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New York State Department of Environmental Conservation

Focused Feasibility Study Operable Unit 2

Former Paulsen-Holbrook Site
Town of Guilderland, New York
Site #401046

Work Assignment # D004439-21

February 2014

ARCADIS

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Focused Feasibility Study

Former Paulsen-Holbrook Site
Town of Guilderland, New York
Site #401046

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ARCADIS

Feasibility Study

Former Paulsen Holbrook
Site – OU2

Certification

I, Daniel Loewenstein, certify that I am currently a NYS registered professional engineer and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

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1. Introduction

The New York State Department of Environmental Conservation (NYSDEC) issued a Work Assignment for a Remedial Investigation and Feasibility Study of the Former Paulsen-Holbrook Site (site), Operable Unit 2 (OU2), located in the Town of Guilderland, New York (Figure 1). ARCADIS of New York, Inc. (ARCADIS) has prepared this Focused Feasibility Study (FFS) to evaluate remedial alternatives for metals in soil at OU2. The purpose of this report is to:

- Identify and screen remedial technologies to address soil containing arsenic, chromium, and/or copper at concentrations exceeding 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives and/or 6 NYCRR Part 375 Commercial Soil Cleanup Objectives; and

- Evaluate potential remedial alternatives based on seven evaluation criteria.

After approval of this FFS, the NYSDEC will issue a Proposed Remedial Action Plan (PRAP) which is open to public comment. Following the public comment period, the NYSDEC will issue a Record of Decision (ROD) for the site.

This FFS was completed in accordance with NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10), NYSDEC DER program policy for Presumptive/Proven Remedial Technologies (DER-15), and other appropriate NYSDEC and United States Environmental Protection Agency (USEPA) guidance.

1.1 Site Description

The Former Paulsen-Holbrook Site is located at 54 Railroad Avenue in the Town of Guilderland, Albany County New York (Figure 1). The Site is comprised of two operable units (OUs). OU1 is the main Site area around the former pressure treating building. The approximately 0.5-acre OU1 site is situated in an industrial and commercial area bounded by Railroad Avenue to the north, a raised railroad bed operated by Amtrak and CSX Transportation to the south, and commercial properties to the east and west (Figure 2). Patroon Creek is located to the south of the site and flows to the east-southeast. The property has been largely unoccupied since at least 2002. Soil excavation and in-situ remediation activities were completed at the OU1 site in 2013 under a separate ROD.

OU2 consists of a portion of the drainage swale that initiates at the storm water drainage discharge point south of the Former Holbrook Site and extends southeasterly approximately 0.33 miles parallel to the CSX/Amtrak Railroad (Figure 2). The swale area is heavily wooded. The width of the swale varies. The bottom elevation of the swale varies from approximately one to eight feet below the level of the adjacent railroad tracks.

1.1.1 Site Physical Setting

A topographic survey of OU2 was conducted on June 6, 2013 as part of the OU2 RI. The survey of the OU2 drainage swale shows that the elevation within the swale is approximately 245 feet above mean sea level (amsl) near the storm drain discharge pipe (located between the railroad tracks and OU1), and decreases in elevation to 233 feet amsl, approximately one quarter mile to the southwest. As shown on Figure 3, there is an area approximately 540 feet from the storm drain discharge where the swale narrows and slightly increases in elevation. This location will be referred to as the “pinch point” through the remainder of this report.

Soils in the vicinity of the site are primarily mapped as lacustrine sand (Figure 4) deposits generally associated with large bodies of water, typically a near shore deposit or near a sand source (Cadwell et. al. 1986). These deposits are typically well sorted, stratified, and generally consist of quartz sand with a variable thickness ranging from 6.5 to 65 feet (Cadwell et. al. 1986). Soils encountered during the OU2 Remedial Investigation were generally fine to medium sand and silty sand. Clay was occasionally encountered at depths of 8-10 feet below ground surface (bgs). Black sandy material was noted in many borings at depths from zero to four feet bgs. This material was also visible along the railroad bed on either side of the tracks.

As shown on Figure 5, bedrock beneath the overburden is the Normanskill shale of the Lorraine, Trenton, and Black River Groups (Fisher et. al. 1970).

1.1.2 Groundwater

Saturated soil in borings drilled in OU2 was encountered between five and nine feet bgs. Based on the OU1 Investigation, groundwater in the vicinity of the site flows generally to the south, south-east toward Patroon Creek.

1.1.3 Surface Water

Water was observed to be flowing from the drainage discharge pipe during the OU1 Remedial Investigation conducted in 2009 (Malcolm Pirnie, July 2009) and had formed a small ponded area. The discharge pipe is shown on Figure 3. This pipe is a discharge point for the site storm water drainage system. Water was not flowing during the OU2 field investigation.

Patroon Creek is located approximately 600 feet to the south of the site and flows to the east-southeast.

1.2 Site History

Various companies who occupied the site operated a wood treatment operation at this location from the early 1950s until sometime before 1978. Wood was treated by pressure treating with chromated copper arsenate (CCA), which is a solution of chromic acid, cupric oxide, and arsenic pentoxide, in a large pressure vessel located in a containment building at the south-central portion of the property. After treatment, batches of lumber were removed from the pressure vessel and allowed to air dry on the site. An estimated (based on the size of the pressure vessel) 2,000 to 3,000 gallon spill of CCA occurred at the site in 1965 when the pressure vessel was opened before the CCA solution had been pumped out. Soil and groundwater contamination resulting from the spill and, potentially, daily operations associated with treated wood storage after removal from the CCA tank, are present at the site. Contaminants of concern in the soil and groundwater include arsenic, chromium, and copper.

The property has been previously investigated under the NYSDEC Voluntary Cleanup Program. The NYSDEC settled with the responsible parties in March 2007 and the site was subsequently referred to the State Inactive Hazardous Waste Disposal Site Program.

During pre-design sampling conducted in November 2010 following a Record of Decision (March 2010) for OU1, additional soil contamination was found extending off-site in the drainage swale between the Site and the railroad tracks (OU2). Soil was contaminated with arsenic, copper, chromium and zinc.

2. Remedial Investigation Summary

2.1 Soil

The primary contaminants at the site, metals, were present in OU2 soil samples at concentrations greater than the 6 NYCRR Part 375 Unrestricted Use and Commercial Use Soil Cleanup Objectives (SCOs). Soil sampling locations are shown on Figure 6. A majority of the metals exceedances were located in the top four feet of soil. As depth from the surface and distance from OU1 increased, the concentrations decreased. Of the metals that were detected in soil samples, arsenic, chromium, and copper are the primary metals of concern.

The primary area of concern is an approximately 540-foot length of the OU2 drainage swale, extending from the storm water drainage discharge point to a pinch point (see Section 1.1.1.), where the swale narrows and increases in elevation. Based on the current topography, metals contamination beyond this "pinch point" is unlikely to have been distributed from OU1 by surface water flow.

Soil containing arsenic at concentrations that exceeded the Commercial SCO of 16 mg/kg is present mainly from zero to four feet bgs and extends the length of the sampling area. At some boring locations, arsenic concentrations measured with an x-ray fluorescence analyzer (XRF) exceeded the Commercial SCO of 16 mg/kg at all sample intervals, from 0 to10 feet bgs.

Soil containing copper at concentrations that exceeded one or more of the SCOs is present from zero to four feet bgs. Soil containing copper at concentrations that exceeded the Commercial SCO of 270 mg/kg extends approximately 800 feet southeast from the storm water discharge point.

Soil containing chromium at concentrations that exceeded the Unrestricted SCO of 30 mg/kg is present from zero to four feet bgs. A majority of elevated chromium concentrations extends approximately 350 feet southeast from the storm water discharge point.

Semi-volatile organic compounds (SVOCs) in soil do not appear to be a concern for this site as they were not detected at concentrations greater than Unrestricted Use or Commercial Use SCOs in samples collected from the swale within the primary area of concern.

2.2 Conceptual Site Model

With the conclusion of RI sampling, the current Conceptual Site Model is as follows:

Historical uses of the property for a wood treatment facility resulted in the release of metals into soil and groundwater. Wood was treated by pressure treating with chromated copper arsenate (CCA) in a large pressure vessel in a containment building located at the south-central portion of the property. After treatment, batches of lumber were removed from the pressure vessel and allowed to air dry on the site. An estimated (based on the size of the pressure vessel) 2,000 to 3,000 gallon spill of CCA occurred at the site in 1965 when the pressure vessel was opened before the CCA solution had been pumped out. Soil and groundwater contamination resulting from the spill and, potentially, daily operations associated with treated wood storage after removal from the CCA tank, are present at OU1. The storm water discharge pipe located at the southeastern corner of the property is believed to be the pathway through which OU1 contaminants were transported to OU2. The primary contaminants of concern in the soil include arsenic, chromium, and copper.

Soil containing metals at concentrations greater than Unrestricted Use and Commercial Use SCOs is present along the full extent of the swale sampling area, approximately 0.33 miles. However, surface topography likely prohibited site-related contaminants (from OU1) from being distributed by surface water flow beyond the swale “pinch point”, which is located approximately 540 feet southeast from the storm water discharge point, since surface elevations beyond this point are higher than those in the swale. Surface soil samples collected outside the OU2 swale (along the upper edge of the swale near the northern side of the railroad, along the southern side of the railroad, and to the northwest of OU1 and OU2, near the railroad), contained concentrations of arsenic and copper that also exceeded the respective SCOs. These samples were collected from black soil that is present along the length of the railroad right-of-way adjacent to the OU-2 investigation area. The samples were located in areas of higher elevation that could not have been impacted by OU1 contaminants via surface water flow. Accordingly, it is likely that the contaminants of concern present in the black soil along the railroad right-of-way are not associated with the site.
The highest concentrations of arsenic (1,440 parts per million [ppm]), chromium (1,810 ppm), and copper (2,350 ppm) measured in laboratory samples were detected in the zero to one foot bgs and one to two foot bgs samples from borings PH-SB-84 and PH-SB-81, respectively. Boring PH-SB-84 is approximately 45 feet southeast and PH-SB-81 is approximately 6 feet northeast of the storm water discharge point.

