Adeka Water Sealant in each knuckle-joint
08 - Impermeable Cap Over Sludge & Vent System Construction						
08-001	Furnish and install 1 layer of triaxial geo-grid	14000	SY	$ 4.00	$ 56,000.00	Vendor estimate. Geo-grid to diffuse cap loads
08-002	Deliver and Install 12-Inches of 3/4-Inch Vent Stone	1400	TON	$ 60.00	$ 84,000.00	Vendor estimate - assumes 3' wide, 1' thick pipe trenches.
08-003	Furnish and Install 6-Inch Multi-Flow Vent Strip	7700	LF	$ 15.00	$ 115,500.00	Vendor estimate
08-004	Import, place, and rough-grade 12 inch sublayer	5000	CY	$ 39.00	$ 195,000.00	NH DOT weighted average materials sheet & vendor estimate
08-005	Furnish and install geosynthetic membrane	14000	SY	$ 6.00	$ 84,000.00	Previous project estimate - up to 60-mil textured membrane, field-extrusion welded
08-006	Furnish and Install Vent Risers	14	EA	$ 1,500.00	$ 21,000.00	Vendor estimate along a 25-foot center
08-007	Construct riser boots	14	EA	$ 100.00	$ 1,400.00	Previous project estimate - seal boot to geomembrane with extrusion welds
08-008	Furnish and install biplanar geocomposite	14000	SY	$ 8.30	$ 116,200.00	Biplaner geocompsite drainage layer in-lieu of sand/gravel drainage layer
08-009	Screen/place/compact/fine grade 12" reuse protective layer	5000	CY	$ 33.00	$ 165,000.00	Vendor estimate - Promote positive water-shedding off the cap screened to 4" minus
08-010	Drainage swale and underdrain construction	1500	LF	$ 37.00	$ 55,500.00	7-inch minus rip-rap downchutes and swale to detention pond. Swales unerlain by 8-inch corrugated HDPE pipe to direct percolated water to the detention pond
08-011	Excavate stormwater detention basin	3700	CY	$ 20.00	$ 74,000.00	4-foot deep detention pond
08-012	Storm water detention system construction	1	Lump	$ 12,000.00	$ 12,000.00	Vegetated detention pond w/high water release to river
08-013	Furninsh & place armoring subgrade/cushion aggregate materials	1000	CY	$ 36.00	$ 36,000.00	NH DOT weighted average materials sheet. 3-inch minus stone and gravel mixture.
08-014	Furninsh & place armoring stone w/in floodplain	2500	CY	$ 40.00	$ 100,000.00	NH DOT weighted average materials sheet - Class B Stone
08-015	Furnish and place 6" topsoil layer	2300	CY	$ 45.00	$ 103,500.00	Vendor estimate
09 - Backfill & Site Restoration						
09-001	Place Reuse Soil Into Areas 6 and 7	8600	CY	$ 20.00	$ 172,000.00	Vendor estimate

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Sheet Pile)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
09-002	Fine-Grade/Compact Areas 6 and 7	2000	SY	$ 3.00	$ 6,000.00	Vendor estimate - Fine-grade and compact top lifts
09-003	Deliver and Place 4-Inches of Topsoil - Areas 6 and 7	200	CY	$ 45.00	$ 9,000.00	Vendor estimate - Deliver and transfer topsoil to work area
09-004	Place Reuse Soil Into Areas 3 and 4	2000	CY	$ 20.00	$ 40,000.00	Vendor estimate
09-005	Fine-Grade/Compact Areas 3 and 4	800	SY	$ 3.00	$ 2,400.00	Vendor estimate - Fine-grade and compact top lifts
09-006	Deliver and Place 4-Inches of Topsoil - Areas 3 and 4	70	CY	$ 45.00	$ 3,150.00	Vendor estimate - Deliver and transfer topsoil to work area
09-007	Hydroseed Encapsulation Area	14000	SY	$ 3.00	$ 42,000.00	Vendor estimate - Hydroseed and mulch the stabilized area.
09-008	Replace Abandoned Monitoring Wells	2	Ea	$ 2,500.00	$ 5,000.00	Previous project experience. Install 2 replacement wells (GZ-09, GZ-10) supply well will not be re-drilled
10 - Decontamination, Temp. Facilities Removal & Demobilization						
10-001	Decontaminate Equipment	8	Ea	$ 1,500.00	$ 12,000.00	Vendor estimate - decontaminate all heavy equipment, hand tools, subcontractor equipment and tools
10-002	Remove Temporary Facilities and E&S Controls	1	LS	$ 40,000.00	$ 40,000.00	Vendor estimate
10-003	Demobilize Equipment	1	LS	$ 50,000.00	$ 50,000.00	Vendor estimate
				SUBTOTAL COST	**$ 5,193,944.00**	

