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REMEDIAL ACTION PLAN

Petrolane/Northern Utilities, Inc. Site
Route 125
Rochester, NH 03867

NHDES Site #: 198712002
Project Type: Hazardous Waste Project
Project Number: 0432

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1. Introduction

The former Rochester Manufactured Gas Plant (MGP) site (Site) is located at the intersection of Route 125 and the Spaulding Turnpike in Rochester, New Hampshire. The Site is bounded by Axe Handle Brook to the north, the Cocheco River to the east, and roadways on the west and south (Figure 1-1). The MGP facility operated in the western portion of the Site from 1903 through 1957.

A Source Removal Action was conducted at the Site during the period of September 1999 to December 1999. The source removal activities focused on those areas of the Site where there was evidence of source material within the practical depth of excavation, i.e., two feet (ft.) below the depth of the water table (Figure 1-2). During the program, 19,500 tons of impacted soil was excavated from the Site (RETEC, 2001). The program was designed to address approximately 95% of the source material identified in the Phase II Site Investigation Report (HLA, 1999).

An additional source removal action was conducted in the Former Tar Well Area (Figure 1-2) during the period of January to April 2004 to address source material that had previously been inaccessible due to the presence of infrastructure for the propane distribution system. As in the previous source removal action, the practical depth of excavation was established to be two ft. below the water table. During the program, the top of the tar well was uncovered and investigated. The circular structure was measured with a diameter of 19 ft. and a depth of 7 ft. (10 ft. bgs). The contents of the structure (i.e., approximately 386 tons of impacted soil, 7,303 gallons of benzene-impacted wastewater, 9,439 gallons of emulsion, and approximately 14 tons of coal tar and debris) were removed and managed off-Site at permitted facilities. Subsequently, the walls of the structure were cleaned, the structure was closed using flowable fill, and the excavation was backfilled (RETEC, 2004a). On December 22, 2004, NHDES issued a Certificate of Completion for the remedial actions implemented at the Site.

The Groundwater Management Permit (GWP) for the Site was renewed by the New Hampshire Department of Environmental Services (NHDES) on July 2, 2018 (GWP-198712002-R-006). Under the current GWP, water quality monitoring events are performed in November of each year, and biennial Groundwater Quality Summary Reports are submitted in January of every even numbered year.

In July of 2018, the NHDES requested that Unitil review the results from the groundwater monitoring program and evaluate options for improving the degradation rate of MGP constituents. Unitil's review demonstrated the following:

- The concentrations of the principal MGP constituents were stable, but at a level that is greater than NHDES criteria for site closure; and
- The dissolved-phase concentrations at the Site would not affect the ambient water quality of the Cocheco River.

In 2021, Unitil conducted an investigation to delineate the source material at the Site in an effort to identify impacts that were continuing to affect groundwater quality. The Source Material Investigation Report (AECOM, 2022) identified MGP residuals that are located below the previous remediation area and proximate to the existing monitoring wells as the likely source of the continuing dissolved-phase impacts.

In June 2022, NHDES approved the report and directed Unitil to develop a Remedial Action Plan (RAP) to address the residual contamination to further decrease the dissolved-phase concentrations of MGP constituents of interest (COI). This document has been developed based on the findings of the investigation to recommend a remedy to address the remaining impacts. It is organized as follows: Section 2 summarizes the findings from the source area investigation; Section 3 presents the goals for the proposed remedial action; Section 4 provides and evaluation of the proposed remedial alternatives; Section 5 presents the recommended remedial alternative and Section 6 lists the references used in the preparation of this

document. The appendices present the information used to develop the cost estimates for the remedial alternatives.

2. Summary of Remaining Site Impacts

The approved RAP for the 2000 source removal action (ReTec, 1999) anticipated that residual impacts in the lower depths of the saturated zone would remain in place since, at that time, it was determined that the significant cost of additional dewatering to support their excavation was not warranted. However, the results from the 2020 investigation indicate that the distribution of MGP impacts below the remediation area are more extensive than those identified previously. Additionally, a further review of the results presented in the Phase II Report (HLA, 1999) indicate that there are additional areas of source material proximate to MW-02D and MW-03S that are likely affecting those locations.

A summary of the impacts believed to be contributing to the current levels of dissolved-phase impacts is presented in Table 2-1. As indicated, oil-like material (OLM), indicative of non-aqueous phase liquid (NAPL) from the MGP process, was observed in the saturated zone at the majority of locations. The NAPL appears to be generally present in a residual state, i.e., not mobile in the environment. There have not been any observations of NAPL in Site monitoring wells, or sheen on the Cocheco River/ Axe Handle Brook.

As discussed in the Source Material Investigation Report, the most significant quantities of NAPL were observed beneath the prior excavation area at locations GP-712 (3.3 [ft. thickness) in a silt/sand layer and GP-708 (9.9 ft. thickness)/ GP-709 (6.8 ft. thickness) in a lower gravel layer. The frequency and thickness of impacts are observed to decrease at locations towards Axe Handle Brook and the Cocheco River. Generally, impacts were observed at deepening intervals with distance from the prior excavation area.

The locations of the principal source area and areas believed to be affecting the monitoring locations, i.e., secondary source areas, are illustrated in Figure 2-1. The source area is approximately 37,000 square feet (sq ft) in size, with impacts present in depths from 8 to 18 ft. in the saturated zone, resulting in approximately 16,400 cubic yards (cy) of impacted media. The location and quantity of impacts in these areas were used in the evaluation of the remedial alternatives presented in Section 4 of this document.

3. Remedial Goals

The prior remedial action was appropriate to address the potential exposure pathways at the Site and achieved the following:

- Trend analyses demonstrate that constituent concentrations of the Site monitoring wells either show no trend or a decreasing trend.
- Modeling demonstrates that groundwater concentrations of MGP constituents will not adversely affect compliance with NHDES Surface Water Quality Criteria under mean stream flow conditions of the Cocheco River.
- The Activity Use Restriction that was implemented as part of the prior source removal action (Appendix A) mitigates the potential risk from exposure to MGP impacts in soil and prohibits the use of groundwater.

Although there is no risk for current and future Site use, the predicted reduction in groundwater constituent concentrations has not been achieved.

As a result, the goals for the proposed remedial action are as follows:

- The continued prevention of the ingestion/direct contact with impacted soil.
- The continued prevention of the ingestion/direct contact with impacted groundwater.
- Obtain a further reduction in the dissolved-phase concentrations of MGP constituents of interest.

Achieving these goals will require the proposed remedial activities to achieve the following objectives:

- reduce the quantity/strength of impacted source material that is affecting groundwater quality to the extent feasible.
- implement institutional controls to address remaining exposure pathways.

The following evaluation of remedial alternatives is intended to identify a remedy that will achieve a reasonable balance between environmental benefit and remedial.

4. Evaluation of Remedial Alternatives

Meeting the Remedial Goals at former MGP sites typically involves removal/treatment or containment of impacted media. The efforts are frequently supported with the use of institutional controls to address potential exposure pathways associated with residual impacts.

The proposed remedies at the Site will focus on the removal/treatment of source material and include the following approaches that are routinely used at former MGP sites: excavation, *in-situ* solidification (ISS) and *in-situ* chemical oxidation (ISCO). Another MGP remedy, product recovery, is not being evaluated since it would not deal with impacts that are not mobile in the environment, i.e., are present at concentrations that are less than their residual saturation point.

Discussions of the application of Excavation, Solidification and Chemical Oxidation at the Site are provided below with evaluations using the following criteria:

- Effectiveness and reliability.
- Feasibility and ease of implementation.
- Risk reduction and associated benefits.
- Cost effectiveness using the net present worth of all future costs.
- Estimated time to reach the no further action criteria.

A summary of the findings from the evaluations is provided in Table 4-1.

4.1 Excavation, Natural Attenuation and Activity and Use Restriction

Excavation involves the removal of impacted soil for subsequent disposal at a permitted off-Site facility. The application of the approach at the Site is complicated by the fact that the source material exists in the saturated zone in areas proximate to a high-pressure gas transmission line, the Cocheco River and Axe Handle Brook. This alternative includes the following activities:

- Removal of 18,000 cy of clean overburden in the vadose zone for temporary stockpiling and reuse.
- Dewatering of the excavation and on-Site management of construction water with discharge under permit.
- Excavation and disposal of 10,100 cy of source material from the saturated zone.
- Backfilling of the excavation using the clean overburden with final restoration using 10,100 cy of commercial fill
- Natural Attenuation of dissolved-phase impacts.
- Continued implementation of the AUR to address potential human health risk associated with exposure to residual impacts in soil and groundwater.

Descriptions of these activities are provided below, with the excavation plan provided as Figure 4-1. Note that it is likely that work in the saturated zone will be conducted in a series of limited areas, or “cells” to better control the quantity of construction water generated for treatment/disposal. In that scenario, several of the activities, e.g., excavation/stockpiling of clean overburden, dewatering, excavation of impacted media and re-placement of overburden happening sequentially within a given cell before moving to the next area.

A principal consideration for the project is the protection of an active gas line that runs through the source area to the on-Site gas regulator station as well as the limitations posed by the proximity of the Cocheco River and Axe Handle Brook. The excavation plan includes 10-foot off-sets from these features and requires the excavation side walls be sloped at 1.5:1 to provide appropriate support. Note that these protective measures limit the quantity of source material that can safely be accessed.

4.1.1 Description of Activities

Site preparation activities would include installation of erosion controls, removal of portions of the phytoremediation plots, delineation of soil stockpile/loading areas, and construction of decontamination pads/facilities. Mobilization and Site preparation activities would be expected to be completed within a 1-month period.

4.1.1.1 Excavation and Stockpiling of Clean Overburden

Within the excavation area, the vadose zone soil (0-14 ft. bgs) is largely comprised of clean backfill from the prior remediation effort. This soil (18,000 cy) would be removed to provide access to the source material in the saturated zone and temporarily stockpiled on-Site for reuse as backfill in the bottom of the excavations.

4.1.1.2 Dewatering and Management of Construction Water

Well points or sumps would be installed within the excavation area to draw down groundwater as the excavation proceeds to the required depth. Collected water would be stored in transportable settling tanks, and pretreated (filtration/activated carbon) for subsequent discharge to the Cocheco River under the State Pollution Discharge Elimination System (SPDES) program. The system effluent would be sampled in accordance with the requirements of the associated discharge permit. It has been assumed, for the purpose of this evaluation that a 500 gallons per minute (gpm) water treatment system would be required to manage construction water.

4.1.1.3 Excavation of Impacted Soil from the Saturated Zone

Excavation will proceed as the groundwater is drawn down to a depth of up to 16 ft. in the saturated zone. Excavated soil would be free drained within the excavation and subsequently placed in lined and covered stockpile areas on Site or loaded directly into trucks. Excavated soil that exhibits residual free liquid would require additional treatment using drying/stabilization agents prior to shipment.

Waste characterization sampling would be conducted either pre- or post-excavation for acceptance at the Clean Earth facility in Loudon, NH. Material would be shipped by truck using appropriate procedures/documentation (waste profile sheets/manifests). Trucks would be inspected, decontaminated as necessary, and covered prior to leaving the Site. Excavation activities would be expected to be completed within an approximate 4-month period.

4.1.1.4 Site Restoration

Once the excavation depth is reached, samples would be collected from the base and sidewalls to document Site conditions, and the excavation would be backfilled using the stockpiled overburden. Additional backfill (10,100 cy) from a commercial source would be used to restore the Site.

Remediation support equipment (water treatment system, soil stockpile areas, decontamination area, and Site trailers) would be removed, and Site features would be restored. Backfilling and restoration activities would be expected to be completed within a 2-month period.

4.1.1.5 Natural Attenuation

Natural attenuation refers to a range of physical and biological processes that can reduce the concentration or mobility of contaminants in the subsurface environment. Biodegradation is typically the predominant process at former MGP sites. Naturally occurring microorganisms, e.g., bacteria, can break down dissolved-phase MGP constituents of interest. The conceptual model for microbial activity at former MGP sites assumes that microorganisms will preferentially use oxygen as a terminal electron acceptor (TEA) as they oxidize the organic compounds to carbon dioxide and water. However, when oxygen is not present, microorganisms may use alternate electron acceptors in order to metabolize available organic constituents under anaerobic conditions. These alternate TEAs include nitrate (reduction), ferric iron (Fe^{+3}) (reduction), sulfate (reduction), and carbon dioxide (methanogenesis). Monitoring parameters to evaluate natural attenuation include the following:

- Dissolved Oxygen – low levels of dissolved oxygen (DO) in the presence of residual constituents may indicate areas where microbial activity is taking place under aerobic conditions.
- Oxidation Reduction Potential (ORP) – highly positive ORP values indicate areas where reactions are taking place under aerobic conditions, while lower to negative values indicate areas where anaerobic reactions predominate.
- Sulfate – a decrease in sulfate concentrations in areas of residual COI may indicate that microbes are utilizing sulfate (SO_4^{2-}) as a TEA, reducing sulfate to sulfide (S^{2-}).
- Methane – the presence of methane in groundwater indicates the anaerobic biodegradation of organic compounds.

The presence of active anerobic biodegradation processes at the Site was established during the initial post-remediation period through by the monitoring of the principal TEAs. Recent monitoring results for DO and ORP support the fact that anaerobic processes continue to be active at locations downgradient from the principal source area. Natural attenuation is responsible for the fact that recent analyses document either no trend or a decreasing trend in constituent concentrations at Site boundary wells.

The reduction in source strength by the remedy would likely increase biodegradation rates in downgradient areas of the Site. The post-remediation monitoring program would evaluate whether aerobic processes can be re-established and identify opportunities for biological enhancement to improve the rate of biological degradation.

Remediation Monitoring

Post-remediation monitoring would be conducted on a semi-annual basis for two years to provide the appropriate information to document decreasing concentration trends and evaluate plume stability. Monitoring parameters would include the MGP constituents required by the Groundwater Permit, as well as the following natural attenuation parameters: DO, ORP, ferric iron, sulfate and nitrate. If plume stability is not established in the initial 2-year period, monitoring would continue on an annual basis until stability, e.g., decreasing or no trend can be documented. Unitil proposes to review the requirements for additional groundwater monitoring with NHDES once the plume is stable. Five years of post-remediation monitoring have been assumed to achieve a stable dissolved-phase plume.

4.1.1.6 Activity and Use Restriction

An AUR was placed on the Site following the previous remediation to limit direct human contact with MGP residuals that were left in place. The AUR restricts Site use to commercial/industrial applications and limits activities to those that do not involve the disturbance of groundcover or involve the extraction of groundwater. Additionally, the AUR requires written notification to NHDES of activities that will involve the disturbance of groundcover or groundwater, and that those activities be conducted using OSHA-trained personnel using a plan developed by an environmental professional.