The highest concentrations of arsenic (1,940 ppm), chromium (3,555 ppm), and copper (2,762 ppm) measured with the XRF were detected in the zero to one foot bgs sample from boring PH-SB-84.

3. Exposure/Risk Assessment

A qualitative exposure assessment was performed using the data collected during the RI. The qualitative exposure assessment consists of characterizing the exposure setting, identifying potential exposure pathways, and evaluating contaminant fate and transport. An exposure pathway describes the means by which an individual may be exposed to contaminants originating from the site. An exposure pathway has five elements: (1) a contaminant source; (2) contaminant release and transport mechanism; (3) a point of exposure; (4) a route of exposure; and (5) a receptor population.

3.1 Potential Exposure Pathways

3.1.1 Soil

OU2 surface soils characterized during the remedial investigation contained arsenic, chromium, and copper at concentrations greater than the Unrestricted Use and Commercial Use SCOs. The site is located primarily on railroad property and is not open to the general public. Therefore, possible exposure pathways are limited to contact with the impacted surface soils by railroad employees or trespassers.

Subsurface soil, as characterized during the remedial investigation, contains elevated concentrations of arsenic, chromium, and copper. These subsurface soils do not presently have an exposure point or route, as they are present at depth. However, contact with the impacted soils by construction and/or utility workers represents a possible future exposure pathway.

3.1.2 Groundwater

Groundwater in this area is not used as a drinking water source and is therefore not considered a potential exposure pathway.

4. Remedial Action Objectives and Evaluation Criteria

The remedial action objective for the Former Paulsen-Holbrook OU2 is the restoration of the site to pre-release conditions, to the extent feasible, given the existing and anticipated land use and potential exposure pathways.

OU2 resides primarily on CSX/Amtrak railroad property in a predominantly commercial area. Accordingly, the remedial action objectives (RAOs) discussed in this section were developed based upon a similar end-use of the site.

According to Title 40 Code of Federal Regulations (CFR) Part 261, under the Resource Conservation and Recovery Act (RCRA) "wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes that use inorganic preservatives containing arsenic and chromium" are considered a listed hazardous waste (F035). Per the NYSDEC, soil containing arsenic or chromium as a result of direct contact with CCA fluid waste is considered hazardous waste for the purposes of this evaluation.

4.1 Remedial Action Objectives

The results of the remedial investigation indicate that exposure to surface soil and subsurface soil containing metal constituents by site workers and/or trespassers is the potential exposure pathway for the Former Paulsen-Holbrook OU2. The RAOs for the site are:

4.1.1 Soil

<u>Public Health Protection</u>

- Prevent ingestion/direct contact with contaminated soil, including soil in surface water runoff areas.

<u>Environmental Protection</u>

- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Generally, these RAOs may be achieved by minimizing the:

- Migratory potential of the contaminants;
- Potential for human exposure to contaminated media; and
- Magnitude and extent of contamination in the affected media.

4.2 Applicable Standards, Criteria, and Guidance (SCGs)

6 NYCRR Part 375 requires that SCGs are identified and that remedial actions conform with SCGs unless “good cause exists why conformity should be dispensed with.” Standards and Criteria are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, or location. Guidance includes non-promulgated criteria and guidelines that are not legal requirements; however, the site’s remedial program should be designed with consideration given to guidance that, based on professional judgment, is determined to be applicable to the site.

The principal SCGs for the site are listed below:

General:

- 6 NYCRR Part 375 – Environmental Remediation Programs, including the Inactive Hazardous Waste Disposal Site Remedial Program
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes
- 40 CFR Part 260 – Environmental Protection Agency Federal Regulations for Hazardous Waste Management

Soil:

- 6 NYCRR Part 375 – Unrestricted Use Soil Cleanup Objectives (SCOs)
- 6 NYCRR Part 375 – Commercial Use Soil Cleanup Objectives (SCOs)
- 6 NYCRR Part 376 – Land Disposal Restrictions
- NYSDEC Division of Solid and Hazardous Materials TAGM 3028 “Contained-in” Criteria for Environmental Media (8/97)

4.3 Evaluation Criteria

In accordance with DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2010), the remedial measure alternatives developed in this Feasibility Study will be screened based on an evaluation of the following criteria:

- Overall Protection of Human Health and the Environment;
- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, and Volume;
- Short-term Effectiveness;
- Implementability;
- Cost; and
- Land Use.

The community acceptance criterion will be evaluated during the review of the Proposed Remedial Action Plan (PRAP) for the site. If cleanup to pre-disposal conditions is determined to be infeasible, the current, intended, and reasonably anticipated future land use may be used in evaluating remedial alternatives.

4.3.1 Overall Protection of Human Health and the Environment

This criterion serves as a final check to assess whether each alternative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria; especially long-term effectiveness and performance, short-term effectiveness; and compliance with SCGs. The evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

4.3.2 Compliance with SCGs

This evaluation criterion assesses how each alternative complies with 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives and 6 NYCRR Part 375 Commercial Soil Cleanup Objectives.

4.3.3 Long-term Effectiveness and Permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and reliability of controls used to manage residual waste.

4.3.4 Reduction of Toxicity, Mobility, and Volume

This evaluation criterion assesses the remedial alternative’s use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC’s policy is to give preference to alternatives that eliminate any significant threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminants mobility, or reduction of the total volume of contaminated media. This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would be irreversible, and the type and quantity of treatment residuals that would remain following treatment.

4.3.5 Short-term Effectiveness

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to the effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a results of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

4.3.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

4.3.7 Cost

Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs, operation and maintenance (O&M) costs, and future capital costs. A cost sensitivity analysis is performed which includes the following factors: the effective life of the remedial action, the O&M costs, the duration of the cleanup, the volume of contaminated material, other design parameters, and the discount rate. Cost estimates developed at the detailed analysis of alternatives phase of a feasibility study generally have an accuracy range of -30 to +50 percent (USEPA, 2000).

4.3.8 Land Use

This criterion is an evaluation of the current, intended and reasonably anticipated future use of the site and its surroundings, as it relates to an alternative or remedy, when unrestricted levels would not be achieved.

4.3.9 Community Acceptance

Following approval of this report and the preparation of the Proposed Remedial Action Plan (PRAP) by the NYSDEC, a summary of the proposed remedial action will be sent to the project’s contact list, which will include the date, time, and location of the public meeting, and announcement of the 30-day period for submission of written comments from the public. A Responsiveness Summary will be prepared to address public comments on the PRAP. After the submission of Responsiveness Summary, a final remedy will be selected and publicized in a Record of Decision (ROD). If the final remedy differs significantly from the proposed remedy, public notices will include descriptions of the differences and the reason for the changes.

5. Identification and Screening of Technologies

5.1 General Response Actions

NYSDEC Program Policy DER-15: *Presumptive /Proven Remedial Technologies*, provides generally accepted presumptive remedies for various site media which comply with 6 NYCRR section 375-1.8. Presumptive remedies for metals contaminated site media are presented in Section 5 of the DER-15 Guidance document. The purpose of the presumptive remedy approach is to streamline the remedy selection process by providing remedies which have been proven to be both feasible and cost-effective for specific site types and/or contaminants. In accordance with Section 4.3(a)3 of the NYSDEC Program Policy DER-10: *Technical Guidance for Site Investigation and Remediation*, the use of presumptive remedies eliminates the need to screen the selected technologies and to proceed directly to the evaluation of the presumptive alternatives.

In accordance with the DER-10 Guidance document, Section 4.3(a)3, General Response Actions (GRAs) have been identified which may be effective remedies for the remediation of soil and/or groundwater at the site. In this section, medium-specific GRAs are identified and potentially applicable technology types and process options for each GRA are evaluated based on the evaluation criteria discussed in Section 5. In general, the GRAs which are applicable to the affected media at OU2 of the Former Paulsen-Holbrook Site include the no action response, institutional controls, engineering controls, and excavation/off-site removal.

- **No Action** - A no action response, required by the DER-10 for the Feasibility Study (FS) process, provides a baseline for comparison with other alternatives.

- **Institutional Controls** - Institutional controls are applied when active remedial measures do not achieve cleanup limits. Potential human exposure is reduced by limiting public access to site contaminants. Institutional controls such as environmental easements can also apply through an extended remediation period, or to sites where cleanups are completed up to feasible levels but still leave residual contamination greater than background levels.

- **Engineering Controls** – Engineering controls are applied when active remedial measures do not achieve cleanup limits. Potential human exposure is reduced by creating a physical barrier or method to eliminate potential exposure pathways to contamination.

- **Removal Measures** - Removal measures provide for the removal of contaminants or contaminated materials from their existing location for treatment (on-site or off-site) or disposal.

5.2 Identification and Screening of Soil Technologies

Soil containing concentrations of arsenic, chromium, and copper greater than Unrestricted and Commercial Use SCOs that is likely to have originated at OU1 is present in the drainage swale, extending from the storm water drainage point to the "pinch point", approximately 540 feet to the southeast.

5.2.1 No Action

The "no action" GRA, by definition, involves no institutional controls, environmental monitoring, or remedial action, and therefore, includes no technological barriers. This GRA defines the minimum steps that would be taken at the site in the absence of any type of action directed at the existing contamination. In accordance with DER-10, the no action alternative will be retained for alternatives development.