Direct Cost Adjustments		
Health and Safety on Labor and Equipment (5%)	$ -	Health and Safety included in performance rates (assumed Level C)
Indirect Cost Adjustments		
Tax on Materials (7%)	$ -	Taxes (if any) are included in the presented rates
G&A @10% of Equipment, Material, and Labor	$ -	G&A is included in the presented rates
Subcontract Fee @ 4%	$ -	Fee is included in the presented rates
Labor OH @60%	$ -	Overhead is included in labor rates
Other Costs		
Profit @ 10% of Subtotal Direct & Indirect	$ -	10% profit is included on capital costs
Engineering Contingency at 15%; Construction Contingency at 10% of Construction Cost	$ 1,084,825.00	
Office & Management Support @ 3% Direct & Indirect	$ 155,818.32	

TOTAL COST **$ 6,434,587.32**

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Slurry Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Pre-Construction Work						
01-001	Pre-Design Investigation					
01-001a	Test-Pit Sample Collection & Extent Verification & Engineering Parameter Samples	1	LS	$ 75,000.00	$ 75,000.00	Previous Project Experience - Excavate/delineate to the edge of the sludge in each area. Collect engineering parameter samples for pile design.
01-001c	Odor control verification testing	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience - Verify selected foam will provide adequate temporary odor control
01-002	Engineering & Removal Designs and Specifications	1	LS	$ 485,544.00	$ 485,544.00	Assume 6% of physical construction capital cost in accordance with costing guidance manual EPA 540-R-00-002
01-003	Project Bonding	1	LS	$ 90,000.00	$ 90,000.00	Industry-Based Estimate (1% of physical construction capital costs)
01-004	Project Planning & Submittals					
01-004a	Construction Work Plan and Schedule	1	LS	$ 20,000.00	$ 20,000.00	Previous Project Experience
01-004b	Health and Safety Plan	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004c	Erosion/Sediment Control Plan	1	LS	$ 10,000.00	$ 10,000.00	Previous Project Experience
01-004d	Storm water and water control plan	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience
01-004e	Construction QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004f	Analytical QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
02 - Project Management and Staffing						
02-001	Site Superintendent	14	MO	$ 20,000.00	$ 280,000.00	Vendor Estimate
02-002	Health & Safety Manager	14	MO	$ 15,000.00	$ 210,000.00	Vendor Estimate
02-003	Contractor QC Manager	14	MO	$ 7,500.00	$ 105,000.00	Vendor Estimate
02-004	Office & Accounting Support	14	MO	$ 3,000.00	$ 42,000.00	Vendor Estimate
03 - Mobilization, Site Preparation, and Temp Facilities						
03-001	Mobilization	1	LS	$ 50,000.00	$ 50,000.00	Vendor Estimate
03-002	Temporary Facilities					
03-002a	Temporary Facilities - Trailer; Storage containers; Phone; Internet; Site Staff Travel Expenses	14	MO	$ 7,500.00	$ 105,000.00	1 Trailers, 1 Storage Container, Phone, Internet, Site Management Travel Expenses
03-002b	Temporary Facilities - Electric; water	14	MO	$ 4,000.00	$ 56,000.00	600-Amp service for the life of the project, includes installation of a power drop and meter establishment
03-002c	Temporary Facilities - MSW Disposal	500	TON	$ 100.00	$ 50,000.00	Weekly pickup at the site
03-002d	Temporary Facilities - Fencing/Dust Screens	2500	LF	$ 15.00	$ 37,500.00	6' secured panel fencing, wind screen, dust fabric
03-002e	Water Management Facilities (tanks, pumps, hose)	14	MO	$ 10,000.00	$ 140,000.00	2 Fractionation tanks, Suction pumps; Transfer pumps; hoses; in-line meter; tank cleanout
03-002f	Water discharge to PTOW	150,000	GAL	$ 0.05	$ 7,500.00	Vendor Estimate; based on known water levels
03-003	Site Preparation					
03-003a	Site Prep. Install/Maintain E&S Controls	3500	LF	$ 8.00	$ 28,000.00	Silt fencing & straw wattles around entire work area. Double silt fence along the Nashua River
03-003b	Clearing/Chipping/Grubbing Work Areas	5	Ac	$ 15,000.00	$ 75,000.00	Medium-thickness clearing to 6" above grade. Off-site recycling.
03-003c	Disposal of below-grade vegetation	250	TON	$ 100.00	$ 25,000.00	Grub stumps from cleared areas; Remove soil/sludge to the extent practicable. Size for off-site disposal

