Remedial Evaluation Report
Hudson Street Site
West Seattle, Washington

Prepared for
Joint Defense Team

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REMEDIAL EVALUATION REPORT
HUDSON STREET SITE
WEST SEATTLE, WASHINGTON

INTRODUCTION

This report presents an evaluation of available environmental data for the project site to determine the potential environmental risks associated with any exposed cement kiln dust (CKD) in two fill areas in West Seattle and to develop an appropriate remedy to correct the identified risks. Note the two CKD fill areas (Puget Park and McFarland lobes) are both included in the Washington State Department of Ecology's (Ecology) Confirmed and Suspected Site's List database. To that end, this report presents data on the environmental quality of Puget Creek, CKD fill material, a seep of perched shallow groundwater, and precipitate material at the Hudson Street site. Additionally, the report provides a feasibility evaluation of possible remedial action alternatives to address exposed CKD at the site, and selects and presents a preferred alternative. Based on the identified remedial action objectives for the site, the key features of the selected remedial option (Enhanced Soil Cover and Revegetation) are described, costed, and detailed in the report and on the attached figures. This document is intended to assist in subsequent planning, permitting, and final design of a selected remedial action plan for the site. This remedial action plan is intended to be a permanent remedy to protect human health and the environment. To this end, the alternate goal after completing the Independent Remedial Action on these two sites is to receive a "No Further Action" determination from Ecology.

PHYSICAL SETTING

The project site consists of two separate CKD fill areas (or lobes) which extend directly off of Puget Way NW, within the densely vegetated greenbelt of West Seattle, along West Marginal Way. The location of the site is shown on Figure 1. The two lobes of fill, identified as the McFarland and Puget Park lobes (Figure 2) are approximately 0.7 and 2.3 acres, respectively. The top surface of each lobe is relatively flat and contains light to dense grass and brush cover. The slopes of the lobes are covered with small (4- to 8-inch-diameter) alders and dense brush, with varying grades ranging from 20 to 45 degrees.

During 1969 and 1970, approximately 11,000 and 40,000 cubic yards of CKD were used to create the McFarland and Puget Park lobes, respectively. Subsequently, the lobes were partially covered with soil and vegetation naturally recovered over the majority of the fill areas.

Project Area Hydrogeology

Previous explorations completed on the project site provide details on the local soil types and perched groundwater occurrences. Both fill areas consist of up to 20-foot-thick layers of CKD, extending west from the roadway (Puget Way SW), following the natural slope of the area. Large portions of the CKD fill areas are covered with a compacted soil fill material, generally consisting of a gravelly, sandy silt. Both CKD fill areas were also observed to contain small quantities of debris, including crushed concrete and brick, wood, and plastic material. Beneath the fill, explorations encountered up to one foot of an organic, sandy silt layer, probably the former forest floor layer before the CKD was filled. This material is underlain by 5 to 10 feet of moist, weathered, medium stiff to stiff, silty clay/clayey silt underlain by unweathered stiff to very stiff silty clay/clayey silt (Geo Group, 1993). This clayey silt material has a very limited permeability and is not likely to transmit any surface water to the underlying groundwater in the region.

No standing groundwater was encountered in the test pits or soil borings from previous explorations (AGRA, 1994). However, perched water was observed in one boring during the Geo Group (1993) investigation. Also perched water is indicated by the presence of a seep and formation of a carbonate precipitates below both the Puget Park and McFarland lobes (see Figure 2). During Hart Crowser's work, 4- to 6-inch-deep test pits were hand excavated into both precipitates; from precipitates below the Puget Park lobe, a small stream of perched water was observed seeping through the test pit approximately 2 to 4 inches below the soil surface. The top 4 to 6 inches of soil of the test pit consisted of an organic sandy silt layer containing a calcium carbonate-like precipitate, underlain by a moist, weathered silty clay/clayey silt. Based on the condition of the underlying stiff clay as previously described, it is unlikely the perched seep water is capable of migrating downward into any lower water-bearing unit. The seep water are likely exposed at the precipitate location, at which point they flow across the forest floor and were observed to be either absorbed or end at Puget Creek.

Surface Water Drainage

Surface water is controlled upstream of the fill lobes through a series of side street drainage ditches and culverts. Storm water generated topographically uphill of the fill lobes originates from an area consisting of wooded hillsides and a few residential homes. The storm water travels down an open channel on the west side of Puget Way SW and through a 20-foot-long drainage culvert near the planned SW Edmunds Street intersection (see Figure 2). At the outlet of the

drainage culvert, storm water empties into a steep ravine which separates the two lobes. As observed in the field, a portion of the drainage turns southwest toward the precipitate area below the Puget Park lobe; the rest of the drainage continues south toward a second precipitate area below the McFarland lobe and eventually discharges into Puget Creek. No flowing surface water was observed during the summer period. No obvious drainage channels, erosion gullies, or slide areas as a result of surface water drainage, were observed during Hart Crowser's investigation work.

FIELD FINDINGS AND ENVIRONMENTAL QUALITY ASSESSMENT

Extent of CKD Fill

The Hudson Street site consists of two separate and distinct CKD fill areas, identified as the Puget Park and McFarland lobes. As delineated on Figure 2 and shown in the historical aerial photo, Figure 4, the Puget Park lobe, the larger of the two fill areas, extends east to west, while the McFarland lobe runs north to south, along Puget Way SW. From previous geotechnical investigations performed by others and our limited site assessment, we have developed estimates of relevant lobe features (e.g., total surface area) which are pertinent to this remedial evaluation report. These features and other details are provided below.

McFarland Lobe

The McFarland lobe has been evaluated previously by Geo Group Northwest, Inc. (1993) and Dames and Moore through the installation of eight soil borings and five exploratory test pits. For this area, Hart Crowser also performed a visual survey of CKD fill material conditions. As shown on Figure 2, the McFarland lobe follows Puget Way SW for approximately 350 feet; the CKD fill occurs along the west slope of Puget Way SW, reaching a maximum width of approximately 140 feet. The lobe has a relatively flat to shallow sloped top with steep side slopes, ranging from 20 to 45 degrees. The toe to the top of the slopes reach elevation gains of 30 to 40 feet. The majority of the top of the lobe is covered with dense grass, blackberry bushes, and other shrubs. The side slopes are densely covered in bushes, shrubs, and small alders.

Using the John Miller survey prepared in 1991 (Geo Group, 1993), a 1970 aerial photograph of the site, and observations made during our assessment, we estimate the total surface area of this CKD fill area is approximately 30,000 square feet. Of this total, approximately 20,000 square feet contains a light to dense grass and shrub cover. As can be seen on Figure 2, over half of this area

(shown in orange) is within the sloped portion of the McFarland lobe. The remaining areas of the McFarland lobe are covered with well-compacted soil, ranging from 6 to 12 inches in thickness, as well as the dense vegetation described above.

Puget Park Lobe

No previous exploratory investigations have been reported for the Puget Park lobe area. As part of Hart Crowser's 1996 assessment, we excavated 21 test pits around the north and south sides of the lobe (see Figure 2). Additionally, we dug several shallow hand-pits along the slope of the fill area. The Puget Park lobe runs predominantly east to west for approximately 550 feet, starting at the north end of the McFarland lobe and the intersection of Puget Way SW and SW Edmunds Street. The lobe has a relatively flat top and steep side slopes, ranging from 20 to 30 degrees. The toe to the top of the slopes reach elevation gains of 30 to 40 feet. Nearly all of the top of the lobe is covered with grass and a dense covering of blackberry bushes. The side slopes are densely covered in bushes, shrubs, and small alders.

Using the 1970 aerial photograph of the site and observations made during our assessment, we estimate the total surface area of the Puget Park CKD fill area is approximately 100,000 square feet. The entire 100,000 square feet of the lobe contains a 2- to 4-inch thick layer of "forest duff" and is heavily vegetated. Of this total, approximately 65,000 square feet within the Puget Park lobe is covered with well-compacted soil, ranging from 6 to 24 inches in thickness, as well as the dense vegetation described above.

The estimated extents of the above-described CKD fill areas are shown on Figure 2.

Puget Creek Environmental Quality

Surface water samples from within Puget Creek were collected to determine whether the CKD fill and potential precipitates were potentially impacting environmental quality of the surface water receptor (creek). Two series of surface water samples from two locations (SW-1 and SW-2) were collected from the creek. Sample locations are shown on Figure 2. Sample SW-2 was collected from Puget Creek approximately 100 feet upstream from the western limit of the Puget Park CKD lobe to represent background surface water quality. At the time of the second round of sampling, Dan Cargill was present and confirmed this upgradient sampling location. Sample SW-1 was collected from Puget Creek just downstream from the eastern edge of the McFarland CKD lobe to represent potential surface water quality impacts from the CKD fill areas.