5.2.2 Institutional Controls

Institutional controls are not technologies, but rather, are legal actions that reduce or prevent exposure of the human population to the contaminated soil and/or groundwater (e.g., deed restrictions, fencing/signs, health advisories). Institutional controls can be used as a stand-alone alternative or can be used in conjunction with other technologies to achieve RAOs. In cases where a portion of the contaminated soil remains in place after remedial activities have concluded, institutional controls could be effective in preventing human exposure to soil. Therefore, institutional controls will be retained for further consideration in conjunction with other technologies.

5.2.3 Engineering Controls

Engineering controls include any physical barrier or method employed to actively or passively contain, stabilize, or monitor contamination, restrict the movement of contamination to ensure the long-term effectiveness of a remedial program, or eliminate potential exposure pathways to contamination. Engineering controls include, but are not limited to, pavement, caps, covers, subsurface barriers, vapor barriers, slurry walls, building ventilation systems, fences, access controls. Institutional controls can be used as a stand-alone alternative or can be used in conjunction with other technologies to achieve RAOs. In cases where a portion of the contaminated soil remains in place after remedial activities have concluded, engineering controls could be effective in preventing human exposure to soil. Therefore, engineering controls will be retained for further consideration in conjunction with other technologies.

5.2.4 Excavation/Off-site Disposal

Excavation is a useful remedial option when the location of the source of contamination is known or if there is a well delineated contaminated area. The concentrations of metals in the drainage swale have been delineated by laboratory and XRF measurements in soil samples. According to DER-15, excavation is a presumptive remedial technology for metals contamination and, therefore, will be retained for alternatives development.

5.2.5 Summary

A summary of the potential soil remedial technology screening is provided below in Table 1.

Table 1. Summary of Soil Remedial Technology Screening

Technology	Retained?	Reason(s)
No Action	Yes	• In accordance with DER-10
Institutional Controls	Yes	• Would reduce potential human exposure pathway. • In accordance with DER-10.
Engineering Controls	Yes	• Would reduce potential human exposure pathway. • In accordance with DER-10.
Excavation/Off-site Disposal	Yes	• In accordance with DER-10 • In accordance with DER-15.

5.3 Remedial Alternatives

Based upon the site characteristics, the General Response Actions, and technology screening presented above, the following remedial alternatives were considered to be potentially applicable for soil treatment at OU2:

Alternative 1: No Action

Alternative 2: Institutional and Engineering Controls

Alternative 3: Excavation to Unrestricted Use SCOs and Off-site Disposal

Alternative 4: Excavation to Commercial Use SCO for Arsenic to a maximum depth of 4 feet + off-site disposal + Institutional Controls

Alternative 5: Excavation of Top One Foot of Soil + off-site disposal + Institutional Controls

Table 2 (below) summarizes the estimated volume of soil containing arsenic or other contaminants of concern included in each alternative. These volumes were calculated based on the concentrations measured with the XRF during the Remedial Investigation and an assumed density of approximately 3,000 pounds per cubic yard (lbs/yd^3).

Table 2. Summary Contaminants of Concern Soil Volumes and Mass

Alternative	Estimated Soil Volume (yd^3)	Estimated Soil Mass (tons)
Alternative 1	---	---
Alternative 2	---	---
Alternative 3	3,700	5,500
Alternative 4	1,900	2,850
Alternative 5	600	900

6. Remedial Alternatives Analysis

The selection and development of the remedial alternatives was conducted in accordance with NYSDEC Division of Environmental Remediation (DER) policy, DER-15: Presumptive/Proven Remedial Technologies. The presumptive remedy approach is to select remedies that have already been proven to be both feasible and cost effective so as to make the remedy selection quicker. In accordance with Section 1 of DER-15, no action, institutional controls, and excavation alternatives are evaluated in this section.

This Section presents an analysis of the potential remedial alternatives for remediation of OU2 at the Former Paulsen-Holbrook Site in accordance with the criteria described in Section 4.3.

6.1 Remedial Alternatives Evaluation

6.1.1 Alternative 1: No Action

6.1.1.1 Description

The no action alternative will serve as the baseline representing the minimum steps to be taken for remediation of the area.

6.1.1.2 Overall protection of public health and the environment

The No Action alternative would not be protective of public health and the environment. Soil impacted by metals would be left at the site. Contaminated soil at the site exists both at the surface and at greater depths (at least up to 10 feet bgs). Exposure to contaminated soil would be via trespassers or construction/excavation activities at the site. This exposure pathway could be reduced through the use of appropriate health and safety protocols during any such work.

6.1.1.3 Compliance with SCGs

The No Action alternative would not meet the SCGs over the long term as the contaminants will remain in-place at concentrations exceeding the SCGs. In addition, metals will not degrade or dilute over time. This is evidenced by the fact that the contaminants have likely been present at the site for more than 40 years and still exceed SCGs.

6.1.1.4 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long-term as the contaminants have likely been present at the site for more than 40 years and still exceed SCGs.

6.1.1.5 Reduction of Toxicity, Mobility, or Volume with Treatment

The No Action alternative would not reduce the toxicity, mobility, or volume of the contaminants.

6.1.1.6 Short-Term Effectiveness

Community Protection

The No Action alternative would not be protective of the community because the soil impacted by metals would remain on-site without institutional or engineering controls to prevent exposure.

Worker Protection

There would not be any worker activities related to the No Action alternative.

Environmental Impacts

Implementation of this alternative would not reduce environmental impacts as the contaminants have likely been present at the site for more than 40 years and still exceed SCGs.

Time Required to Implement

The No Action alternative would not require any time to implement.

6.1.1.7 Implementability

The No Action alternative can be easily implemented.

6.1.1.8 Cost

The No Action Alternative would not require any additional costs to implement.

6.1.1.9 Land Use

The No Action Alternative would not require any modifications to land use.

6.1.2 Alternative 2: Institutional and Engineering Controls

6.1.2.1 Description

Alternative 2 would include implementation of administrative and physical restrictions to prevent access to the metals-contaminated OU2 soil. Land restrictions would include deed restrictions to minimize exposure to potentially contaminated soil and control activities at the site in accordance with the NYSDEC requirements. Physical restrictions would include perimeter fencing to restrict public access to contaminated soil (Figure 7).

Because contamination would remain onsite, a Site Management Plan (SMP) would be required that would provide specific requirements for site maintenance, development and use.

6.1.2.2 Overall protection of public health and the environment

Alternative 2 would be minimally protective of public health and the environment in that public access to contaminated soil would be restricted; however, soil impacted by metals would be left at the site. Contaminated soil at the site exists both at the surface and at greater depths (at least up to 10 feet bgs). Potential future exposure to contaminated soil would be to trespassers and/or construction/excavation activities at the site or adjacent property. This exposure pathway could be mitigated through the use of appropriate health and safety protocols during any such work. Since Alternative 2 does not reduce metals contamination, soil impacted by metals would continue to be subject to transport via storm/surface water.

6.1.2.3 Compliance with SCGs

Alternative 2 would not meet the SCGs over the long term as the contaminants will remain in-place at concentrations exceeding the SCGs. In addition, metals will not degrade or dilute over time. This is evidenced by the fact that the contaminants have likely been present at the site for more than 40 years and still exceed SCGs.

6.1.2.4 Long-Term Effectiveness and Permanence

Alternative 2 would not be effective in the long-term as the contaminants have been present at the site for more than 40 years and still exceed SCGs. This alternative would not reduce contaminant volume; however, this alternative would be effective in minimizing exposure to contaminated soil.

6.1.2.5 Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 2 would not reduce the toxicity or mobility of the contaminants.

6.1.2.6 Short-Term Effectiveness

Community Protection

Alternative 2 would be protective to the community since access to the metals-impacted soil would be restricted by institutional and engineering controls.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not reduce environmental impacts since metals-impacted soil would still be exposed to the environment.

Time Required to Implement

This alternative would likely require less than one year to implement.

6.1.2.7 Implementability

Alternative 2 could be easily implemented using readily available technologies.

6.1.2.8 Cost

The capital, O&M and present worth costs for Alternative 2 are presented in Table 3. A 10 year monitoring period was chosen for this alternative in accordance with DER-10 guidance.

- Capital Costs: The probable capital cost to construct and implement Alternative 2 is approximately $133,900.
- O&M Costs: The probable annual operations, monitoring and maintenance cost for Alternative 2 is $1,500.
- Present Worth Cost: Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $145,000. This was calculated using a 5% annual discount rate.

6.1.3 Alternative 3: Excavation to Unrestricted SCOs for CCA + Institutional Controls

6.1.3.1 Description

Alternative 3 would include the Institutional Controls listed in Alternative 2, plus the following items:

- Excavation of approximately 3,700 cubic yards (yd3) of soil that contains copper, chromium and/or arsenic at concentrations greater than Unrestricted Use SCOs to a maximum depth of 10 feet bgs (Figure 8);
- Off-site disposal of excavated soil in accordance with applicable federal, state, and local regulations;
- Placement of a geotextile fabric to serve as a demarcation layer between clean fill and soil left in place; and
- Backfilling of excavation with clean fill following confirmation sampling that indicates that impacted soil has been removed, or to document remaining metals concentrations of the maximum depth has been reached.

6.1.3.2 Overall protection of public health and the environment

Alternative 3 would be more protective of public health and the environment than the No Action and institutional controls alternatives because the removal of surface and subsurface soil would eliminate the exposure pathway for contaminants in the soil.

6.1.3.3 Compliance with SCGs

Alternative 3 meets the SCGs by removing soil with concentrations exceeding the Unrestricted SCOs for site contaminants of concern.

6.1.3.4 Long-Term Effectiveness and Permanence

Alternative 3 will be effective in the long-term through removal of soil exceeding the Unrestricted SCOs for site contaminants of concern.

6.1.3.5 Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 3 would not reduce the toxicity or mobility of the contaminants, but would remove the contaminant mass from the site.