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Slurry Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
03-003d	Decontamination Facilities	4	Ea	$ 5,000.00	$ 20,000.00	1 Stabilized construction entrance; 3 equipment/personnel decontamination stations located on-site
03-003e	Access Road Construction/Improvement	1	LS	$ 36,000.00	$ 36,000.00	1,000 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric. Installed to access Broad Street Parkway
03-003f	On-site Haul Road Improvement	1	LS	$ 27,000.00	$ 27,000.00	750 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric for on-site access roads.
03-003g	Stockpile/Staging Area Preparation	1	LS	$ 20,000.00	$ 20,000.00	Graded 100'X100' pad with soil berms, water collection sump, and bedded with a nonwoven geotextile over crushed stone
03-003h	By-Pass/Remove/Replace Sewer	350	LF	$ 300.00	$ 105,000.00	Locate and protect 48-inch RCP during construction.
03-003I	Abandon Monitoring Wells	3	Ea	$ 2,000.00	$ 6,000.00	Abandon GZ-9, GZ-10, and the supply well
04 - Project Controls						
04-001	Health and Safety Equipment Purchase/Maintenance	14	MO	$ 4,500.00	$ 63,000.00	Purchase, store, and use Tyvek suits, full-face respirators, respirator cartridges, PIDs, Multi-gas meters, ammonia meters, perimeter air monitoring equipment
04-002	Dust Control Equipment	14	MO	$ 5,000.00	$ 70,000.00	Air misting equipment, water truck with water bar/sprayer, multiple layers of ballasted polyethylene sheeting over stockpiles
04-003	Work Area Odor Control Equipment and Materials					
04-003a	Odor Foam Machines	14	MO	$ 5,000.00	$ 70,000.00	Purchase and operate two Rusmar foam disperser pumps
04-003b	Odor Foam 40 drums per month	280	DRUMS	$ 550.00	$ 154,000.00	Delivery and store Rusmar anti-odor foam
04-004	Perimeter Odor Control Equipment and Materials	14	MO	$ 7,500.00	$ 105,000.00	Air-misting equipment at the site perimeter with the neighborhood with anti-odor scents
04-005	Establishment of Survey Controls	1	LS	$ 50,000.00	$ 50,000.00	Surveys for the following: pre-construction, post-construction, performance & progress payments
04-006	Materials/QC Testing	1	LS	$ 25,000.00	$ 25,000.00	Materials QC testing, strength testing, permeability testing, compaction testing, and engineering submittal testing
05 - Excavation of Overlying Soil and SRS-Exceeding Soil						
05-001	Area 1 -Excavate Soil Berms, Transport, Stockpile	1500	CY	$ 20.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-002	Area 2 - Excavate 3 feet, Transport, Stockpile	9000	CY	$ 20.00	$ 180,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-003	Area 3 - Excavate 2 feet, Transport, Stockpile	225	CY	$ 25.00	$ 5,625.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-004	Area 4 - Excavate 3 feet, Transport, Stockpile	400	CY	$ 25.00	$ 10,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-005	Area 6 - Excavate 3 feet, Transport, Stockpile	675	CY	$ 25.00	$ 16,875.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-006	Area 7 - Excavate 4 feet, Transport, Stockpile	2250	CY	$ 20.00	$ 45,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Slurry Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
05-007	SRS-Exceeding Soil, Transport to Area 1	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
06 - Sludge Consolidation						
06-001	Area 3 - Excavate 5 feet Transport to Area 1/2	550	CY	$ 25.00	$ 13,750.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-002	Area 4 - Excavate 6 feet Transport to Area 1/2	800	CY	$ 25.00	$ 20,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-003	Area 6 - Excavate 5 feet Transport to Area 1/2	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-004	Area 7 - Excavate 8 feet Transport to Area 1/2	4500	CY	$ 20.00	$ 90,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
07 - Slurry Wall Vertical Encapsulation						
07-001	Install Guidewalls for Slurry Wall	1600	LF	$ 50.00	$ 80,000.00	RS Means - 4-feet deep trench 3 feet wide along the proposed alignment; reinforced at the surface with cast in-place concrete
07-002	Install Soldier Pile Slurry Wall	36000	SF	$ 125.00	$ 4,500,000.00	Vendor Estimate & R.S. Means Slurry Trench - 1,600 feet of 22-foot trench; H-Piles 8' on center. Inject Slurry. Slurry management crew cost included
07-003	Management of Slurry & Consolidation with Sludge	140000	GAL	$ 0.75	$ 105,000.00	Construct a lagoon on-site to allow slurry to dewater. Excavate and transport dewatered slurry to be interred with sludge.
08 - Impermeable Cap Over Sludge & Vent System Construction						
08-001	Furnish and install 1 layer of triaxial geo-grid	14000	SY	$ 4.00	$ 56,000.00	Vendor estimate. Geo-grid to diffuse cap loads
08-002	Deliver and Install 12-Inches of 3/4-Inch Vent Stone	1400	TON	$ 60.00	$ 84,000.00	Vendor estimate - assumes 3' wide, 1' thick pipe trenches.
08-003	Furnish and Install 6-Inch Multi-Flow Vent Strip	7700	LF	$ 15.00	$ 115,500.00	Vendor estimate
08-004	Import, place, and rough-grade 12 inch sublayer	5000	CY	$ 39.00	$ 195,000.00	NH DOT weighted average materials sheet & vendor estimate
08-005	Furnish and install geosynthetic membrane	14000	SY	$ 6.75	$ 94,500.00	Previous project estimate - up to 60-mil textured membrane, field-extrusion welded
08-006	Furnish and Install Vent Risers	14	EA	$ 1,500.00	$ 21,000.00	Vendor estimate along a 25-foot center
08-007	Construct riser boots	14	EA	$ 100.00	$ 1,400.00	Previous project estimate - seal boot to geomembrane with extrusion welds
08-008	Furnish and install biplanar geocomposite	14000	SY	$ 8.30	$ 116,200.00	Biplaner geocompsite drainage layer in-lieu of sand/gravel drainage layer
08-009	Screen/place/compact/fine grade 12" reuse protective layer	5000	CY	$ 33.00	$ 165,000.00	Vendor estimate - Promote positive water-shedding off the cap screened to 4" minus
08-010	Drainage swale and underdrain construction	1500	LF	$ 37.00	$ 55,500.00	7-inch minus rip-rap downchutes and swale to detention pond. Swales unerlain by 8-inch corrugated HDPE pipe to direct percolated water to the detention pond
08-011	Excavate stormwater detention basin	3700	CY	$ 20.00	$ 74,000.00	4-foot deep detention pond
08-012	Storm water detention system construction	1	Lump	$ 12,000.00	$ 12,000.00	Vegetated detention pond w/high water release to river
08-013	Furninsh & place armoring subgrade/cushion aggregate materials	1000	CY	$ 36.00	$ 36,000.00	NH DOT weighted average materials sheet. 3-inch minus stone and gravel mixture.
08-014	Furninsh & place armoring stone w/in floodplain	2500	CY	$ 40.00	$ 100,000.00	NH DOT weighted average materials sheet - Class B Stone
08-015	Furnish and place 6" topsoil layer	2300	CY	$ 45.00	$ 103,500.00	Vendor estimate
09 - Backfill & Site Restoration						
09-001	Place Reuse Soil Into Areas 6 and 7	8600	CY	$ 20.00	$ 172,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-002	Fine-Grade/Compact Areas 6 and 7	2000	SY	$ 3.00	$ 6,000.00	Vendor estimate - Fine-grade and compact top lifts

