Cleanup Action Plan

Former Aladdin Plating Site
1657 Center Street
Tacoma, Washington

for
Washington State Department of Ecology

December 10, 2014

GeoEngineers
Earth Science + Technology

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File No. 0504-095-00

December 10, 2014

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GEOENGINEERS

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
cm	centimeters
Ecology	Washington State Department of Ecology
FS	Feasibility Study
mg/kg	milligram per kilogram
MTCA	Model Toxics Control Act
RAOs	remedial action objectives
RCW	Revised Code of Washington
RI	Remedial Investigation
SEPA	State Environmental Policy Act
Site	Aladdin Plating Site
TCLP	toxicity characteristic leaching procedure
UTS	Universal Treatment Standards
µg/L	microgram per liter
WAC	Washington Administrative Code

1.0 INTRODUCTION

This document presents GeoEngineers, Inc.'s (GeoEngineers) Cleanup Action Plan (CAP) for the Aladdin Plating Site (Site) originating from the property at 1657 Center Street in Tacoma, Washington (Figure 1). The Site is a corner lot on the northeast corner parcel at the intersection of Center Street and South Alaska Street measuring approximately 100 feet long and 30 feet wide, with no building structures currently standing on the parcel (Figure 2).

The Site was used historically for commercial electroplating between 1958 and 1994. Chemicals used at the Site have included chromium, nickel, lead, caustic soda, sulfuric acid, and alkaline cleaners. The Site is currently owned by Pierce County and is managed by the Washington State Department of Ecology (Ecology) as an orphan site. Several investigations were performed at the Site between 2005 and 2007 by Ecology and Landau Associates to characterize Site soil and groundwater. Current Site contaminants of concern (COC) have been identified as total chromium, hexavalent chromium, lead, and nickel in on-property soil, and total chromium, hexavalent chromium, and nickel in the shallow groundwater aquifer. Several rounds of groundwater monitoring were conducted at the Site from 2006 to 2007, including both on-property and off-property wells. The extent of Site contaminants was not fully delineated vertically in soil or laterally in groundwater within the context of those investigations and monitoring events.

This CAP has been prepared pursuant to the requirements of the Model Toxics Control Act (MTCA) administered by Ecology under Chapter 173-340 of the Washington Administrative Code (WAC). This CAP provides a general description of the proposed remedial action for the Site and sets forth functional requirements that the cleanup must meet to achieve the remedial action objectives (RAOs) for the Site.

The purpose of this CAP is to:

- Describe the Site, including a summary of its history and extent of contamination presented in the Remedial Investigation (RI);
- Identify site-specific cleanup levels and points of compliance for each contaminant and applicable exposure medium;
- Identify applicable state and federal laws for the proposed remedial action;
- Summarize the remedial action alternatives evaluated in the Feasibility Study (FS);
- Identify and describe the selected remedial action alternative for the Site;
- Outline elements of the selected remedial action for the different media that result in protection of human health and the environment; and
- Discuss environmental covenants and Site use restrictions.

Ecology's Toxic Cleanup Program is managing the completion of the RI/FS and CAP for the Site. GeoEngineers has prepared the RI/FS and CAP under contract to Ecology.

2.0 SUMMARY OF SITE CONDITIONS

Several investigations have been performed at the Site between 2005 and 2007 by Ecology and Landau Associates to characterize Site soil and groundwater. Groundwater monitoring wells, both on-property and off-property, have been screened from approximately 30 to 55 feet below ground surface (bgs) to assess impacts to the local shallow aquifer. Several wells were screened from depths of approximately 80 to 155 feet to characterize deeper groundwater conditions. Site contaminants of concern have been identified as total chromium, hexavalent chromium, lead, and nickel in on-property soil, and total chromium, hexavalent chromium, and nickel in the shallow groundwater aquifer. Several rounds of groundwater monitoring were conducted at the Site from 2006 to 2007, including both on-property and off-property wells. The extent of Site contaminants was not fully delineated vertically in soil or laterally in groundwater within the context of those investigations and monitoring events.

In April 2007, Landau Associates proposed additional remedial investigation to define the extent of on-property and off-property impacts at the Site. Results of this investigation would be used to evaluate and select effective remediation strategies to achieve Site cleanup. Landau Associates' proposed remedial investigation and feasibility study (RI/FS) was intended to support a Cleanup Action Plan (CAP) addressing Site soil and groundwater contamination; this proposal was not implemented.

GeoEngineers prepared a RI/FS report in 2014 that summarized previous investigations and the results of supplemental soil and groundwater sampling on- and off-property. Detailed descriptions of Site conditions and the nature-extent of contamination are provided in the RI/FS report. The report also identified existing data gaps and further delineated the vertical extent of metals contamination in soil and the lateral extent of metals contamination in groundwater (GeoEngineers, 2014). Based on the information evaluated in the RI, the majority of the property contained soils with concentrations greater than proposed cleanup levels for one or more metals. Analytical results for groundwater samples collected for the RI indicate that nickel and chromium concentrations exceed proposed cleanup levels in on-property monitoring wells and in groundwater collected from off-property soil borings.

2.1. Site History

The Site was used historically for commercial electroplating between 1958 and 1994. Chemicals present at the Site have included chromium, nickel, lead, caustic soda, sulfuric acid, and alkaline cleaners. Historical Site operations and activities that were likely sources of metals contamination in soil and groundwater are discussed in the RI/FS. The Site is currently owned by Pierce County and is managed by Ecology as an orphan site.

2.2. Conceptual Site Models

Conceptual site models were developed to evaluate contaminant transport and exposure pathways. A conceptual site contaminant transport model was developed to describe historical releases of hazardous substances at the Site and the subsequent potential migration of those hazardous substances in environmental media. The conceptual site contaminant transport model is presented in Section 2.2.1. Separate conceptual site exposure models were developed to describe potential exposure pathways for human and ecological receptors. The conceptual site exposure models are presented in Section 2.2.2.

2.2.1. Conceptual Site Contaminant Transport Model

The potential contaminant sources and transport mechanisms identified for the Site are the following:

- Previous Site operations included commercial electroplating between 1958 and 1994. Chemicals used at the Site have included chromium, lead, nickel, caustic soda, sulfuric acid, and alkaline cleaners, which may have spilled to Site soil at the Aladdin Plating property. Past releases represent potential sources of contamination to soil and groundwater.
- Contaminants in soil leach to the groundwater through dissolution into groundwater or dissolution into infiltrating/percolating stormwater and subsequent downward migration to groundwater. Site groundwater flows generally east-southeast.

2.2.2. Conceptual Site Exposure Models

The conceptual site exposure models were developed to identify exposure pathways and potential human and ecological receptors for contaminants detected in environmental media at the Site. The conceptual site exposure models were developed based on physical features, historical activities, and field observations at the Site, and are depicted graphically in Figure 3 (human receptors).

2.2.3. Potentially Complete Exposure Pathways – Human Receptors

Potential future use of the Site is for light industrial and commercial purposes, including limited residential purposes such as day care centers. Human receptors that could potentially be exposed to contaminants at the Site include site workers, residents, and visitors. Because residential exposures and associated risks are typically greater than exposures/risks to site workers and visitors, a hypothetical residential scenario (i.e., unrestricted land use) was assumed for the purpose of assessing potential human health risks in the RI. The following sections present the potentially complete exposure pathways for human receptors.

Soil

Potentially complete soil-based exposure pathways exist for humans in the upland area of the Site via incidental soil ingestion, dermal contact with soil, and inhalation of particulates. In accordance with WAC 173-340-740, human health exposure to on-Site soil is evaluated based on the direct contact with soil exposure pathway (i.e., incidental soil ingestion; unrestricted land use).

Groundwater

Exposure of human receptors to contaminants in groundwater via direct contact is not a potential exposure pathway. Groundwater at the Site is protected under the South Tacoma Groundwater Protection District. The nearest potable well is approximately 1 mile to the southwest of the Site (Figure 1). Additionally, three public supply wells are located approximately 1 mile upgradient (northeast) of the Site. While not used for potable (i.e. drinking) water, groundwater at the Site has been affected by Site contaminants in soil, and could potentially affect local drinking water supply. In accordance with WAC 173-340-720, human health exposure to Site groundwater is evaluated based on the ingestion pathway (i.e., protection of groundwater as drinking water).

Stormwater

Stormwater on the Site infiltrates in unpaved areas. No stormwater collection and conveyance features are present at the Site. Remediation of the Site soils will be required prior to future Site use. Remedial actions for Site soil will include removal of contaminated soil. Therefore, a complete exposure pathway for human receptors to stormwater runoff contaminated by Site media does not exist. As a result, exposure of human receptors to stormwater runoff contaminated by Site media was not considered further in the RI.

During the construction and remediation phase of this project, best management practices (BMPs) will be implemented to control runoff during excavation and to secure and protect soil stockpiles from the elements. These BMPs will be developed fully in the remedial action design report to follow the RI/FS and CAP.

2.2.4. Potentially Complete Exposure Pathways – Ecological Receptors

The following sections present the potentially complete exposure pathways for ecological receptors.