Samples were analyzed for pH, hardness, total suspended solids, total dissolved solids, and total and dissolved arsenic, cadmium, and lead. The laboratory data are presented in Table 1 for both rounds of the creek surface water samples. Metal concentrations in the creek samples do not exceed freshwater acute or chronic ambient surface water quality criteria. Total and dissolved metals (arsenic, cadmium, and lead) were generally not detected except for lead (0.0037 mg/L) in the second sample collected at SW-1. Note that the slightly elevated pH (relative to a neutral range of 6.5 to 7.5) measured along the creek may be a result of approximately 12 similar readings found in the soil adjacent to creek, between SW-1 and SW-2. The values determined for hardness, suspended solids, dissolved solids, and pH fall within the normal range for surface water bodies.

The data results indicate that there is no significant impact to the environmental quality of Puget Creek surface water which is attributable to the presence of the CKD fill.

CKD Chemical Data

The environmental characteristics of the CKD present in the fill have been evaluated by Agra Earth and Environmental, Inc. (Agra) in two studies completed in 1994 (July and December 1994). For the studies, Agra collected approximately 30 samples of fill material across the extent of the McFarland lobe from depths of between 0.5 and 4.0 feet below ground surface. The total metals content of 16 selected samples was determined using the EPA Method 6000/7000 series for arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury. In addition, four of the collected samples were also analyzed for leachability using EPA SW-846 Method 1311 (Toxicity Characteristic Leaching Procedure [TCLP]). The laboratory data are presented in Table 2 along with mean concentrations and the range of detected constituents.

The total metals content of the fill is summarized as follows:

Metal	Range of Concentration in mg/kg	Mean Value in mg/kg
Arsenic	120 to 440	266
Barium	39 to 130	99
Cadmium	3.1 to 13	7.6
Chromium	10 to 35	14
Lead	880 to 3,600	2,104
Selenium	Not Detected	Not Detected
Silver	4.1 to 10	6.9
Mercury	Not Detected	Not Detected
pH	7.9 to 12.4	11.7

Although the selected samples had total metals concentrations ranging between 140 to 370 ppm for arsenic, 3.2 and 10 ppm for cadmium, and 880 to 3,300 ppm for lead, none of the samples had leachable metals concentrations that exceeded the TCLP criteria for State Dangerous Waste designation.

The data from Agra's investigation confirm the basic characteristics of CKD and show the fill material to be a cement kiln by-product with typical characteristics of a carbonate mineral residue with elevated alkalinity and the presence of some total metals, such as arsenic and lead.

Precipitate Areas

As shown on Figure 2, formations of calcium carbonate (known as precipitates) are present at shallow depths in surface soil, downhill from the CKD fill lobes. The formations appear as a thin, hardened layer of material which coats the surficial soil and organic debris (roots, twigs, leaves) within its formation. The precipitate areas were observed to be physically located just downhill of the CKD fill lobes. Precipitate areas A1 and A2 were observed to contain some saturated surface soil, evidence of perched, shallow water in the topsoil layer at the locations.

The "travertine-like' deposits observed at the seep discharge locations were likely produced by the dissolution and precipitation of carbonate materials associated with the CKD. Cement kiln dust typically contains high concentrations of carbonate materials. As the CKD-containing fill material is exposed to rainwater

infiltration and subsurface water flow, the carbonate materials (including carbonates containing iron and lead) dissolve into the water and are transported downgradient toward the creek. The amount of carbonates dissolved in the subsurface water is likely to be very high (supersaturated) based on the presence of alkaline conditions and high total dissolved solids concentrations. As the water discharges at the seep locations, exposure to the atmosphere causes much of the dissolved carbonates and iron-containing materials to precipitate forming the "travertine-like" carbonate deposits. As measured in a seep water sample collected from within precipitate A2 (sample PP-Seep), the seep water contained no detectable arsenic and cadmium, and a measurable amount of dissolved lead (1.0 mg/L). The pH of the sample was measured at 12.3 pH units. (See ***Perched Groundwater Seeps*** section discussion below.) Note that the selection of the precipitate seep sample (PP-Seep) location was directly from within the formation thereby resulting in sampling results that are likely higher than those measured at the future sampling location - point of compliance - that location where seep water, if any, is contacting Puget Creek.

Soil samples were collected from the shallow precipitate material at eight locations around the two precipitate areas (A1 and A2) and analyzed for total metals (arsenic, cadmium, and lead) and pH. Laboratory data for precipitate samples are presented in Table 3. Our sampling and analysis data for the precipitate material are similar to the quality of CKD evaluated in the EPA nation-wide study (EPA, 1993) for total arsenic and lead. The cadmium values are generally lower than typical CKD. When compared to the site's CKD lobe material, the precipitate material exhibits the presence of similar chemical constituents; however, most values for total metals in the precipitate fall in the low end of the range for CKD.

Perched Groundwater Seeps

As described above, two areas of precipitate formations (A1 and A2) contained surface seep water in the surface soils. These areas were examined by digging down through the surface soils and completing shallow trenches 4 to 6 inches below ground surface into the underlying clay. From visual observation, the saturated materials exist in a thin layer in organic/silt sandy soil which is approximately 4 to 6 inches thick. In area A1 there was no discernible free flow of water into the observation trench. In area A2, a small trickle of surface flow (a seep of approximately 0.2 gallon per hour) was established within the northern (uphill) edge of the precipitate formation.

A sample was collected from the seep by allowing the seep water to flow freely and directly into a clean sampling jar placed below the trench. From the jar, a water sample was extracted using a peristaltic pump. The seep sample was

analyzed for total and dissolved arsenic, cadmium, lead; for total suspended and dissolved solids; for pH; and for hardness. Data for the seep sample (PP-SEEP) are presented in Table 1.

The chemical data show no detectable concentrations of total or dissolved arsenic and cadmium. The seep sample does have measurable lead at concentrations of 1.3 mg/L (total) and 1.0 mg/L (dissolved).

The seep sample also has elevated hardness (1,200 mg/L) and TDS (2,500 mg/L) values which reflect the saturated nature of the mineral content of the seep water.

Laboratory data for the seep water generally reflect the nature of a perched groundwater flowing within an organic sandy silt and the CKD fill, which is dissolving some carbonate mineral and associated lead, as described in the previous section on precipitate formation.

ENVIRONMENTAL RISK SUMMARY AND REMEDIAL ACTION OBJECTIVES

As determined from the findings of this study, the primary concerns associated with the Hudson Street site are associated with portions of the CKD fill areas, which have little to no soil cover with only a forest duff and vegetative cover, and the precipitate areas. The CKD in such areas may be subject to the natural forces of weather (storm water and wind), and may present a direct contact risk to individuals who come on to the site. Significant rainfall events could erode the exposed surface material and carry it into drainage ravines and nearby Puget Creek.

However, as determined from observations and analytical data presented in this study, the impact of CKD to surrounding receptors has been minimal based on the following conditions:

- Although the entire area is well vegetated and stable, a fraction of both CKD fill areas have CKD surfaces with little to no soil cover which are susceptible to human contact or erosional effects, as opposed to areas which support up to 2 feet of soil fill cover. However, these areas are generally covered with a "forest duff" mat of leaves and compressed vegetative debris.

- Water samples were collected from Puget Creek (at both upstream and downstream locations of the CKD fill) and analyzed for the conventional parameters (pH, hardness, TDS, and TSS) and total and dissolved arsenic,

cadmium, and lead. No measurable impacts to the creek from metals or pH were noted.

- Limited areas of calcium carbonate formations (precipitate areas) are present just below the CKD fill lobes as a result of perched water flowing through the CKD. The material forming the precipitates show chemical characteristics similar to CKD for metals and alkalinity (pH).

- A localized perched groundwater seep was observed at one precipitate area just below the Puget Park lobe. Chemical analysis of the seep sample indicates elevated hardness and TDS which reflect the saturated nature of the mineral content in the sample. Additionally, even though the sample contained a measurable dissolved lead concentration of 1.0 mg/L, the volume of the seep is minimal and appears to be absorbed across the forest floor.

As described above, observed or measurable issues related to the CKD are in limited areas of the CKD lobes and the precipitate/perched groundwater seep areas just below the two CKD fill lobes.

The selection of an appropriate remedy for the areas of the CKD fill areas that do not support a soil cover and the identified precipitate areas at the Hudson Street site were based principally on three factors: the potential environmental impacts related to CKD in the environment (based on potential direct contact, air emissions, and erosion); the appropriateness and suitability of the selected remedy on the site as it relates to its future use as a greenbelt; and the overall cleanup costs of the remedy relative to its incremental degree of protection and reduction in the site risk the remedial action would achieve over other alternatives.

Hart Crowser evaluated applicable remedial measures which would provide controls to the issues related to the exposed CKD. In summary, we focused the design on the following Remedial Action Objectives (RAOs):

- Eliminate the potential for human contact with CKD and precipitates;

- Eliminate potential dust generation and releases to the atmosphere from the CKD fill;

- Control runoff, further sedimentation, and precipitation of the CKD to the surrounding environment; and

- Provide a remedial measure that maintains/enhances the wooded greenbelt in and around the City of Seattle's Puget Park.

The overall RAOs for the site are to provide a remedy which protects human health and the environment (WAC 173-340-350). The outcome of these RAOs is the development of four possible remedial alternatives. These alternatives and a screening-level feasibility evaluation of the alternatives are provided next.