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Slurry Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
09-003	Deliver and Place 4-Inches of Topsoil - Areas 6 and 7	200	CY	$ 45.00	$ 9,000.00	Vendor estimate - Deliver and transfer topsoil to work area
09-004	Place Reuse Soil Into Areas 3 and 4	2000	CY	$ 20.00	$ 40,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-005	Fine-Grade/Compact Areas 3 and 4	800	SY	$ 3.00	$ 2,400.00	Vendor estimate - Fine-grade and compact top lifts
09-006	Deliver and Place 4-Inches of Topsoil - Areas 3 and 4	70	CY	$ 45.00	$ 3,150.00	Vendor estimate - Deliver and transfer topsoil to work area
09-007	Hydroseed Encapsulation Area	14000	SY	$ 3.00	$ 42,000.00	Vendor estimate - Hydroseed and mulch the stabilized area.
09-008	Replace Abandoned Monitoring Wells	2	Ea	$ 2,500.00	$ 5,000.00	Previous project experience. Install 2 replacement wells (GZ-09, GZ-10) supply well will not be re-drilled
10 - Decontamination, Temp. Facilities Removal & Demobilization						
10-001	Decontaminate Equipment	8	Ea	$ 1,500.00	$ 12,000.00	Vendor estimate - decontaminate all heavy equipment, hand tools, subcontractor equipment and tools
10-002	Remove Temporary Facilities and E&S Controls	1	LS	$ 40,000.00	$ 40,000.00	Vendor estimate
10-003	Demobilize Equipment	1	LS	$ 50,000.00	$ 50,000.00	Vendor estimate