4.1.2 Evaluation Criteria

4.1.2.1 Effectiveness and reliability

The alternative is rated Medium for effectiveness and reliability. Excavation is routinely used at former MGP sites and offers a permanent remedy through the removal and off-Site management of source material. Additionally, the removal of source material will facilitate the reduction of dissolved-phase impacts through on-going biological processes.

However, setbacks from the Cocheco River and Axe Handle Brook will limit access to impacted media in the principal source area and dewatering issues will make the excavation of the secondary source areas infeasible due to the significant depth of the impacts (up to 30 ft. bgs) and the proximity to the Cocheco River.

4.1.2.2 Feasibility and ease of implementation

The alternative is rated Medium for feasibility and ease of implementation since the source material is located in the saturated zone and will require significant dewatering and management of construction water.

4.1.2.3 Risk reduction and associated benefits

The alternative is rated High for overall protection of public health and the environment since it addresses the potential risk for current and future Site uses.

4.1.2.4 Cost Effectiveness

The estimated capital cost of the alternative is $5,320,000, with transportation and disposal estimated to comprise $2,176,000 of that amount. Additional design and oversight costs are estimated to be $660,000. The estimated cost for post-remediation monitoring is $160,000 for the assumed 5-year monitoring period. The total net present value (NPV) project cost (Table B-1) including contingency at 20% is estimated to be $5,660,000.

4.2 Solidification, Natural Attenuation and Activity and Use Restriction

Solidification involves the introduction of cement slurry (grout) into impacted media using an auger or excavator bucket to decrease permeability and increase strength. Treatment would create a permanent solidified mass that would eliminate the potential for MGP residuals to migrate from the Site and “isolate” the areas of contamination from groundwater flow. Solidification would control the ability of the source material to adversely affect groundwater quality. This alternative includes the following activities:

- Removal of 15,400 cy of clean overburden in the vadose zone for temporary stockpiling and reuse.
- Solidification of 19,900 cy of soil, with on-Site management of excess grout within the treatment area.
- Backfilling of the excavation and grading of the treatment area using 15,400 cy of the clean overburden.
- Natural Attenuation of dissolved-phase impacts.
- Continued implementation of the AUR to address potential human health risk associated with exposure to residual impacts in soil and groundwater.

4.2.1 Description of Activities

Site preparation activities would include the removal of a portion of the phytoremediation plot, installation of erosion controls, delineation of soil stockpile/loading areas, and construction of decontamination pads/facilities. Preparation activities are expected to be completed within a 1-month period.

4.2.1.1 Solidification of Impacted Soil

The solidification of source material would occur in three phases: the stabilization of areas adjacent to the active gas line, temporary removal/stockpiling of vadose zone soil and solidification of the source material.

The solidification plan includes a 10-foot offset from the active gas line. The soil around the line would be supported by the installation of two rows of overlapping grout columns from ground surface to a depth of 20 ft. bgs. The columns would be installed using a 6-8 ft diameter auger. After the columns have cured, vadose zone soil in the primary source area would be removed to a depth of 12 ft bgs, i.e., 2 ft. above the water table, to provide a working platform for the solidification of the underlying source material.

Soil in the principal source area (14,300 cy) would then be solidified, with samples analyzed to demonstrate compliance with the established performance criteria. Excess grout is expected to be generated at a rate of 20-30% by volume of soil treated. The excess (3,600 cy) would be managed within the vadose zone excavation and allowed to cure in place. Soil in the secondary source areas (5,600 cy) would be treated by the installation of overlapping grout columns from the ground surface to the depth of impacts (up to 25 ft bgs). The excess grout from these areas would be allowed to cure in the principal source area excavation. Solidification activities are expected to be completed within a 6-month period.

The stockpiled overburden (15,400 cy) would be used to backfill the excavation and re-grade the excavation area. Remediation support equipment (water treatment system, soil stockpile areas, decontamination area, and Site trailers) would be removed, and Site features would be restored. Backfilling and restoration activities are expected to be completed within a 1-month period.

4.2.1.2 Natural Attenuation of Dissolved-Phase Impacts

A discussion of Natural Attenuation has been provided previously in Section 4.1.1.5.

Post-remediation monitoring would be conducted on a semi-annual basis for two years to provide the appropriate information to document decreasing concentration trends and evaluate plume stability. Monitoring parameters would include the MGP constituents required by the Groundwater Permit, as well as the following natural attenuation parameters: DO, ORP, ferric iron, sulfate and nitrate. If plume stability is not established in the initial 2-year period, monitoring would continue on an annual basis until stability can be documented. Unitil proposes to review the requirements for additional groundwater monitoring with NHDES once the plume is stable. Five years of post-remediation monitoring have been assumed to achieve a stable dissolved-phase plume.

4.2.1.3 Activity and Use Restriction

A discussion of the AUR has been provided previously in Section 4.1.1.6.

4.2.2 Evaluation Criteria

4.2.2.1 Effectiveness and reliability

The alternative is rated High for effectiveness and reliability. It is routinely used at former MGP sites and offers a permanent remedy through the treatment of source material. The approach provides the benefit of being able to control the distribution of reagents in the subsurface. The isolation of source material in the solidified mass will facilitate the reduction of dissolved-phase impacts through on-going biological processes.

4.2.2.2 Feasibility and ease of implementation

The alternative is rated High for feasibility and ease of implementation. The approach is well suited for addressing impacts in the saturated zone and can access both the principal and secondary source areas.

4.2.2.3 Risk reduction and associated benefits

The alternative is rated High for overall protection of public health and the environment since it addresses the potential risk for current and future Site uses.

4.2.2.4 Cost Effectiveness

The estimated capital cost of the alternative is $4,760,000. Additional design and oversight costs are estimated to be $650,000. The estimated cost for post-remediation monitoring is $160,000 for the proposed 5-year monitoring period. The total NPV project costs (Table B-2) including contingency at 20% is estimated to be $5,130,000.

4.3 Chemical Oxidation, Natural Attenuation and Activity and Use Restriction

In-Situ chemical oxidation involves the subsurface injection of catalyzed hydrogen peroxide (CHP) to treat volatile organic and polynuclear aromatic hydrocarbon constituents in MGP residuals. CHP is a solution of hydrogen peroxide and a ferrous iron catalyst, which generate hydroxyl free radicals that act as the active oxidizing agent. The oxidation of organic compounds by hydroxyl free radicals is a rapid and exothermic reaction. Although intermediate degradation products can be generated, the end products of oxidation are primarily carbon dioxide and water. None of the injected reagents pose an environmental hazard. Unconsumed reagent naturally degrades to oxygen and water after injection. This alternative includes the following activities:

1. Installation of 130 permanent injection wells in the source areas.
2. Injection of 977,000 pounds of CHP reagent over a multi-year period.
3. Process Monitoring.
4. Natural Attenuation of dissolved- phase impacts.
5. Continued implementation of the AUR to address potential human health risk associated with exposure to residual impacts in soil and groundwater.

4.3.1 Description of Activities

Site preparation activities would include installation of erosion controls, delineation of soil stockpile/loading areas, and construction of decontamination pads/facilities. Mobilization and Site preparation activities are expected to be completed within a 2-week period.

4.3.1.1 Installation of Injection Wells

The injection plan would incorporate a 20 ft off-set from the gas line and include the installation of 130 injection wells (104 in the principal source area and 26 in the secondary source areas). The placement assumes a radius of influence (ROI) of 7.5 ft. and the installation in a 15 ft on-center, pattern. The proposed locations of the injection wells are illustrated in Figure 4-3.

The injection points would be constructed of ¾-inch Schedule 80 Chlorinated Poly Vinyl Chloride (CPVC) pipe and be equipped with 10-ft sections of 0.010 slot screen. The injection points would be installed to the depth of the source material (14 to 30 ft bgs) using direct push technology.

4.3.1.2 Injection of Reagent

The injection equipment would include tanks, pumps, gauges and flow control valves to prepare and deliver CHP solutions safely and effectively. The injection of reagents (hydrogen peroxide and catalyst) would be conducted via specially designed mixing heads that are attached to the casing for each injection well. The mixing heads are designed with redundant safety features and are constructed of polypropylene and CPVC for reagent compatibility. Reagent flow would be controlled and monitored at the flow control board on the injection vehicle, the control valves on the mixing heads, and the control valves on the reagent storage tanks.

For the purpose of this evaluation, a minimum injection volume of 400 gal of 34% hydrogen peroxide per injection well has been assumed, providing for the use of 52,000 gallons (501,400 lbs) for the 130 wells. Experience at a similar site resulted in a daily injection volume 700 gallons of 34% hydrogen peroxide (diluted prior to injection) per day, which equates to 75 days of active injection.

The evaluation assumes that three separate injection events will be required over a 7-year period, with injections at 50% and 25% of the locations during the second and third applications, respectively. The approach provides for a total injection quantity of approximately 91,000 gal (877,500 lbs) of 34% hydrogen peroxide.

4.3.1.3 Process Monitoring

Performance monitoring of groundwater conditions and off-gas would be conducted daily throughout the injection program. The analytes measured, purpose, and typical frequency are as follows:

- Groundwater samples would be collected from monitoring, vent, and injection wells within and adjacent to the treatment area. Groundwater samples would be collected daily, prior to beginning the injection each day. The parameters to be measured would include pH, dissolved iron, and hydrogen peroxide concentration, photoionization detector headspace (which provides a semi-quantitative measurement of VOC concentration), and temperature.
- Off-gas measurements would be conducted several times daily during the treatment. Injection, vent, and monitoring wells would be tested daily with field meters for carbon dioxide, oxygen, and VOCs (by PID). Carbon dioxide is produced by oxidation of organic compounds; thus, carbon dioxide production is a sensitive measure of the efficiency and progress of the treatment. Oxygen is produced by reaction of hydroxyl free radicals with hydrogen peroxide, other radicals, or other non-organic compounds; thus, oxygen production is also useful to gauge treatment performance. VOCs are liberated due to the oxygen and carbon dioxide off-gases passing through potentially contaminated water. The concentration of VOCs in off-gases is typically at maximum levels in the initial stages (first few days) of injection and then decreases over the course of the treatment.
- Systems monitoring would include injection pressure monitoring and regular inspections. The pressure is monitored in order to ensure a controlled reaction is occurring and is observed and recorded regularly during each day of injection. Example injection pressures for this type of application are typically between 10 and 60 psi. System components (hoses, fittings, valves, pumps, etc.) are constantly monitored and observed to ensure proper operation and to check for leaks.

Minimal amounts of remediation waste are expected to be generated during well installation and injection activities. Expected waste types include used PPE including Tyvek suits and nitrile gloves, spent field test kits and spent bulk chemical containers. Unless grossly contaminated, PPE would be disposed of as general waste. Depending on the type of field test kits used, spent test materials would either be disposed of as general waste, or secured in 55-gallon drums for off-Site transport and disposal at an appropriate facility. Empty chemical containers would be rinsed then used to collect residuals from the injection process and returned to the chemical vendor for recycling and re-use. All remediation waste containers would be properly labeled while on Site.

De-mobilization activities for each of the injection events are expected to be conducted in less than a week.

4.3.1.4 Natural Attenuation of Dissolved-Phase Impacts

A discussion of Natural Attenuation has been provided previously in Section 4.1.1.5.

Semi-annual groundwater monitoring would be conducted between the first/second and second/third injection events. Post-remediation monitoring would then be conducted on an annual basis following the third injection event to provide the appropriate information to document decreasing concentration trends and evaluate plume stability. Monitoring parameters would include the MGP constituents required by the Groundwater Permit, as well as the following natural attenuation parameters: DO, ORP, ferric iron, sulfate and nitrate. Unitil proposes to review the requirements for additional groundwater monitoring with NHDES once the plume is stable. Three years of additional post-remediation monitoring have been assumed for the purpose of this evaluation.

The well points would be decommissioned at the end of the monitoring program in accordance with NHDES regulations and an Abandoned Well Decommissioning Report will be filed with the agency.

4.3.1.5 Activity and Use Restriction

A discussion of the AUR has been provided previously in Section 4.1.1.6.

4.3.2 Evaluation Criteria

4.3.2.1 Effectiveness and reliability

The alternative is rated Medium for effectiveness and reliability. Although it has been used at MGP sites, it is difficult to control the distribution of reagent in the subsurface and in some instances the approach has not been effective in treating NAPL.

4.3.2.2 Feasibility and ease of implementation

The alternative is rated High for feasibility and ease of implementation. The approach is well suited for addressing impacts in the saturated zone and can access both the principal and secondary source areas.

4.3.2.3 Risk reduction and associated benefits

The alternative is rated High for overall protection of public health and the environment since it addresses the potential risk for current and future Site uses.

4.3.2.4 Cost Effectiveness

The estimated capital cost of the alternative is $ 1,670,000. Additional design and oversight costs are estimated to be $620,000. The estimated cost for post-remediation monitoring is $250,000 for the 7 proposed events. The total NPV project costs (Table B-3) including contingency at 20% is estimated to be $2,060,000.

5. Recommended Remedial Alternative

A review of the evaluation criteria presented in Section 4 indicates that Alternative 2 Solidification would be the most effective and implementable remedy. Solidification provides a permanent remedy and is routinely used at Former MGP sites. The alternative provides the ability to effectively control the distribution of reagents and is well suited to address impacts in the saturated zone. As a result, the use of the approach will maximize the amount of source material that can be treated. The approach will include a monitoring program to document the progress of natural attenuation of dissolved-phase impacts, and the continued implementation of the existing AUR to address the remaining exposure pathways that are potentially complete.

The following discussion provides the details of the activities associated with the implementation of the remedy, including the Pre-Design Investigation, solidification of impacted soil, post-remediation monitoring and continued implementation of the AUR. Note that the work will be supported by the preparation of a Fact Sheet that will be distributed to Town officials and property abutters. The sheet will provide a summary of proposed Site activities and contact information for those seeking further details.

5.1 Pre-Design Investigation

A pre-design investigation will be conducted to collect additional Site data related to the proposed Alternative 2 activities in support of the preparation of the design and Technical Specifications. Overviews of the proposed investigation activities are provided below.

5.1.1 Geotechnical Investigation

Geotechnical data will be collected to define the structural requirements of the solidification mixture. Two (2) borings will be installed within the limit of the principal source area and one boring will be installed in each of the secondary source areas. The borings will be installed from the ground surface to a depth of 35 ft. bgs to address the anticipated depth of treatment (approximately 30 ft. bgs). Two-inch diameter by 24-inch-long split-spoon samples will be collected continuously to the boring termination depth following in accordance with ASTM Method D1586. Soils collected in the split spoons will be field classified in accordance with ASTM Method D2487. Up to three (3) samples will be collected from each boring and analyzed for grain size, bulk density, and moisture content. Additional samples for subsequent treatability testing will be composited from boring locations/intervals exhibiting the most significant MGP impacts.