6.1.3.6 Short-Term Effectiveness

Community Protection

Implementation and initial operation of this alternative is not expected to pose risk to the community. A community air monitoring plan (CAMP) will be in place to measure fugitive dust/particulates related to excavation activities. Dust control measures will be implemented if necessary based on the monitoring results. The work area will be marked out with caution tape and/or temporary fencing every day immediately following work activities to prevent trespassers from unknowingly entering the site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

This alternative would be protective of the environment since any excavated soil staged temporarily at the Site prior to transport and disposal would be placed on, and covered with, 6-mil poly sheeting.

Time Required to Implement

The time required to implement this alternative is approximately one year.

6.1.3.7 Implementability

Alternative 3 could be implemented using readily available technologies.

6.1.3.8 Cost

The capital, O&M, and present worth costs for Alternative 3 are presented in Table 4.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $2,116,400.
- O&M Costs: There are no anticipated operations, monitoring, or maintenance costs for this Alternative.
- Present Worth Cost: Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $2,116,400.

6.1.4 Alternative 4: Excavation to a maximum depth of four feet below ground surface based on 6 NYCRR Part 375 Commercial Use SCOs for Arsenic + Institutional Controls

6.1.4.1 Description

Alternative 4 would include Institutional Control elements of Alternative 2 , plus the following items:

- Excavation of approximately 1,900 yd3 of soil that contains arsenic at concentrations greater than Commercial Use SCOs to a maximum depth of four feet bgs, tapering to two feet bgs where applicable (i.e., where contamination was not identified below 2 feet bgs) (Figure 9).

- Off-site disposal of excavated soil in accordance with applicable federal, state, and local regulations;
- Placement of a geotextile fabric to serve as a demarcation layer between clean fill and soil left in place; and
- Backfilling of excavation with clean fill.

6.1.4.2 Overall protection of public health and the environment

Alternative 4 would be more protective of public health and the environment than Alternatives 1 and 2 because removal of the soil would eliminate higher concentrations of arsenic in the surface and subsurface soil. This alternative removes soil with arsenic concentrations exceeding the Commercial SCO in the top four feet of soil. This alternative does not address soil deeper than four feet bgs, nor does it address soil with arsenic concentrations exceeding the Unrestricted SCO. While other site contaminants of concern (such as chromium and copper) may be removed in the process of implementing Alternative 4, this alternative does not directly address these other contaminants of concern as cleanup limits would be based on the arsenic distribution.

6.1.4.3 Compliance with SCGs

Alternative 4 would meet the Commercial SCO for arsenic in soil between zero and four feet bgs while also removing a large portion of soil containing other contaminants of concern with concentrations exceeding their respective Unrestricted SCOs. However, it does not address the approximately 140 cubic yards of soil exceeding Unrestricted SCOs for copper, chromium, or arsenic between four and ten feet bgs, which extends 450 feet southeast from the drainage discharge point

6.1.4.4 .Long-Term Effectiveness and Permanence

Alternative 4 would be effective in the long-term by eliminating the exposure pathway for arsenic in soil (through partial removal of soil containing arsenic in the top four feet).

6.1.4.5 Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 4 would not reduce the toxicity or mobility of the contaminants, but would reduce the contaminant mass in the soil through excavation and removal.

6.1.4.6 Short-Term Effectiveness

Community Protection

Implementation and initial operation of this alternative is not expected to pose significant risk to the community. A community air monitoring plan (CAMP) will be in place to measure fugitive dust/particulates related to excavation activities. The work area will be marked out with caution tape and/or temporary fencing every day immediately following work activities to prevent trespassers from unknowingly entering the site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would reduce environmental impacts through the removal of higher concentration arsenic contamination in the soil.

Time Required to Implement

The time required to implement this alternative is approximately one year.

6.1.4.7 Implementability

Alternative 4 could be implemented using readily available technologies.

6.1.4.8 Cost

The capital, O&M, and present worth costs for Alternative 4 are presented in Table 5.

- Capital Costs: The probable capital cost to construct and implement this alternative is approximately $1,166,700.

- O&M Costs: The probable annual operations, monitoring, and maintenance cost for this alternative is $1,500.

- Present Worth Cost: Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $1,178,000.

6.1.5 **Alternative 5: Excavation to one foot below ground surface + Institutional Controls**

6.1.5.1 Description

Alternative 5 would include the Institutional Controls listed in Alternative 2, plus following items:

- Excavation of approximately 600 yd3 of soil to one foot below ground surface, regardless of contaminant concentration (Figure 10);

- Off-site disposal of excavated soil in accordance with applicable federal, state, and local regulations;

- Placement of a geotextile fabric to serve as a demarcation layer between clean fill and soil left in place; and

- Backfilling of excavation with clean fill.

6.1.5.2 Overall protection of public health and the environment

Alternative 5 would be more protective of human health and the environment than Alternatives 1 and 2 because it reduces the potential for exposure pathways by removing contaminated surface soil.

6.1.5.3 Compliance with SCGs

Alternative 5 would only partially meet the SCGs. Subsurface contamination below one foot that exceeds SCOs would not be removed.

6.1.5.4 Long-Term Effectiveness and Permanence

Alternative 5 would be effective in the long-term through removal of soil containing contaminants of concern in the top one foot, and through elimination of the exposure pathway for arsenic in soil. In addition, the remediation activities conducted at OU1 from October 2012 to April 2013 will prevent further discharge of contaminants to OU2.

6.1.5.5 Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 5 would not reduce the toxicity or mobility of the contaminated soil, but it would reduce the contaminant mass by soil excavation and removal.

6.1.5.6 Short-Term Effectiveness

Community Protection

Implementation and initial operation of this alternative is not expected to pose significant risk to the community. A community air monitoring plan (CAMP) will be in place to measure fugitive dust/particulates related to excavation activities. The work area will be marked out with caution tape and/or temporary fencing every day immediately following work activities to prevent trespassers from entering the site unknowingly.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would benefit the environment through the removal of surface soil, which decreases contaminant transport via surface water flow.

Time Required to Implement

The time required to implement this alternative is approximately one year.

6.1.5.7 Implementability

Removal of contaminated soil could be implemented using readily available technologies.

6.1.5.8 Cost

The capital, O&M and present worth costs for Alternative 5 are presented in Table 6.

- Capital Costs: The probable capital cost to construct and implement this alternative is $457,100.
- O&M Costs: The probable annual operations, monitoring and maintenance cost for this alternative is $1,500.
- Present Worth Cost: Over a five year monitoring period, the probable net present worth for this alternative is approximately $469,000. This was calculated using a 5% annual discount rate.

6.2 Comparative Analysis

6.2.1 Overview

The RAOs for the Former Paulsen-Holbrook Site are concerned with the prevention of contact with contaminated soil, prevention of migration of contaminants, and removal of the source of contamination. The alternatives presented for the site provide varying levels of remediation.

Alternative 1, the No Action alternative, defines the minimum steps to be taken for remediation of the site. This alternative alone would not meet the RAOs over the long-term. Alternative 2, the Institutional and Engineering Controls alternative, is similar to the No Action alternative, but would include deed restrictions, engineering controls, and activity/use limitations for soil. Alternative 3, excavation to Unrestricted SCOs plus Institutional Controls, would meet the RAOs for soil, since all contamination exceeding SCOs for select metals would be removed to a depth of 10 feet bgs. The remaining two alternatives include the components of the No Action and Institutional Controls. Alternatives 4 and 5, (Excavation to Commercial SCO for arsenic to a final depth of two to four feet bgs plus Institutional Controls, and Excavation to one foot bgs plus Institutional Controls) would only partially meet the

RAOs over the long-term. These two alternatives would prevent direct contact with contaminated soil in most instances; however, both would leave contaminated soil in place.

6.2.2 Overall Protection of Public Health

Alternative 1 would not be protective of human health and the environment, as the contaminated soil would remain in place. If the site remains closed to the public, routes of exposure are limited to construction workers, utility workers, and trespassers. Exposure to construction and utility workers can be controlled through the implementation of health and safety protocols for work in the area.

Alternative 2 provides a similar level of protection to Alternative 1 except that property use would be restricted and the potential exposure pathways would be monitored over time. Therefore, Alternative 2 would be protective of human health and the environment by providing control of potential exposure pathways.

Alternative 3 would be more protective than Alternatives 1 and 2 because direct contact with contaminated soil would be eliminated through soil excavation and removal.

Alternative 4 would be more protective than Alternatives 1 and 2 because contact with contaminated soil would be eliminated through excavation and waste removal; however, it would not be as protective as Alternative 3 since some contamination would remain in place at depth. If the site remains closed to the public, routes of exposure are limited to construction workers, utility workers, and trespassers. Exposure to construction and utility workers can be controlled through the implementation of health and safety protocols for work in the area. Exposure to trespassers would be controlled by the clean soil cover over the area of concern.

Alternative 5 would be more protective of human health than Alternatives 1 and 2 because surface contact with contaminated soil would be eliminated through soil excavation and removal; however, it would not be as protective as Alternatives 3 or 4 since a larger amount of contamination would remain in place at depth.

6.2.3 Compliance with SCGs

Alternatives 1 and 2 would not meet the SCGs. Alternative 3 would meet the SCGs. Alternatives 4 and 5 would only meet the SCGs at specific depths below ground surface.

6.2.4 Long-Term Effectiveness and Permanence

Alternative 1 would not be effective in the long-term. Alternative 2 would be more effective than Alternative 1 through control of exposure pathways. Alternatives 3, 4, and 5 would be effective in the long-term. However, Alternative 3, which includes excavation of all soil exceeding SCGs for site-related metals, would be more permanent than Alternatives 4 and 5 which include partial excavation of contaminated soil.

6.2.5 Reduction of Toxicity, Mobility, or Volume with Treatment

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of the contaminants. Alternative 3 would reduce the contaminant volume by removal of all site-related soil contamination up to ten feet bgs.