Soil

The Site is currently covered with compact sand and gravel and generally does not provide suitable habitat for ecological receptors. Remediation of soil will be required prior to future Site use. Remedial actions for Site soil will include removal of contaminated soil. The property and areas within 500 feet of the property constitute less than 1.5 acres of undeveloped land, qualifying for an exclusion from terrestrial ecological evaluation under MTCA 173-340-7491(1). As a result, exposure of ecological receptors to contaminated soil was not considered further in the RI.

Groundwater

Potentially complete exposure pathways exist for exposure of terrestrial ecological receptors to contaminants in groundwater via direct contact. However, because of the depth to groundwater at the Site (generally 30 to 40 feet bgs), these exposure pathways are considered insignificant and were not considered further in the RI.

Stormwater

A complete potential pathway does not exist for benthic invertebrate and fish exposure to contaminants in stormwater runoff because no stormwater leaves the Site. As stated in Section 2.2.3, BMPs to control runoff during excavation and to secure and protect soil stockpiles will be developed fully in the remedial action design report to follow the RI/FS and CAP.

2.3. Summary of Environmental Conditions

Environmental conditions and nature-extent of contamination were investigated through several investigations performed between 2005 and 2014. Figure 4 shows the locations where samples were collected to characterize environmental conditions and the nature-extent of contamination at the Site. Figures 5 through 8 present the extent of contamination and Figure 9 identifies the locations and media requiring remedial action evaluation at the Site based on the investigations. The following sections summarize environmental conditions at the Site and nature-extent of contamination in soil and groundwater.

2.3.1. Soil

Thirteen test pits were completed to depths ranging from 2.5 to 17 feet bgs as part of Ecology's initial soil characterization in 2005. Landau Associates collected soil samples during installation of five on-property monitoring wells in 2005, and three off-property wells in 2006. In 2014, 14 soil borings were advanced by GeoEngineers to depths up to approximately 20 feet bgs as part of the RI investigations of the subject property.

Soil at the Site property was characterized as brown silty sand to sand with silt and varying gravel content, with no definitive contact delineating fill material from native soil. In general, soil observed in borings advanced off-property exhibited similar characteristics to depths of approximately 13 to 20 feet bgs, underlain by a brown to grey, fine to medium sand to explored depths of 35 to 40 feet bgs. The following describes soil material encountered beneath the Site in general order from the ground surface to greater depths:

- Sandy fill: Brown fill material ranging in composition from silty sand to sand with gravel was encountered from the surface in the majority of on-property borings to the explored depth (15 feet bgs). Pockets of silt, gravel, or cobbles appear intermittently throughout the property, generally under 1 foot in thickness.
- Gravelly fill: Gravelly fill with sand was encountered in the majority of the on-property explorations to depths of about 10 feet bgs. The thickness of the gravelly fill ranged from 0.5 to 5 feet. Grain size ranges from fine to coarse gravel with fine to coarse sand. In some borings on-property, this fill was observed to contain six inches of brick debris at approximately 12 feet bgs, and in one boring from about 13 to 15 feet bgs. The three borings containing brick material are located near the northern extent of the property.
- Sand: Brown or grey, fine to medium sand was observed in off-property borings from depths of approximately 15 to 16 feet bgs to the explored depths of 35 to 40 feet bgs. Fine to medium gravel was encountered again in several borings beginning at 37 feet until the explored depths of the borings. The sediment is brown, fine to medium gravel, with fine to course sand and traces of silt.

The analytical results for soil samples obtained in 2014 at the property were summarized and compared against proposed cleanup levels. Sampling locations and estimated extent of metals at concentrations greater than proposed cleanup levels are shown on Figures 5 through 8. The soil data indicates the majority of the property contained soils with one or more metals at concentrations greater than proposed cleanup levels.

- The central portion of the property, including the areas surrounding the historical nickel rinse, nickel strike, chrome rinse, sulfuric residue, and caustic sludge Site features, was identified as having soil with metals concentrations greater than proposed cleanup levels.
- Seven soil samples collected from the surface to approximately 1 foot bgs at sampling locations SB-3, SB-4, SB-6, SB-7, SB-8, SB-9, and SB-10 contained hexavalent chromium and/or lead at concentrations greater than proposed cleanup levels (Figures 6 and 7). Nickel was present in shallow soils (0.5 to 1 foot bgs) at concentrations exceeding the proposed cleanup level in all borings except SB-1 (Figure 8).

- Soil with concentrations of nickel greater than the proposed cleanup level also was detected at greater depths in samples collected from SB-3, SB-4, SB-5, SB-6, SB-7, SB-8, SB-10, SB-11, SB-12, SB-13, and SB-14. Soil sampled at SB-4 contained nickel at concentrations greater than the proposed cleanup level to the explored depth of 15 feet bgs.
- Lead was detected at a concentration greater than the proposed cleanup level in the sample from 3 to 3.5 feet bgs at SB-7.
- From 7 to 7.5 feet bgs at sampling location SB-14, nickel was detected at concentrations greater than the proposed cleanup levels.

The estimated horizontal and vertical extent of metals-contaminated soil that exceeds proposed cleanup levels is based on sample results for SB-1 through SB-14. Remedial action alternatives for soil that are protective of human receptors and other Site media (i.e., groundwater) were developed for all of these areas.

2.3.2. Groundwater

Static groundwater measurements were obtained from wells MW-1s through MW-7s and MW-4d on 15 separate occasions between 2005 and 2014. In March 2014, groundwater was present in borings at the Site at depths ranging from 21.5 to 27 feet bgs, and measured in Site monitoring wells at approximately 218.5 to 221.5 feet Above Mean Sea Level. The inferred groundwater flow direction was to the east-southeast during the groundwater measurement events. The groundwater gradient during the 2014 measurement events was approximately 0.003 ft/ft.

There are no groundwater supply wells located at or in the vicinity of the Site, and Site groundwater is not a current source of drinking water. Based on a review of the Washington State Well Log Viewer (Ecology, 2014), the closest water supply well is located about 1 mile southwest of the Site (Figure 1). The groundwater supply well is located a sufficient distance from the Site to not be pertinent to the investigation. The RI/FS provides additional detail concerning the classification of Site groundwater as non-potable (GeoEngineers, 2014).

Analytical results for groundwater samples collected in March 2014 indicate that nickel and chromium concentrations exceed proposed cleanup levels in on-property monitoring wells and in groundwater collected from off-property soil borings. Approximate monitoring well locations and locations where metals contamination in groundwater exceeds proposed groundwater cleanup levels are shown on Figures 5 and 8. Metals concentrations either were not detected, or were detected at concentrations less than proposed groundwater cleanup levels, in other Site monitoring wells or off-property borings.

As noted in the RI/FS, the absence of detectable concentrations of hexavalent chromium in groundwater from borings SB-16 and SB-19 indicate that total chromium detected in groundwater at these locations represents trivalent chromium. Trivalent chromium has a much higher cleanup level, suggesting that exceedances of chromium in Site groundwater are likely limited to the source property.

A remedial action alternative for groundwater was developed that is protective of human and ecological receptors. The remedial action alternative for groundwater will be coordinated with soil remedial actions because contaminated soil is the source of the contaminated groundwater.

3.0 CLEANUP REQUIREMENTS

The MTCA cleanup regulations specify that a remedial action must comply with cleanup levels for contaminants present at the Site, meet cleanup levels at the points of compliance, and comply with applicable or relevant and appropriate requirements (ARARs) based on federal and state laws (WAC 173-340-710). Remedial action objectives (RAOs) consist of goals for protecting human health and the environment based on the conceptual site models, and provide the objectives for the cleanup action. The Site RAOs, cleanup levels, points of compliance, and ARARs for the selected remedial action are summarized in the following sections.

3.1. Remedial Action Objectives

This section presents the RAOs that are applicable to the Site. RAOs consist of chemical- and medium-specific goals for protecting human health and the environment. The RAOs specify the media and contaminants of interest, potential exposure routes and receptors, and proposed cleanup goals.

3.1.1. Soil and Groundwater

The objective of the proposed remedial action is to eliminate, reduce, or otherwise control to the extent feasible and practicable, unacceptable risks to human health and the environment posed by hazardous substances in soil and groundwater in accordance with the MTCA Cleanup Regulation (WAC 173-340) and other applicable regulatory requirements. Specifically, the objective of the cleanup is to mitigate risks associated with the following potential exposure routes and receptors:

- Contact (dermal, incidental ingestion, or inhalation) by residents, visitors, workers (including excavation workers) and other Site users with hazardous substances in soil;
- Ingestion of Site contaminants in groundwater as drinking water.

The cleanup goal is to mitigate these risks by meeting the soil and groundwater cleanup levels that are identified in Section 3.2.

3.2. Cleanup Standards

Cleanup standards consist of cleanup levels that are protective of human health and the environment, and the points of compliance at which the cleanup levels must be met. Proposed Site-specific cleanup standards were developed in the RI and adopted during preparation of the FS for the purpose of developing the RAOs described above for the Site. The proposed soil and groundwater cleanup levels and points of compliance are summarized below.