As part of the field investigation, the monitoring well locations that are located within the treatment area (MW-02 S/D and MW-03 S/D) will be decommissioned in accordance with NHDES requirements. Replacement wells will be installed at downgradient locations.

5.1.2 Treatability Testing

Samples of the MGP-related source material will be collected from soil boring locations/intervals that exhibit significant levels of visual/olfactory impact. The samples will be composited into two 5-gallon containers for use in bench-scale treatability testing.

Upon receipt at the treatability lab, the samples will be screened to remove oversized material, i.e., >0.5 inches, and generally homogenized to provide material appropriate for replicate testing. The unit weight of several samples will be determined to provide a basis for conversion from weight-based (lab use) to volume-based (production use) dosing rates.

Tests will be conducted using a cementitious material of 4:1 ground granulated blast furnace slag (GGBFS)/ Portland cement at a broad range of addition rates, e.g., 5%, 8% and 11% to wet weight of soil to determine

the appropriate mix to address Site impacts. The mixes will be evaluated after 7 days of curing using a pocket penetrometer for UCS using ASTM Method D-2166. Note that GGBFS is proposed for use because it is generally available locally and has been demonstrated to improve results for UCS.

A second round of testing will be conducted to evaluate additional cement mixes and to determine the benefit of the use of additives, e.g., bentonite typically at rates of 0.25 to 0.5 % - by wt., to improve permeability. These tests will be conducted using a target ratio of 1:1 water to cementitious mixture to ensure the relative comparison of results across the range of addition rates. The rates will be adjusted to achieve a “pumpable” slurry during production. Note that more “exotic” additives such as organoclay and activated carbon will not be tested since, due to cost/availability, they are generally not practical for production use. UCS testing will be conducted on these samples after 7 and 28 days of curing. Permeability testing will be conducted on those samples that achieve an acceptable UCS value, i.e., >50 psi.

5.2 Solidification of Impacted Soil

Solidification will involve the introduction of a Portland cement slurry (grout) into impacted media to decrease its permeability and increase its strength to meet the following performance standards:

- UCS
  - 28-day UCS of at least 50 pounds psi.
- Permeability
  - 28-day hydraulic conductivity of less than $1X10^{-6}$ cm/sec.

The grout mixture will be developed using the information from the treatability test. Treatment will be conducted by installing overlapping columns using a 6-8 ft. diameter auger. Treatment will create a solidified mass that will eliminate the potential for NAPL to migrate and “isolate” the impacts from groundwater flow. As a result, solidification will control the ability of source material to adversely affect groundwater quality. The treatment area, 36,800 sq. ft. is illustrated in Figure 4-2. An estimated schedule for the implementation of the remedy is provided as Figure 1.

The solidification of source material will occur in four phases: Site preparation; the stabilization of the area adjacent to the active gas line; removal of vadose zone soil and solidification of the remaining impacted soil. All work will be conducted in accordance with a Health and Safety Plan (HASP) developed by the Contractor.

5.2.1 Site Preparation

Prior to the start of the excavation work, Dig Safe will be contacted and companies with subsurface utilities present will be requested to mark-out their utilities in the remediation area. Unitil will locate and mark all underground utilities in the vicinity of the treatment area. Site preparation activities will include the removal of a portion of the phytoremediation plot installation of erosion controls and odor controls, delineation of soil stockpile/loading areas, and construction of decontamination pads/facilities. Sediment controls, e.g., hay bales, silt fence, etc. will be used in accordance with the applicable NHDES guidance. Stormwater run-off will be controlled to prevent contact with impacted soils. Stormwater that does contact impacted soils will be collected and disposed off-Site.

5.2.2 Stabilization of the High-Pressure Gas Transmission Line

The solidification plan includes a 10-foot offset from the high-pressure gas line. The soil adjacent to the line will be stabilized by installing two rows of overlapping ISS support columns along 200 ft. of the gas line to a depth of 20 ft. bgs. The treatment will involve approximately 2,400 cy of soil. The support columns will be required to meet the following performance criteria:

- UCS - 7-day UCS of at least 50.
- Permeability - 28-day hydraulic conductivity of less than 1X10-6 cm/sec.

The support columns will be mixed using a grout mixture that is designed to maximize the strength of the solidified mass. Unitil may elect to include a monitoring program in the design of the remedy to ensure that the line is not disturbed during the remediation.

5.2.3 Removal of Vadose Zone Soil

Once the support columns have cured, vadose zone soil in the principal source area will be removed to a depth of 12 ft bgs, i.e., 2 ft. above the water table, to provide a working platform for the solidification of the underlying source material.

5.2.4 Solidification of Impacted Soil

Soil in the principal source area (14,300 cy) will then be solidified, with samples analyzed to demonstrate compliance with the established performance criteria. Excess grout is expected to be generated at a rate of 20-30% by volume of soil treated. The excess (3,600 cy) will be managed within the vadose zone excavation and allowed to cure in place. Soil in the secondary source areas (5,600 cy) will be treated by the installation of overlapping grout columns from the ground surface to the depth of impacts (up to 25 ft bgs). The excess grout will be allowed to cure in the principal source area excavation.

5.2.4.1 Remedial Action Monitoring

The location of the soil columns will be laid out by survey prior to the start of work. During treatment, the contractor will continuously monitor the following parameters:

Process Monitoring

- Verticality and position of the mixing auger;
- Top of column and bottom of column elevations;
- The quantity/rate of ad-mix for each column;
- Rotation rate of the auger;
- Number of treatment passes; and
- Auger penetration and withdrawal rates.

Performance Standards

Wet column samples will be collected at a frequency of 1 sample/ 500 cy of treated material, for a total of approximately 30 samples. They will be visually inspected to verify that a homogeneous mixture has been created based on the following criteria:

- No visible NAPL or sheen;
- Grout and soil are thoroughly mixed;
- Consistent color for samples collected from different depth intervals and locations; and
- There are no unmixed soil clumps greater than three inches.

The samples will be recovered into standard soil mold cylinders and allowed to cure for subsequent analysis for unconfined compressive strength, permeability and free liquids. The following performance standards will be used for the project.

- UCS
  28-day UCS of at least 50 pounds psi. The 7-day test results will be used to provide an early indicator that the 28-day results will meet the performance standard.
- Permeability
  28-day hydraulic conductivity of less than 1X10-6 cm/sec, with preliminary results obtained at 7 and 14 days to provide an early indicator that the 28-day results will meet the performance standard.
- Free Liquids
  The solidified soil shall have no free liquid present observed along the break point of the UCS testing detailed above.

5.2.5 Perimeter Air Monitoring

Air monitoring activities will be conducted throughout the program to document ambient air quality/ conditions at the Site and evaluate conditions at the property line to ensure that the measures used to control potential fugitive emissions are effective. The monitoring program will consist of the following types of activities:

- Real-time monitoring – to promptly identify potential Site problems to allow the appropriate engineering/emission controls to be implemented, and prevent significant off-Site issues; and
- Constituent-Specific sampling and analysis – to verify that the real-time monitoring process and associated controls are effective for the community.

5.2.5.1 Real-Time Air Monitoring

Continuous real-time data will be collected for total volatile organic compounds (TVOCs) and particulate matter. The results from these measurements will be compared to a set of Site-specific Action Levels, i.e., the concentration/level at which control measures are required to ensure that Site conditions will not pose a potential health risk to off-Site receptors.

Real-time air monitoring will consist of a property line network of portable air monitoring (PAM) stations, supplemental monitoring using hand-held devices, meteorological monitoring, and a notification system to identify periods of elevated emissions. The initial, recommended positions of the monitoring locations are illustrated in Figure 5-2. Locations of sample stations may change to reflect specific Site activities, wind conditions, and/or accessibility. These real-time monitoring activities are discussed in more detail in the following sections.

Portable Air Monitoring (PAM) Stations

The PAM units will be used to collect and analyze data from the three (3) locations during active work periods throughout the duration of the project. At the discretion of Site personnel, the units may also be left in operation during extended non-active work periods (i.e., overnight and/or weekends) based on Site status and anticipated weather conditions.

The following monitors will be used at each station:

- TVOCs – ambient concentrations of TVOCs will be measured using a RAE®, or equivalent PID; and
- Particulate matter – a DustTrak® dust monitor, or equivalent, will be used to monitor respirable particulate (PM_{10}) concentrations 10-microns or smaller.

The monitors will be housed in weather tight enclosures, with sampling inlets located in the breathing zone at the top of the perimeter fence (approximately 2-meters). The TVOC and dust monitors at each PAM

station will be set up to calculate 15-minute block averages and have the capability to compare the results to the Action Levels, as well as provide notification to field staff of exceedances. Data will be transmitted in real-time to the central computer using a radio telemetry system. An automated interactive computer display will notify field staff to Site conditions.

Meteorological Monitoring

A meteorological tower will be erected at the central trailer location following the installation guidelines established by the United States Environmental Protection Agency (USEPA) for meteorological monitoring systems. The tower will be equipped with sensors to measure wind speed and direction, sigma theta (wind variability), temperature, and relative humidity on a continuous basis during remedial activities.

A Climatronics® system (or equivalent) will be used for meteorological measurements. A Campbell Scientific® data logger (or equivalent) provided with the meteorological system also includes a digital standard deviation (sigma) processor which calculates the wind fluctuation (sigma theta). Sigma theta is an important parameter to observe during remediation activity, so that the potential for fugitive emissions to change direction during slow wind periods can be assessed and documented.

The on-Site meteorological system will continuously collect data and log the results as 15-minute block averages. The data from both the monitoring instruments and the meteorological system will be transmitted in real-time to the central computer system.

Supplemental Monitoring

During active work periods, measurements from the automated monitoring systems will be supplemented with data collected by the field technician at the Site property line immediately downwind from the work areas using hand-held monitors. Hand-held measurements for TVOCs and particulate matter will be conducted on an as-needed basis throughout active work periods depending on the location of the work and the potential to impact sensitive receptors. In addition to TVOC and particulate measurements, the field staff will also make routine observations of odor intensity and visible dust. The following monitors and/or observations will be used by the technician:

- TVOCs –a RAE® PID, or equivalent PID, will be used to monitor for TVOCs;
- Particulate matter – a DustTrak® dust monitor, or equivalent, will be used to monitor respirable particulate concentrations;
- Odor intensity levels – subjective assessment by the field technicians; and
- Visible dust – subjective assessment by the field technicians.

Field notes from these activities will be documented in project notebooks and transcribed into computer spreadsheets. Monitoring data generated on Site, including field log sheets and field notebooks, will be filed and secured in the Site office trailer, with copies transferred to the office project files.

5.2.5.2 Constituent-Specific Sampling and Analysis

Constituent-Specific sampling and analysis will be conducted for the principal MGP constituents of interest to document the appropriateness of the Action Levels and effectiveness of the emission controls. During field activities, one set of continuous, composite samples will be collected at each of the three fence line stations (approximately 10 hours per day, 50 hours per week). Each canister will be placed within the breathing zone at the PAM stations. The locations of the integrated time-averaged sampling may change based on Site activities, accessibility, and/or weather conditions.

Ambient concentrations of BTEX and naphthalene will be characterized using USEPA Method TO-15: *Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography/Mass Spectrometry*. The composite ambient samples

will be collected in 6-liter (L) Summa Canisters using flow controllers calibrated to collect a 6 L samples over an approximate 60-hour period during each week of remedial activities.

Prior to shipping, the laboratory will evacuate the canisters to the prescribed negative pressure, not less than -28 inches of mercury (in. Hg). If the pressure is less than -28 in. Hg, the canister will not be used and will be returned to the laboratory for replacement.

At the start of each week a pre-cleaned, evacuated canister will be positioned at each of the four fence line locations and labeled with the sample location and date. The sampling valve will be opened at the start of Site activities for the day and the initial canister pressure and time noted.

At the conclusion Site activities for the day (approximately 10 hrs duration), the current pressure of the canister and time will be documented, and the sampling valve will be closed. The labeled container will be secured in a container, e.g., a cooler with a lid, that is sealed with chain of custody tape and transferred to a secure location for overnight storage. The canisters will be repositioned for each of the following days of the week and the process repeated.

At the conclusion of each week's sampling, the canisters will be transferred to a secure location until ready for shipment back to the laboratory. Prior to shipping air samples, a Chain of Custody (COC) form will be completed for each batch of samples. The COC form will include information such as project name, project number, sampler's name, sampling date, reporting address, sample contact, laboratory and contact information, sample identifications, sample matrix, analysis required, starting and ending pressures and special instructions or comments. The completed COC will be signed and timed/dated before the samples are shipped. A copy of the COC will be retained for the project file.

Laboratory personnel will sign and date the COC form in acknowledgement of receipt and comment, as necessary to document the sample conditions upon receiving each batch of samples. The laboratory will also assign a case number or unique sample identification number to each sample, and will retain one (1) copy of the completed COC for its records.

5.2.5.3 Odor and Dust Control

An odor and vapor suppressing foam (Rusmar AC-654 foam or similar), water and plastic sheeting will be available at all times during the remedial activity to control potential fugitive emissions.

5.2.6 Waste Management

The implementation of the remedy is not expected to generate wastes for off-Site disposal. In the event that small quantities of wastes are generated, they will be characterized with laboratory analyses in accordance with the requirements of the disposal facilities. They may include: Toxicity Characteristic Leaching Procedure (TCLP), corrosivity, ignitability, reactivity, total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs). Waste transportation and disposal of all contaminated wastes at an off-Site permitted facility will be managed by an approved Unitil contractor. All shipments of waste from the Site will be documented using waste tracking forms, bills of lading, and receipts.

5.2.6.1 Soil

Soil showing significant signs of MGP impact, e.g., heavy staining of NAPL, will be stockpiled and characterized for off-Site thermal treatment at the Clean Earth facility in Loudon, NH.

5.2.6.2 Construction Debris

Construction and Demolition (C&D) materials, e.g., concrete and pavement, removed during the excavation will be segregated, visually inspected, and decontaminated using scrapers, shovels, and a steam cleaner, as necessary, and loaded into roll-offs for off-Site transportation and disposal.

5.2.6.3 Excess Grout

Excess grout that cannot be managed within the excavation of the principal source area will be consolidated on-Site, characterized and managed off-Site at a permitted landfill.

5.2.7 Off-Site Transportation

The transportation of impacted materials from the Site will be performed in accordance with all regulatory requirements. All haul trucks will have impermeable poly bed liners and impermeable poly covers that fully line the bed of the truck and can be overlapped to cover the top of the load to manage odors during transportation and, if there is the potential for liquids or tarry material leaking from the waste, they will have gasketed tailgates. The trucks may be sprayed, as necessary, with odor suppressive foam prior to covering to reduce vapor and odor emissions.