FEASIBILITY EVALUATION OF REMEDIAL ALTERNATIVES

Identification of Remedial Alternatives

This CKD feasibility evaluation describes the development and evaluation of alternatives to eliminate, reduce, or otherwise control the potential risks posed by the CKD at the Hudson Street site. This feasibility evaluation follows a systematic, step-wise approach for developing and evaluating the possible remedial alternatives, in compliance with the requirements of the Model Toxics Control Act (MTCA).

To fulfill the remedial action objectives described in the previous section, four remedial action alternatives (including the Institutional Controls) were identified and screened for applicability. The remedial options were evaluated for short- and long-term effectiveness in eliminating the identified environmental risks of the CKD fill; for the ability to reduce mobility, toxicity, or volume of the CKD; implementability; and relative costs. The results of our preliminary screening efforts are summarized in Table 4. These alternatives range from simple to complex with low to high costs.

The four alternatives developed for detailed analysis are:

- Institutional Controls
- Enhanced Soil Capping, Revegetation, and Precipitate Management
- Stabilization and Capping
- Excavation and Off-Site Disposal.

Institutional Controls

The Institutional Controls alternative provides the minimum acceptable approach for addressing environmental impacts from the CKD at the site. The

Institutional Controls alternative provides a reasonable, low-cost option as a basis for remedial alternative evaluation. Institutional Controls consist of administrative and physical barriers to reduce public areas and contact with the site. For the Hudson Street site, the appropriate institutional controls include deed restrictions and site access restrictions, including perimeter fencing and ingress/egress security. This alternative would rely on existing vegetation to reduce erosional effects. The fencing would be intended to prevent direct contact. This alternative may also include a long-term confirmational monitoring program for surface water and perched groundwater seeps.

The estimated cost of this option is $150,000. Details of this cost estimate are provided in Table B-1 in Appendix B.

Enhanced Soil Capping, Revegetation, and Precipitate Management

This remedial option reduces the potential for contact between any wildlife and the public with the CKD by placing an enhanced soil and vegetative cap over the CKD fill areas which contain little soil cover. Currently, nearly all of the Puget Park lobe and approximately half of the McFarland lobe areas are protected with a compacted, 6- to 24-inch-thick soil cover and a dense cover of vegetation. This remedial alternative would complete the soil cap for the remaining CKD fill areas. The majority of the CKD fill areas within the steep slopes of the Puget Park and McFarland lobes already support a dense vegetative cover and "forest duff" floor. In a small portion of these slopes, the vegetation cover is light. To minimize disturbances to surrounding vegetation cover and tree growth, these areas would only receive a thin layer (2 to 4 inches) of topsoil and a hydroseed cover, likely applied by hand. Areas with little or no grade changes (top, flat areas) would receive a 12- to 24-inch-thick soil cover and be revegetated with select grasses, shrubs, and trees. The flow direction of existing drainage paths would be maintained; however, the channels would be cleared of all CKD and armored to prevent soil erosion.

This option would also address the precipitate areas below the CKD fill areas. Each precipitate area would be excavated and the material relocated to within the limits of the CKD fill. The excavated area would then be improved with a gravel precipitation chamber.

The estimated construction cost of this option is estimated at $350,000. This includes $100,000 for soil capping, and approximately $50,000 for drainage and seep control. Table B-2 within Appendix B of this report provides details of this cost estimate.

Stabilization and Capping

This alternative includes surficial treatment of the top 12 to 18 inches of the CKD fill through soil-cement stabilization, in areas with little soil cover. The CKD would be stabilized with a mix of Portland cement, aggregate, and the surficial CKD. A honeycomb shaped geomembrane (Geoweb) would be anchored to the fill banks on sloped sections of the fill and filled with imported soil. The top of the fill areas in locations of little to no grade change would be covered with one foot of imported topsoil. The imported soil cover would be vegetated with native shrubs, grasses, and small trees.

This remedial option would also address the precipitate areas below the CKD fill areas. Each precipitate area would be excavated and the material relocated to within the limits of the CKD fill. The excavated area would be improved with a gravel precipitation and collection chamber. Collected seep water would then be hard piped (and possibly pumped) along Puget Creek and eventually discharged to the sanitary sewer located near West Marginal Way. The long-term effectiveness of the conveyance system is questionable, given the high alkalinity of the seep water. Likely operation and maintenance costs associated with the system would be high.

Because of the shallow depth to the stabilized CKD material, the stabilized area would not support large forest growth.

The estimated cost of this option is $550,000. This includes $180,000 for stabilization of the CKD and $200,000 for construction of the soil cover. Details of this cost estimate are provided in Table B-3 in Appendix B.

Excavation and Off-Site Disposal

In this alternative, all CKD within both lobes of the Hudson Street site would be excavated and disposed of in a permitted solid waste landfill. The McFarland lobe would be regraded to support the existing 16th Avenue Street roadway section. The site would be backfilled with sufficient topsoil to support vegetation. The topsoil will be revegetated with native trees, shrubs, and grasses.

We estimate that within as few as 5 years, the park vegetation would recover and approach a natural state. In the interim, erosion control measures such as silt fencing and protected drainage channels would be required to reduce sediment loading on the stream during this time.

This alternative would provide a permanent solution by complete removal of the material of concern.

The estimated cost of this option is $5,500,000. This total includes $250,000 for excavating the CKD and $5,000,000 for landfill disposal (at a tipping fee of $55/ton). Details of this cost estimate are provided in Table B-4 in Appendix B.

Evaluation and Screening of Remedial Alternatives

The purpose of the evaluation of remedial action alternatives is to compare relevant information and allow selection of a preferred site remedy. In this section, the alternatives are compared against each other with respect to the MTCA criteria for selection of cleanup actions (WAC 173-340-360).

MTCA requires that all cleanup sections meet the following threshold requirements:

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

In addition, MTCA requires that cleanup actions meet the following requirements:

- Use permanent solutions to the maximum extent practicable;
- Provide for a reasonable restoration time frame; and
- Consider public concerns.

As presented in Table 4, the remedial alternatives were screened to compare how well each alternative is able to control or eliminate risk from the site (e.g., meeting RAOs). Evaluation or screening criteria include short-and long-term effectiveness; reduction in toxicity, mobility, or volume; implementability; and cost. These criteria provide a means by which one alternative can be compared to another. With respect to the use of permanent solutions, Ecology recognizes that permanent solutions may not be practicable for all sites (WAC 173-340-360[5][d]. MTCA specifies that the screening criteria listed in this section should be considered in determining whether a cleanup action is permanent to the maximum extent practicable.

Table 4 presents a comparative analysis summary and identifies one alternative as the preferred remedial approach. The evaluation criteria for each alternative are defined as follows:

Short-Term Effectiveness. The effectiveness of the alternative in meeting RAOs during construction and implementation is assessed under a short-term time frame (3 to 6 months).

Long-Term Effectiveness (Permanence). The effectiveness of the alternative in maintaining RAOs after implementation is assessed under a long-term schedule. This criterion measures the permanence of the alternative and considers magnitude of residual risk and adequacy and reliability of any site controls.

Treatment for Reduction of Mobility, Toxicity, or Volume. The method of treatment, destruction, and removal are evaluated for each alternative to assess the reduction of mobility, toxicity, or volume.

Implementability. The technical and administrative feasibility of the alternative are evaluated to assess the remedy's implementability.

Cost. With respect to relative cost, WAC 173-340-360(5)(d)(vi) states "A cleanup action shall not be considered practicable if the incremental cost of the cleanup action is substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference cleanup action." The regulation recognizes that there are different levels of site complexity and that practicability evaluations may vary from qualitative to quantitative.

Capital, operation, and maintenance costs are estimated and evaluated for each alternative. A cost analysis is based on engineering judgment and is evaluated as to whether costs are high, medium, or low relative to other remedial options. Details of the preparation of the estimated costs are provided in Appendix B.

Selection of a Preferred Remedial Alternative

The systematic evaluation and ultimate selection of remedial alternatives, as performed herein and presented in Table 4, results in the selection of the Enhanced Soil Capping, Revegetation, and Precipitate Management alternative for the Hudson Street site. This alternative provides protection and containment of the surfaces of both the Puget Park and McFarland CKD lobes. As compared to other alternatives, the technical and regulatory requirements of implementing Enhanced Soil Capping, Revegetation, and Precipitate Management are easily and routinely performed. The low rating for reduction of toxicity and volume does not present an increased risk to human health and the environment since

constituents of concern will be contained and not available to sensitive receptors. RAOs are met at the site and the cost is reasonable, especially when compared to higher cost alternatives whose implementability is questionable. Similarly, when compared to the other alternatives, construction of the Enhanced Soil Capping activities results in lesser risk by avoiding generation of CKD dust and erosion (expected during excavation or stabilization activities). This alternative will also preserve much of the existing vegetation at the Site.

The specific benefits realized by the selection of the Enhanced Soil Cover, Revegetation, and Precipitate Management alternative are further presented below.