Alternatives 4 and 5 would also reduce contaminant volume and mobility through partial removal of contaminated soil. Alternative 4 would reduce the volume of contaminants to a greater extent than Alternative 5 by removing a larger volume of contaminated soil.

6.2.6 Short-Term Effectiveness

Alternative 1 would not be effective in the short-term. Alternative 2 would be more effective than Alternative 1 through control of exposure pathways. Alternatives 3, 4, and 5 would be most effective in the short term through contaminant removal. Alternative 3 may take slightly longer to implement because the volume of soil removed would be greater than in Alternatives 4 and 5.

6.2.7 Implementability

Each of the alternatives could be readily implemented using regionally available resources.

6.2.8 Cost

A comparison of the costs for each alternative is provided in Table 7. The ranking of each of the alternatives, in order of estimated cost (from lowest to highest) is shown below.

Alternative 1:	No Action
Alternative 2:	Institutional Controls
Alternative 5:	Excavation of Top One Foot of Soil + Institutional Controls
Alternative 4:	Excavation to Commercial Use SCO for Arsenic to a maximum depth of 4 feet + Institutional Controls
Alternative 3:	Excavation to Unrestricted Use SCOs

7. References

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Tables

TABLE 3
Remedial Alternative Cost Summary

Alternative 2
Institutional + Engineering Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2013
Date: December 2013

Description: Alternative 2 consists of institutional and engineering controls that include installation of a 6-foot chain link fence around the perimeter of OU2. Capital costs are incurred in Year 1. O&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Engineering Controls					
Mobilization	1	lump sum	$2,500	$2,500	
6' Chain Link Fence Installation	1,184	linear foot	$42	$49,444	
SUBTOTAL				$76,944	
Contingency	20%			$15,389	
SUBTOTAL				$92,333	
Design/Project Management*	30%			$27,700	
Remedial Oversight/Reporting*	15%			$13,850	
TOTAL CAPITAL COST				**$133,900**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Annual Inspection	1	YR	$1,500	$1,500	
SUBTOTAL				$1,500	
TOTAL ANNUAL O&M COST				**$1,500**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$133,900	$133,900	1.00	$133,900	
Annual OM&M	1-10	$15,000	$1,500	7.72	$11,583	
					$145,483	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$145,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 4
Remedial Alternative Cost Summary

Alternative 3
Excavation to meet 6 NYCRR Unrestricted Use SCOs for CCA + Plus Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2013
Date: December 2013

Description: Alternative 3 consists of soil excavation to meet 6NYCRR Unrestricted Use SCOs for Copper, Chromium, and Arsenic, with maximum excavation depth to 10 feet and backfill, and annual inspections. Capital costs are incurred in Year 1.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$60,000	$60,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
SUBTOTAL				$90,000	
Excavation of Hazardous Soil					
Excavation	3,700	CY	$8	$29,600	Assumes maximum depth of 10'.
Confirmation Sampling	60	EA	$150	$9,000	
Loading, Transportation & Disposal (F035 haz. waste)	5,500	Tons	$225	$1,237,500	
SUBTOTAL				$1,276,100	
Demarcation Layer					
Separation Fabric (geotextile)	16,560	SF	$0.30	$4,968	
SUBTOTAL				$4,968	
Backfill & Site Restoration					
Backfill Costs (incl. Load and Haul)	5,550	Tons	$15	$83,250	
Backfill & Compaction	5,550	Tons	$5	$27,750	
SUBTOTAL				$111,000	
SUBTOTAL				$1,482,100	
Contingency	20%			$296,420	
SUBTOTAL				$1,778,520	
Design/Project Management*	13%			$231,208	
Remedial Oversight/Reporting*	6%			$106,711	
TOTAL CAPITAL COST				**$2,116,400**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Annual Inspection	0	YR	$1,500	$0	
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$2,116,400	$2,116,400	1.00	$2,116,400	
Annual OM&M	1-10	$0	$0	--	$0	
					$2,116,400	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$2,116,400**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 5
Remedial Alternative Cost Summary

Alternative 4
Excavation to meet 6 NYCRR Commercial Use SCO for Arsenic + Plus Institutional and Engineering Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2013
Date: December 2013

Description: Alternative 4 consists of soil excavation to meet 6NYCRR Commercial Use SCO for Arsenic, with maximum excavation depth to 4 feet and backfill, and Institutional and Engineering controls. Capital costs are incurred in Year 1. O&M costs occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$60,000	$60,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
SUBTOTAL				$90,000	
Excavation of Hazardous Soil					
Excavation	1,900	CY	$8	$15,200	Assumes maximum depth of 4'.
Confirmation Sampling	60	EA	$150	$9,000	
Loading, Transportation & Disposal (F035 haz. waste)	2,850	Tons	$225	$641,250	
SUBTOTAL				$665,450	
Demarcation Layer					
Separation Fabric (geotextile)	15,220	SF	$0.30	$4,566	
SUBTOTAL				$4,566	
Backfill & Site Restoration					
Backfill Costs (incl. Load and Haul)	2,850	Tons	$15	$42,750	
Backfill & Compaction	2,850	Tons	$5	$14,250	
SUBTOTAL				$57,000	
SUBTOTAL				$817,000	
Contingency	20%			$163,400	
SUBTOTAL				$980,400	
Design/Project Management*	13%			$127,452	
Remedial Oversight/Reporting*	6%			$58,824	
TOTAL CAPITAL COST				**$1,166,700**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Annual Inspection	1	YR	$1,500	$1,500	
SUBTOTAL				$1,500	
TOTAL ANNUAL O&M COST				**$1,500**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$1,166,700	$1,166,700	1.00	$1,166,700	
Annual OM&M	1-10	$15,000	$1,500	7.72	$11,583	
					$1,178,283	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$1,178,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 6
Remedial Alternative Cost Summary

Alternative 5
Excavation to a depth of 1 foot + Plus Institutional and Engineering Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2013
Date: December 2013

Description: Alternative 5 consists of soil excavation to a maximum excavation depth of 1 foot and backfill, and institutional and engineering controls. Capital costs are incurred in Year 1. O&M costs occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$60,000	$60,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
SUBTOTAL				$90,000	
Excavation of Hazardous Soil					
Excavation	600	CY	$8	$4,800	Assumes maximum depth of 1'.
Loading, Transportation & Disposal (F035 haz. waste)	900	Tons	$225	$202,500	
SUBTOTAL				$207,300	
Demarcation Layer					
Separation Fabric (geotextile)	15,950	SF	$0.30	$4,785	
SUBTOTAL				$4,785	
Backfill & Site Restoration					
Backfill Costs (incl. Load and Haul)	900	Tons	$15	$13,500	
Backfill & Compaction	900	Tons	$5	$4,500	
SUBTOTAL				$18,000	
SUBTOTAL				$320,100	
Contingency	20%			$64,020	
SUBTOTAL				$384,120	
Design/Project Management*	13%			$49,936	
Remedial Oversight/Reporting*	6%			$23,047	
TOTAL CAPITAL COST				**$457,100**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Annual Inspection	1	YR	$1,500	$1,500	
SUBTOTAL				$1,500	
TOTAL ANNUAL O&M COST				**$1,500**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$457,100	$457,100	1.00	$457,100	
Annual OM&M	1-10	$15,000	$1,500	7.72	$11,583	
					$468,683	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$469,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 7

Remedial Alternative Cost Summary

OPINION OF PROBABLE COST SUMMARY

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2013
Date: December 2013

Alternative	Description	Capital Costs	Annual O&M Costs	Estimated Remediation Time (years)	Total Present Value
Alternative 2	INSTITUTIONAL AND ENGINEERING CONTROLS + ANNUAL INSPECTION	$133,900	$1,500	10	$145,000
Alternative 3	EXCAVATION (USCO) + ANNUAL INSPECTION	$2,116,400	$0	10	$2,116,400
Alternative 4	EXCAVATION (CSCO) + ANNUAL INSPECTION + INSTITUTIONAL AND ENGINEERING CONTROLS	$1,166,700	$1,500	10	$1,178,000
Alternative 5	EXCAVATION TO A DEPTH OF 1 FOOT + ANNUAL INSPECTION + INSTITUTIONAL AND ENGINEERING CONTROLS	$457,100	$1,500	10	$469,000

Note: Unit prices used herein based on vendor quotes/information and/or prior experience.