SUBTOTAL COST **$ 9,443,944.00**

Direct Cost Adjustments		
Health and Safety on Labor and Equipment (5%)	$ -	Health and Safety included in performance rates (assumed Level C)
Indirect Cost Adjustments		
Tax on Materials (7%)	$ -	Taxes (if any) are included in the presented rates
G&A @10% of Equipment, Material, and Labor	$ -	G&A is included in the presented rates
Subcontract Fee @ 4%	$ -	Fee is included in the presented rates
Labor OH @60%	$ -	Overhead is included in labor rates
Other Costs		
Profit @ 10% of Subtotal Direct & Indirect	$ -	10% profit is included on capital costs
Engineering Contingency at 15%; Construction Contingency at 10% of Construction Cost	$ 2,023,100.00	
Office & Management Support @ 3% Direct & Indirect	$ 283,318.32	

TOTAL COST **$ 11,750,362.32**

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Secant Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Pre-Construction Work						
01-001	Pre-Design Investigation					
01-001a	Test-Pit Sample Collection & Extent Verification & Engineering Parameter Samples	1	LS	$ 75,000.00	$ 75,000.00	Previous Project Experience - Excavate/delineate to the edge of the sludge in each area. Collect engineering parameter samples for pile design.
01-001c	Odor control verification testing	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience - Verify selected foam will provide adequate temporary odor control
01-002	Engineering & Removal Designs and Specifications	1	LS	$ 527,124.00	$ 527,124.00	Assume 6% of physical construction capital cost in accordance with costing guidance manual EPA 540-R-00-002
01-003	Project Bonding	1	LS	$ 90,000.00	$ 90,000.00	Industry-Based Estimate (1% of physical construction capital costs)
01-004	Project Planning & Submittals					
01-004a	Construction Work Plan and Schedule	1	LS	$ 20,000.00	$ 20,000.00	Previous Project Experience
01-004b	Health and Safety Plan	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004c	Erosion/Sediment Control Plan	1	LS	$ 10,000.00	$ 10,000.00	Previous Project Experience
01-004d	Storm water and water control plan	1	LS	$ 5,000.00	$ 5,000.00	Previous Project Experience
01-004e	Construction QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
01-004f	Analytical QAPP	1	LS	$ 8,000.00	$ 8,000.00	Previous Project Experience
02 - Project Management and Staffing						
02-001	Site Superintendent	25	MO	$ 20,000.00	$ 500,000.00	Vendor Estimate
02-002	Health & Safety Manager	25	MO	$ 15,000.00	$ 375,000.00	Vendor Estimate
02-003	Contractor QC Manager	25	MO	$ 7,500.00	$ 187,500.00	Vendor Estimate
02-004	Office & Accounting Support	25	MO	$ 3,000.00	$ 75,000.00	Vendor Estimate
03 - Mobilization, Site Preparation, and Temp Facilities						
03-001	Mobilization	1	LS	$ 50,000.00	$ 50,000.00	Vendor Estimate
03-002	Temporary Facilities					
03-002a	Temporary Facilities - Trailer; Storage containers; Phone; Internet; Site Staff Travel Expenses	25	MO	$ 7,500.00	$ 187,500.00	1 Trailers, 1 Storage Container, Phone, Internet, Site Management Travel Expenses
03-002b	Temporary Facilities - Electric; water	25	MO	$ 4,000.00	$ 100,000.00	600-Amp service for the life of the project, includes installation of a power drop and meter establishment
03-002c	Temporary Facilities - MSW Disposal	500	TON	$ 100.00	$ 50,000.00	Weekly pickup at the site
03-002d	Temporary Facilities - Fencing/Dust Screens	2500	LF	$ 15.00	$ 37,500.00	6' secured panel fencing, wind screen, dust fabric
03-002e	Water Management Facilities (tanks, pumps, hose)	25	MO	$ 10,000.00	$ 250,000.00	2 Fractionation tanks, Suction pumps; Transfer pumps; hoses; in-line meter; tank cleanout
03-002f	Water discharge to PTOW	150,000	GAL	$ 0.05	$ 7,500.00	Vendor Estimate; based on known water levels
03-003	Site Preparation					
03-003a	Site Prep. Install/Maintain E&S Controls	3500	LF	$ 8.00	$ 28,000.00	Silt fencing & straw wattles around entire work area. Double silt fence along the Nashua River
03-003b	Clearing/Chipping/Grubbing Work Areas	5	Ac	$ 15,000.00	$ 75,000.00	Medium-thickness clearing to 6" above grade. Off-site recycling.
03-003c	Disposal of below-grade vegetation	250	TON	$ 100.00	$ 25,000.00	Grub stumps from cleared areas; Remove soil/sludge to the extent practicable. Size for off-site disposal