Enhanced Soil Cover and Revegetation

This remedial alternative will provide a physical barrier (12 to 24 inches of dense, well-compacted soil) and thereby minimize contact of the CKD with the public and wildlife. It will also reduce contact between storm water and CKD by allowing surface water sheet and drainage flows created by heavy rain storms to flow over the enhanced soil cover and not across CKD material. Surface water contact with the CKD will be further reduced by the installation of an upgradient culvert and drainage improvements that will redirect surface waters before they enter the site.

New and select wooded plantings will be placed in all areas disturbed during construction or historically did not develop a dense variety of vegetation; contributing to the physical barrier from the capped CKD. In addition, this alternative will hydroseed all disturbed areas on the site after construction to provide rapid but temporary erosion and sediment control.

Finally, a combination of thorny wild rosebush and fast growing, densely wooded hazelnut will be strategically planted along obvious public access points to the site to discourage trespassing. The natural barrier fence will also be established along Puget Way SW and around the precipitate chambers.

Precipitate Management Features

This remedial alternative will provide oversized precipitation chambers at the two identified locations of ongoing precipitation so that precipitation will occur more efficiently and within a protected area. This alternative recognizes the natural precipitation mechanism occurring at the site, and attempts to maximize and accelerate this natural precipitation process with the chambers.

The proposed precipitation chambers will accommodate precipitation at the site. By redirecting the majority of current storm water sources away from and around the CKD through the drainage improvements described above, the remedy will reduce or possibly even eliminate seeps and precipitation of dissolved carbonates at the bottom of the lobes. The existence of historical, inactive precipitate areas also suggests that subsurface water pathways through and under the CKD material are getting cutoff over time due to the natural precipitation and cementation within these pathways. Therefore, additional precipitate management is likely occurring naturally at the site.

The successful establishment, performance, and expected results of these precipitate management features will be monitored and confirmed during post closure monitoring efforts, as detailed on the Operation and Maintenance (O&M) Plan.

CONCEPTUAL DESIGN OF SELECTED REMEDY

The selected alternative for the Hudson Street site, Enhanced Soil Cover, Revegetation, and Precipitate Management is further detailed below at a conceptual design level. As discussed, the alternative includes the installation of an enhanced soil and vegetative cover, drainage controls of current surface water sources including the construction of an upgradient culvert, the placement of barrier plantings, and management of the existing precipitation areas through the construction of precipitate chambers.

Consistent with the greenbelt designation for the site, the construction of the selected alternative will be carried out to minimize disturbances and impacts to the existing 25 years of natural growth cover, on most of the CKD fill area. Conceptual construction details of the soil and vegetative cover and precipitate chamber are provided on Figure 3.

CKD Fill Cutting and Grading

Only selected areas on the flat slopes of the CKD fill areas will be modified by minor cutting and grading activities. The drainage ravine that separates the two lobes will be cleared of any eroded CKD and solid waste, then fortified with quarry spalls. All excavated CKD will be relocated to the top of the lobes, within areas that will eventually be capped with a soil and vegetative cover.

Slope Protection - Topsoil and Revegetate

Within the McFarland CKD lobe, steep slope areas containing little soil and vegetative cover will be enhanced with a minimum of 2 inches of topsoil and hydroseeding to promote reestablishment of a natural vegetative cover. All work will be performed by hand to minimize any further disturbances to the existing, thick vegetation.

Soil Cover

Following limited clearing/grubbing and cutting/grading to access and stabilize the work zones, the identified CKD areas at the top, flat surfaces of the lobes will be covered with a minimum of 12 to 24 inches of a clean, imported soil. The soil will be graded and lightly compacted to match the established contours.

Revegetation

Immediately following the installation of the soil cover, the capped areas will be hydroseeded with a standard soil erosion seed mixture to provide temporary erosion control within the disturbed areas. Soon thereafter, the soil cover will be revegetated with select native trees and shrubs that typically grow on low elevational south- and west-facing slopes in this region.

In vegetated areas within the CKD fill lobes which will not be disturbed during construction, the existing red alders will be thinned to encourage healthier growth by promoting stronger, larger trees. The larger trees will encourage better soil holding capacity (e.g., minimizing erosional effects) as a result of larger, more healthy root systems.

Barrier Plantings

To discourage trespassing and access to the capped CKD fill areas, a selective planting scheme consisting of thorny rose bush and rapid growing, densely wooded hazel nut will be planted along the perimeter of the fill areas, particularly along Puget Way SW (see Figure 2). Additionally, a wall of plantings will also be established around the precipitate chambers to hide and exclude the chambers from passerbys.

Drainage Improvements

A large quantity of surface water from uphill sources currently flows through the two lobes, down a ravine which starts at the intersection of the two lobes (on Puget Way SW) and ends near the two active precipitate locations. Drainage

improvement plans are to redirect this surface water to the east across Puget Way SW and down the street. Surface water will be collected and conveyed away from the lobes through a culvert and the existing ditch on the east side of the street.

Seep Water and Precipitate Management

The material within the precipitates identified below the two lobes will be excavated and relocated to the top of the McFarland lobe, under the planned soil cap. The precipitates are generally 4 to 6 inches deep and represent a total area of approximately 3,000 square feet.

The precipitates are presumed to be a formation produced from perched groundwater which infiltrates through the CKD fill and day-lights at these locations to form the calcium carbonate precipitate. The voids left after excavating the precipitate formations will be replaced with a gravel-screen chamber; the chamber will consist of a very porous, rock-media layer which provides surface area for precipitate formation as the seep waters travel through. The gravel-screen chamber will consist of a gravel layer covered with a geotextile and protective soil cover, as shown on Figure 4. The soil cover is intended to minimize human contact.

The goal of the precipitate chamber is to allow for effective, long-term precipitation to occur, thus improving the quality of the seep water which appear at these locations. With the added benefit of re-directing most of the surface water sources away from the top of the CKD fill (see ***Drainage Improvements*** section), the current seep water conditions are likely to reduce in flow rate or quantity and improve in water quality. Seep water sampling performed as part of the O&M plan will confirm improvements to the seep water.

IMPLEMENTATION OF SELECTED REMEDY

Construction Process and Factors Influencing Costs

The following considerations or uncertainties are factors of the overall implementation of the selected remedy and may have impacts on overall construction schedule and costs:

- Precise limits of the exposed CKD, as shown on Figure 2, were field determined and will change slightly for construction activities. The actual

limits of existing soil-covered CKD will be determined at the time of construction.

- No modifications or improvements to City of Seattle Parks property or existing underground utilities are planned or anticipated.

- Adverse weather conditions, particularly heavy rainfall, may increase construction costs and extend installation schedule by creating poor staging and access areas and soil handling conditions.

Construction Event Sequence and Schedule

The major construction activities associated with the construction and installation of the enhanced soil cap for exposed CKD are as follows:

- Installing construction BMPs, such as silt fences;

- Clearing and grading limited vegetation;

- CKD slopes topsoil placement and revegetation;

- CKD flat slopes, regrading, soil cover, and revegetation;

- Precipitate and seep water management; and

- Surface water drainage modifications.

The total estimated duration to complete construction of the CKD cover, revegetation, drainage improvements, and precipitate chambers will be approximately 4 to 6 weeks.

Permit Information

We anticipate the following permits or regulatory approvals to perform the proposed remedial action on the site:

- A City of Seattle State Environmental Protection Act (SEPA) checklist and permit was prepared with respect to the remediation of the site. The City of Seattle subsequently issued a DNS. No comments or appeals were filed during the applicable comment period.

Operation and Maintenance Plan

Following successful completion of the remedial action, the site will undergo a thorough operation and maintenance inspection period, lasting a minimum of 10 years. A proposed O&M schedule is as follows:

Year	Frequency	O&M Activity
1	4 times	Visual inspection of soil cover and precipitate chambers
	2 times	Seep water quality sampling from chambers
2	2 times	Visual inspection of soil cover and precipitate chambers
	1 time	Seep water quality sampling from chambers
3	2 times	Visual inspection of soil cover and precipitate chambers
4	1 time	Visual inspection of soil cover and precipitate chambers
5	1 time	Visual inspection of soil cover and precipitate chambers
6, 8, 10	1 time	Visual inspection of soil cover and precipitate chambers

Repairs or improvements to the cover or vegetation will be made immediately and to the extent necessary. A report of findings will be submitted annually to Ecology on these findings. If the precipitate chambers are unable to improve the seep water quality to ambient freshwater quality standards, corrective action will be considered.

LIMITATIONS

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Joint Defense Team for specific application to the referenced property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

Any questions regarding our work and this report, the presentation of the information, and the interpretation of the data are welcome and should be referred to the undersigned.

We trust that this report meets your needs.

Sincerely,

HART CROWSER, INC.

ROY K. KUROIWA, P.E.
Associate Engineer

RKK:sde
462801/RemedialEval.doc

REFERENCES

AGRA, Inc., July 18, 1994. Limited Environmental Assessment of Mayer Hudson Street Project.

AGRA, Inc., December 29, 1994. Analytical Results for Additional Environmental Assessment of Mayer Hudson Street Project.