3.2.1. Soil

Cleanup levels for soil that are protective of human health and terrestrial ecological receptors were developed in accordance with MTCA requirements. Based on current zoning and anticipated future use, cleanup levels for Site soil are for unrestricted land use and are based on MTCA Method A and Method B soil cleanup levels. In general the most conservative criteria (i.e., lowest of MTCA Method A and Method B) were identified as the cleanup level unless background concentrations for soil were greater than the cleanup level.

The standard point of compliance (upper 15 feet) is considered applicable to prevent human exposure by direct contact to Site soil, as defined in WAC 173-340-740(6)(d). The selected soil cleanup levels are also protective of groundwater as drinking water, as discussed below.

3.2.2. Groundwater

The highest beneficial use of groundwater at the Site is based on the protection of groundwater as drinking water. In general, the most conservative (i.e., lowest) published numerical values selected from available state and federal surface water criteria were selected as the cleanup level for groundwater.

The standard point of compliance (the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the Site) is considered applicable for the protection of groundwater as drinking water, as defined in WAC 173-340-720(8)(b).

3.3. Applicable Regulatory Requirements

In addition to the cleanup standards developed through the MTCA process and presented above, other regulatory requirements must be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be “at least as stringent as all applicable state and federal laws” [WAC 173-340-700(6)(a)]. Besides establishing minimum requirements for cleanup standards, applicable state and federal laws may also impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710. Table 1 presents the ARARs identified as being applicable at this Site.

4.0 ALTERNATIVES CONSIDERED AND BASIS FOR REMEDY SELECTION

This section summarizes the development and evaluation of remedial action alternatives performed in the RI/FS.

4.1. Remedial Alternatives Considered

Two potential cleanup action alternatives were evaluated in the RI/FS report (GeoEngineers, 2014). The process of developing remedial alternatives for evaluation involved screening applicable remediation technologies for inclusion in a reasonable set of complete remedial action alternatives. Each remedial action alternative addresses the contaminated media present at the Site. The screening and assembly of remedial technologies resulted in 2 complete remedial action alternatives that were evaluated in the RI/FS. These remedial alternatives are listed below and described in more detail in Table 2.

- Alternative 1 – Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Groundwater as Drinking Water;
- Alternative 2 – Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Direct Contact.

4.2. Evaluation Methodology

The two remedial alternatives developed in the FS were evaluated in accordance with the process outlined in MTCA.

As a first step, the alternatives were evaluated with respect to the threshold requirements. Remedial action alternatives that do not comply with the threshold requirements are not considered suitable cleanup actions under MTCA. As provided in WAC 173-340-360(2)(a), the four threshold requirements for cleanup actions are:

- Protect human health and the environment;
- Comply with cleanup standards;
- Comply with applicable state and federal laws; and
- Provide for compliance monitoring.

The seven MTCA criteria used to evaluate the proposed remedial alternatives include protectiveness, permanence, cost, long-term effectiveness, management of short-term risks, implementability and consideration of public concerns.

The comparison of benefits relative to costs may be quantitative, but will often be qualitative. When possible, quantitative factors such as mass of contaminant removed or percentage of area of impacts remaining were compared to costs for the alternatives evaluated, but many of the benefits associated with the MTCA criteria described below were necessarily evaluated qualitatively.

Protectiveness

The overall protectiveness of a cleanup action alternative is evaluated based on several factors. First, the extent to which human health and the environment are protected and the degree to which overall risk at a Site is reduced are considered. Both on-site and off-site reduction in risk resulting from implementing the alternative are also considered.

Permanence

MTCA specifies that when selecting a cleanup action alternative, preference shall be given to actions that are "permanent solutions to the maximum extent practicable." Evaluation criteria include the degree to which the alternative permanently reduces the toxicity, mobility or mass of hazardous substances, including the effectiveness of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment processes, and the characteristics and quantity of treatment residuals generated.

Cost

The analysis of remedial action alternative costs under MTCA includes all costs associated with implementing an alternative, including design, construction, long-term monitoring, and institutional controls. Costs are intended to be comparable among different alternatives to assist in the overall analysis of relative costs and benefits of the alternatives. The costs to implement an alternative include the cost of construction, the net present value of any long-term costs, and agency oversight costs. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Unit costs used to develop overall remediation costs for the FS were derived using a combination of published engineering reference manuals (i.e., R.S. Means); construction cost estimates solicited from applicable vendors and contractors; review of actual costs incurred during similar, applicable projects; and professional judgment.

Long-Term Effectiveness

Long-term effectiveness is a parameter that expresses the degree of certainty that the alternative will be successful in maintaining compliance with cleanup standards over the long-term performance of the cleanup action. The MTCA regulations contain a specific preference ranking for different types of technologies that is to be considered as part of the comparative analysis. The ranking places the highest preference on technologies such as reuse/recycling, treatment, immobilization/solidification, and disposal in an engineered, lined, and monitored facility. Lower preference rankings are applied for technologies such as on-site isolation/containment with attendant engineered controls, and institutional controls and monitoring.

Management of Short-term Risks

Evaluation of this criterion considers the relative magnitude and complexity of actions required to maintain protection of human health and the environment during implementation of the cleanup action. Cleanup actions carry short-term risks, such as potential mobilization of contaminants during construction, or safety risks typical of large construction projects. In-water dredging activities carry a risk of temporary water quality degradation and potential sediment recontamination. Some short-term risks can be managed through the use of best practices during project design and construction, while other risks are inherent to project alternatives and can offset the long-term benefits of an alternative.

Implementability

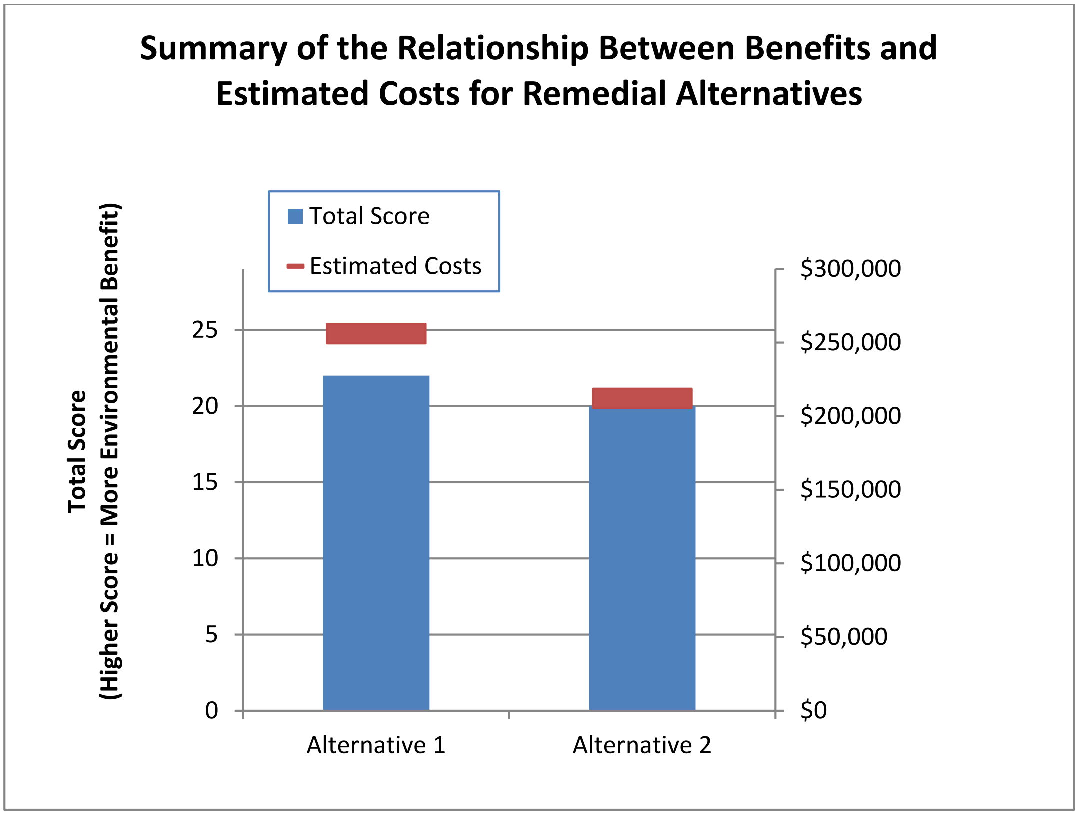
Implementability is an overall metric expressing the relative difficulty and uncertainty of implementing the remedial action. Evaluation of implementability includes consideration of technical factors such as the availability of mature technologies and experienced contractors to accomplish the cleanup work. It also includes administrative factors associated with permitting and completing the cleanup.

Consideration of Public Concerns

The public involvement process under MTCA is used to identify potential public concerns regarding remedial action alternatives. The extent to which an alternative addresses those concerns is considered as part of the evaluation process. This includes concerns raised by individuals, community groups, local governments, tribes, federal and state agencies, and other organizations that may have an interest in or knowledge of the Site. In particular, public concerns for this Site generally would be associated with environmental concerns and performance of the remedial action, which are addressed under other criteria such as protectiveness and permanence.