5.2.8 Decontamination

During and upon completion of the excavation/solidification phases of the project, decontamination of equipment will be performed to prevent contaminated material from being spread to un-impacted areas of the Site.

Decontamination of the earth-moving equipment will occur at the completion of the excavation phase and prior to the handling of clean backfill or mobilization off-Site. The method of equipment decontamination will consist of pressure washing to remove any impacted soil.

Trucks used for the off-Site transport of material will be decontaminated using dry decontamination methods (i.e., removal of loose material with a broom or brush) to the extent practicable to limit the volume of decontamination water. These methods, along with parking of trucks on plastic sheeting during loading, will effectively prevent the spread of contaminated materials onto roadways during transport to disposal facilities.

Decontamination water generated during cleaning of tools and equipment will be temporarily stored on-Site for later off-Site disposal at an approved facility. Water generated from decontaminating personnel will be minimal due to the availability of disposable personal protective equipment (PPE) such as Tyvek® coveralls, booties, and nitrile gloves.

5.2.9 Site Restoration

The stockpiled overburden (15,400 cy) will be used to backfill the excavation and re-grade the treatment area. Remediation support equipment (water treatment system, soil stockpile areas, decontamination area, and Site trailers) would be removed. Backfilling and restoration activities are expected to be completed within a 1-month period.

5.3 Post Remediation Monitoring

Post-remediation monitoring will be conducted on a semi-annual basis for two years to provide the appropriate information to document decreasing concentration trends and evaluate plume stability. Monitoring parameters will include the MGP constituents required by the Groundwater Permit, as well as the following natural attenuation parameters: DO, ORP, ferric iron, sulfate and nitrate. If plume stability has not been established in the initial 2-year period, monitoring will continue on an annual basis until stability can be documented. Unitil proposes to review the requirements for additional groundwater monitoring with NHDES once the plume is stable. Five years of post-remediation monitoring have been assumed to achieve a stable dissolved-phase plume.

5.4 Activity and Use Restriction

An Activity and Use Restriction (AUR) was placed on the Site following the previous remediation to limit direct human contact with MGP residuals that were left in place. The AUR will continue in effect to restrict Site use to commercial/industrial applications and limits activities to those that do not involve the disturbance of groundcover or involve the extraction of groundwater. Additionally, the AUR requires written notification to NHDES of activities that will involve the disturbance of groundcover or groundwater, and that those activities be conducted using OSHA-trained personnel using a plan developed by an environmental professional.

6. References

AECOM, 2021, Source Material Investigation Report, Petrolane/Northern Utilities, Inc. Site, January 2022.

HLA, 1999. Phase II and IIA Site Investigation Report, Former Rochester MGP Site, Rochester, New Hampshire. February 1999.

RETEC, 2001. Completion Report, Former Manufactured Gas Plant, Source Removal Action, Rochester, New Hampshire. April 2001.

RETEC, 2004a. Completion Report Addendum Source Removal Action, Former Manufactured Gas Plant, Rochester, New Hampshire. June 2004.

AECOM, 2019. 2018 and 2019 Biennial Water Quality Report and November 2019 Water Monitoring Data Submittal, Petrolane/Northern Utilities, Inc. site, Route 125, Rochester NH. January 2020.

Tables

Table 2-1
Source Material Summary

Location/ Surface Elevation (ft.) [1]	Boring Interval (ft. bgs)	OLM Thickness (ft.)	Constituent Concentration (mg/Kg)		
			Sampling Interval (ft.)	Naphthalene	Benzene
GP-705 (185 ft.)	20-25	---	20-22	91	<3.1
GP-706 (186 ft.)	20-25	---	21.5-23.5	1,700	<41
GP-708 (180 ft.)	5-10	8.8-9.1	---	---	---
	10-15	11.1-13.9	11.9-13.9	1,500	<41
	15-20	15-15.9	---	---	---
		16.4-19.6	---	---	---
	20-24.5	20-20.5	---	---	---
		21.7-23.1	21.7-23.7	1,600	<36
GP-709 (186.5 ft.)	15-20	16.5-17.8	---	---	---
	20-25	20-21	---	---	---
		---	20-22	540	<1.8
		21.5-23.3	---	---	---
		---	22-24	670	<2.1
	25-30	25-26.2	---	---	---
GP-712 (186 ft.)	10-15	12.2-12.7	---	---	---
	15-20	15-18.3	---	---	---
	20-25	---	20-22	1,100	<37
B-2 (182 ft.)	14-20	14-20	---	---	---
B-3 (184 ft.)	14-20	14-20	---	---	---
	26-30	26-30	---	---	---
B-409 (187 ft.)	14-18	14-18	64	0.48	---
B-410 (188 ft.)	14-22	14-22	12-24	800	9.8
B-411 (185 ft.)	18-24	18-24	12-24.6	840	61
GP-304 (188 ft.)	16-22	16-22	12-15	0.019	---
GP-322 (187.5 ft.)	14-24	14-24	---	---	---
GP-324 (187.5 ft.)	14-24	14-24	---	---	---
GP-325 (188 ft.)	14-20	14-20	---	---	---
GP-326 (185 ft.)	14-16	14-16	---	---	---
MW-403D (181 ft.)	10-16	10-16	---	---	---

Notes:

1 Surface Elevation (MSL)

Bold Source Material Investigation Report (AECOM, 2021)

Itlalics Phase II and Phase IIa Investigation Report, Harding Lawson Assoc, 1999

--- No OLM Observed or No Sample Collected

Table 4-1
Summary of Evaluation of Alternatives

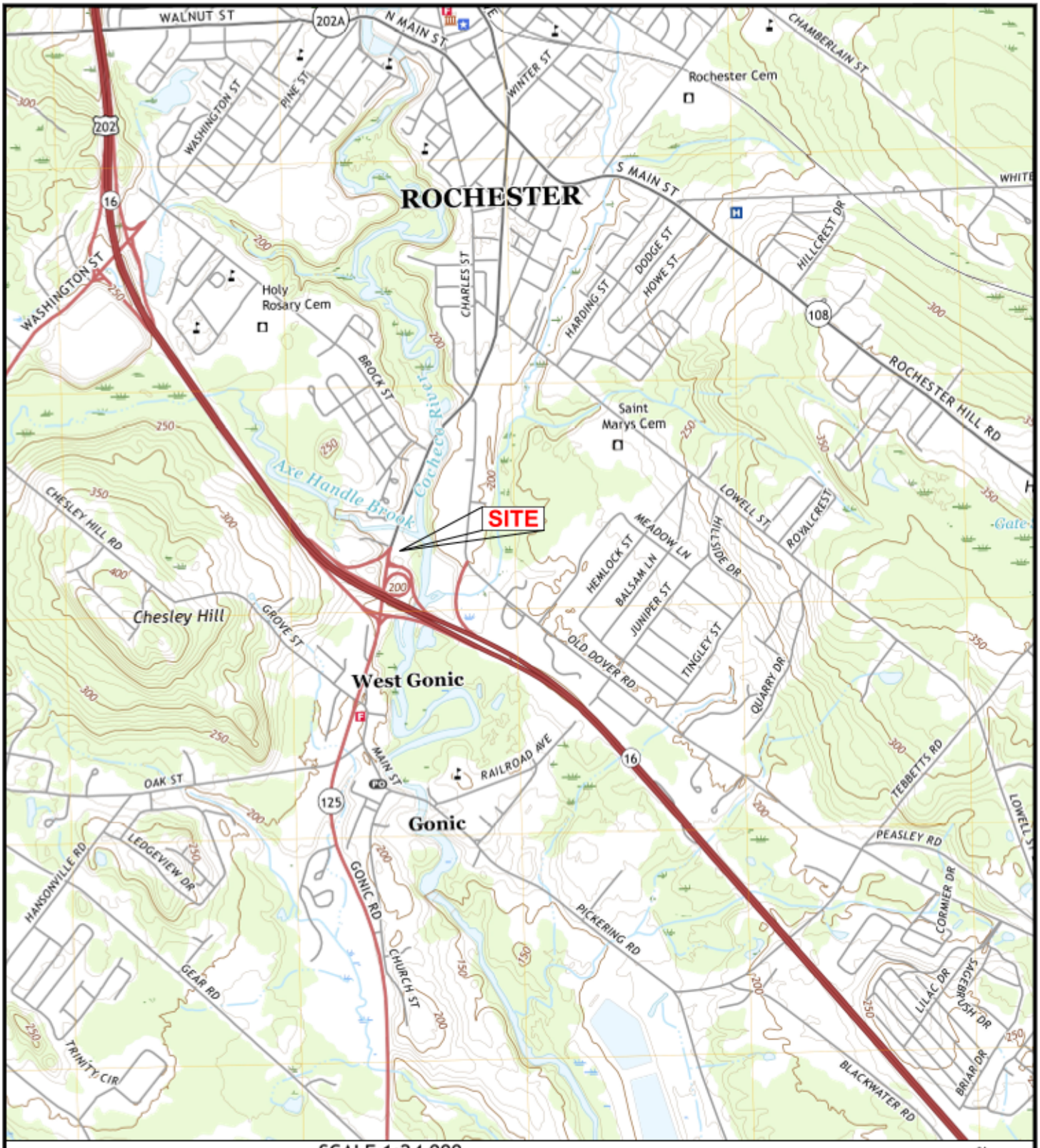
Evaluation Criteria	Alternative 1 Excavation, Natural Attenuation and AUR	Alternative 2 Solidification, Natural Attenuation and AUR	Alternative 3 Chemical Oxidation, Natural Attenuation and AUR
Impacted Media Addressed	**10,100 cubic yards**	**16,400 cubic yards**	**16,400 cubic yards**
Effectiveness and Reliability	**Medium** - It is routinely used at former MGP sites and offers a permanent remedy through the removal and off-site management of source material. Additionally, the removal of source material will facilitate the reduction of dissolved-phase impacts through on-going biological processes. However, setbacks from the Cocheco River and Axe Handle Brook will limit access to impacted media in the primary source area and dewatering issues will make the excavation of the secondary source areas infeasible due to the significant depth of the impacts (up to 30 ft bgs) and the proximity to the Cocheco River.	**High** - It is routinely used at former MGP sites and offers a permanent remedy through the treatment of source material. The approach provides the benefit of being able to control the distribution of source material in the ssubsurface. Additionally, the isolation of source material in the solidified mass will facilitate the reduction of dissolved-phase impacts through on-going biological processes.	**Medium** - It has been used at MGP sites, but it is difficult to control the distribution of reagent in the subsurface and in some instances the approach has not been effective in treating NAPL.
Feasibility and Ease of Implementation	**Medium** - The source material is located in the saturated zone and will require significant dewatering and management of construction water.	**High** - All areas of source materiral can be readily accessed.	**High** - All areas of source material can be readily accessed.
Risk Reduction and Associated Benefits	**High** - It addresses the potential risk for current and future site uses.	**High** - It addresses the potential risk for current and future site uses.	**High** - It addresses the potential risk for current and future site uses.
Cost (including 20% Contingency)			
Capital	$5,320,000	$4,760,000	$1,670,000
Design and Oversight	$660,000	$650,000	$620,000
Post-Remediation Monitoring	$160,000	$160,000	$250,000
Total	$6,140,000	$5,570,000	$2,540,000
Net Present Value [1]	$5,660,000	$5,130,000	$2,060,000
Estimated Time Achieve Plume Stability [2]	5 years	5 years	9 years

Notes:

1 Assumes Discount Rate of 8 %

2 Unitil will review the need for additional monitoring with NHDES once plume stability has been demonstrated

Figures



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

1000 500 0 METERS 1000 2000

1 0.5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

FEET

QUADRANGLE LOCATION

AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732	SITE LOCUS
DATE: 04/01/21 DRWN: K.P.B.	FIGURE 1-1

File: C:\Users\barryk\OneDrive - AECOM Directory\Working Jobs\Northern Utilities - Rochester NH\Site Locus\Fig 1-1 - Site Locus.dwg Layout: Fig 1-1 - Site Locus User: BarryK Plotted: Apr 01, 2021 - 1:06pm

ROUTE 16 RAMP

ROUTE 125

PAVED LOT

FORMER BRICK BUILDING

FORMER TANK

FORMER TAR WELL AREA

GRANITE RAILROAD ABUTMENT

FORMER GAS TANKS & CANS STORAGE AREA

FORMER EXCAVATION AREA

GAS

GRANITE WALL

BRIDGE

AXE HANDLE BROOK

GRANITE RAILROAD ABUTMENT

COCHECO RIVER

LEGEND

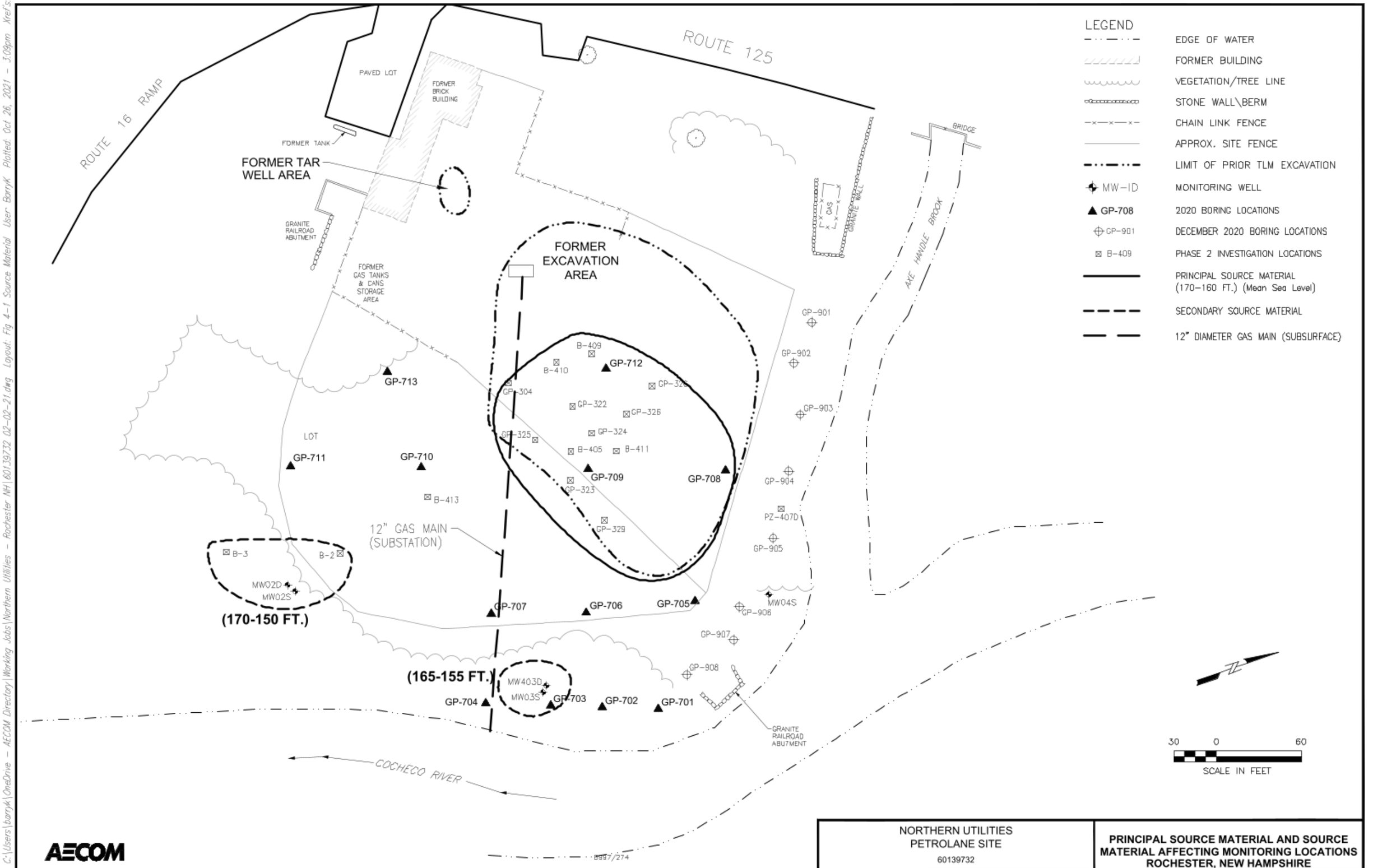
- EDGE OF WATER
- FORMER BUILDING
- VEGETATION/TREE LINE
- STONE WALL\BERM
- CHAIN LINK FENCE
- APPROX. SITE FENCE
- LIMIT OF TLM EXCAVATION