EPA, 1993. Report to Congress on Cement Kiln Dust, Publication No. 530-R-94-001.

Geo Group, 1993. Geo Group Northwest, Inc., December 30, 1993. Geotechnical Engineering Study, Puget Way SW Street Improvement, W. Marginal Way SW to SW Alaska Street, Seattle, Washington.

Means Site Work & Landscape Cost Data 15th Edition, 1996.

Table 1 - Puget Creek and Seep Water Chemical Data

	Puget Creek				Perched Water Seep	Ecology's Ambient) Water Quality Criteria (Chronic)
	SW-1(1)	SW-1(2)	SW-2(1)	SW-2(2)	PP-Seep	
Conventionals						
pH	8.0	8	8.1	6.2	12.3	--
Hardness in mg/L	350	220	200	180	1,200	--
Total Dissolved Solids in mg/L	760	450	240	370	2,500	--
Total Suspended Solids in mg/L	33	12	10 U	10 U	18	--
Dissolved Metals in mg/L						
Arsenic	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.190
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.002
Lead	0.003 U	0.003 U	0.003 U	0.003 U	1.0	0.007
Total Metals in mg/L						
Arsenic	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.190
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.002
Lead	0.003 U	0.0037	0.003 U	0.003 U	1.3	0.011

Notes:

U Not detected at the laboratory detection limit indicated.

(#) Indicates sampling round:
(1) Round 1 collected on 10/4/96
(2) Round 2 collected on 7/25/97

Ecology's Ambient Water Quality Criteria based on a hardness equal to 275 mg/L.

SW-1 downgradient sampling location
SW-2 upgradient sampling location

462801/TABLE1.xls

Table 2 - Cement Kiln Dust Chemical Data

	CKD Chemical Data from Project Site								
Sample ID	Mayer-2	Mayer-3	Mayer-4(1)	Mayer-5(1)	7 + 00(1)	7 + 75	7 + 50	8 + 10, 13W	8 + 63, 11W
Sample Depth in Feet	2.5	3.0	1.5	1.5	4.0	4.0	0.5	0.4	0.5
pH	9.38	12.36	8.29	8.15	8.38	12.29	12.33	11.61	12.39
Total Metals in mg/kg									
Arsenic	150	140	14	9.3	12	150	130	120	440
Barium	74	39	160	46	66	130	57	86	120
Cadmium	3.1	3.2	3.2	1.7	2.1	5.4	5.2	4.7	13
Chromium	13	14	70	29	35	21	13	27	15
Lead	890	880	12	34	13	1,400	960	920	3,600
Selenium	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U
Silver	3.9	4.4	0.91	0.78	0.8	6.4	4.1	3.8	10
Mercury	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Leachable Metals in mg/L									
Arsenic	–	0.10 U	–	–	–	–	–	–	–
Barium	–	0.42	–	–	–	–	–	–	–
Cadmium	–	0.005 U	–	–	–	–	–	–	–
Chromium	–	0.01 U	–	–	–	–	–	–	–
Lead	–	0.58	–	–	–	–	–	–	–
Selenium	–	0.015 U	–	–	–	–	–	–	–
Silver	–	0.017	–	–	–	–	–	–	–
Mercury	–	0.002 U	–	–	–	–	–	–	–

Table 2 - Cement Kiln Dust Chemical Data

	CKD Chemical Data from Project Site								
Sample ID	8 + 50	9 + 08, 26W	9 + 35, 15E	9 + 49, 10W	9 + 2.5	9 + 2.5	10 + 19	9 + 25, 6E	9 + 35, 10E
Sample Depth in Feet	2.5	0.3	0.4	0.5	1.5	4.0	1.5		
pH	12.31	12.29	12.27	12.32	7.87	12.37	12.34	8.1	12.5
Total Metals in mg/kg									
Arsenic	230	320	360	390	330	330	370	–	–
Barium	93	120	110	120	110	110	120	–	–
Cadmium	7.3	8.4	9.6	12	10	8.6	8.8	–	–
Chromium	14	13	12	12	10	12	11	–	–
Lead	1,800	2,200	3,100	3,500	3,000	2,600	2,500	–	–
Selenium	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	–	–
Silver	6.1	7.6	9	9.8	8.5	8.3	8.3	–	–
Mercury	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	–	–
Leachable Metals in mg/L									
Arsenic	–	–	–	–	0.10 U	–	0.10 U	1.4	–
Barium	–	–	–	–	1.3	–	0.46	–	–
Cadmium	–	–	–	–	0.005 U	–	0.005 U	–	–
Chromium	–	–	–	–	0.01 U	–	0.01 U	–	–
Lead	–	–	–	–	1.7	–	2.1	0.53	–
Selenium	–	–	–	–	0.015 U	–	0.015 U	–	–
Silver	–	–	–	–	0.019	–	0.22	–	–
Mercury	–	–	–	–	0.002 U	–	0.002 U	–	–

Table 2 - Cement Kiln Dust Chemical Data

Sample ID Sample Depth in Feet	Mean Values (1)	Range Values (1)] Min.	Max.	Nationwide CKD EPA Reference (2) Total Metals	Nationwide CKD EPA Reference (2) Avg. TCLP Leachate(3)	Comparative Values Method A Reg. (3) Method A Industrial	Comparative Values Method A Reg. (3) TCLP Reg. Levels
pH	11.7	7.87	12.5	–	–	–	–
Total Metals in mg/kg							
Arsenic	266	120	440	16 to 34	NA	200	NA
Barium	99	39	130	186 to 235	NA	–	NA
Cadmium	7.6	3.1	13	20 to 24	NA	10	NA
Chromium	14	10	35	–	NA	500	NA
Lead	2104	880	3600	435 to 858	NA	1,000	NA
Selenium	–	–	–	–	–	–	NA
Silver	6.9	3.8	10	7 to 10	NA	–	NA
Mercury	–	–	–	–	NA	–	NA
Leachable Metals in mg/L							
Arsenic	0.43	0.1	1.4	NA	0.02	–	5
Barium	0.73	0.42	1.3	NA	0.6	–	100
Cadmium	0.01	0.005	0.005	NA	0.01	–	1
Chromium	0.01	0.01	0.01	NA	0.05	–	5
Lead	1.23	0.53	2.1	NA	0.21	–	0.2
Selenium	0.02	0.015	0.015	NA	0.07	–	1
Silver	0.09	0.017	0.22	NA		–	NA
Mercury	0.002	0.002	0.002	NA	0.0008	–	5

– Not analyzed or analyzed.

(1) AGRA, 1994 report indicates samples are from soil adjacent to CKD fill. These values not used to calculate mean or range values

(2) EPA 1993, Report to Congress on CKD (530-R-94-001).

(3) Model Toxics Control Act Method A-Industrial Soil Cleanup Levels, Chapter 173-340 WAC.

(4) Toxicity Characteristic Leaching Procedure, Chapter 173-303-090 WAC.

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Table 3 - Precipitate Material Chemical Data

	Puget Park Lobe Area				McFarland Lobe Area			Nationwide CKD EPA Reference (1)
	PP-6	PP-7	PP-8	PP-9	MC-1	MC-2	MC-3	
pH	11.5	10.8	7.0	7.9	10.0	9.6	7.9	
Total Metals in mg/kg								
Arsenic	10	10	6.2	35	35	5.2	2.4	16 to 34
Cadmium	1.8 U	0.88	1.5 U	1.9	1.8 U	1.5 U	0.91 U	20 to 24
Lead	1,300	280	38	1,600	410	13	130	435 to 858

Notes:

U Indicates not detected above detection limit indicated.

(1) EPA 1993, Report to Congress on CKD (530-R-94-001).

(2) Model Toxics Control Act Method A-Industrial Soil Cleanup Levels, Chapter 173-340 WAC.

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Table 4 - Feasibility Evaluation of Remedial Alternatives

Hudson Street Site

Alternative	Short-term Effectiveness	Long-term Effectiveness	Treatment for Reduction of			Implementability	Cost
			Toxicity	Mobility	Volume		
Institutional Controls	Medium, requires little to no contact with CKD; minimal impact on the environment	Low, reduces risk by restricting access only	None	None	None	High	Low
Enhanced Soil Cover, Revegetation, and Precipitate Management	Medium, requires little contact with CKD; low impact on the environment	Medium to High, minimizes potential of contact; good environmental recovery	Low	Medium	Low	High	Medium
Stabilization and Capping of CKD Fill	Low, places workers at risk; high impact on the environment	Medium, minimizes potential of contact; little environmental recovery	Low	Medium	Low	Medium, major impacts on greenspace	Medium
Excavation and Off-Site Disposal of CKD Fill	Low, places workers at risk; high impact on the environment	High, removes CKD from site; environment is eventually restored	High	High	High	Low, major impacts on greenspace	High

= Not retained for further consideration.