4.3. Evaluation And Comparison Of Alternatives

The evaluation of remedial alternatives performed in the FS showed that both alternatives met the MTCA threshold requirements and warranted inclusion in the evaluation process. The evaluation was based on a comparative analysis of costs against the MTCA evaluation criteria identified above. Relative rankings of each alternative for these criteria using a numeric scoring scale of 1 (lowest) to 5 (highest) are summarized in Table 3. Table 4 summarizes how each alternative scores with respect to each of the criterion. Additionally, the chart below shows how each alternative scored according to the criteria and how the relative benefit corresponds to the relative cost of each alternative. Results of the remedial alternatives evaluation are summarized in the following sections.



Notes:

Vertical (blue) bars represent environmental benefit scoring for each alternative.

The scale for scoring of environmental benefit is on the left axis.

Horizontal (red) lines represents cost for each alternative.

The scale for the cost of the remedial actions is on the right axis.

Protectiveness

Alternatives 1 and 2 provide similar levels of protectiveness. Alternative 1 scored slightly higher because a lager quantity of contaminated soil would be removed, and all metals soil cleanup levels are protective of groundwater as drinking water.

Permanence

Remedial Alternatives 1 and 2 provide similar levels of permanence through removal of soil with contaminant concentrations that exceed cleanup levels. Alternative 2 is less permanent relative to Alternative 1 because it leaves a larger amount of contamination in place.

Long-Term Effectiveness

Both Alternatives 1 and 2 rely on using proven technologies to remove contaminant mass from the Site to the greatest extent practicable and, therefore, achieve similar levels of long-term effectiveness.

Management of Short-Term Risks

Remedial Alternatives 1 and 2 both involve soil removal. The relative difference between the short-term risks associated with the two remedial alternatives is low (smaller volume of soil removed in Alternative 2, but not significant relative to risk).

Technical and Administrative Implementability

Both of the Remedial Alternatives are generally technically implementable using commonly available methods.

Cost

The cost estimates for Remedial Alternatives 1 and 2 were developed as described in Section 4.2.

- **Remedial Alternative 1** (Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Groundwater as Drinking Water) has an estimated cost of approximately $256,000. This alternative includes the removal and disposal of approximately 400 cubic yards of contaminated soil.
- **Remedial Alternative 2** (Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Direct Contact) has an estimated cost of approximately $212,000. This alternative includes the removal and disposal of approximately 260 cubic yards of contaminated soil.

4.3.1. Reasonable Restoration Time Frame

The time frame for design, permitting, contracting, and construction for both proposed remedial alternatives is expected to be on the order of one year. The time frame for natural recovery of contaminated groundwater depends on natural attenuation processes and could be up to 10 years. Long-term monitoring may be necessary to ensure natural attenuation in groundwater is occurring.

4.3.2. Considerations of Public Concerns

The remedial alternatives proposed for the Site are generally expected to be acceptable to the public. The alternatives that achieve the greatest level of protection and certainty rely on the greatest level of soil removal and result in the most intrusive Site activities. Remedial Alternatives 1 and 2 scored equally high for this criterion (low to moderate public concern).

5.0 SELECTED SITE CLEANUP ACTION

Based on the comparative analysis presented in the FS and summarized above, the preferred remedial action alternative for the Site is Remedial Alternative 1. Figure 10 presents the remedial actions to be performed at the Site during implementation of Remedial Alternative 1. This alternative significantly reduces risk to potential human and ecological receptors through:

- Removal of metals-contaminated soil at the subject property that exceeds MTCA Method A and B cleanup levels protective of direct human contact and MTCA Method B cleanup levels for soil protective of groundwater as drinking water. Metals-contaminated soil is the source of metals-contaminated groundwater on, and downgradient of, the Site.
- Monitoring the natural attenuation of metals concentrations in groundwater after the contaminated soil is removed.

The table below summarizes the selected soil and groundwater cleanup levels applicable for Remedial Alternative 1.

SELECTED SOIL AND GROUNDWATER CLEANUP LEVELS

Parameter	Soil Cleanup Level[1] (mg/kg)	Groundwater Cleanup Level[2] (µg/L)
Total Chromium	2,000	50
Hexavalent Chromium	18.4	48
Trivalent Chromium	–	24,000
Lead	250	15
Nickel	417[3]	320

[1] Soil cleanup levels are taken from MTCA Method A Soil Cleanup Levels for unrestricted land use and MTCA Method B carcinogen and non-carcinogen values for human health protection and for protection of groundwater as drinking water, taken from Ecology's CLARC database. In general, the lowest of the regulatory criteria listed were identified as the proposed cleanup levels.

[2] Groundwater cleanup levels are taken from published values for the Safe Water Drinking Act and MTCA Method B carcinogen and non-carcinogen standard formula values for human health protection obtained from Ecology's CLARC database. In general, the lowest of the regulatory criteria listed were identified as the proposed cleanup levels.

[3] Soil cleanup level derived by entering MTCA Method B groundwater cleanup level protective of drinking water into the MTCA fixed parameter three-phase partitioning model (Equation 747-1).

The following sections provide additional information on the preferred (selected) remedial action alternative.

5.1. Excavation and Off-site Disposal of Material Contributing to Groundwater Exceedances

Soil containing metals at concentrations greater than cleanup levels is present at the Site. Contaminants of concern (metals) have been detected in groundwater adjacent to and downgradient of the source areas on the property at concentrations exceeding MTCA cleanup levels. Remediation of groundwater (natural attenuation of metals in groundwater) is not effective without removal of the source of the metals contamination. Therefore, for the remedial action to be protective of groundwater, the metals-contaminated soil must be removed. Natural attenuation is anticipated to be an effective remedy for groundwater after source removal is completed.

Remedial Alternative 1 would remove metals-contaminated soil to comply with MTCA Method A and B cleanup levels protective of direct human contact and MTCA Method B cleanup levels protective of groundwater as drinking water. Figure 10 identifies proposed areas and depths of excavation to remove contaminated soil to achieve these cleanup levels.

The excavated soil would be characterized for disposal as required by MTCA, the Washington State Dangerous Waste Regulations and the disposal facility. The contaminated soil is anticipated to fall into two categories: non-dangerous waste suitable for disposal at a Subtitle D landfill (or similar facility approved by the local permitting agency and Ecology) or Dangerous Waste requiring disposal at a Subtitle C landfill.

For soil to be categorized as non-dangerous waste and suitable for disposal at a Subtitle D landfill (or similar facility approved by the local permitting agency and Ecology), it would be necessary to demonstrate that Site contaminants are not present at concentrations greater than 10 times the Universal Treatment Standards (UTS), as defined in 40 CFR 268.48 and/or results of toxicity characteristic leaching procedure (TCLP) testing for metals must confirm the excavated material does not designate as Dangerous Waste based on Toxicity Characteristic Criteria (WAC 173-303-100).

It is anticipated that some of the excavated soil will designate as Dangerous Waste and will therefore be precluded from disposal at a Subtitle D (or similar) landfill. For cost estimating purposes in the FS, it was assumed that 25 percent of the soil excavated from the Site will fail TCLP testing and will need to be disposed at a Subtitle C landfill.

5.2. Groundwater Monitoring

The removal and off-site disposal of soil containing metals is anticipated to result in gradual reduction of metals concentrations in groundwater, thereby alleviating the need for active groundwater remediation. To verify that the removal of metals-contaminated soil is effective at reducing metals concentrations in groundwater and that natural attenuation of groundwater is occurring, new monitoring wells will be installed near the point of compliance following completion of the soil removal activities.

For cost estimating purposes, it was assumed that three of the five existing on-property monitoring wells would be decommissioned as part of remedial actions at the Site (MW-1s and MW-2s would be preserved). One new monitoring well would be installed at the property and one well would be installed 100 to 150 feet downgradient of the property to monitor the natural attenuation of metals concentrations in groundwater. The monitoring wells would be sampled and analyzed for metals COCs and indicators of natural attenuation during at least four semi-annual monitoring events to demonstrate that impacts to groundwater have been addressed. Ecology would then review the groundwater data to determine if quarterly monitoring should continue or if the frequency can be reduced.

6.0 IMPLEMENTATION OF THE CLEANUP ACTION

The schedule for starting the cleanup action described in this CAP is not known at this time. The cleanup action will require development of remedial design documents, permit applications, and contract documents prior to construction. This section describes the necessary steps to construct the proposed cleanup action following approval of this CAP.

6.1. Permits/Other Requirements

The remedial action is expected to be conducted under an Ecology Agreed Order, Enforcement Order, or Consent Decree. Accordingly, the remedial action meets the permit exemption provisions of MTCA (WAC 173-340-710[9]), which eliminates the need to follow the procedural requirements of most State and local laws that would otherwise apply to the action. The remedial action will, however, comply with the substantive requirements of applicable State and local laws. The exemption is not applicable if Ecology determines that the exemption would result in the loss of approval from a federal agency that may be necessary for the state to administer any federal law. Permits and substantive requirements applicable to the remedial action are discussed below.