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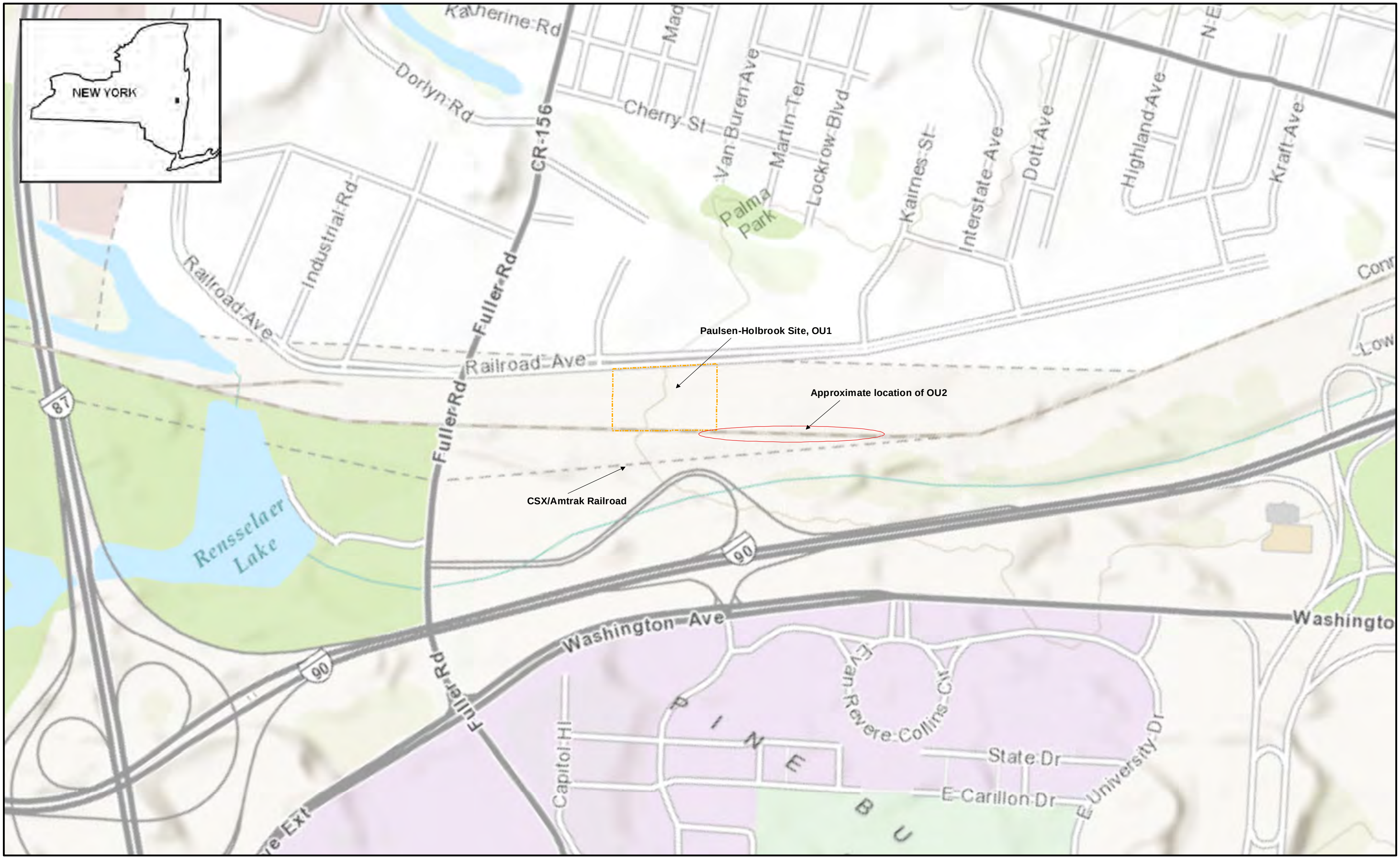
Figures



0 900 1,800 3,600 5,400 7,200 Feet

N

NYSDEC
Former Paulsen-Holbrook Site (#401046)
Town of Guilderland, Albany County, New York
FOCUSED FEASIBILITY STUDY

SITE LOCATION

ARCADIS

FIGURE
1

G:\GISMOD\0266376\RIFS_2012\FFS_SiteMap.mxd

NYSDEC
Former Paulsen-Holbrook Site (#401046)
Town of Guilderland, Albany County, New York
FOCUSED FEASIBILITY STUDY

SITE MAP
Operable Units 1 & 2

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FIGURE
2

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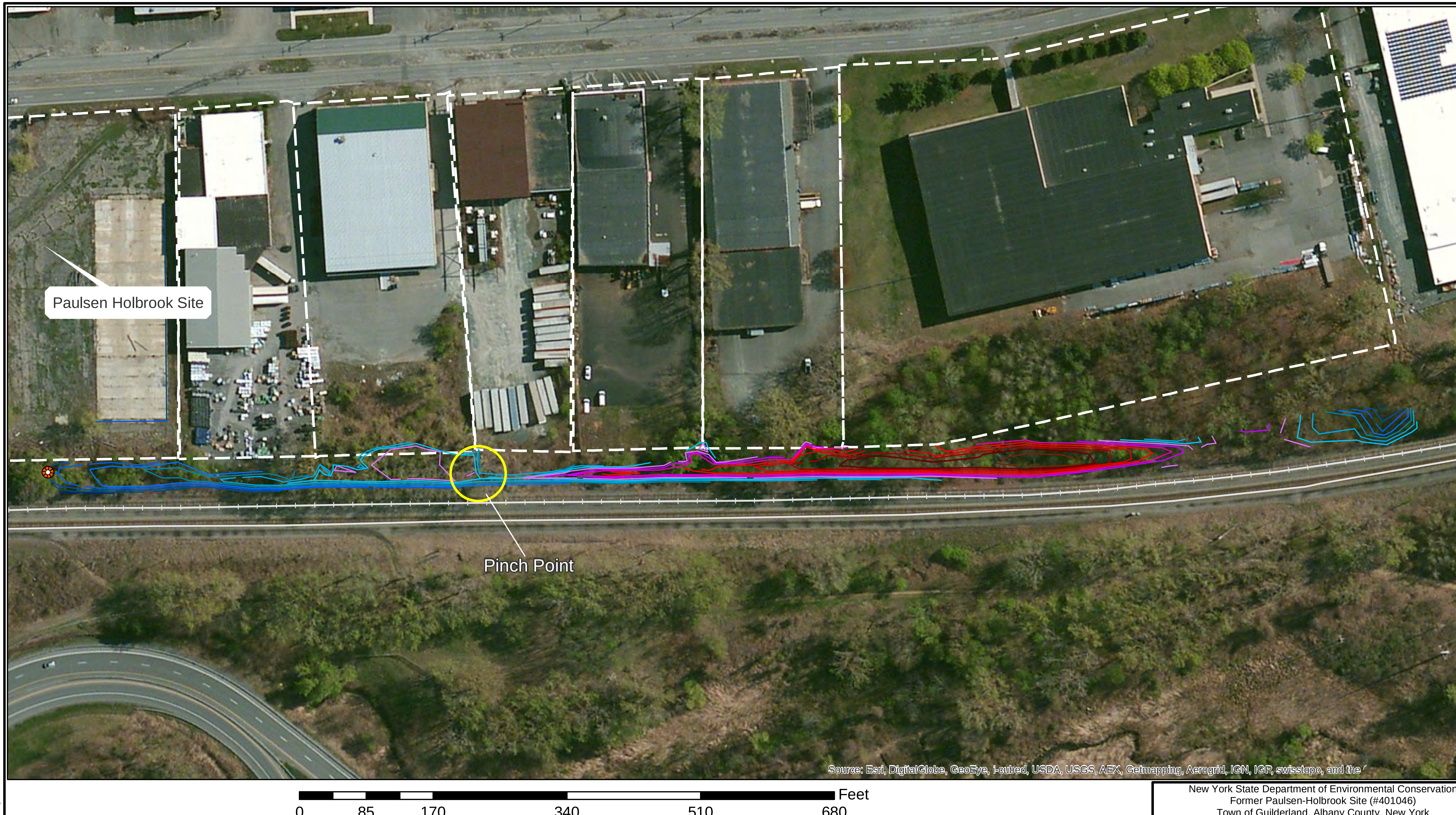

New York State Department of Environmental Conservation
Former Paulsen-Holbrook Site (#401046)
Town of Guilderland, Albany County, New York