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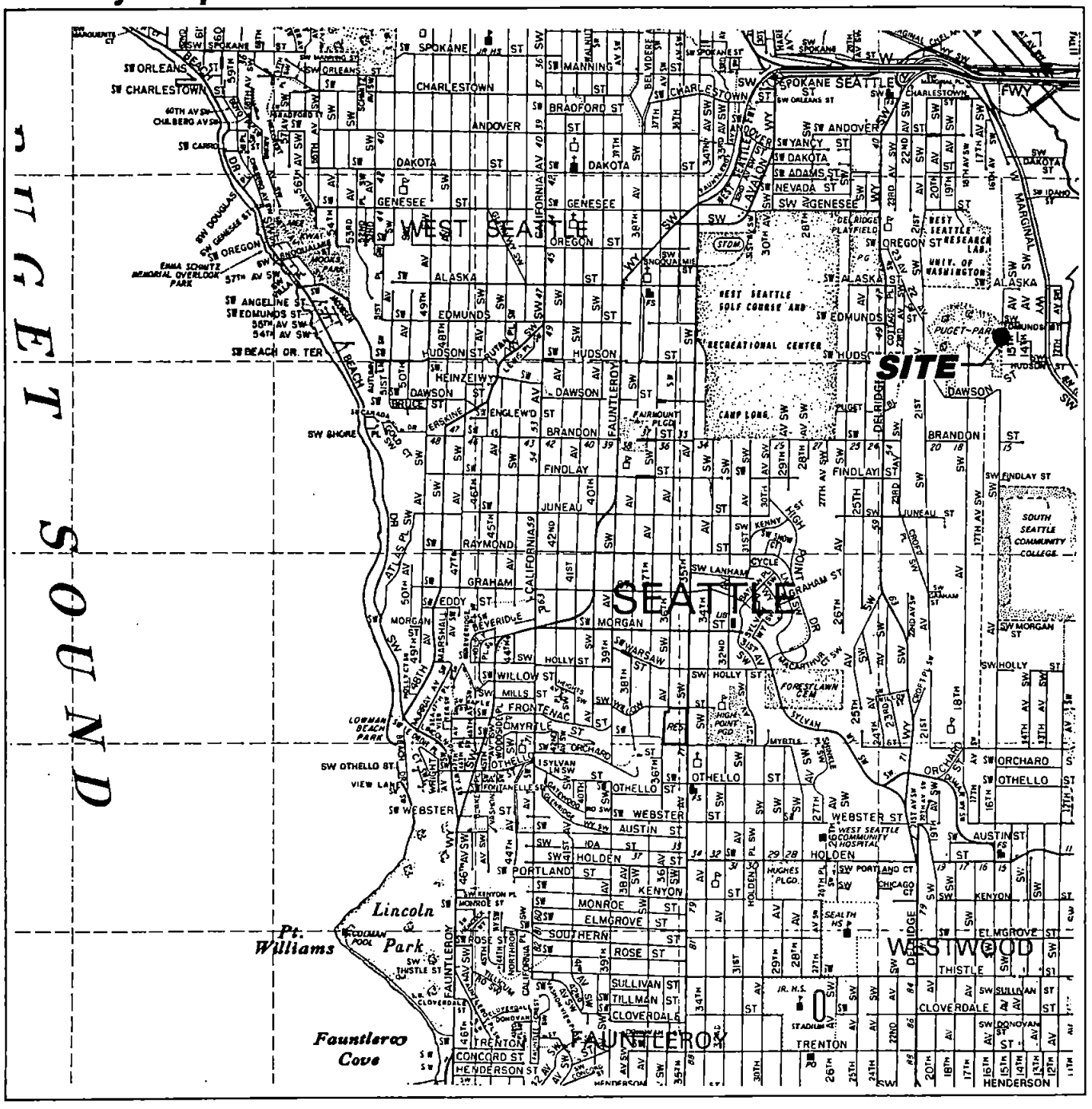
Vicinity Map



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Scale in Miles

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HARTCROWSER

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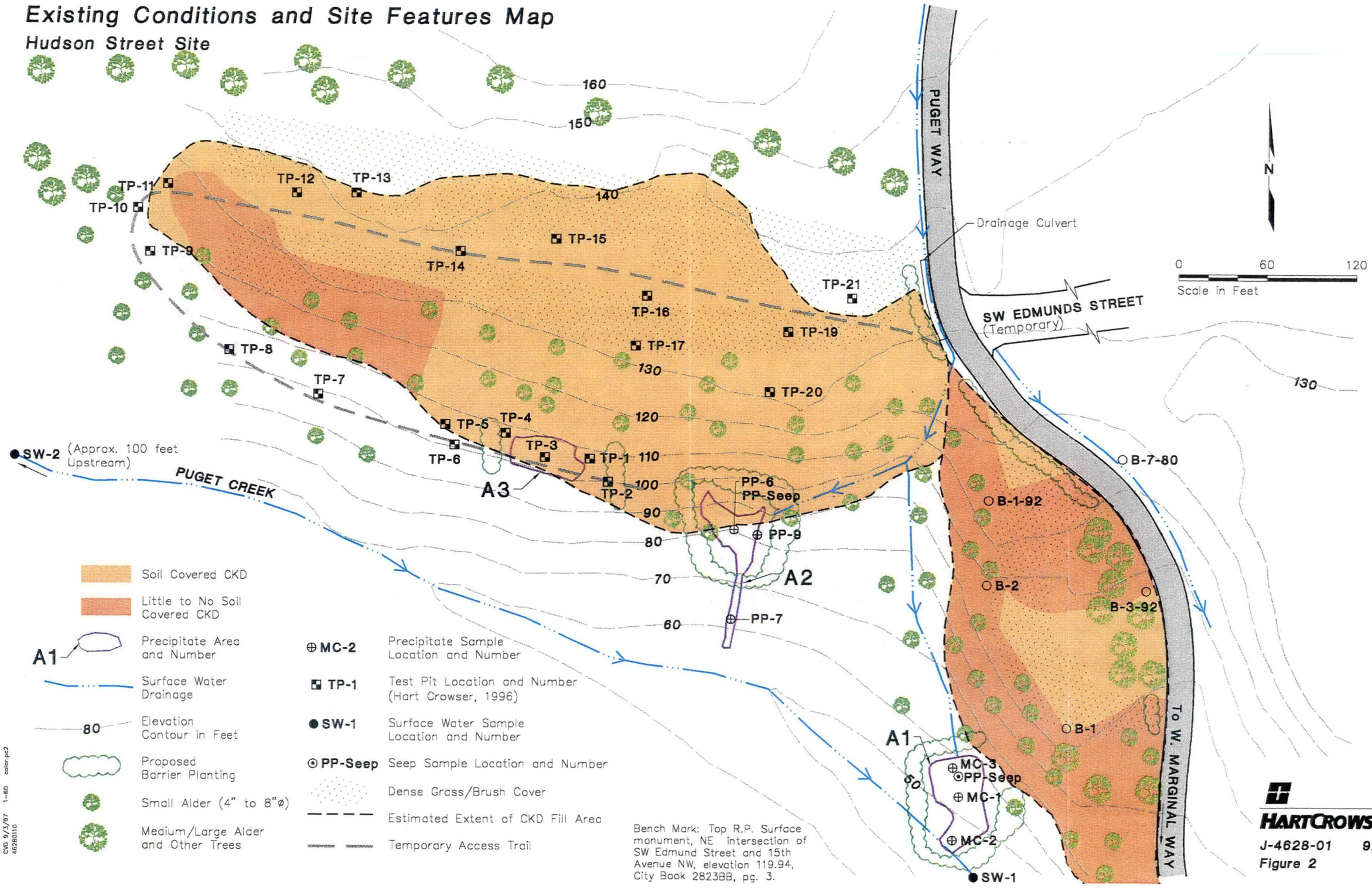
Figure 1

Existing Conditions and Site Features Map

Hudson Street Site



Bench Mark: Top R.P. Surface monument, NE intersection of SW Edmund Street and 15th Avenue NW, elevation 119.94, City Book 2823BB, pg. 3.