6.1.1. State Environmental Policy Act

The State Environmental Policy Act (SEPA) (Revised Code of Washington [RCW] 43.21C; WAC 197-11) and the SEPA procedures (WAC 173-802) are intended to ensure that State and local government officials consider environmental values when making decisions. A SEPA checklist will be prepared as part of the permitting process for the remedial action.

6.1.2. Water Quality Permitting

Construction activities that disturb one acre or more of land need to comply with the provisions of State construction stormwater regulations. The area of the Site is approximately 3,000 square feet (less than 1/10th of an acre), which will exempt it from an Ecology Construction Stormwater General Permit required for cleanup actions at larger sites.

6.2. Engineering Design Report

An Engineering Design Report (EDR) will be prepared that includes construction plans and specifications that document the engineering concepts and design criteria for the remedial action to be performed at the Site. Information required under WAC 173-340-400(4)(a) will be presented in the EDR including an Operations, Maintenance, and Monitoring Plan describing long-term operations, maintenance, and monitoring required following completion of remedial action construction. The EDR also will include the proposed language of an environmental covenant that is required to document institutional controls that are part of the cleanup action.

6.3. Construction Plans and Specifications

Construction plans and specifications will be prepared that detail the design criteria and construction requirements to perform the remedial actions at the Site. As required by WAC 173-340-400(4)(b), the documents will include the following information, as applicable:

- A description of the work to be performed, and a summary of the engineering design criteria from the Engineering Design Report;
- A site location map and a map of existing conditions;
- A copy of applicable permit applications and/or approvals;
- Detailed plans, procedures, and specifications necessary for the remedial action;
- Specific quality control tests to be performed to document the construction, including specifications for testing or reference to specific testing methods, frequency of testing, acceptable results, and other documentation methods;
- Methods for implementing BMPs for stormwater control relative to the remedial excavations and stockpiles, and controlling the tracking of impacted soil off-site by trucking operations; and
- Provisions to ensure that the health and safety requirements of WAC 173-340-810 are met.

All aspects of construction will be performed and documented in accordance with WAC 173-340-400(6). This includes approval of all of the plans listed above prior to commencement of work, oversight of construction by a Professional Engineer licensed in the State of Washington, and submittal of a Construction Completion Report that documents all aspects of the cleanup and includes the engineer's opinion on whether the cleanup was conducted in substantial compliance with the CAP, EDR, and Construction Plans and Specifications.

6.4. Schedule for Remedial Action Design and Implementation

The schedule for remedial action design and implementation is not known at this time.

7.0 REFERENCES

GeoEngineers, Inc., Remedial Investigation/Feasibility Study Report (RI/FS), Former Aladdin Plating Site, Tacoma, Washington. GEI File No 0504-095-00. December 10, 2014.

Washington State Department of Ecology (Ecology). 2014. Washington State Well Log Viewer. https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx. Revised 2014.

TABLES

Table 1

Site Specific Applicable or Relevant and Appropriate Requirements (ARARS)

Aladdin Plating CAP

Tacoma, Washington

Authorizing Statute	Implementing Regulation	Description	Rationale
Potential Chemical-Specific ARARs			
Hazardous Waste Management; Chapter 70.105D RCW	Washington Model Toxics Control Act Cleanup Regulation; Chapter 173-340 WAC	Establishes groundwater and soil cleanup levels.	Potentially applicable to contaminated soil and groundwater at the Site.
Potential Action-Specific ARARs			
Hazardous Waste Management; Chapter 70.105D RCW	Selection of Cleanup Actions; WAC 173-340-350	Minimum requirements and procedures for conducting remedial investigation and feasibility studies.	Applicable to remedial action selection and implementation.
Hazardous Waste Management; Chapter 70.105D RCW	Institutional Controls; WAC 173-340-440	Institutional control requirements.	Potentially applicable to remedial action selection and implementation.
Hazardous Waste Management; Chapter 70.105D RCW	Compliance Monitoring Requirements; WAC 173-340-410, -720(9), -730(7), -740(7), and -745(8)	Compliance monitoring requirements for soil, groundwater, and surface water.	Potentially applicable to remedial action selection and implementation.
Ecology Area of Contamination Policy	8/20/1991 Interprogram Policy	Allows movement/placement of excavated contaminated material within the regulated site without triggering dangerous waste designation.	Could be applicable for containment remedial alternatives.
Water Well Construction; Chapter 18.104 RCW	Minimum Standards for Construction and Maintenance of Wells; Chapter 173-160 WAC	Applies to the construction and maintenance of monitoring wells	Potentially applicable to wells constructed for groundwater withdrawal and monitoring and decommissioning of existing or future wells.
Hazardous Waste Management; Chapter 70.105 RCW	Dangerous Waste Regulations; Chapter 173-303 WAC	Applies if dangerous wastes are generated during remedial program	These regulations must be fully complied with for any off site disposal of waste determined to be dangerous waste. This would only apply to upland remedial options as dredged sediment is exempt from waste classification.
Washington State Water Pollution Control Act; Chapter 90.48 RCW	NPDES Permit Program; Chapter 173-220 WAC	Applicable to the discharge of pollutants and other wastes and materials to the surface waters of the state	NPDES may be required for discharges related to ongoing remedial actions or discharge of stormwater/drainage.
State Environmental Policy Act (SEPA); Chapter 43.21C.110 RCW	SEPA Rules; Chapter 197-11 WAC	Applies if future construction/remedial action occurs at the site	Applies if future construction/ remedial action occurs at the site.
Solid Waste Management; Chapter 43.21A RCW	Minimum Functional Standards for Solid Waste Handling WAC 173-304	Establishes minimum functional standards for the handling of solid waste.	Applies if non-dangerous wastes are generated during remedial action
Transportation of Hazardous Material; 49 USC 5101-5127	Hazardous Materials Regulations; 49 CFR Parts 171 through 180	Regulations that govern the transportation of hazardous materials.	Applies to any hazardous materials transported off-site as part of remediation.
Hazardous Waste-Land Disposal Restrictions; USEPA	40 CFR 268/22 CCR 66268	Establishes land disposal restrictions and treatment standards for hazardous wastes applicable to generators.	Any hazardous wastes generated as a result of on-site activities or by treatment systems must meet land disposal restriction requirements.
Washington State Clean Air Act; Chapter 70.94 RCW	General Requirements for Air Pollution Sources; Chapter 173-400 WAC. Controls for New Sources of Toxic Air Pollutants; Chapter 173-460 WAC	Establishes technically feasible and reasonably attainable standards and rules generally applicable to the control and/or prevention of the emission of air contaminants.	May apply to remedial alternatives that produce emissions to air.

Table 2

Summary of Remedial Alternatives

Aladdin Plating CAP

Tacoma, Washington

Matrix	Contaminants Exceeding Proposed Cleanup Levels	CLEANUP ACTION ALTERNATIVE COMPONENTS	
		REMEDIAL ALTERNATIVE 1 **Soil Excavation to Cleanup Levels Using Method B Values Protective of Groundwater as Drinking Water**	**REMEDIAL ALTERNATIVE 2** **Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Direct Contact**
Soil	Metals	Excavation and off-site disposal of metals-contaminated soil contributing to contamination in groundwater in compliance with the MTCA Method A and B cleanup levels protective of direct human contact and MTCA Method B cleanup levels for soil protective of groundwater as drinking water.	Excavation and off-site disposal of metals-contaminated soil contributing to contamination in groundwater in compliance with the MTCA Method A and B cleanup levels protective of direct human contact and MTCA Method B and cleanup levels for soil protective of groundwater as drinking water, with the exception of nickel, which would be remediated only to protection of direct contact.
Groundwater	Metals	Installation of monitoring wells to monitor the natural attenuation of groundwater after completion of metal debris and metals contaminated soil removal.	Installation of monitoring wells to monitor the natural attenuation of groundwater after completion of metal debris and metals contaminated soil removal.