30 0 60

SCALE IN FEET

AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732		LIMITS OF PREVIOUS SOURCE REMOVAL ACTIONS ROCHESTER, NEW HAMPSHIRE
DATE 11/14/22	DRWN: K.P.B.	FIGURE 1-2



LEGEND

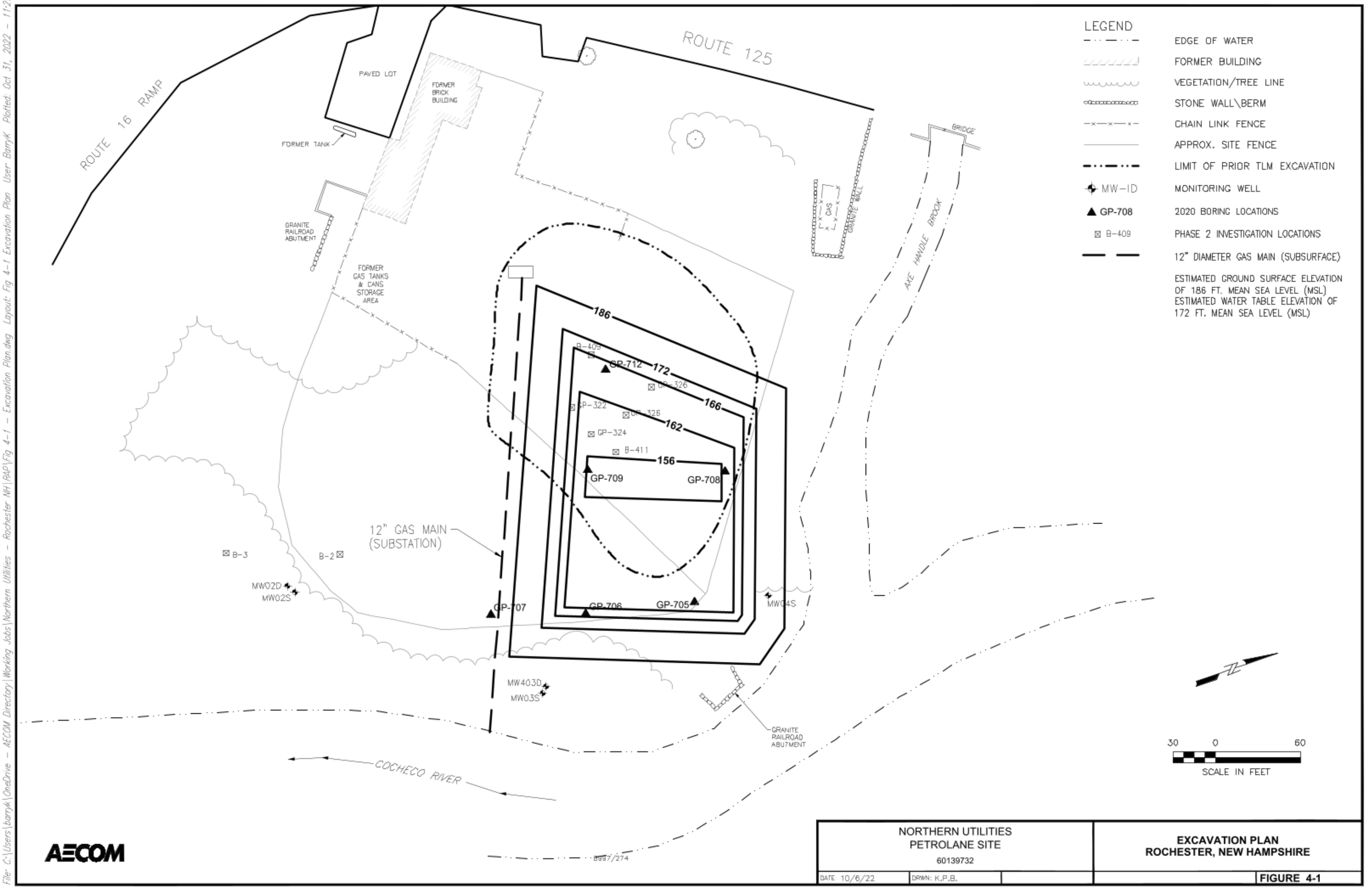
- EDGE OF WATER
- FORMER BUILDING
- VEGETATION/TREE LINE
- STONE WALL\BERM
- CHAIN LINK FENCE
- APPROX. SITE FENCE
- LIMIT OF PRIOR TLM EXCAVATION
- MW-ID — MONITORING WELL
- GP-708 — 2020 BORING LOCATIONS
- GP-901 — DECEMBER 2020 BORING LOCATIONS
- B-409 — PHASE 2 INVESTIGATION LOCATIONS
- PRINCIPAL SOURCE MATERIAL (170-160 FT.) (Mean Sea Level)
- SECONDARY SOURCE MATERIAL
- 12" DIAMETER GAS MAIN (SUBSURFACE)

30 0 60

SCALE IN FEET

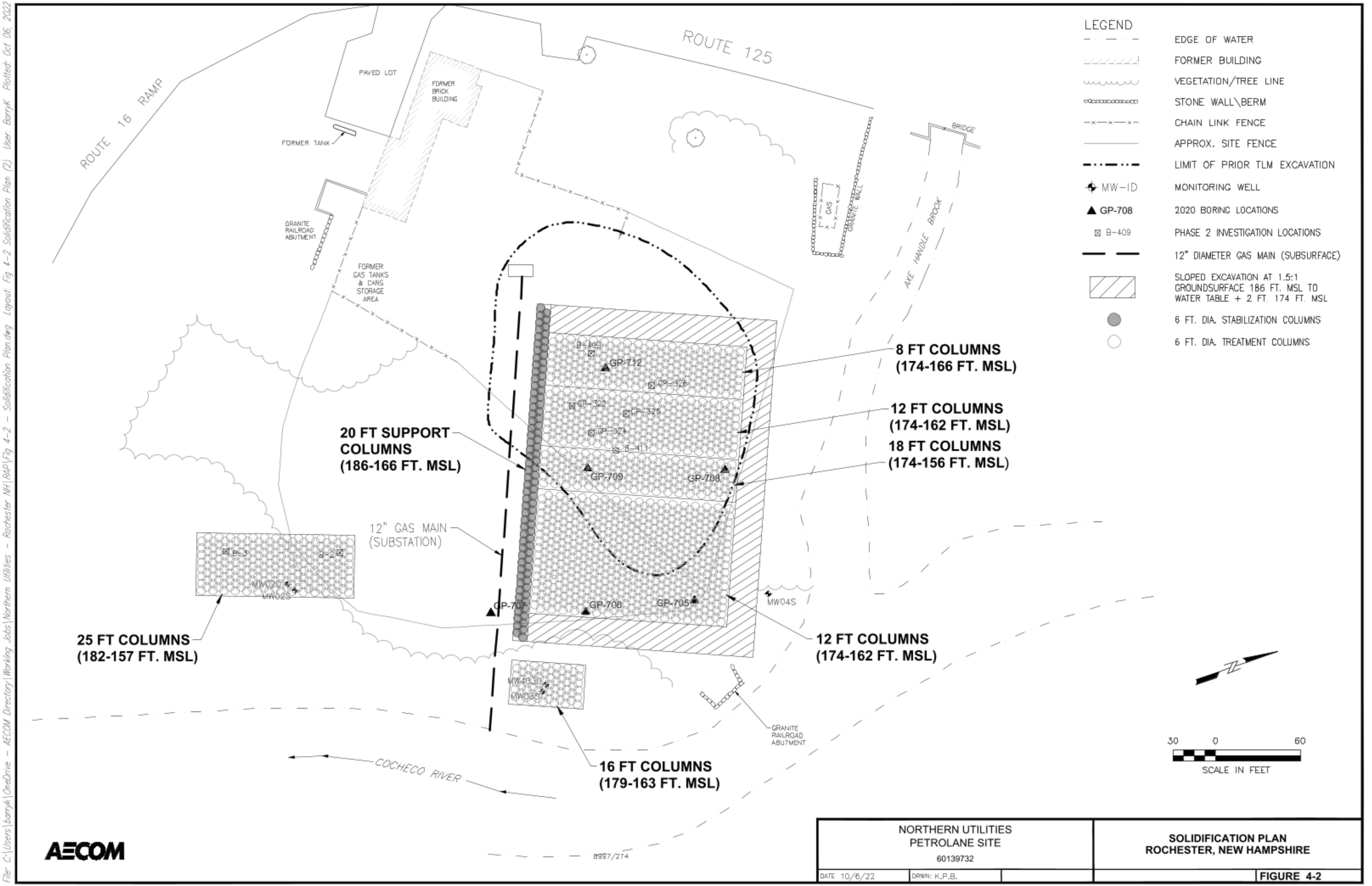
AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732		PRINCIPAL SOURCE MATERIAL AND SOURCE MATERIAL AFFECTING MONITORING LOCATIONS ROCHESTER, NEW HAMPSHIRE
DATE 04/09/21	DRWN: K.P.B.	FIGURE 2-1



AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732			EXCAVATION PLAN ROCHESTER, NEW HAMPSHIRE
DATE: 10/6/22	DRWN: K.P.B.		FIGURE 4-1



AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732			SOLIDIFICATION PLAN ROCHESTER, NEW HAMPSHIRE
DATE: 10/6/22	DRWN: K.P.B.		FIGURE 4-2

File: C:\Users\barryk\OneDrive - AECOM Directory\Working Jobs\Northern Utilities - Rochester NH\RAP\Fig 4-2 - Solidification Plan.dwg Layout: Fig 4-2 Solidification Plan (2) User: BarryK Plotted: Oct 06, 2022

ROUTE 16 RAMP

ROUTE 125

PAVED LOT

FORMER BRICK BUILDING

FORMER TANK

GRANITE RAILROAD ABUTMENT

FORMER GAS TANKS & CANS STORAGE AREA

GAS

GRANITE WALL

BRIDGE

AXE HANDLE BROOK

GP-712

GP-709

GP-708

GP-705

GP-706

GP-707

GP-703

MW02D

MW02S

MW03D

MW03S

MW04S

12" GAS MAIN (SUBSTATION)

GRANITE RAILROAD ABUTMENT

COCHECO RIVER

8997/274

LEGEND

- EDGE OF WATER
- FORMER BUILDING
- VEGETATION/TREE LINE
- STONE WALL\BERM
- CHAIN LINK FENCE
- APPROX. SITE FENCE
- LIMIT OF PRIOR TLM EXCAVATION
- MW-ID MONITORING WELL
- GP-708 2020 BORING LOCATIONS
- INJECTION WELL LOCATIONS
- PRINCIPAL SOURCE MATERIAL (166-156 FT.) (Mean Sea Level)
- SECONDARY SOURCE MATERIAL
- 12" DIAMETER GAS MAIN (SUBSURFACE)