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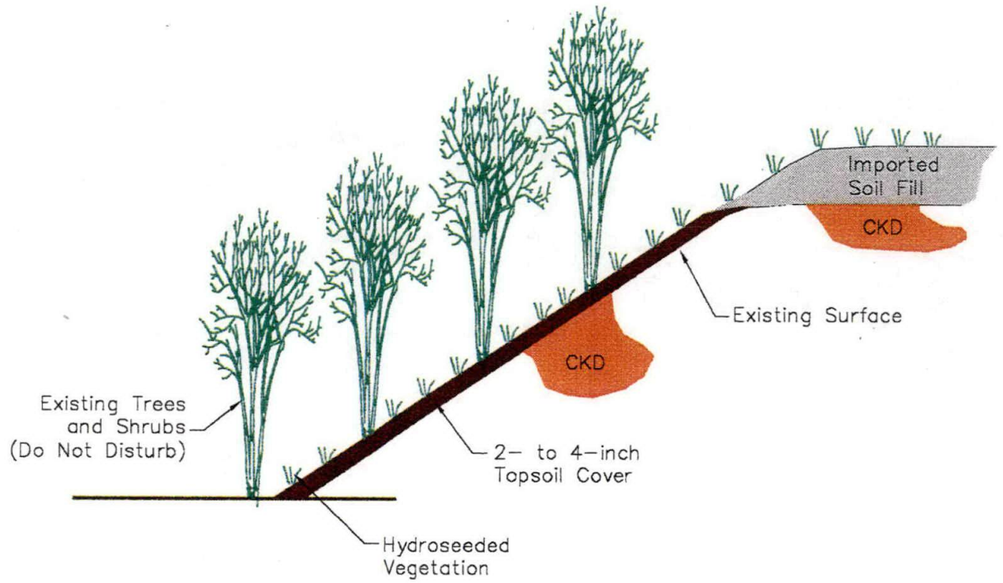
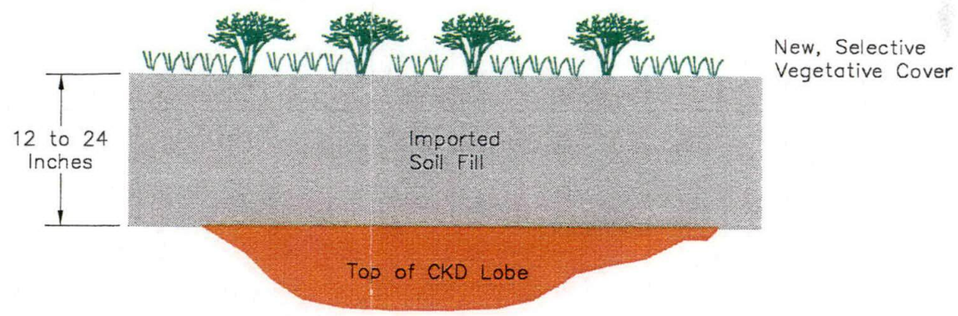
Figure 2

Construction Details
Remedial Action

Detail 1: Typical Topsoil and Hydroseed Slope Protection (with Undisturbed Existing Trees and Shrubs)



Detail 2: Typical Soil Cover Design



Detail 3: Gravel - Screen Chamber

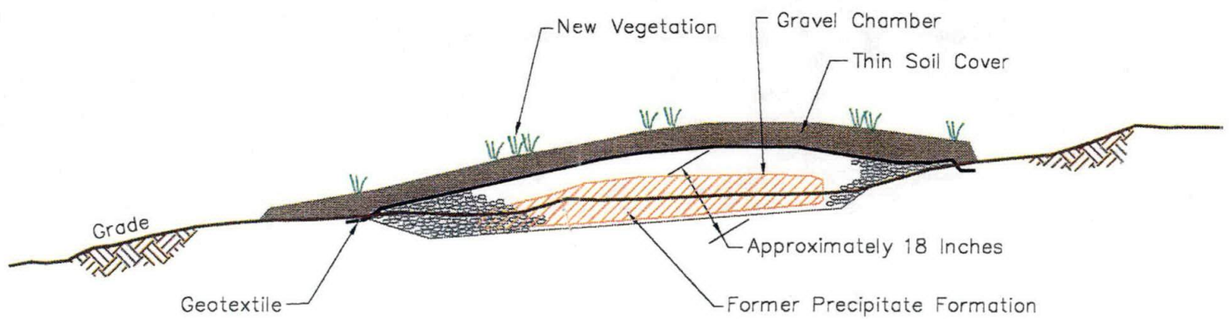


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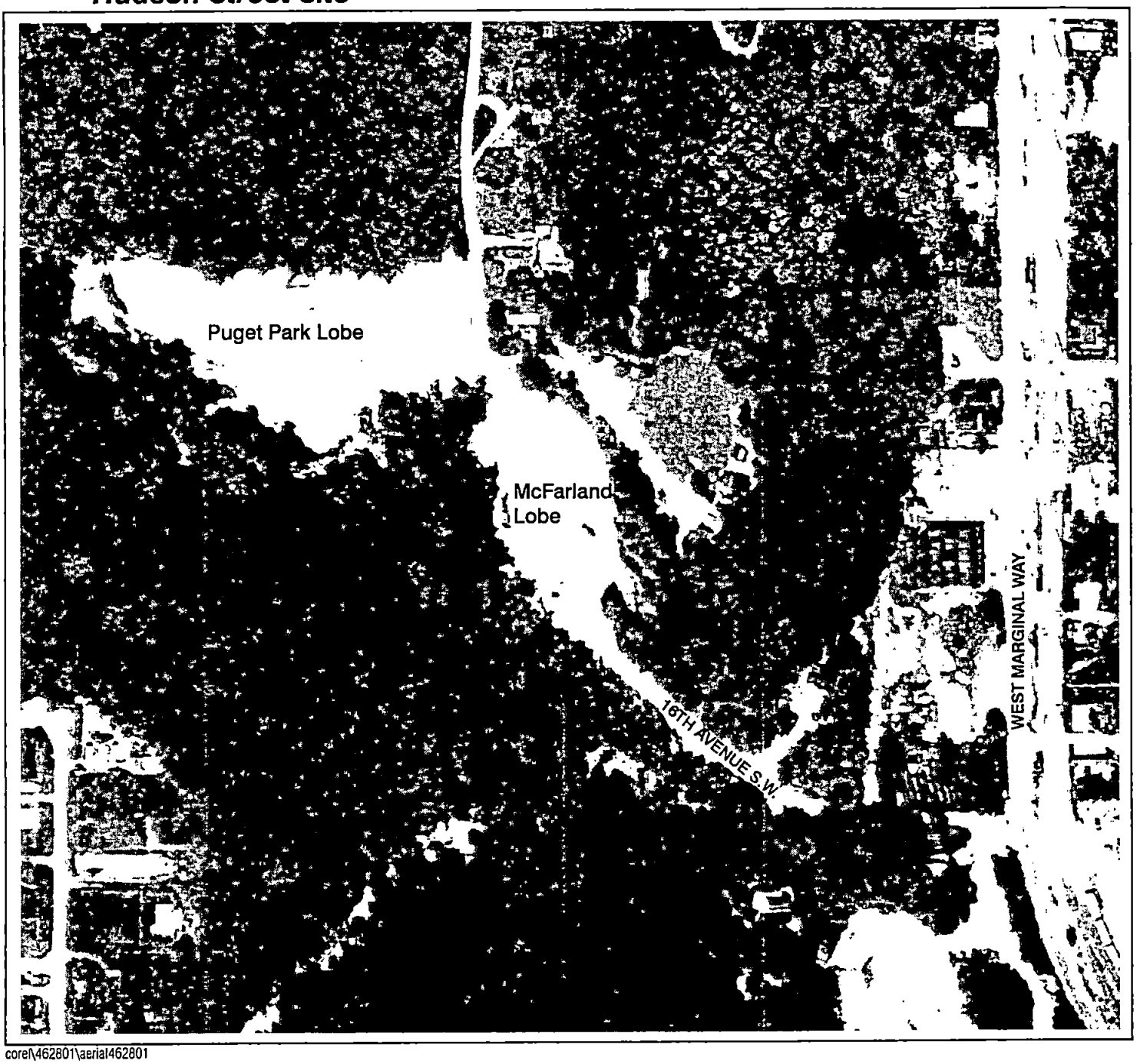
Figure 3

1970 Aerial Photograph of CKD Fill Areas

Hudson Street Site



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Scale in Feet

N

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Figure 4

ATTACHMENT A
LABORATORY ANALYTICAL REPORT
MULTICHEM ANALYTICAL SERVICES

MultiChem Analytical Services 560 Naches Avenue S.W., Suite 101, Renton, WA 98055
(Formerly Analytical Technologies, Inc.-Washington) (800) 609-0580 ◆ (206) 228-8335 ◆ Fax (206) 363-1742

MAS I.D. # 608125

September 23, 1996

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle WA 98102-3699

Attention : Roy Kuroiwa

Project Number : 4628

Project Name : Holnam - Hudson St.

Dear Mr. Kuroiwa:

On August 29, 1996, MultiChem Analytical Services received 15 samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Stina B. Kensler
Assistant Project Manager

SBK/hal/mrj

Enclosure

MultiChem Analytical Services

MAS I.D. # 608125

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

MAS #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
608125-1	PP-1	08/29/96	SOIL
608125-2	PP-2	08/29/96	SOIL
608125-3	PP-3	08/29/96	SOIL
608125-4	PP-4	08/29/96	SOIL
608125-5	PP-5	08/29/96	SOIL
608125-6	PP-6	08/29/96	SOIL
608125-7	PP-7	08/29/96	SOIL
608125-8	PP-8	08/29/96	SOIL
608125-9	PP-9	08/29/96	SOIL
608125-10	MC-1	08/29/96	SOIL
608125-11	MC-2	08/29/96	SOIL
608125-12	MC-3	08/29/96	SOIL
608125-13	SW-1	08/29/96	WATER
608125-14	SW-2	08/29/96	WATER
608125-15	PP-SEEP	08/29/96	WATER

----- TOTALS -----

MATRIX	# SAMPLES
SOIL	12
WATER	3

MAS STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

MultiChem Analytical Services

MAS I.D. # 608125

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ANALYSIS	TECHNIQUE	REFERENCE	LAB
ARSENIC	AA/GF	EPA 7060	R
CADMIUM	ICAP	EPA 6010	R
LEAD	ICAP	EPA 6010	R
HARDNESS	CALCULATION	EPA 6010	R
PH	ELECTRODE	EPA 150.1	R
PH	ELECTRODE	EPA 9045	R
TOTAL DISSOLVED SOLIDS	GRAVIMETRIC	EPA 160.1	R
TOTAL SUSPENDED SOLIDS	GRAVIMETRIC	EPA 160.2	R
MOISTURE	GRAVIMETRIC	CLP SOW ILM03.0	R

R = MAS - Renton
ANC = MAS - Anchorage
SUB = Subcontract

MultiChem Analytical Services

MAS I.D. # 608125

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

CASE NARRATIVE: METALS AND INORGANICS ANALYSIS

The following anomalies were associated with the samples for this accession:

The matrix spike (MS) percent recovery of arsenic in the associated quality control (QC) was outside the required control limits of 33-134% for the non-aqueous. The arsenic content in the QC sample was greater than four (4) times the amount of spike added. The total arsenic MS recovery was flagged with a "G".