Table 3

Summary of Evaluation and Comparison of Remedial Alternatives

Aladdin Plating CAP
Tacoma, Washington

Alternative Description	REMEDIAL ALTERNATIVE 1 Soil Excavation to Cleanup Levels Using Method B Values Protective of Groundwater as Drinking Water	REMEDIAL ALTERNATIVE 2 Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Direct Contact
Alternative Ranking Under MTCA		
1. Compliance with MTCA Threshold Criteria		
Protection of Human Health and the Environment	Yes - Alternative would protect human health and the environment through a combination of removal, capping, and natural attenuation/recovery.	Yes - Alternative would protect human health and the environment through a combination of removal, capping, and natural attenuation/recovery.
Compliance With Cleanup Standards	Yes - Alternative would require long term monitoring to ensure compliance with cleanup standards.	Yes - Alternative would require long term monitoring to ensure compliance with cleanup standards.
Compliance With Applicable State and Federal Regulations	Yes - Alternative complies with state and federal regulation.	Yes - Alternative complies with state and federal regulation.
Provision for Compliance Monitoring	Yes - Alternative includes provisions for monitoring to assess the natural attenuation of groundwater concentrations.	Yes - Alternative includes provisions for monitoring to assess the natural attenuation of groundwater concentrations.
2. Restoration Time Frame		
	Time frame for design, permitting, and construction of remedial actions is relatively short. The time frame for natural recovery is moderate. The time frame for long-term monitoring and maintenance is indefinite as the remedial actions will be required to be maintained into the future.	Time frame for design, permitting, and construction of remedial actions is relatively short. The time frame for natural recovery is moderate. The time frame for long-term monitoring and maintenance is indefinite as the remedial actions will be required to be maintained into the future.
3. Relative Benefits Ranking		
Protectiveness	Score = 4 Achieves a medium-high level of overall protectiveness as a result of soil removal to MTCA Method B cleanup levels protective of groundwater as drinking water. Majority of contaminated soil would be removed and remaining metals-impacted soil would effectively be isolated from human and ecological receptors. Longterm protectiveness reliant on natural attenuation of contaminants in groundwater.	Score = 3 Achieves a medium level of overall protectiveness as a result of soil removal to combined MTCA Method B cleanup levels protective of groundwater as drinking water, with the exception of nickel, which would be remediated only to protection of direct contact. Contaminated soil would be removed and remaining metals-impacted soil would effectively be isolated from human and ecological receptors. Longterm protectiveness reliant on natural attenuation of contaminants in groundwater.
Permanence	Score = 4 Achieves reduction of toxicity and mobility of hazardous substances at the Site by removal of contaminated soil and containment and isolation of remaining contaminated soil. The quantity of impacted soil removed from site is greater than with Alternative 2.	Score = 3 Achieves reduction of toxicity and mobility of hazardous substances at the Site by removal of contaminated soil and containment and isolation of remaining impacted soil. The quantity of contaminated soil allowed to remain on site is greater than Alternative 1.
Long-Term Effectiveness	Score = 3 Removes a signifcant quantity of hazardous substances from the Site to cleanup levels protective of groundwater as drinking water. Prevents contact with remaining impacted soil by human and ecological receptors. Long term effectiveness reliant on monitoring of natural attenuation in groundwater.	Score = 3 Removes a signifcant quantity of hazardous substances from the Site to cleanup levels protective of groundwater as drinking water. Prevents contact with remaining impacted soil by human and ecological receptors. Long term effectiveness reliant on monitoring of natural attenuation in groundwater.
Management of Short-Term Risks	Score = 4 Involves removal of contaminated soil from the Site. The construction methods required under this alternative are well established and capable of reducing short-term risks.	Score = 4 Involves removal of contaminated soil from the Site. The construction methods required under this alternative are well established and capable of reducing short-term risks.
Technical and Administrative Implementability	Score = 4 Soil removal and monitoried attenuation are common approaches for remediation of contaminated Sites. Common construction methods and equipment are used.	Score = 4 Soil removal and monitored attenuation are common approaches for remediation of contaminated Sites. Common construction methods and equipment are used.
Consideration of Public Concerns	Score = 3 Addresses the exposure of human and ecological receptors to contaminated soil, groundwater, and stormwater runoff. Includes removal and offsite disposal of the most contaminated soil from the Site.	Score = 3 Addresses the exposure of human and ecological receptors to contaminated soil and groundwater. Includes removal and offsite disposal of contaminated soil from the Site.

Table 4

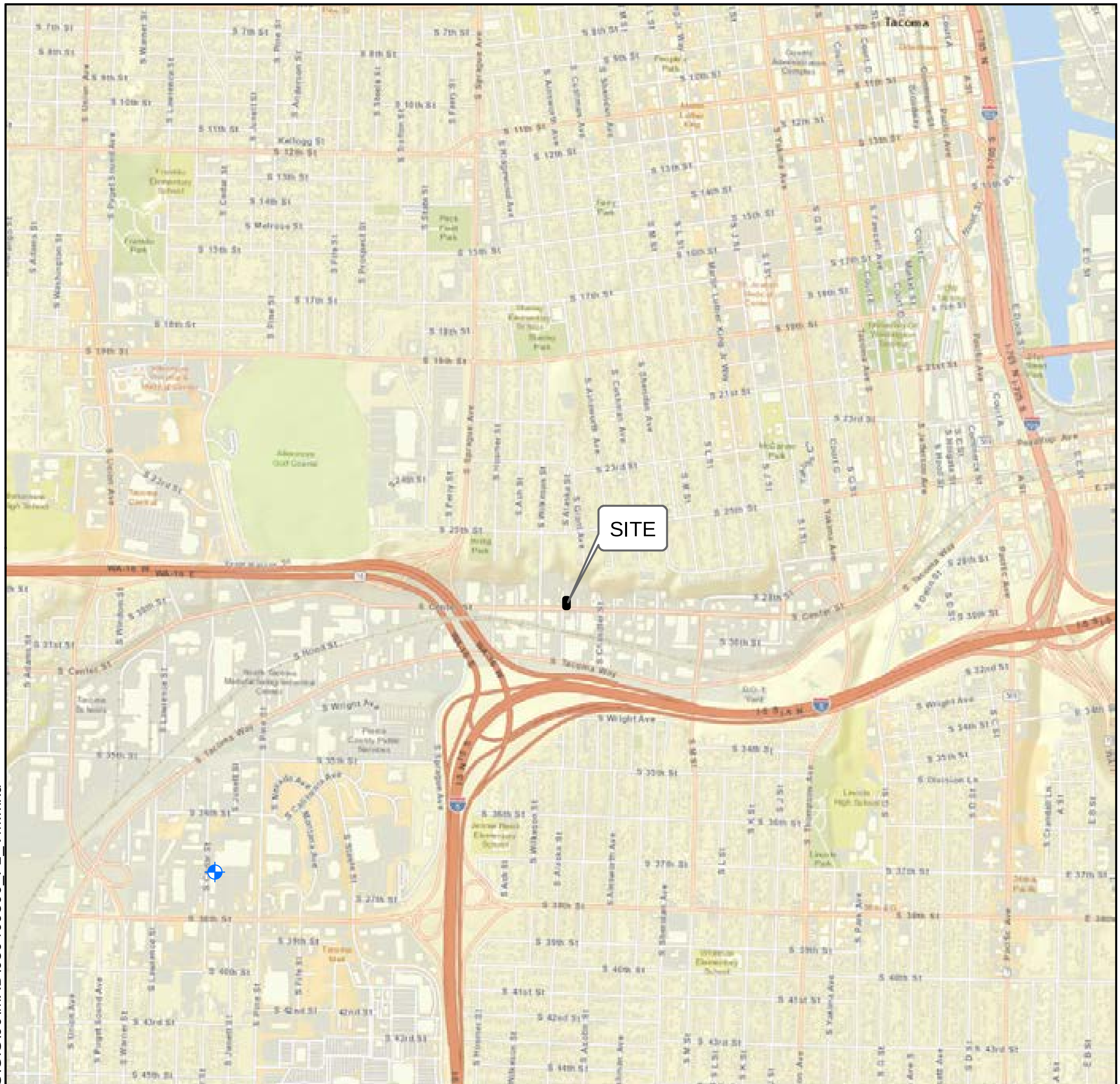
Summary of MTCA Evaluation and Ranking of Remedial Action Alternatives

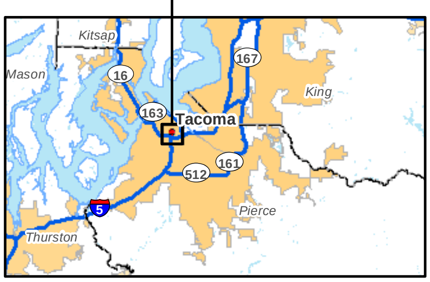
Aladdin Plating CAP

Tacoma, Washington

Alternative Number	ALTERNATIVE 1 Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Drinking Water	ALTERNATIVE 2 Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Direct Contact
Alternative Ranking Under MTCA		
1. Compliance with MTCA Threshold Criteria	YES	YES
2. Restoration Time Frame	Design/construction - Short Natural attenuation/recovery - Moderate	Design/construction - Short Natural attenuation/recovery - Moderate
3. Relative Benefits Ranking	2nd	1st
Protectiveness	4	3
Permanence	4	3
Long-Term Effectiveness	3	3
Management of Short-Term Risks	4	4
Technical and Administrative Implementability	4	4
Consideration of Public Concerns	3	3
Total of Scores	**22**	**20**
Overall Alternative Ranking	**1st**	**2nd**

FIGURES





City of Tacoma production well

N
W E
S

2,000 0 2,000
Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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Data Sources: ESRI Data & Maps, Street Maps 2005
Base map from ESRI Data Online.
Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Vicinity Map

Former Aladdin Plating Facility
Tacoma, Washington

GeoEngineers

Figure 1

Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\0504409500_F1_VM.mxd

Office: PORT

Property Boundary

Parcel Boundary (Pierce County)

N
W
E
S

100 0 100

Feet

Notes:
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Data Sources: Parcel Boundary and roads from Pierce County GIS.
Base map from ESRI Data Online.
Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