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Secant Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
03-003d	Decontamination Facilities	4	Ea	$ 5,000.00	$ 20,000.00	1 Stabilized construction entrance; 3 equipment/personnel decontamination stations located on-site
03-003e	Access Road Construction/Improvement	1	LS	$ 36,000.00	$ 36,000.00	1,000 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric. Installed to access Broad Street Parkway
03-003f	On-site Haul Road Improvement	1	LS	$ 27,000.00	$ 27,000.00	750 feet of 16-foot wide 1.5-inch crushed stone-bedded with filter fabric for on-site access roads.
03-003g	Stockpile/Staging Area Preparation	1	LS	$ 20,000.00	$ 20,000.00	Graded 100'X100' pad with soil berms, water collection sump, and bedded with a nonwoven geotextile over crushed stone
03-003h	By-Pass/Remove/Replace Sewer	350	LF	$ 300.00	$ 105,000.00	Locate and protect 48-inch RCP during construction.
03-003I	Abandon Monitoring Wells	3	Ea	$ 2,000.00	$ 6,000.00	Abandon GZ-9, GZ-10, and the supply well
04 - Project Controls						
04-001	Health and Safety Equipment Purchase/Maintenance	25	MO	$ 4,500.00	$ 112,500.00	Purchase, store, and use Tyvek suits, full-face respirators, respirator cartridges, PIDs, Multi-gas meters, ammonia meters, perimeter air monitoring equipment
04-002	Dust Control Equipment	25	MO	$ 5,000.00	$ 125,000.00	Air misting equipment, water truck with water bar/sprayer, multiple layers of ballasted polyethylene sheeting over stockpiles
04-003	Work Area Odor Control Equipment and Materials					
04-003a	Odor Foam Machines	25	MO	$ 5,000.00	$ 125,000.00	Purchase and operate two Rusmar foam disperser pumps
04-003b	Odor Foam 40 drums per month	280	DRUMS	$ 550.00	$ 154,000.00	Delivery and store Rusmar anti-odor foam
04-004	Perimeter Odor Control Equipment and Materials	25	MO	$ 7,500.00	$ 187,500.00	Air-misting equipment at the site perimeter with the neighborhood with anti-odor scents
04-005	Establishment of Survey Controls	1	LS	$ 50,000.00	$ 50,000.00	Surveys for the following: pre-construction, post-construction, performance & progress payments
04-006	Materials/QC Testing	1	LS	$ 25,000.00	$ 25,000.00	Materials QC testing, strength testing, permeability testing, compaction testing, and engineering submittal testing
05 - Excavation of Overlying Soil and SRS-Exceeding Soil						
05-001	Area 1 -Excavate Soil Berms, Transport, Stockpile	1500	CY	$ 20.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-002	Area 2 - Excavate 3 feet, Transport, Stockpile	9000	CY	$ 20.00	$ 180,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-003	Area 3 - Excavate 2 feet, Transport, Stockpile	225	CY	$ 25.00	$ 5,625.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-004	Area 4 - Excavate 3 feet, Transport, Stockpile	400	CY	$ 25.00	$ 10,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-005	Area 6 - Excavate 3 feet, Transport, Stockpile	675	CY	$ 25.00	$ 16,875.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
05-006	Area 7 - Excavate 4 feet, Transport, Stockpile	2250	CY	$ 20.00	$ 45,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Secant Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
05-007	SRS-Exceeding Soil, Transport to Area 1	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, D5-dozer
06 - Sludge Consolidation						
06-001	Area 3 - Excavate 5 feet Transport to Area 1	550	CY	$ 25.00	$ 13,750.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-002	Area 4 - Excavate 6 feet Transport to Area 1	800	CY	$ 25.00	$ 20,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-003	Area 6 - Excavate 5 feet Transport to Area 1	1200	CY	$ 25.00	$ 30,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
06-004	Area 7 - Excavate 8 feet Transport to Area 1	4500	CY	$ 20.00	$ 90,000.00	Vendor estimate - 300 Series excavator, 30-ton haul truck
07 - Secant Wall Vertical Encapsulation						
07-001	Installation of Secant Pile Wall	1	EA	$ 4,200,000.00	$ 4,200,000.00	Vendor Estimate-Single Rig & Slurry support crew
07-002	Installation of Reinforcing Steel	500	EA	$ 1,210.00	$ 605,000.00	R.S. Means - Driven H-Pile; Size 14X73; 22 feet long; apprx. 4 feet O.C.
07-002	Excavation spoils management	3500	CY	$ 30.00	$ 105,000.00	Vendor estimate - 300-series excavator, 3 CY bucket, 30-ton haul truck, significant stand-by time
08 - Impermeable Cap Over Sludge & Vent System Construction						
08-001	Furnish and install 1 layer of triaxial geo-grid	14000	SY	$ 4.00	$ 56,000.00	Vendor estimate. Geo-grid to diffuse cap loads
08-002	Deliver and Install 12-Inches of 3/4-Inch Vent Stone	1400	TON	$ 60.00	$ 84,000.00	Vendor estimate - assumes 3' wide, 1' thick pipe trenches.
08-003	Furnish and Install 6-Inch Multi-Flow Vent Strip	7700	LF	$ 15.00	$ 115,500.00	Vendor estimate
08-004	Import, place, and rough-grade 12 inch sublayer	5000	CY	$ 39.00	$ 195,000.00	NH DOT weighted average materials sheet & vendor estimate
08-005	Furnish and install geosynthetic membrane	14000	SY	$ 6.00	$ 84,000.00	Previous project estimate - up to 60-mil textured membrane, field-extrusion welded
08-006	Furnish and Install Vent Risers	14	EA	$ 1,500.00	$ 21,000.00	Vendor estimate along a 25-foot center
08-007	Construct riser boots	14	EA	$ 100.00	$ 1,400.00	Previous project estimate - seal boot to geomembrane with extrusion welds
08-008	Furnish and install biplanar geocomposite	14000	SY	$ 8.30	$ 116,200.00	Biplaner geocompsite drainage layer in-lieu of sand/gravel drainage layer
08-009	Screen/place/compact/fine grade 12" reuse protective layer	5000	CY	$ 33.00	$ 165,000.00	Vendor estimate - Promote positive water-shedding off the cap screened to 4" minus
08-010	Drainage swale and underdrain construction	1500	LF	$ 37.00	$ 55,500.00	7-inch minus rip-rap downchutes and swale to detention pond. Swales unerlain by 8-inch corrugated HDPE pipe to direct percolated water to the detention pond
08-011	Excavate stormwater detention basin	3700	CY	$ 20.00	$ 74,000.00	4-foot deep detention pond
08-012	Storm water detention system construction	1	Lump	$ 12,000.00	$ 12,000.00	Vegetated detention pond w/high water release to river
08-013	Furninsh & place armoring subgrade/cushion aggregate materials	1000	CY	$ 36.00	$ 36,000.00	NH DOT weighted average materials sheet. 3-inch minus stone and gravel mixture.
08-014	Furninsh & place armoring stone w/in floodplain	2500	CY	$ 40.00	$ 100,000.00	NH DOT weighted average materials sheet - Class B Stone
08-015	Furnish and place 6" topsoil layer	2300	CY	$ 45.00	$ 103,500.00	Vendor estimate
09 - Backfill & Site Restoration						
09-001	Place Reuse Soil Into Areas 6 and 7	8600	CY	$ 20.00	$ 172,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil
09-002	Fine-Grade/Compact Areas 6 and 7	2000	SY	$ 3.00	$ 6,000.00	Vendor estimate - Fine-grade and compact top lifts
09-003	Deliver and Place 4-Inches of Topsoil - Areas 6 and 7	200	CY	$ 45.00	$ 9,000.00	Vendor estimate - Deliver and transfer topsoil to work area
09-004	Place Reuse Soil Into Areas 3 and 4	2000	CY	$ 20.00	$ 40,000.00	Vendor estimate - Load, transport, backfill, compact re-use soil