FOCUSED FEASIBILITY STUDY

TOPOGRAPHIC SURVEY OF OPERABLE UNIT 2

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FIGURE **3**

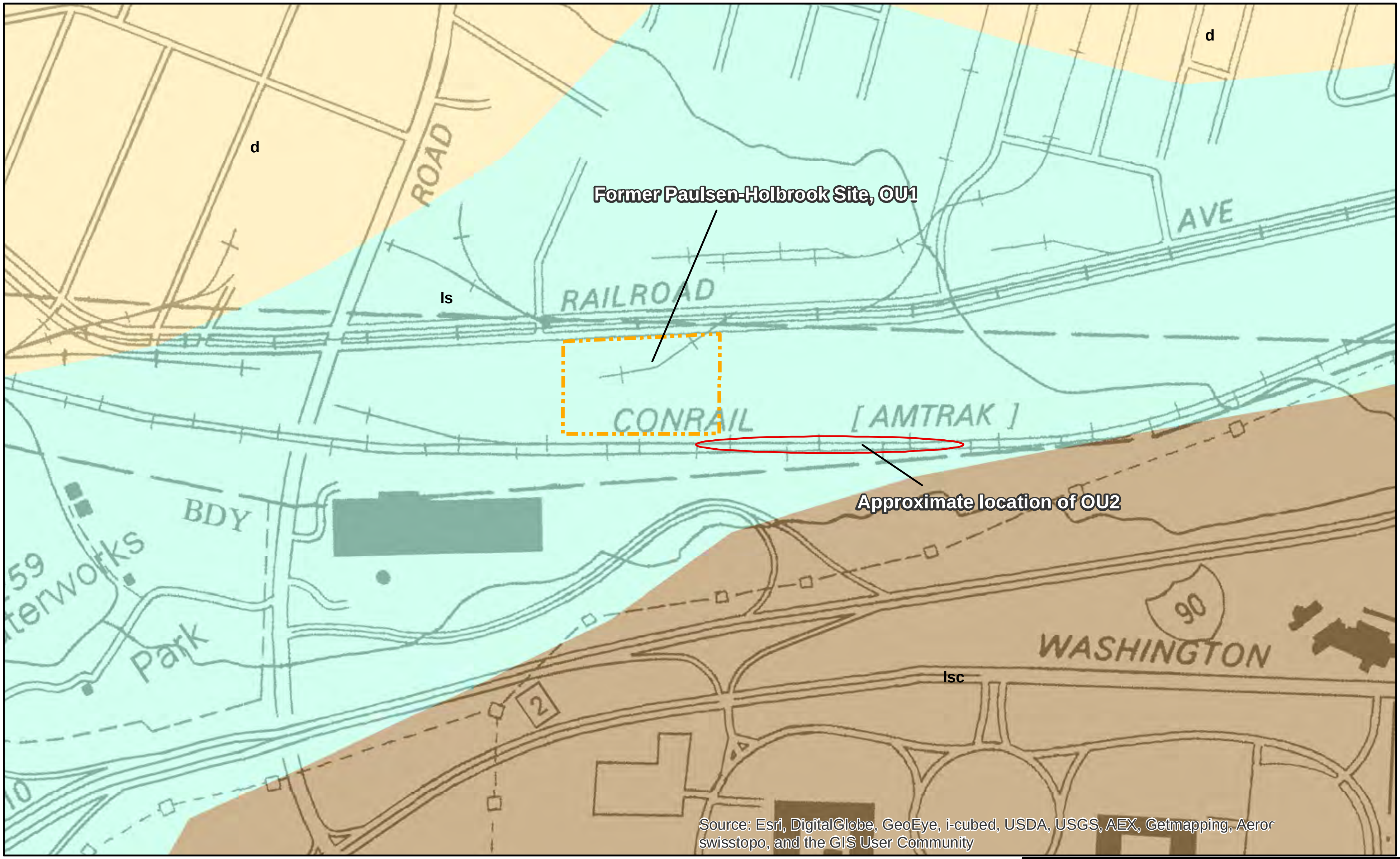
Legend

Storm Drain Discharge

Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

G:\GIS\MOD\0266376\RIFS_2012\Boring Locations.mxd



0 600 1,200 2,400 3,600 4,800 Feet

N

Legend

Surficial Geology

OU1

MATERIAL

d - Dunes

ls - Lacustrine sand

lsc - Lacustrine silt and clay

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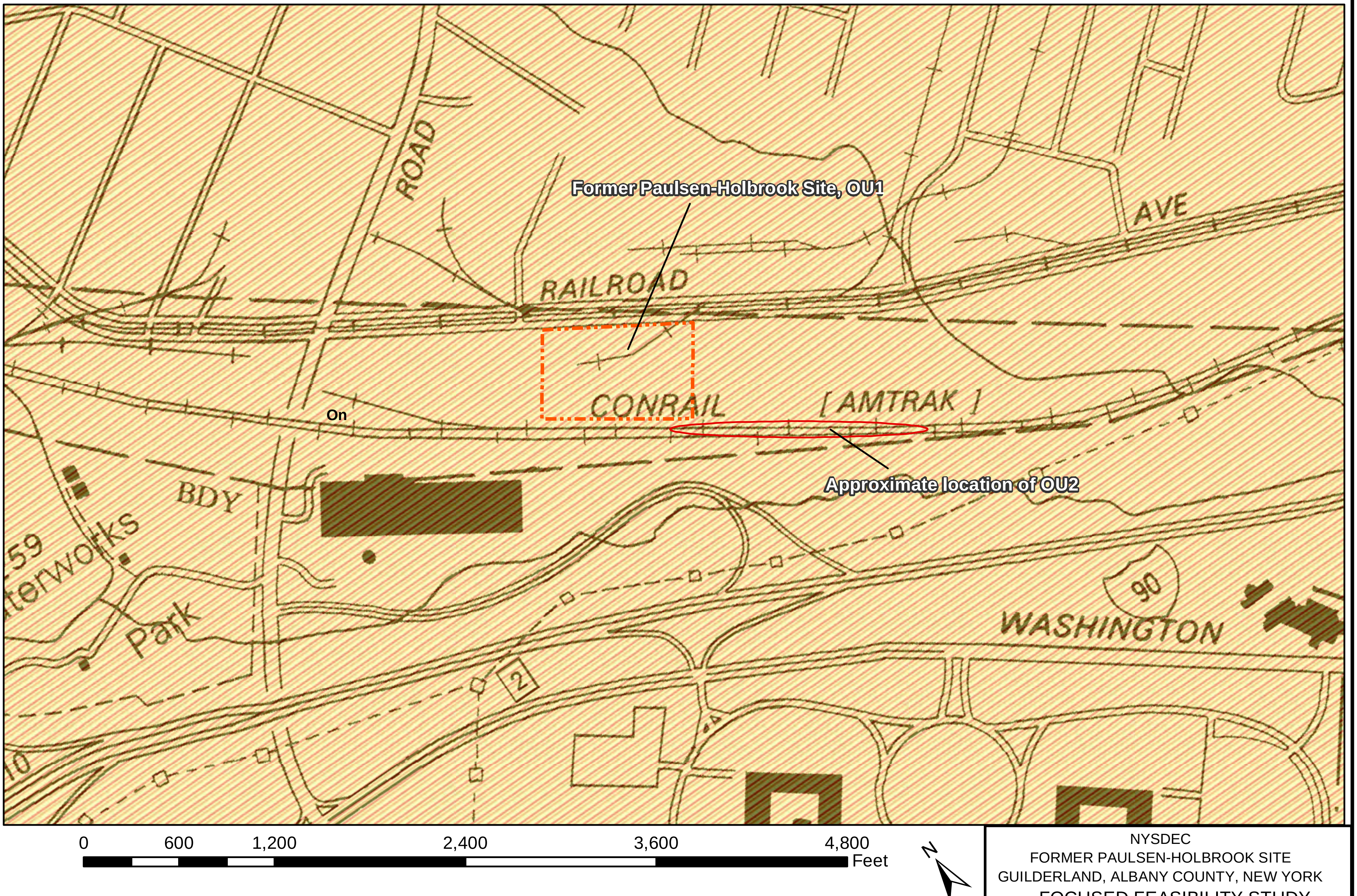
Town of Guilderland, Albany County, New York
FOCUSED FEASIBILITY STUDY

SURFICIAL GEOLOGY

ARCADIS

FIGURE
4



NYSDEC
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GUILDERLAND, ALBANY COUNTY, NEW YORK
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BEDROCK GEOLOGY

ARCADIS

FIGURE
5

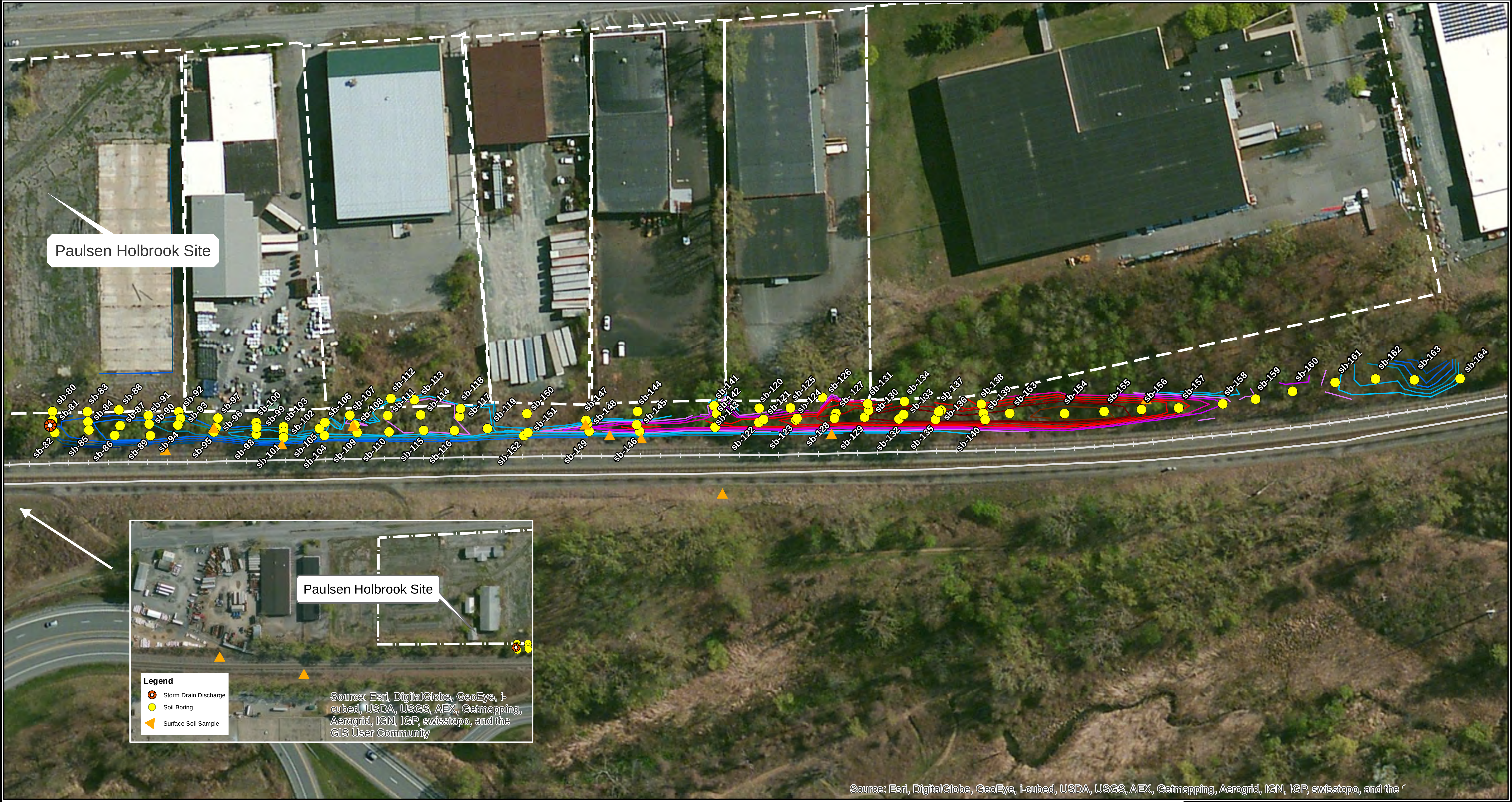
Legend

OU1

MATERIAL

On - Normanskill shale, minor mudstone, sandstone.