30 0 60

SCALE IN FEET

AECOM

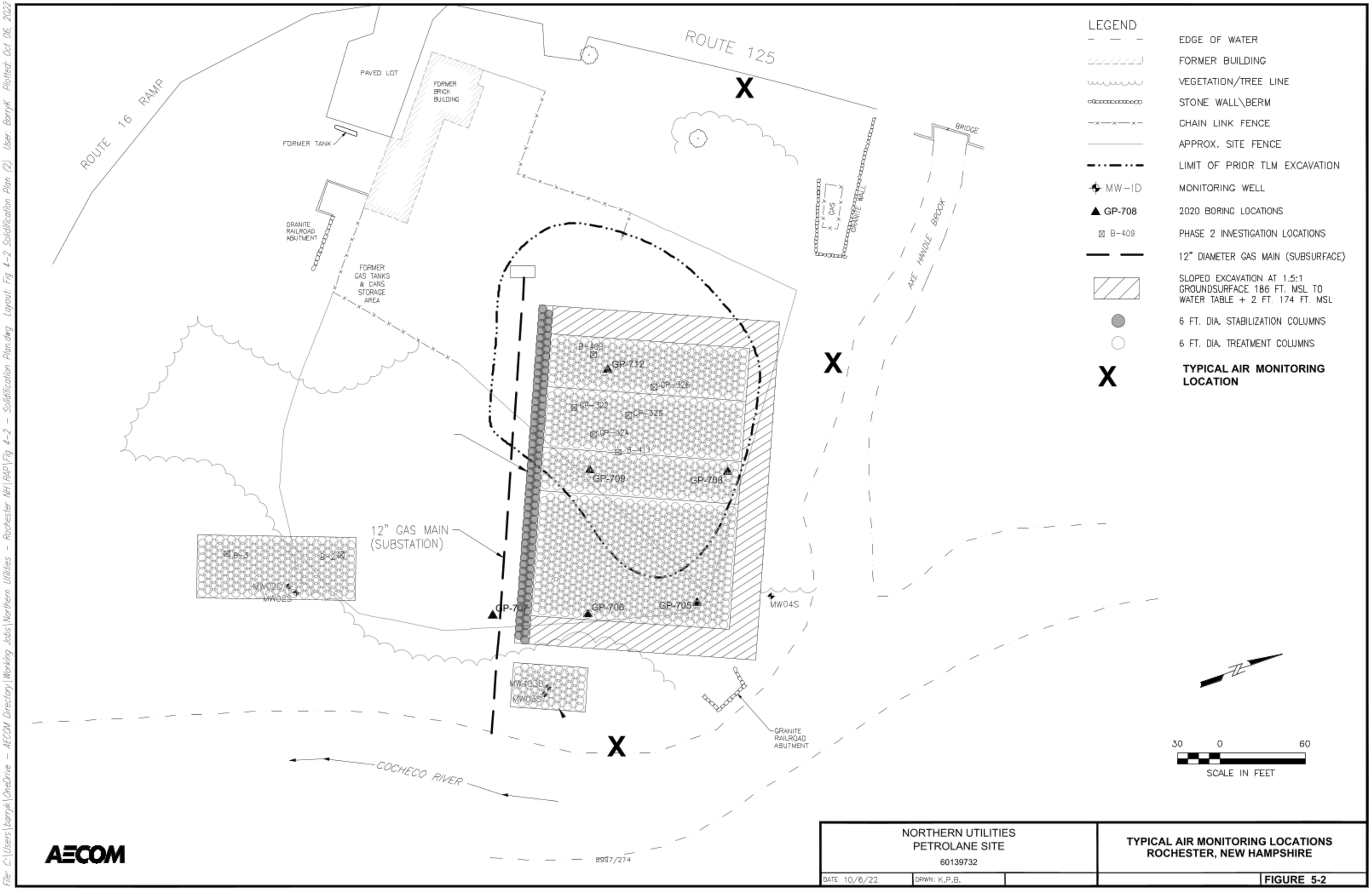
NORTHERN UTILITIES PETROLANE SITE 60139732			CHEMICAL OXIDATION PLAN ROCHESTER, NEW HAMPSHIRE
DATE 11/3/22	DRWN: K.P.B.		FIGURE 4-3

File: C:\Users\barryk\OneDrive - AECOM Directory\Working Jobs\Northern Utilities - Rochester NH\PAP\Fig 4-3 - Chemical Oxidation Plan.dwg Layout: Fig 4-3 Chem Oxidation User: BarryK Plotted: Nov 03, 2022

Figure 5-1
General Project Schedule

Activity	Duration	Year 1 Month 1	2	3	4	5	6	7	8	9	10	11	12	Year 2 Month 1	2	3	4	5	6	7	8	9	10	11	12
Design/Procurement[1]	9 months																								
Mobilization	0.5 months																								
Stabilization of High Pressure Gas Line	0.5 months																								
Solidification of Principal Source Material[2]	4 months																								
Solidification of Secondary Source Material	0.5 months																								
Site Restoration	0.5 months																								
Demobilization	0.5 months																								
Post-Remediation Monitoring[3]	5 years																						First Monitoring Event		

1. The design process will be iniitated upon NHDES approval of the RAP
2. Assumes that the removal of clean vadose soil, management of spoils and backfilling will happen in concert with the treatment activites as the solidification equipment moves through the source
3. Conducted until the stability of the plume is established.
   RAP assumes semi-annual sampling for 2-years and annual sampling for 3-years.
   NHDES RAP approval in 2023 provides for monitoring through 2029.



AECOM

NORTHERN UTILITIES PETROLANE SITE 60139732			TYPICAL AIR MONITORING LOCATIONS ROCHESTER, NEW HAMPSHIRE
DATE 10/6/22	DRWN: K.P.B.		FIGURE 5-2

File: C:\Users\barryk\OneDrive - AECOM Directory\Working Jobs\Northern Utilities - Rochester NH\RAP\Fig 4-2 - Solidification Plan.dwg Layout: Fig 4-2 Solidification Plan (2) User: BarryK Plotted: Oct 06, 2022

Appendix A Activity and Use Restriction

023498

2002 SEP 18 PM 12:51

STRAFFORD COUNTY
REGISTRY OF DEEDS

NOTICE OF ACTIVITY AND USE RESTRICTION

The following Activity and Use Restrictions are hereby placed upon the property belonging to Northern Utilities, Inc., a New Hampshire Corporation (the "Owner" or the "Grantor"), of 300 Friberg Parkway, Westborough, Massachusetts as to the property located on or near Gonic Road, City of Rochester, Strafford County, State of New Hampshire (the "Property"). The Property being certain tracts of the premises conveyed by warranty deed at Book 1506/Page 473 as described in Exhibit A and recorded in the Strafford County Registry of Deeds. The Property is the location of the "Former Rochester Manufactured Gas Plant (MGP) Site", or "Site" which has been assigned site number 871202 by the New Hampshire Department of Environmental Services ("NHDES").

Grantor has conducted site investigation and remediation at the Former Rochester MGP Site to remove coal gasification-related materials ("CGRM") that were generated and accidentally released and/or spilled when the Site was used as a manufactured gas plant between 1903 and 1957. For purposes of these Activity and Use Restrictions, CGRM is defined as any coal, oil and other petroleum wastes and other related products or byproducts of manufacturing gas from coal, oil, or other petroleum products.

The purpose of these Activity and Use Restrictions is to limit direct human exposure to any residual CGRM that was not removed from Grantor's Property. These restrictions shall continue and run with the land until expressly modified or terminated by or on behalf of NHDES and the Grantor and notice of such modifications or termination shall be recorded in the Registry of Deeds. These Activity and Use Restrictions shall be incorporated either in full or by reference into all subsequent deeds, easements, mortgages, leases, licenses, occupancy agreements, or any other instrument conveying an interest in or a right to use that portion of the Grantor's Property.

Restricted Uses and Activities: No use of or activity on the Grantor's Property is permitted which is inconsistent with the objectives of this Activity and Use Restriction, or which might result in a significant risk of harm to health, safety, public welfare or the environment, or in a substantial hazard.

a) The Owner will not use ground water in a manner inconsistent with the prevailing Groundwater Permit issued by the NHDES.

b) To adequately protect neighbors, the general public, and the environment, the Owner shall not excavate or permit other parties to excavate soils within the subject Property, including taking samples for testing and evaluations, unless Owner:

BK2582PG0335

i) Notifies NHDES prior to commencing excavation and provides a description of the conditions and intended nature of the excavation;

ii) Limits disturbance of CGRM-impacted media to the minimum reasonable necessary for the intended purpose;

iii) Ensures that excavation workers are adequately protected in accordance with prevailing industrial hygiene standards (including federal OSHA standards) associated with excavations involving CGRM;

iv) Ensures that CGRM-impacted soil and other regulated materials are excavated and handled in accordance with applicable federal and NHDES standards for CGRM-impacted media, including, but not limited to, hazardous waste requirements, if appropriate;

v) Engages the services of an environmental professional to prepare and implement or supervise the preparation and implementation of a written plan for excavating and handling CGRM-impacted soils and restoring the Property to a condition consistent with this Notice of Activity and Use Restriction;

vi) Restores the Property to a condition consistent with this Notice of Activity and Use Restriction as determined by the NHDES, including proper disposal of any CGRM-impacted media; and

vii) Provides copies of any relevant plan or review and evaluation, and related correspondence to NHDES for approval prior to commencement of excavation activities.

c) Owner shall not permit growing of food on the Property.

d) Owner shall not permit residential use of the Property.

e) Owner shall not permit day care activities, a playground, or children's school on the Property.

f) The Owner shall not permit outdoor recreational activities that disturb landscaping or groundcover.

Permitted Uses and Activities: The following uses of and activities on the Property are allowed, so long as they do not result in a disturbance of landscaping, groundcover, or pavement on Grantor's Property, or involve extraction of groundwater:

a) Retail/commercial uses;

b) Industrial uses;

c) Construction, maintenance, or repair of above-ground improvements, including utility related activities;

d) Maintenance of landscaping and floral gardens and grass;

e) Outdoor recreation uses that do not disturb the landscaping or groundcover (including but not limited to uses such as walking and bird watching); and

f) Any work which may disturb the grounds, excavation, or relocation of contaminated soils undertaken with the written approval of the NHDES.

Emergency Activities: The Owner may conduct excavations within the subject Restricted Area in emergency circumstances that require immediate excavation without obtaining prior written approval of the NHDES in order to repair underground utility lines or other infrastructure or to respond to other types of emergencies. The Owner must meet the conditions outlined in paragraphs (b)(i) through (b)(vi) above under "Restricted Uses and Activities". NHDES shall be afforded a reasonable opportunity to review and comment on any relevant plan developed by an acceptable environmental professional.

Obligations and Conditions Necessary for Implementation: The Owner shall perform the following or ensure that the following actions are taken with respect to the Property:

a) Prevent all excavation on Grantor's Property, except that associated with allowed activities and uses with the written approval of the NHDES;

b) Prevent removal of soils from Grantor's Property, unless authorized by the NHDES;

c) Prevent the use or extraction of groundwater from Grantor's Property, except that associated with allowed uses and activities;

d) Maintain all landscaping, groundcover, and pavement on Grantor's Property in good repair, and fully and immediately repair or replace any landscaping, groundcover, or pavement disturbed as a result of allowed activities and uses; and

e) Maintain all existing fences on Grantor's Property in good repair and prevent unauthorized individuals from entering Grantor's Property.

Proposed Changes in Activities and Uses. Any changes in activities and uses at the Grantor's Property that might result in higher levels of exposure to CGRM than currently exist, including undertaking a prohibited activity or use, must be reflected in a change to this Activity and Use Restriction, approved by the NHDES in accordance with relevant laws, regulations, policies and procedures.

The undersigned officer of Northern Utilities, Inc. warranties under oath that he/she has the actual authority to execute this instrument on behalf of said corporation.

Northern Utilities, Inc.,
A New Hampshire Corporation

By: Kenneth M. Margossian

Name: Kenneth M. Margossian

Title: Executive Vice President

ACKNOWLEDGMENT

Commonwealth of Massachusetts
County of Worcester

On this the 12th day of September, 2002, before me, William MacGillivray, the undersigned officer, personally appeared Kenneth M. Margossian, who acknowledged him/herself to be the Executive Vice President of Northern Utilities, Inc. a New Hampshire Corporation, and that he/she, as such Executive Vice President, being authorized so to do, executed the foregoing instrument for the purposes therein contained, by signing the name of the corporation by him/herself as Northern Utilities, Inc.

In witness whereof I hereunto set my hand and official seal.

William D. MacGillivray

Notary Public
My commission expires May 7, 2004

BK2582PG0338

NORTHERN UTILITIES, INC.
STRAFFORD COUNTY
ROUTE 125
ROCHESTER, NH

EXHIBIT A

Three tracts or parcels of land situate easterly of New Hampshire Route 125, the road from Rochester to Gonic, in Rochester, near Gonic Village, County of Strafford and State of New Hampshire, bounded and described as follows:

TRACT I: Beginning at a point on the easterly sideline of New Hampshire Route 125 at the northwesterly corner of land now or formerly of Pyrofax Gas Corp.; thence running North Eighteen Degrees Twenty-Four Minutes Fifty-Five Seconds East (N 18° 24' 55" E) a distance of Seventy-Nine and Twenty-Four Hundredths (79.24) feet to a point in the center of Axe Handle Brook, so-called; thence turning and running South Sixty-Five Degrees Eleven Minutes Ten Seconds East (S 65° 11' 10" E) along the center of Axe Handle Brook, so-called, a distance of One-Hundred Twenty-Six and Seventy-Five Hundredths (126.75) feet to a point; thence turning and running South Seventy-Six Degrees Forty-Six Minutes Twenty Seconds East (S 76° 46' 20" E) along the center of Axe Handle Brook, so-called, a distance of Two Hundred Fifty-Seven and Eighty-Four Hundredths (257.84) feet to a point in the center of the Cocheco River; thence turning and running South Forty Degrees Fifty-One Minutes Twenty Seconds East (S 40° 51' 20" E) along the center of the Cocheco River a distance of Fourteen and Three Hundredths (14.03) feet to a point on the northwesterly sideline of land now or formerly of the Boston and Maine Corporation; thence turning and running South Forty-Seven Degrees Twenty-One Minutes Twenty Seconds West (S 47° 21' 20" W) feet along the Boston and Maine Corporation land to the northeasterly corner of said Pyrofax Gas Corp. land; thence turning and running North Seventy-One Degrees Eight Minutes Twenty Seconds West (N 71° 08' 20" W) a distance of Three Hundred Forty-Eight and Thirty-Three Hundredths (348.33) feet along said Pyrofax Gas Corp. land to the point of beginning, be all said measurements, more or less. Meaning and intended to describe Tract I in deed Book 1606 Page 473.

TRACT II: Beginning at a point at the southwesterly corner of the tract herein conveyed at land now or formerly of the Boston and Maine Corporation and land now or formerly of the State of New Hampshire adjacent to the Spaulding Turnpike; thence running northeasterly on a curve to the right having a radius of One Thousand Three Hundred Ninety-One and Twenty-Five Hundredths (1,391.25) feet, a distance of Three Hundred Eight and Thirty Hundredths (308.30) feet along said Boston and Maine Corporation land to a point; thence continuing North Forty-Seven Degrees Twenty-Two Minutes Fifteen Seconds East (N 47° 22' 15" E) along said Boston and Maine Corporation land a distance of One Hundred Fifty-Three and Eighty-Four Hundredths (153.84) feet to a point; thence turning and running South Fifty-Two Degrees Fifty Minutes Five Seconds East (S 52° 50' 05" E) a distance of Seventy-Five and Ninety-Five Hundredths (75.95) feet along said Boston and Maine Corporation land to a point in the center of the Cocheco River; thence turning and running South Ten Degrees Twenty-

Three Minutes Fifty Seconds West (S 10° 23' 50" W) a distance of Three Hundred Seventy-Six and Twenty-Four Hundredths (376.24) feet along the center of the Cocheco River to a point on the northeasterly sideline of said State of New Hampshire land; thence turning and running North Forty-Three Degrees Three Minutes Zero Seconds West (N 43° 03' 00" W) a distance of Two Hundred Thirty-Two and Zero Hundredths (232.00) feet along said State of New Hampshire land to a New Hampshire Highway bound; thence turning and running North Fifty-Eight Degrees Thirty-Eight Minutes Twenty-Five Seconds West (N 58° 38' 25" W) a distance of Two Hundred Two and Eleven Hundredths (202.11) feet along said State of New Hampshire land to said Boston and Maine Corporation land to the point of beginning, be all said measurements, more or less. Meaning and intended to describe Tract II in deed Book 1606 Page 473.