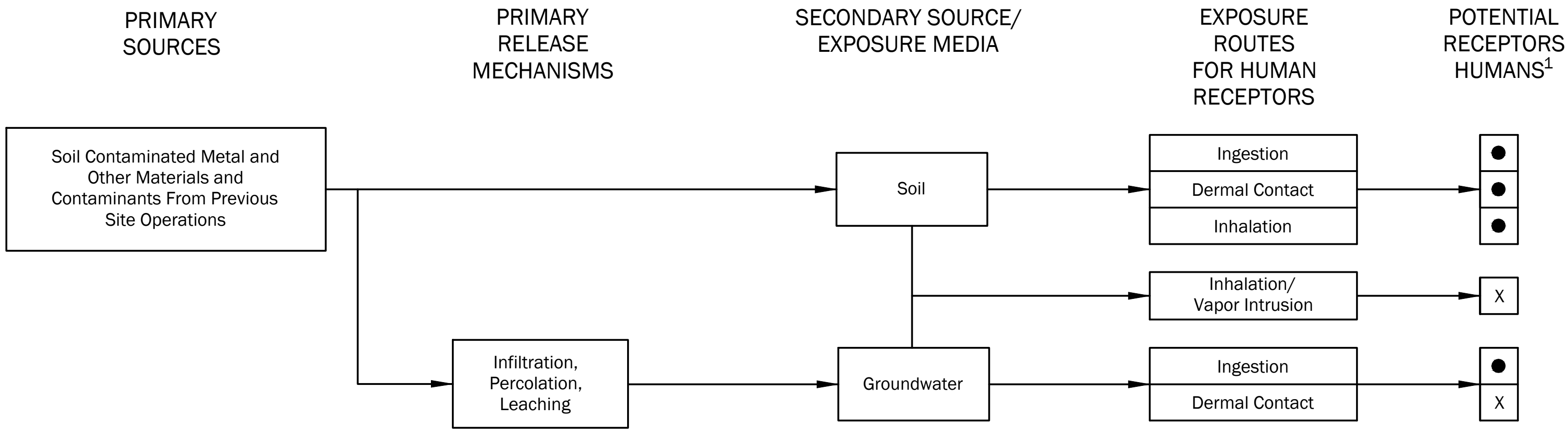
Site Map

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 2

Office: PORT Path: P:\0\0504095_GIS\GIS\00\MXD\0504095000_F2_SM.mxd Map Revised: 08 January 2014 ccabrera



Notes:

- ● Complete Exposure Pathway
- X Potentially Complete But Insignificant Exposure Pathway
- 1 Future Commercial Workers, Residents, and Visitors

Notes:

1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Conceptual Site Exposure Model - Human Receptors

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 3

Data Source: Aerial base from ArcGIS Data Online.
Existing monitoring well locations from Landau Associates, Monitoring Well Locations and Groundwater Contours March 2007, Figure 4, 7/30/2007.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Office: PORT Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\0504095500_F4_Remedial_Investigation.mxd Map Revised: 22 September 2014 maugust

Remedial Investigation

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 4

Map Revised: 22 September 2014 maugust

Office: PORT Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\050409500_F5_Total_Chromium.mxd

Data Source: Aerial base from ArcGIS Data Online.
Existing monitoring well locations from Landau Associates, Monitoring Well Locations and Groundwater Contours March 2007, Figure 4, 7/30/2007.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
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Extent of Total Chromium Contamination in Site Soil and Groundwater

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 5

Office: PDX Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\050409500_F6_Extent_of_Hex_Chromium.mxd Map Revised: 22 September 2014 maugust

MW-1s — Groundwater Monitoring Well Location and Number

SB-3 — Boring Location and Number

Property Boundary

Historical Site Features

Soil with hexavalent chromium concentrations above the MTCA Method B cleanup level of 18.4 mg/kg.

N E S W

15 0 15

Feet

Data Source: Aerial image base from Google Earth Pro
Historical site features from Landau Associates, Historical Electroplating Operations, Figure 3, November 7, 2005.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

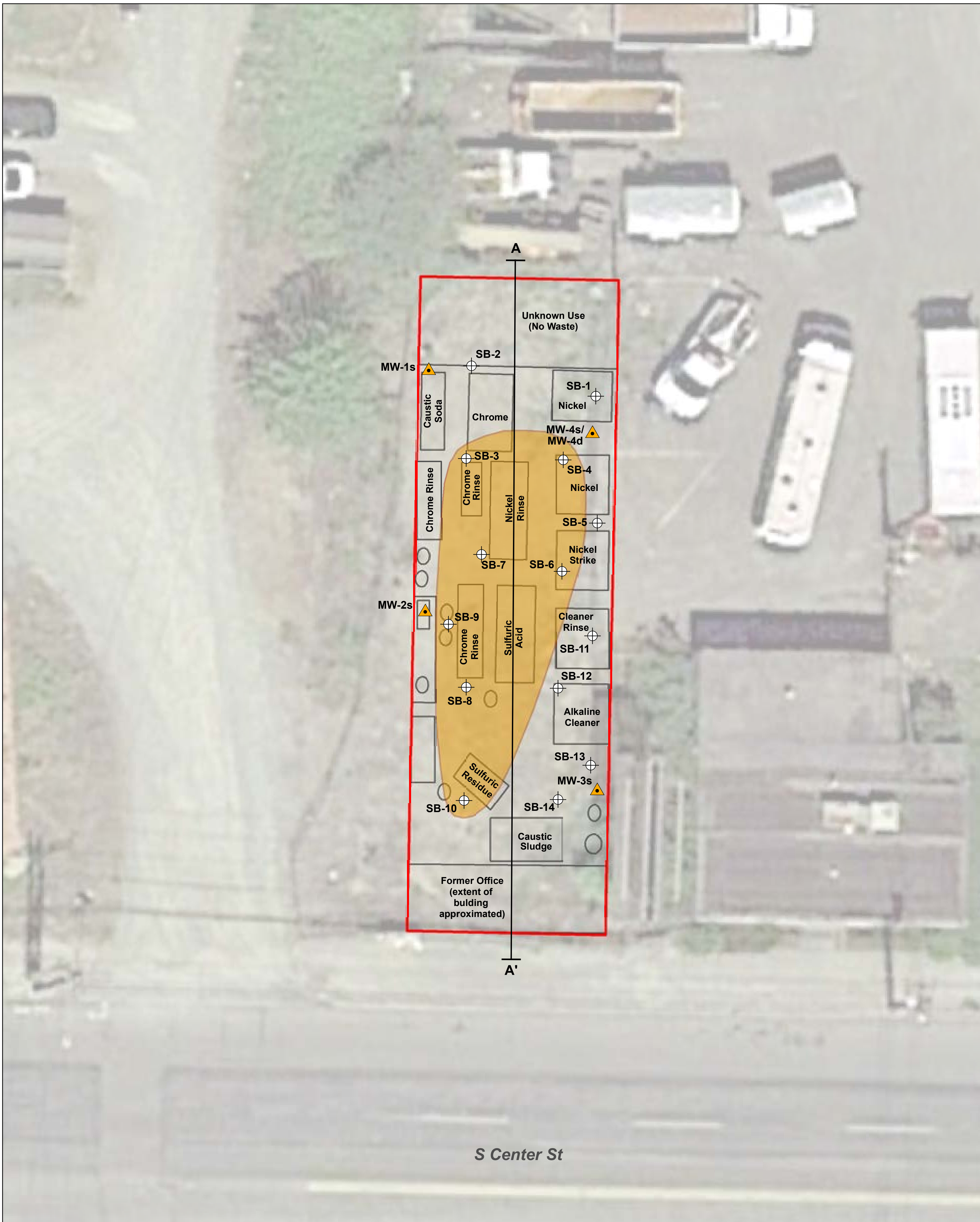
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Extent of Hexavalent Chromium Contamination in Site Soil

Former Aladdin Plating Facility
Tacoma, Washington

GeoEngineers

Figure 6



MW-1s	Groundwater Monitoring Well Location and Number
SB-3	Boring Location and Number
	Property Boundary
	Historical Site Features
	Soil with lead concentrations above the MTCA Method A cleanup level of 250 mg/kg.