G:\GIS\MOD\0266376\RIFS_2012\FFS_Bedrock.mxd



Feet

0 85 170 340 510 680

N

Legend

- Soil Boring
- Surface Soil Sample
- Storm Drain Discharge

Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

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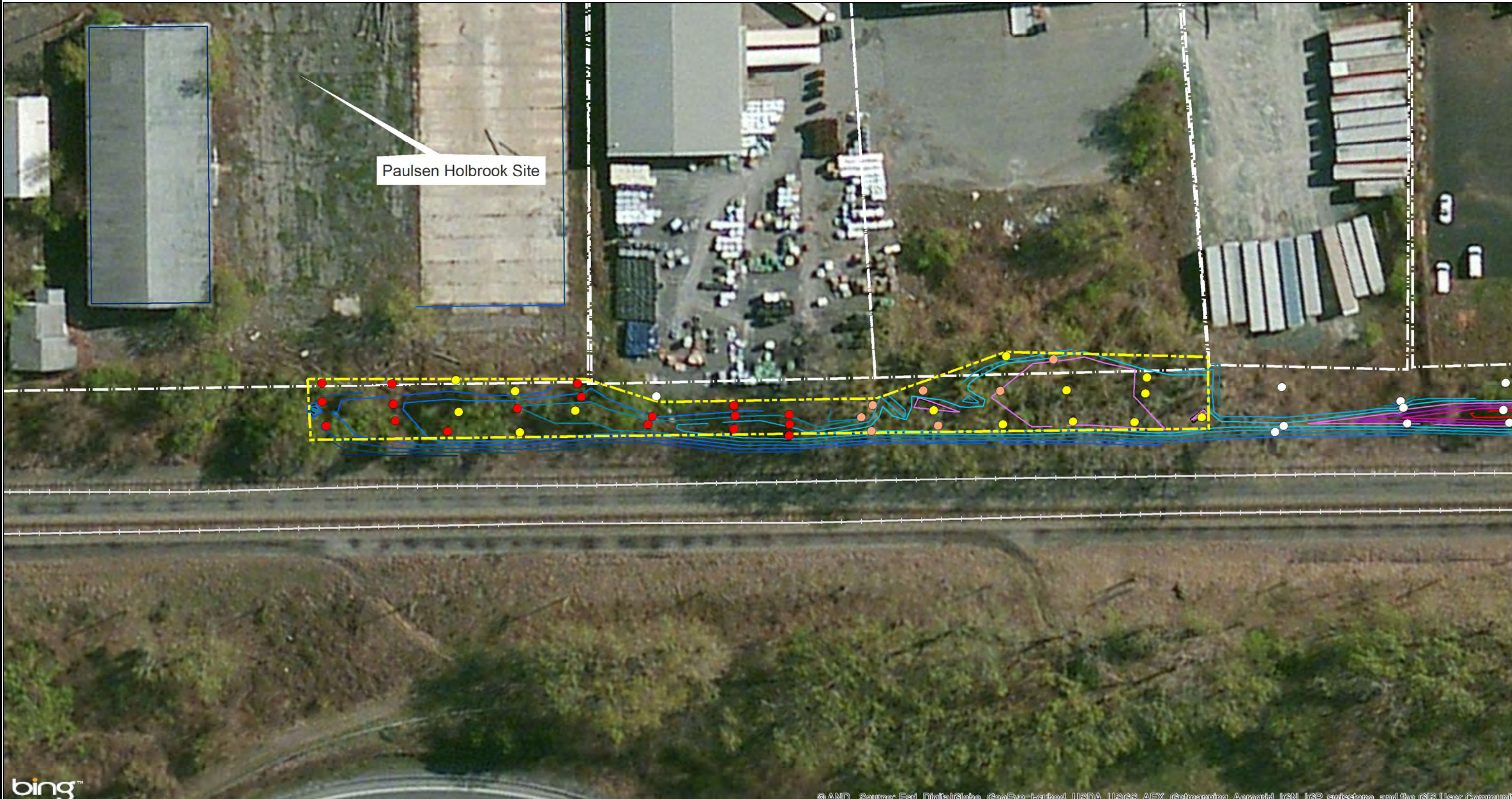
SOIL BORING SAMPLING LOCATIONS

ARCADIS

FIGURE

6

G:\GISMOD\0266376\RIFS_2012\Boring Locations.mxd



Legend

Unrestricted SCO* Exceedance Depth

Feet Below Ground Surface

- 0
- 2-3
- 4-5
- 6-10
- Fence

Scale (Feet): 0, 40, 80, 160, 240, 320

* For Arsenic, Chromium, and/or Copper

Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

N

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FOCUSED FEASIBILITY STUDY

ALTERNATIVE 2
PERIMETER FENCE

ARCADIS

FIGURE **7**

G:\GIS\MOD\0266376\RIFS_2012\FFS_Alt2.mxd

0 35 70 140 210 280 Feet

N

Legend

Unrestricted SCO Exceedance Depth

Feet Below Ground Surface

- 0
- 2-3
- 4-5
- 6-10

Excavation to 3 Feet

Excavation to 5 Feet

Excavation to 10 Feet

Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

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FOCUSED FEASIBILITY STUDY

ALTERNATIVE 3
EXCAVATION LIMITS

ARCADIS

FIGURE

8

G:\GISMOD\0266376\RIFS_2012\FFS_Alt3.mxd

Legend

Commercial SCO Arsenic Exceedance Depth

Feet Below Ground Surface

- 0
- 2
- 4
- Excavation to 2 Feet
- Excavation to 4 Feet

0 35 70 140 210 280 Feet

Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

N

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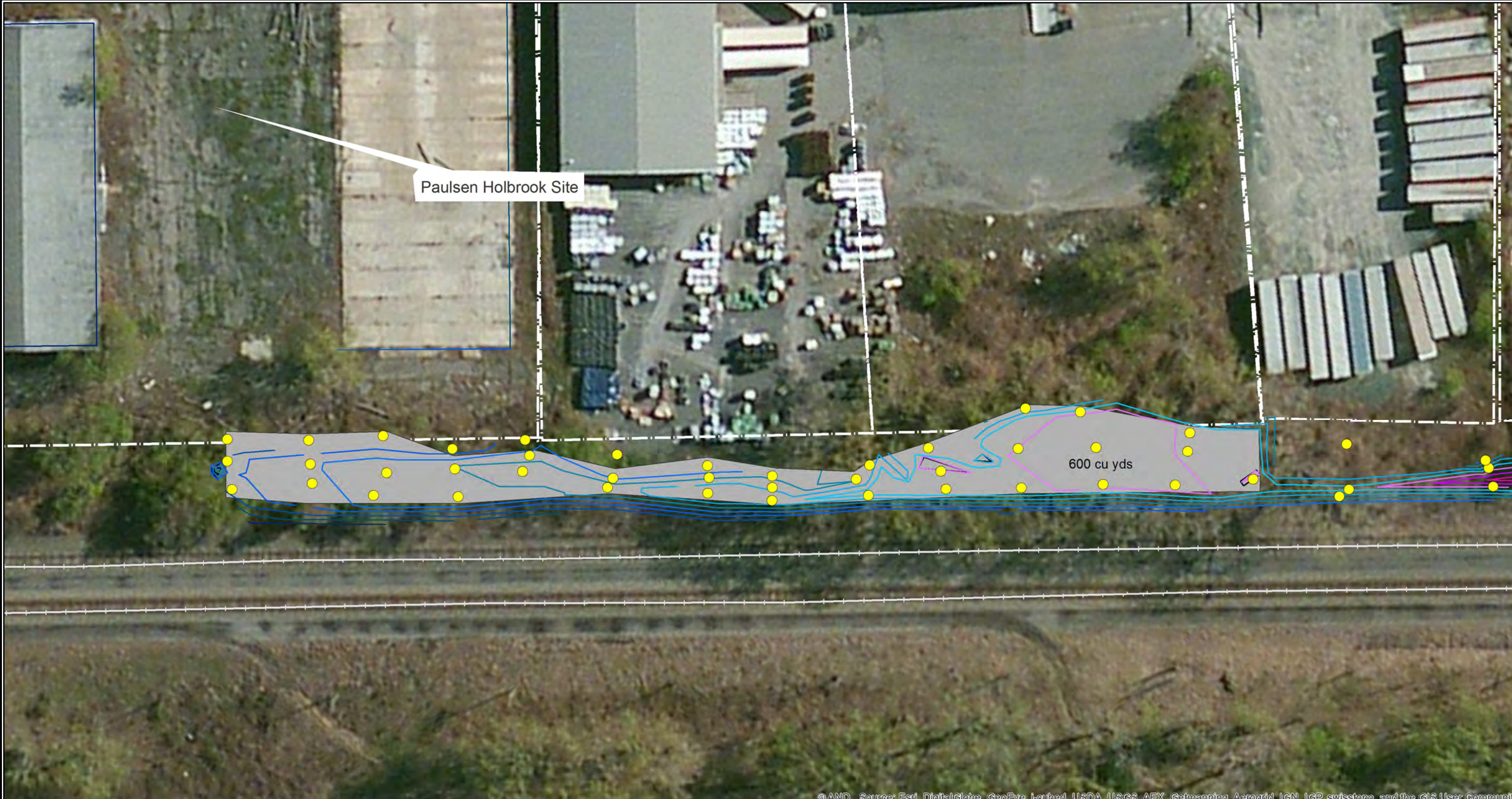
FOCUSED FEASIBILITY STUDY

ALTERNATIVE 4
EXCAVATION LIMITS

ARCADIS

FIGURE
9

G:\GISMOD\0266376\RIFS_2012\FFS_Alt3.mxd



Legend

- Soil Boring
- Excavation to 1 Foot
- Topographic Contours (Feet AMSL)

Blue contours represent higher elevations; red contours represent lower elevations.

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FOCUSED FEASIBILITY STUDY

ALTERNATIVE 5
EXCAVATION LIMITS

ARCADIS

FIGURE **10**

G:\GISMOD\026376\RIFS_2012\FFS_Alt3.mxd