TRACT IIIA: Beginning at a New Hampshire Highway Department concrete bound located North Fifty-Eight Degrees Thirty-Eight Minutes Twenty-Five Seconds West (N 58° 38' 25" W), Three and Eight-One Hundredths (3.81) feet westerly from Station 4895+45+/- of the centerline of location of the Boston and Maine Corporation; thence turning North Fifty-Seven Degrees Twenty-Eight Minutes Fifty Seconds West (N 57° 28' 50" W) a distance of Thirty-Seven and Forty-Seven Hundredths (37.47) feet to a point at land now or formerly of Pyrofax Gas Corp.; thence turning and running northeasterly along a curve to the right having a radius of One Thousand Four Hundred Seventy Three and Seventy-Five Hundredths (1,473.75) feet a distance of Three Hundred Thirty and Sixty Hundredths (330.60) feet to a point of tangency; thence turning and running North Forty-Seven Degrees Twenty-Two Minutes Fifteen Seconds East (N 47° 22' 15" E) a distance of Two Hundred Fourteen and Seventeen Hundredths (214.17) feet to a point located in the Cocheco River; thence turning and running southeasterly by the center of the Cocheco River One Hundred Sixty-Five (165) feet, more or less, to a point; thence turning and running North Fifty-Two Degrees Fifty Minutes Fifteen Seconds West (N 52° 50' 15" W) a distance of Seventy-Five and Ninety-Five Hundredths (75.95) feet to a point on the westerly bank of the Cocheco River; thence turning and running South Forty-Seven Degrees Twenty-Two Minutes Fifteen Seconds West (S 47° 22' 15" W), a distance of One Hundred Fifty-Three and Eighty-Four Hundredths (153.84) feet to a point of curvature located opposite Station 4898+39.6 of the centerline of location of the Boston and Maine Corporation; thence running along a curve to the left having a radius of One Thousand Three Hundred Ninety-One and Twenty-Five Hundredths (1,391.25) feet a distance of Three Hundred Eight and Thirty Hundredths (308.30) feet to a point at said New Hampshire Highway Department land; thence turning and running North Fifty-Eight Degrees Thirty-Eight Minutes Twenty-Five Seconds West (N 58° 38' 25" W) a distance of Forty-Five and Thirteen Hundredths (45.13) feet to the point of beginning, be all said measurements, more or less. Meaning and intending to describe that part of Tract III in deed Book 1506 Page 473 which lies southwesterly of the center of the Cocheco River.

Said tracts of land are shown on "Plan of Land on Route 125 Rochester, NH for Northern Utilities Showing Activity and Use Restriction Areas, July 02, 2002 Owen Haskell, Inc." to be recorded.

Plan #67-20

BK2582PG0340

Appendix B Cost Estimates for Remedial Alternatives

Appendix B-1
Excavation and Natural Attenuation

AECOM

Project Name:	Rochester Former MGP	**Revision No.:**	4
Cost Estimate No.:	Alternative 1	**Date:**	10/21/22
Client	Northern Utilities	**Status:**	Draft
Location	Rochester, NH	**Author:**	MM
		Office:	Chelms
Project Element:	Excavation	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Rochester, NH
Project Start Date:	2024
Project Duration:	4 Mo
Type of Contract:	Direct Owner
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

Excavation of soils to 30' and Natural Attenuation

Excavation Volume	10,100	CY

Document Source: Source Material Investigation **Rev. Date** 10/13/2022 **Site Visit?** yes
Document Source: **Rev. Date**
Document Source: **Rev. Date**

Cost Summary

Prime Contractor Costs	**$**	**3,145,701**
Other Contracts & Purchases	**$**	**2,175,600**
Subcontractor Costs		
Project Total Estimated Cost	**$**	**6,137,588**

Notes:
1. *Note intended use and audience*
2. *List major project assumptions*
3. *Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"*

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. *Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000*

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

Rochester Former MGP
Alternative 1
Northern Utilities
Rochester, NH

AECOM

Excavation

By: MM Rev Date: 10/21/2022

Prime Contractor Costs					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Mobilization/Demobilization	LS	1	$66,000	$0	$13,200	$79,200	$79,200	3%
2	Temporary Facilities and Controls	MO	6	$248,560	$0	$49,712	$298,272	$49,712	9%
3	Erosion and Sediment Controls	LF	1,500	$29,145	$0	$5,829	$34,974	$23	1%
4	Odor Foam Consumables	LS	1	$65,465	$0	$13,093	$78,558	$78,558	2%
5	Surface Soil Excavation and Stockpiling	CY	18000	$274,023	$0	$54,805	$328,828	$18	10%
6	Construction Water Management	LS	1	$973,200	$0	$194,640	$1,167,840	$1,167,840	37%
7	Impacted Soil Excavation and Stockpilin	CY	10,100	$274,023	$0	$54,805	$328,828	$33	10%
8	Backfill On-Site Soil	CY	18000	$274,023	$0	$54,805	$328,828	$18	10%
9	Site Restoration	LS	1	$416,977.65	$0	$83,396	$500,373	$500,373	16%
				$2,621,418	$0	$524,284	$3,145,701		100%

Other Contracts & Purchases					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Waste Disposal	Ton	18,130	$1,813,000	$0	$362,600	$2,175,600	$120	100%
				$1,813,000	$0	$362,600	$2,175,600		100%

Costs					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Design	LS	1	$115,000	$0	$23,000	$138,000	$138,000	17%
2	Waste Characterization Sampling	Samples	40	$37,500	$0	$7,500	$45,000	$1,125	6%
3	Air Monitoring and Health and Safety	LS	1	$34,400	$0	$6,880	$41,280	$41,280	5%
4	Operations and Maintenance	Quarterly Event	7	$133,000	$0	$26,600	$159,600	$22,800	20%
5	Oversight Personnel	Man Hours	2737	$360,339	$0	$72,068	$432,407	$158	53%
				$680,239	$0	$136,048	$816,287		100%

Grand Total	$6,137,588

Rochester Former MGP
Alternative 1
Northern Utilities
Rochester, NH

AECOM

Excavation

Add Task | Delete Row | Add 1 Blank Row

By: MM Rev Date: 10/21/22

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost	
Prime Contractor Costs		NOTE- All costs include contractor Overhead and Profit				
1	**Mobilization/Demobilization**	LS	1		$66,000.00	
	Excavation Equipment	LS	1	66000	$66,000.00	
2	**Temporary Facilities and Controls**	MO	6		$248,560.30	
	Temporary Facilities- Trailers/Storage Box	Mo.	6	$ 998.88	$5,993.28	
	Portable Toilets	Mo.	6	$ 245.55	$1,473.30	
	Office Equipment	Mo.	6	$ 233.54	$1,401.24	
	Office Supplies	Mo.	6	$ 92.51	$555.06	
	Electric Connection to Office Trailer	Ea.	6	$ 1,352.18	$8,113.08	
	Electric Usage	Mo.	6	$ 200.00	$1,200.00	
	Connection to Hydrant/Water Usage	L.S.	6	$ 2,000.00	$12,000.00	
	Pick Up Truck	Mo.	6	$ 2,198.00	$13,188.00	
	Decontamination Pad	L.S.	1	$ 5,000.00	$5,000.00	
	Decontamination Trailer and Personal Hygiene Facilities	L.S.	1	$ 5,000.00	$5,000.00	
	Water Truck	Mo.	6	$ 1,269.39	$7,616.34	
	Dumpster	Week	24	$ 480.00	$11,520.00	
	Survey	Event	6	$ 5,000.00	$30,000.00	
	Project Manager	Week	30	$ 2,500.00	$75,000.00	
	Superintendent	Event	30	$ 2,350.00	$70,500.00	
3	**Erosion and Sediment Controls**	LF	1,500		$29,145.00	
	Silt Fence	LF	1500	3.13	$4,695.00	
	Hay Bales	LF	1500	8.3	$12,450.00	
	Temporary Fencing	LF	1500	8	$12,000.00	
4	**Odor Foam Consumables**	LS	1		$65,464.80	
	Odor Control Rushmar Foam	gallon	400	$30.00	$12,000.00	
	Odor Control - 1 Laborer, 4 hours per day, 110 days	Hours	440	$87.42	$38,464.80	
	Odor Control Rushmar Unit	Mo.	5	$3,000.00	$15,000.00	
5	**Surface Soil Excavation and Stockpiling**	CY	18,000		$274,023.30	
	Excavator	Hours	670	$150.00	$100,500.00	
	Dozer	Hours	670	$55.00	$36,850.00	
	Equip Oper	Hours	670	$116.57	$78,101.90	
	Laborer	Hours	670	$87.42	$58,571.40	
6	**Construction Water Management**	LS	1		$973,200.00	
	Permitting	LS	1	$20,000.00	$20,000.00	
	Mobilization/Demobilization	LS	1	$400,000.00	$400,000.00	
	Operation	week	16	$25,000.00	$400,000.00	
	Excavation Dewatering	LS	1	$150,000.00	$150,000.00	
	Sampling	Weekly	16	$200.00	$3,200.00	
7	**Impacted Soil Excavation and Stockpiling**	CY	10,100		$274,023.30	
	Excavator	Hours	670	$150.00	$100,500.00	
	Dozer	Hours	670	$55.00	$36,850.00	
	Equip Oper	Hours	670	$116.57	$78,101.90	
	Laborer	Hours	670	$87.42	$58,571.40	
8	**Backfill On-Site Soil**	CY	18,000		$274,023.30	
	Excavator	Hours	670	$150.00	$100,500.00	
	Dozer	Hours	670	$55.00	$36,850.00	
	Equip Oper	Hours	670	$116.57	$78,101.90	
	Laborer	Hours	670	$87.42	$58,571.40	
9	**Site Restoration**	LS	1		$416,977.65	
	Excavator	Hours	80	$150.00	$12,000.00	
	Dozer	Hours	335	$55.00	$18,425.00	
	Equip Oper	Hours	335	$116.57	$39,050.95	
	Laborer	Hours	335	$87.42	$29,285.70	
	Commercial Fill	CY	10,100	$30.00	$303,000.00	
	Seeding	SY	4800	$3.17	$15,216.00	
					$0.00	
	SUB-TOTAL CONTRACTOR				$2,621,417.65	$2,621,417.65
	Mark-up					$0.00
	Contingency	20%				$524,283.53
	Total Subcontractor					$3,145,701.18
Other Contracts & Purchases						
1	**Waste Disposal**	Ton	18,130		$1,813,000.00	
	Transportation and Disposal (Non-Haz)	Ton	18130	$100	$1,813,000.00	
	Water Disposal	gallon	0		$0.00	
	SUB-TOTAL OTHER CONTRACTS				$1,813,000.00	$1,813,000.00
	Mark-up					$0.00
	Contingency	20%				$362,600.00
	Total Subcontractor					$2,175,600.00

Costs						
1	**Design**				**$115,000.00**	
	Pre-Design Investigation	LS	1	$40,000.00	$40,000.00	
	Drawings and Specifications	LS	1	$75,000.00	$75,000.00	
2	**Waste Characterization Sampling**	**Samples**	**40**		**$37,500.00**	
	Waste Sampling	Samples	45	$700.00	$31,500.00	
	Confirmation Sampling	Samples	20	$300.00	$6,000.00	
3	**Air Monitoring and Health and Safety**	**LS**	**1**		**$34,400.00**	
	Air Monitoring-Equip	Mo	4	$3,300.00	$13,200.00	
	Suma Canisters	Samples	48	$275.00	$13,200.00	
	HSO-Air Monitoring/Office Support	Hr	80	$100.00	$8,000.00	
					$0.00	
4	**Operations and Maintenance**	**Quarterly Event**	**7**		**$133,000.00**	
	Quarterly GW Monitoring	Quarterly Event	7	$19,000.00	$133,000.00	
5	**Oversight Personnel**	**Man Hours**	**2737**		**$360,338.88**	
	Project Manager	Hr	240	$175.10	$42,024.00	
	Construction Manager	HR	1200	$159.65	$191,580.00	
	Field Staff	Hr	1200	$85.49	$102,588.00	
	Administration (Home Office)	HR	96	$95.28	$9,146.88	
	Travel Expenses	LS	1	$15,000.00	$15,000.00	
	SUB-TOTAL COSTS				**$680,238.88**	**$680,238.88**
	Mark-up (ODCs Only)				(no m/u on labor)	**$0.00**
	Contingency	20%				**$136,047.78**
	Total					**$816,286.66**
	GRAND TOTAL					**$6,137,587.84**

AECOM

Project Name:	Rochester Former MGP	**Revision No.:**	6
Cost Estimate No.:	Alternative 2	**Date:**	11/14/22
Client	Northern Utilities	**Status:**	Draft
Location	Rochester, NH	**Author:**	MM
		Office:	Chelms
Project Element:	Solidification	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Rochester, NH
Project Start Date:	2024
Project Duration:	3 Mo
Type of Contract:	Direct Owner
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

ISS of soils to 30' and Natural Attenuation

Soil ISS Vol	20,000	CY
Total ISS Volume	20,000	CY

Document Source: Source Material Investigation **Rev. Date** 10/13/2022 **Site Visit?** yes
Document Source: **Rev. Date**
Document Source: **Rev. Date**

Cost Summary

Prime Contractor Costs	**$**	**4,756,445**
Other Contracts & Purchases	**$**	**-**
Subcontractor Costs		
Project Total Estimated Cost	**$**	**5,568,772**

Notes:
1. *Note intended use and audience*
2. *List major project assumptions*
3. *Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"*

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. *Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000*

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

Rochester Former MGP
Alternative 2
Northern Utilities
Rochester, NH

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Solidification

By: MM Rev Date: 11/14/2022

Prime Contractor Costs									
					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Mobilization/Demobilization	LS	1	$436,000	$0	$87,200	$523,200	$523,200	11%
2	Temporary Facilities and Controls	MO	6	$136,560	$0	$27,312	$163,872	$27,312	3%
3	Erosion and Sediment Controls	LF	1,500	$29,145	$0	$5,829	$34,974	$23	1%
4	Odor Foam Consumables	LS	1	$68,465	$0	$13,693	$82,158	$82,158	2%
5	Surface Soil Excavation and Stockpiling	CY	15400	$188,135	$0	$37,627	$225,762	$15	5%
6	ISS Standard 8' Columns	CY	20,000	$2,800,000	$0	$560,000	$3,360,000	$168	71%
7	Spoils Management	CY	5,000	$47,034	$0	$9,407	$56,441	$11	1%
8	Backfill	CY	16000	$235,169	$0	$47,034	$282,203	$18	6%
9	Site Restoration	LS	1	$23,195.94	$0	$4,639	$27,835	$27,835	1%
				$3,963,705	$0	$792,741	$4,756,445		100%

Other Contracts & Purchases									
					10%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Waste Disposal	Ton	-	$0	$0	$0	$0	#DIV/0!	#DIV/0!
				$0	$0	$0	$0		#DIV/0!