15 0 15
Feet

Data Source: Aerial image base from Google Earth Pro
Historical site features from Landau Associates, Historical Electroplating Operations, Figure 3, November 7, 2005.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Notes:
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Extent of Lead Contamination in Site Soil

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 7

Data Source: Aerial base from ArcGIS Data Online.
Existing monitoring well locations from Landau Associates, Monitoring Well Locations and Groundwater Contours March 2007, Figure 4, 7/30/2007.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Extent of Nickel Contamination in Site Soil and Groundwater

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 8

Map Revised: 22 September 2014 maugust

Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\0504095500_F8_Extent_of_Nickel.mxd

Office: PORT

Data Source: Aerial base from ArcGIS Data Online.
Existing monitoring well locations from Landau Associates, Monitoring Well Locations and Groundwater Contours March 2007, Figure 4, 7/30/2007.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Locations and Media Requiring Cleanup Action Evaluation

Former Aladdin Plating Facility
Tacoma, Washington

GEOENGINEERS

Figure 9

Office: PORT Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\050409500_F9_Locations_Media_Requiring_Cleanup.mxd Map Revised: 22 September 2014 maugust

Office: PDX Path: \\pdx\Projects\0\0504095_GIS\GIS\00\MXD\CAP_figures\050409500_F10_Remedial_Alt_1.mxd Map Revised: 22 September 2014 maugust

SB-2

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	123	1.92	61	1,050
3.0 to 3.5	39.7	< 0.423	10	106
5.0 to 5.5	32.5	< 0.418	2	51
7.0 to 7.5	35.9	< 0.450	< 2	64

SB-4

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	487	96.2	532	4,250
3.0 to 3.5	34.7	0.769	< 2	248
5.0 to 5.5	40.0	0.772	< 2	255
7.0 to 7.5	41.0	2.44	< 2	377
9.0 to 9.5	--	1.31	5	61
11.0 to 11.5	--	10.9	127	2,410
13.0 to 13.5	--	0.425	< 2	84
14.5 to 15.0	--	0.578	< 2	448

SB-3

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	460	22.1	734	1,480
3.0 to 3.5	43.0	1.58	< 2	115
5.0 to 5.5	221	13.6	< 2	119
7.0 to 7.5	38.9	0.934	< 2	277
9.0 to 9.5	--	< 0.480	3	--
11.0 to 11.5	--	1.15	3	--
13.0 to 13.5	--	< 0.413	< 2	--
14.5 to 15.0	--	< 0.414	< 2	--

SB-1

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	57.8	< 0.404	33	223
3.0 to 3.5	22.4	< 0.424	< 2	31
5.0 to 5.5	27.7	< 0.409	< 2	34
7.0 to 7.5	23.2	< 0.466	< 2	34

SB-5

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	51.3	< 0.406	6	626
3.0 to 3.5	26.7	< 0.414	< 2	208
5.0 to 5.5	28.4	< 0.417	< 2	279
7.0 to 7.5	140	7.31	< 2	326

SB-7

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	334	23.6	239	2,180
3.0 to 3.5	467	15.2	321	1,730
5.0 to 5.5	543	16.3	5	159
7.0 to 7.5	167	8.70	< 2	149
9.0 to 9.5	--	1.17	4	146
11.0 to 11.5	--	11.3	30	326
13.0 to 13.5	--	0.877	< 2	122
14.5 to 15.0	--	0.540	< 2	240

SB-6

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	1,130	934	3,120	2,690
3.0 to 3.5	153	1.80	< 2	96
5.0 to 5.5	679	15.5	2	125
7.0 to 7.5	556	12.7	< 2	102
9.0 to 9.5	--	4.28	< 7	607
11.0 to 11.5	--	8.83	38	223
13.0 to 13.5	--	0.919	< 2	276
14.5 to 15.0	--	1.25	< 2	175

SB-9

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	955	15.0	357	1,780
3.0 to 3.5	143	4.10	3	65
5.0 to 5.5	257	11.0	5	66
7.0 to 7.5	59.7	3.24	< 2	100
9.0 to 9.5	--	--	3	104
11.0 to 11.5	--	--	4	84
13.0 to 13.5	--	--	2	74
14.5 to 15.0	--	--	2	84

SB-11

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	51.5	< 0.424	37	970
3.0 to 3.5	26.6	< 0.416	< 2	438
5.0 to 5.5	26.7	< 0.422	< 2	306
7.0 to 7.5	670	11.9	2	257

SB-8

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	482	7.02	292	2,060
3.0 to 3.5	82.5	2.18	28	255
5.0 to 5.5	80.1	0.439	4	163
7.0 to 7.5	99.9	39.0	11	143
9.0 to 9.5	--	--	14	167
11.0 to 11.5	--	--	41	314
13.0 to 13.5	--	--	39	359
14.5 to 15.0	--	--	3	184

SB-12

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	63.2	< 0.414	16	499
3.0 to 3.5	29.4	< 0.415	< 2	65
5.0 to 5.5	34.8	< 0.410	2	93
7.0 to 7.5	744	10.7	< 2	171

SB-13

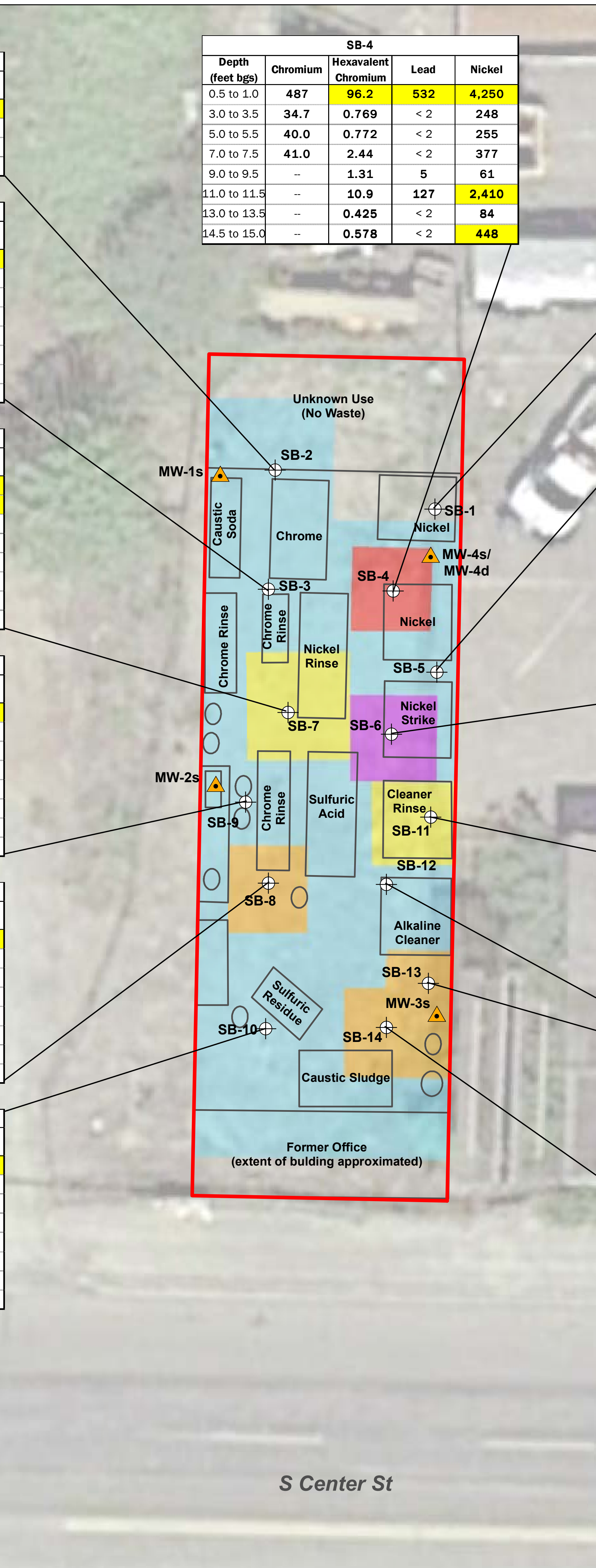
Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	148	< 0.421	40	834
3.0 to 3.5	34.2	< 0.413	< 2	63
5.0 to 5.5	30.3	< 0.419	< 2	135
7.0 to 7.5	431	7.67	< 7	568

SB-10

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	428	15.4	275	2,190
3.0 to 3.5	92.7	4.55	2	65
5.0 to 5.5	107	5.19	3	62
7.0 to 7.5	172	4.32	5	162
9.0 to 9.5	--	--	5	105
11.0 to 11.5	--	--	28	223
13.0 to 13.5	--	--	2	91
14.5 to 15.0	--	--	2	69

SB-14

Depth (feet bgs)	Chromium	Hexavalent Chromium	Lead	Nickel
0.5 to 1.0	343	< 0.431	70	904
3.0 to 3.5	43.5	0.794	< 2	133
5.0 to 5.5	102	3.00	10	145
7.0 to 7.5	198	3.23	< 2	3,010
9.0 to 9.5	--	--	--	138
11.0 to 11.5	--	--	--	138
13.0 to 13.5	--	--	--	110
14.5 to 15.0	--	--	--	127



MW-1s Groundwater Monitoring Well Location and Number

SB-3 Boring Location and Number

Property Boundary

Historical Site Features

Proposed Excavation Depths

- Excavate to 2.5 ft bgs
- Excavate to 5.0 ft bgs
- Excavate to 9.0 ft bgs
- Excavate to 11.0 ft bgs
- Excavate to 16.0 ft bgs

Soil Cleanup Levels Using MTCA Method B Values Protective of Groundwater as Drinking Water (mg/kg)

Total Chromium	2,000[1]
Chromium VI	18.4
Lead	250
Nickel	417

[1]Cleanup Level for Chromium III

N W E S

15 0 15 Feet

Results reported in milligrams per kilograms (mg/kg).
Bold results indicate detection of analyte.
Shaded results indicate exceedances of MTCA cleanup levels.

Data Source: Aerial image base from Google Earth Pro
Historical site features from Landau Associates, Historical Electroplating Operations, Figure 3, November 7, 2005.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Figure 10. Remedial Alternative 1: Soil Excavation to Cleanup Levels Using MTCA Method B Values Protective of Drinking Water

Former Aladdin Plating Facility
Tacoma, Washington

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Figure 10

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