Attachment B-5 - Table 3-CC
Capital Costs for Alternative 5 - Encapsulation (Secant Wall)/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
09-005	Fine-Grade/Compact Areas 3 and 4	800	SY	$ 3.00	$ 2,400.00	Vendor estimate - Fine-grade and compact top lifts
09-006	Deliver and Place 4-Inches of Topsoil - Areas 3 and 4	70	CY	$ 45.00	$ 3,150.00	Vendor estimate - Deliver and transfer topsoil to work area
09-007	Hydroseed Encapsulation Area	14000	SY	$ 3.00	$ 42,000.00	Vendor estimate - Hydroseed and mulch the stabilized area.
09-008	Replace Abandoned Monitoring Wells	2	Ea	$ 2,500.00	$ 5,000.00	Previous project experience. Install 2 replacement wells (GZ-09, GZ-10) supply well will not be re-drilled
10 - Decontamination, Temp. Facilities Removal & Demobilization						
10-001	Decontaminate Equipment	8	Ea	$ 1,500.00	$ 12,000.00	Vendor estimate - decontaminate all heavy equipment, hand tools, subcontractor equipment and tools
10-002	Remove Temporary Facilities and E&S Controls	1	LS	$ 40,000.00	$ 40,000.00	Vendor estimate
10-003	Demobilize Equipment	1	LS	$ 50,000.00	$ 50,000.00	Vendor estimate