Costs									
					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Design	LS	1	$125,000	$0	$25,000	$150,000	$150,000	18%
2	QA/QC Sampling	Samples	40	$17,600	$0	$3,520	$21,120	$528	3%
3	Air Monitoring and Health and Safety	LS	1	$41,000	$0	$8,200	$49,200	$49,200	6%
4	Operations and Maintenance	Quarterly Event	7	$133,000	$0	$26,600	$159,600	$22,800	20%
5	Oversight Personnel	Man Hours	2737	$360,339	$0	$72,068	$432,407	$158	53%
				$676,939	$0	$135,388	$812,327		100%

Grand Total	$5,568,772

Rochester Former MGP
Alternative 2
Northern Utilities
Rochester, NH

AECOM

Solidification

Add Task | Delete Row | Add 1 Blank Row

By: MM Rev Date: 11/14/22

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost	
Prime Contractor Costs		NOTE- All costs include contractor Overhead and Profit				
1	**Mobilization/Demobilization**	**LS**	**1**		**$436,000.00**	
	ISS Equipment	LS	1	370000	$370,000.00	
	Excavation Equipment	LS	1	66000	$66,000.00	
2	**Temporary Facilities and Controls**	**MO**	**6**		**$136,560.30**	
	Temporary Facilities- Trailers/Storage Box	Mo.	6	$998.88	$5,993.28	
	Portable Toilets	Mo.	6	$245.55	$1,473.30	
	Office Equipment	Mo.	6	$233.54	$1,401.24	
	Office Supplies	Mo.	6	$92.51	$555.06	
	Electric Connection to Office Trailer	Ea.	6	$1,352.18	$8,113.08	
	Electric Usage	Mo.	6	$200.00	$1,200.00	
	Connection to Hydrant/Water Usage	L.S.	6	$2,000.00	$12,000.00	
	Pick Up Truck	Mo.	6	$2,198.00	$13,188.00	
	Decontamination Pad	L.S.	1	$5,000.00	$5,000.00	
	Decontamination Trailer and Personal Hygiene Facilities	L.S.	1	$5,000.00	$5,000.00	
	Water Truck	Mo.	6	$1,269.39	$7,616.34	
	Dumpster	Week	24	$480.00	$11,520.00	
	Survey	Event	3	$ 5,000.00	$15,000.00	
	Project Manager	Week	10	$ 2,500.00	$25,000.00	
	Superintendent	Event	10	$ 2,350.00	$23,500.00	
3	**Erosion and Sediment Controls**	**LF**	**1500**		**$29,145.00**	
	Silt Fence	LF	1500	$3.13	$4,695.00	
	Hay Bales	LF	1500	$8.30	$12,450.00	
	Temporary Fencing	LF	1500	$8.00	$12,000.00	
4	**Odor Foam Consumables**	**LS**	**1**		**$68,464.80**	
	Odor Control Rushmar Foam	gallon	400	$30.00	$12,000.00	
	Odor Control - 1 Laborer, 4 hours per day, 110 days	Hours	440	$87.42	$38,464.80	
	Odor Control Rushmar Unit	Mo.	6	$3,000.00	$18,000.00	
5	**Surface Soil Excavation and Stockpiling**	**CY**	**15400**		**$188,135.40**	
	Excavator	Hours	460	$150.00	$69,000.00	
	Dozer	Hours	460	$55.00	$25,300.00	
	Equip Oper	Hours	460	$116.57	$53,622.20	
	Laborer	Hours	460	$87.42	$40,213.20	
6	**ISS Standard 8' Columns**	**CY**	**20000**		**$2,800,000.00**	
	ISS Unit Rate	CY	20000	$140.00	$2,800,000.00	
7	**Spoils Management**	**CY**	**5000**		**$47,033.85**	
	Excavator	Hours	115	$150.00	$17,250.00	
	Dozer	Hours	115	$55.00	$6,325.00	
	Equip Oper	Hours	115	$116.57	$13,405.55	
	Laborer	Hours	115	$87.42	$10,053.30	
8	**Backfill**	**CY**	**16000**		**$235,169.25**	
	Excavator	Hours	575	$150.00	$86,250.00	
	Dozer	Hours	575	$55.00	$31,625.00	
	Equip Oper	Hours	575	$116.57	$67,027.75	
	Laborer	Hours	575	$87.42	$50,266.50	
9	**Site Restoration**	**LS**	**1**		**$23,195.94**	
	Excavator	Hours	24	$150.00	$3,600.00	
	Dozer	Hours	24	$55.00	$1,320.00	
	Equip Oper	Hours	24	$116.57	$2,797.68	
	Laborer	Hours	3	$87.42	$262.26	
	Topsoil	cy	0	$0.00	$0.00	
	Seeding	SY	4800	$3.17	$15,216.00	
					$0.00	
	SUB-TOTAL CONTRACTOR				**$3,963,704.54**	**$3,963,704.54**
	Mark-up					**$0.00**
	Contingency	20%				**$792,740.91**
	Total Subcontractor					**$4,756,445.45**
Other Contracts & Purchases						
1	**Waste Disposal**	**Ton**	**0**		**$0.00**	
	Transportation and Disposal (Haz)-	ton	0		$0.00	
	Transportation and Disposal (Non-Haz)-Assumes 30% spoils	Ton	0		$0.00	
	Water Disposal	gallon	0		$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$0.00**	**$0.00**
	Mark-up	10%				**$0.00**
	Contingency	20%				**$0.00**
	Total Subcontractor					**$0.00**

Costs						
1	**Design**				**$125,000.00**	
	Pre-Design Investigation and Treatability Testing	LS	1	$50,000.00	$50,000.00	
	Drawings and Specifications	LS	1	$75,000.00	$75,000.00	
2	**QA/QC Sampling**	**Samples**	**40**		**$17,600.00**	
	QA/QC Sampling	Samples	40	$440.00	$17,600.00	
					$0.00	
3	**Air Monitoring and Health and Safety**	**LS**	**1**		**$41,000.00**	
	Air Monitoring-Equip	Mo	5	$3,300.00	$16,500.00	
	Suma Canisters	Samples	60	$275.00	$16,500.00	
	HSO-Air Monitoring/Office Support	Hr	80	$100.00	$8,000.00	
					$0.00	
4	**Operations and Maintenance**	**Quarterly Even**	**7**		**$133,000.00**	
	Quarterly GW Monitoring	Quarterly Event	7	$19,000.00	$133,000.00	
5	**Oversight Personnel**	**Man Hours**	**2737**		**$360,338.88**	
	Project Manager	Hr	240	$175.10	$42,024.00	
	Construction Manager	HR	1200	$159.65	$191,580.00	
	Field Staff	Hr	1200	$85.49	$102,588.00	
	Administration (Home Office)	HR	96	$95.28	$9,146.88	
	Travel Expenses	LS	1	$15,000.00	$15,000.00	
		SUB-TOTAL COSTS			**$676,938.88**	**$676,938.88**
		Mark-up (ODCs Only)			(no m/u on labor)	**$0.00**
		Contingency	20%			**$135,387.78**
		Total				**$812,326.66**
		GRAND TOTAL				**$5,568,772.10**

AECOM

Project Name:	Rochester Former MGP	**Revision No.:**	5
Cost Estimate No.:	Alternative 3	**Date:**	11/8/22
Client	Northern Utilities	**Status:**	Draft
Location	Rochester, NH	**Author:**	MM
		Office:	Chelms
Project Element:	In-Situ Oxidation (ISCO)	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Rochester, NH
Project Start Date:	2024
Project Duration:	3 Mo
Type of Contract:	Direct Owner
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

ISCO of soils to 30' and Natural Attenuation

Soil ISCO Volume	16,400	CY
Total ISCO Volume	16,400	CY

Document Source: Source Material Investigation **Rev. Date** 10/13/2022 **Site Visit?** yes
Document Source: **Rev. Date**
Document Source: **Rev. Date**

Cost Summary

Prime Contractor Costs	**$**	**1,670,335**
Other Contracts & Purchases		**#REF!**
Subcontractor Costs		
Project Total Estimated Cost	**$**	**2,539,815**

Notes:
1. *Note intended use and audience*
2. *List major project assumptions*
3. *Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"*

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. *Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000*

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

Rochester Former MGP
Alternative 3
Northern Utilities
Rochester, NH

AECOM

In-Situ Oxidation (ISCO)

By: MM **Rev Date:** 11/8/2022

Prime Contractor Costs					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Mobilization/Demobilization	LS	1	$11,130	$0	$2,226	$13,356	$13,356	1%
2	Temporary Facilities and Controls	MO	7	$104,303	$0	$20,861	$125,163	$17,880	7%
3	Erosion and Sediment Controls	LF	1,500	$29,145	$0	$5,829	$34,974	$23	2%
4	Transportation/Travel Costs	Weeks	26	$138,918	$0	$27,784	$166,702	$6,412	10%
5	Well Installation	Wells	130	$58,810	$0	$11,762	$70,572	$543	4%
6	Reagent Injection	Events	3	$1,023,640	$0	$204,728	$1,228,368	$409,456	74%
7	Site Restoration	LS	5,000	$26,000	$0	$5,200	$31,200	$6	2%
	Total			$1,391,946	$0	$278,389	$1,670,335		100%

Costs					0%	20%			
Task ID	Task Descr.	Unit	Quantity	Bare Cost	MU	Contingency	Total Cost	Unit Rate	%
1	Pre-Design Investigation and Treatability	LS	1	$50,000	$0	$10,000	$60,000	$60,000	7%
2	Air Monitoring and Health and Safety	LS	1	$54,200	$0	$10,840	$65,040	$65,040	7%
3	Operations and Maintenance	Quarterly Event	7	$209,000	$0	$41,800	$250,800	$35,829	29%
4	Oversight Personnel	Man Hours	3137	$411,367	$0	$82,273	$493,640	$157	57%
	Total			$724,567	$0	$144,913	$869,480		100%

Grand Total	$2,539,815

Rochester Former MGP
Alternative 3
Northern Utilities
Rochester, NH

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In-Situ Oxidation (ISCO)

Add Task | Delete Row | Add 1 Blank Row

By: MM Rev Date: 11/8/22

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost	
Prime Contractor Costs		NOTE- All costs include contractor Overhead and Profit				
1	**Mobilization/Demobilization**	**LS**	**1**		**$11,130.00**	
	Dessign Mobilization	Event	3	3710	$11,130.00	
2	**Temporary Facilities and Controls**	**MO**	**7**		**$104,302.54**	
	Temporary Facilities- Trailers/Storage Box	Mo.	7	$499.44	$3,496.08	
	Portable Toilets	Mo.	7	$245.55	$1,718.85	
	Office Equipment	Mo.	7	$233.54	$1,634.78	
	Office Supplies	Mo.	7	$92.51	$647.57	
	Electric Connection to Office Trailer	Ea.	7	$1,352.18	$9,465.26	
	Electric Usage	Mo.	7	$200.00	$1,400.00	
	Connection to Hydrant/Water Usage	L.S.	7	$2,000.00	$14,000.00	
	Decontamination Pad	L.S.	1	$5,000.00	$5,000.00	
	Decontamination Trailer and Personal Hygiene Facilities	L.S.	1	$5,000.00	$5,000.00	
	Dumpster	Week	28	$480.00	$13,440.00	
	Project Manager	Week	10	$ 2,500.00	$25,000.00	
	Superintendent	Event	10	$ 2,350.00	$23,500.00	
3	**Erosion and Sediment Controls**	**LF**	**1500**		**$29,145.00**	
	Silt Fence	LF	1500	$3.13	$4,695.00	
	Hay Bales	LF	1500	$8.30	$12,450.00	
	Temporary Fencing	LF	1500	$8.00	$12,000.00	
4	**Transportation/Travel Costs**	**Weeks**	**26**		**$138,918.00**	
	Transportation /Travel	Week	26	$5,343.00	$138,918.00	
5	**Well Installation**	**Wells**	**130**		**$58,810.00**	
	Mobilization/Demobilization	LS	1	$2,000.00	$2,000.00	
	Installation	Well	130	$130.00	$16,900.00	
	Well Material	Well	130	$307.00	$39,910.00	
6	**Reagent Injection**	**Events**	**3**		**$1,023,640.00**	
	Labor and Equipment	Day	130	$4,156.00	$540,280.00	
	Reagent	Gallons	91200	$5.30	$483,360.00	
7	**Site Restoration**	**LS**	**5000**		**$26,000.00**	
	Mobilization	LS	1	$2,000.00		
	Well Decomissioning	Wells	130	$200.00	$26,000.00	
	SUB-TOTAL CONTRACTOR				**$1,391,945.54**	**$1,391,945.54**
	Mark-up					**$0.00**
	Contingency	20%				**$278,389.11**
	Total Subcontractor					**$1,670,334.65**
Other Contracts & Purchases						
1	**Waste Disposal**	**Ton**	**#REF!**		**$0.00**	
	Transportation and Disposal (Non-Haz)	ton	0		$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$0.00**	**$0.00**
	Mark-up					**$0.00**
	Contingency	20%				**$0.00**
	Total Subcontractor					**$0.00**
Costs						
1	**Pre-Design Investigation and Treatability Testing**				**$50,000.00**	
	Pre-Design Investigation and Treatability Testing	LS	1	$50,000.00	$50,000.00	
2	**Air Monitoring and Health and Safety**	**LS**	**1**		**$54,200.00**	
	Air Monitoring-Equip	Mo	7	$3,300.00	$23,100.00	
	Suma Canisters	Samples	84	$275.00	$23,100.00	
	HSO-Air Monitoring/Office Support	Hr	80	$100.00	$8,000.00	
					$0.00	
3	**Operations and Maintenance**	**Quarterly Even**	**7**		**$209,000.00**	
	Quarterly GW Monitoring	Quarterly Event	11	$19,000.00	$209,000.00	
4	**Oversight Personnel**	**Man Hours**	**3137**		**$411,366.88**	
	Project Manager	Hr	240	$175.10	$42,024.00	
	Construction Manager	HR	1400	$159.65	$223,510.00	
	Field Staff	Hr	1400	$85.49	$119,686.00	
	Adiministration (Home Office)	HR	96	$95.28	$9,146.88	
	Travel Expenses	LS	1	$17,000.00	$17,000.00	
	SUB-TOTAL COSTS				**$724,566.88**	**$724,566.88**
	Mark-up (ODCs Only)			(no m/u on labor)		**$0.00**
	Contingency	20%				**$144,913.38**
	Total					**$869,480.26**
	GRAND TOTAL					**$2,539,814.90**