SUBTOTAL COST **$ 10,679,024.00**

Direct Cost Adjustments		
Health and Safety on Labor and Equipment (5%)	$ -	Health and Safety included in performance rates (assumed Level C)
Indirect Cost Adjustments		
Tax on Materials (7%)	$ -	Taxes (if any) are included in the presented rates
G&A @10% of Equipment, Material, and Labor	$ -	G&A is included in the presented rates
Subcontract Fee @ 4%	$ -	Fee is included in the presented rates
Labor OH @60%	$ -	Overhead is included in labor rates
Other Costs		
Profit @ 10% of Subtotal Direct & Indirect	$ -	10% profit is included on capital costs
Engineering Contingency at 15%; Construction Contingency at 10% of Construction Cost	$ 2,196,350.00	
Office & Management Support @ 3% Direct & Indirect	$ 320,370.72	

TOTAL COST **$ 13,195,744.72**

Attachment B-5 - Table 3-PRSC
Post-Removal Site Control Costs for Alternative 5 - Encapsulation/Impermeable Capping
Mohawk Tannery Site
Nashua, New Hampshire

Item No.	Item	Qty.	Unit	Unit Cost ($)	Total Cost ($)	Comments/Reference
01 - Post-Construction Monitoring						
01-001	Vegetation/Erosion Verification	8	Event	$ 786.00	$ 6,288.00	Previous project experience. Mobilize to the site quarterly for 2 years, document cap conditions, document deficiencies, prepare/issue inspection report.
01-002	Groundwater Monitoring	60	Event	$ 8,300.00	$ 498,000.00	Previous project experience. Biannual groundwater monitoring of 8 monitoring wells using standard sampling methods. Estimate assumes dedicated sampling equipment for each sampling round, and two field personnel. Assumes 30 years of monitoring, submittal of a data report for each sampling event, and an annual groundwater monitoring report.
01-003	Annual Groundwater Reporting	30	Year	$ 4,600.00	$ 138,000.00	Previous project experience. Biannual groundwater monitoring of 8 monitoring wells using standard sampling methods. Estimate assumes dedicated sampling equipment for each sampling round, and two field personnel. Assumes 30 years of monitoring, submittal of a data report for each sampling event, and an annual groundwater monitoring report.
01-004	Annual Cap Inspection	30	Year	$ 7,500.00	$ 225,000.00	Previous project experience. Assumes annual inspections and cap inspection report submittals consistent with solid waste cap inspection reports. For an assumed period of 30 years.
04-005	Cap maintenance	30	Year	$ 3,500.00	$ 105,000.00	Cap mowing twice per year using a tractor-pulled brush mower. Cuttings allowed to mulch in-place. Animal burrow mainteance assumed to require approximately $500 annually.
			SUBTOTAL COST		**$ 972,288.00**	

Direct Cost Adjustments		
Health and Safety on Labor and Equipment (5%)	$ -	Health and Safety included in performance rates
Indirect Cost Adjustments		
Tax on Materials (7%)	$ -	Taxes (if any) are included in the presented rates
G&A @10% of Equipment, Material, and Labor	$ -	G&A is included in the presented rates
Subcontract Fee @ 4%	$ -	Fee is included in the presented rates
Labor OH @60%	$ -	Overhead is included in labor rates
Other Costs		
Profit @ 10% of Subtotal Direct & Indirect	$ -	10% profit is included on capital costs
Engineering Contingency at 10% of PRSC Cost	$ 97,228.80	Factors applied consistent with EPA cost guidance 540-R-00-002.
Office & Management Support @ 3% Direct & Indirect	$ 97,228.80	Factors applied consistent with EPA cost guidance 540-R-00-002.

TOTAL COST **$ 1,166,745.60**