The MS percent recovery of hardness in the associated QC was outside the required control limits of 75-125%. The hardness content in the QC sample was greater than four (4) times the amount of spike added. The total hardness MS recovery was flagged with a "G".

The MS recovery of lead was outside the established control limits of 70-100% for the non-aqueous samples. A post-digestion spike for lead was performed, and the resulting percent recovery was within the established control limits. Therefore, the lead MS recovery was flagged with an "H".

The reporting limits for cadmium were raised by a factor of 5 for samples 608125-3 (PP-3), 608125-4 (PP-4), 608125-6 (PP-6), 608125-8 (PP-8), 608125-10 (MC-1) and 608125-11 (MC-2) due to matrix interference from high levels of calcium and iron. The corresponding dilutions were performed to eliminate the effects of matrix interference and the reporting limits were raised accordingly.

Due to limited volumes for samples 608125-13 (SW-1) through 608125-15 (PP-SEEP), relative percent duplicate (RPD) result was reported from a laboratory control sample duplicate instead of a matrix duplicate for total suspended solids (TSS) and total dissolved solids (TDS).

The reporting limit for TSS was raised by a factor of 10/3 for sample 608125-13 (SW-1) due to limited sample volume. TDS results for the sample was also analyzed with a dilution factor of 10/3. Only 30 milliliters of the sample was available for the analysis for both TSS and TDS.

All other corresponding quality assurance/quality control (QA/QC) parameters were within established MAS control limits.

MultiChem Analytical Services

MAS I.D. # 608125

TOTAL
METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	09/06/96	09/13/96
CADMIUM	09/06/96	09/12/96
LEAD (SAMPLES 13,-14)	09/06/96	09/12/96
LEAD (SAMPLE -15)	09/06/96	09/13/96

MultiChem Analytical Services

MAS I.D. # 608125

TOTAL
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	ARSENIC	CADMIUM	LEAD	
608125-13	SW-1	<0.0050	<0.0050	<0.0030	
608125-14	SW-2	<0.0050	<0.0050	<0.0030	
608125-15	PP-SEEP	<0.0050	<0.0050	1.3	D7
METHOD BLANK	-	<0.0050	<0.0050	<0.0030	
FILTER BLANK	-	-	-	<0.0030	

D7 = Value from a 100 fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 608125

TOTAL METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.00500	N/A	N/A	0.0253	0.0250	101
ARSENIC	820723-3	<0.00500	<0.00500	NC	0.0312	0.0250	125
CADMIUM	BLANK	<0.00500	N/A	N/A	0.986	1.00	99
CADMIUM	608059-1	<0.00500	<0.00500	NC	0.996	1.00	100
LEAD	BLANK	<0.00300	N/A	N/A	0.0237	0.0250	92
LEAD	820723-3	<0.00300	<0.00300	NC	0.0236	0.0250	94

NC = Not Calculable.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

DISSOLVED
METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	09/06/96	09/13/96
CADMIUM	09/03/96	09/12/96
LEAD (SAMPLES -13,-14)	09/06/96	09/12/96
LEAD (SAMPLE -15)	09/06/96	09/13/96

MultiChem Analytical Services

MAS I.D. # 608125

DISSOLVED
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	ARSENIC	CADMIUM	LEAD
608125-13	SW-1	<0.0050	<0.0050	<0.0030
608125-14	SW-2	<0.0050	<0.0050	<0.0030
608125-15	PP-SEEP	<0.0050	<0.0050	1.0 D7
METHOD BLANK	-	<0.0050	<0.0050	<0.0030
FILTER BLANK	-	<0.0050	<0.0050	<0.0030

D7 = Value from a 100 fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 608125

DISSOLVED METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.00500	N/A	N/A	0.0253	0.0250	101
ARSENIC	820723-3	<0.00500	<0.00500	NC	0.0312	0.0250	125
CADMIUM	BLANK	<0.00500	N/A	N/A	1.03	1.00	103
CADMIUM	608054-10	<0.00500	<0.00500	NC	0.952	1.00	95
LEAD	BLANK	<0.00300	N/A	N/A	0.0237	0.0250	95
LEAD	820723-3	<0.00300	<0.00300	NC	0.0236	0.0250	94

NC = Not Calculable.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	09/04/96	09/09/96
CADMIUM	09/05/96	09/17/96
LEAD	09/05/96	09/17/96

MultiChem Analytical Services

MAS I.D. # 608125

METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/Kg
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

MAS I.D. #	CLIENT I.D.	ARSENIC		CADMIUM		LEAD	
608125-1	PP-1	9.0	D4	0.70		51	
608125-2	PP-2	2.9	D3	0.60		95	
608125-3	PP-3	16	D0	<1.6	D3	1500	D3
608125-4	PP-4	270	D8	<1.7	D3	250	D3
608125-5	PP-5	100	D7	19	D3	5300	D3
608125-6	PP-6	10	D3	<1.8	D3	1300	D3
608125-7	PP-7	10	D3	0.88	D1	280	D1
608125-8	PP-8	6.2	D3	<1.5	D3	38	D1
608125-9	PP-9	35	D5	1.9	D1	1600	D1
608125-10	MC-1	35	D5	<1.8	D3	410	D3
608125-11	MC-2	5.2	D3	<1.5	D3	13	D1
608125-12	MC-3	2.4	D1	<0.91		130	
METHOD BLANK	-	<0.25		<0.25		<1.5	

D1 = Value from a two fold diluted analysis.
D3 = Value from a five fold diluted analysis.
D4 = Value from a ten fold diluted analysis.
D5 = Value from a twenty fold diluted analysis.
D7 = Value from a 100 fold diluted analysis.
D8 = Value from a 250 fold diluted analysis.
D0 = Value from a 25 fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE PREPARED	DATE ANALYZED
HARDNESS	09/06/96	09/12/96
PH	-	08/29/96
TOTAL DISSOLVED SOLIDS	09/03/96	09/04/96
TOTAL SUSPENDED SOLIDS	09/03/96	09/04/96

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	HARDNESS	TOTAL DISSOLVED SOLIDS	TOTAL SUSPENDED SOLIDS
608125-13	SW-1	350	760	<33
608125-14	SW-2	200	240	<10
608125-15	PP-SEEP	1200	2500	18
METHOD BLANK	-	<0.50	<10	<10

MultiChem Analytical Services

MAS I.D. # 608125

METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/Kg

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.250	N/A	N/A	1.35	1.25	108
ARSENIC	608129-1	6.264	7.84	22	9.84	1.53	G
CADMIUM	BLANK	<0.250	N/A	N/A	46.8	50.0	94
CADMIUM	608125-2	0.604	0.792	27	53.6	61.3	86
LEAD	BLANK	<1.50	N/A	N/A	47.8	50.0	96
LEAD	608125-2	94.6	99.3	5	160	61.3	107H

G = Out of limits due to high levels of target analytes in sample.
H = Out of limits.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
HARDNESS	BLANK	<0.500	N/A	N/A	6.83	6.62	103
HARDNESS	608059-1	113	109	4	114	6.62	G
TOTAL DISSOLVED SOLIDS	LCS	<10.0	N/A	N/A	867	859	101
TOTAL DISSOLVED SOLIDS	LCS/LCSD	867	876	1	N/A	N/A	N/A
TOTAL SUSPENDED SOLIDS	LCS	<10.0	N/A	N/A	451	464	97
TOTAL SUSPENDED SOLIDS	LCS/LCSD	451	473	5	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

MAS I.D. #	CLIENT I.D.	PH
608125-13	SW-1	8.0
608125-14	SW-2	8.1
608125-15	PP-SEEP	12.3

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RANGE	SPIKED RESULT	SPIKE ADDED	% REC.
PH	608125-13	8.01	8.01	0	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE ANALYZED
PH	09/04/96

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

MAS I.D. #	CLIENT I.D.	PH
608125-1	PP-1	7.2
608125-2	PP-2	9.2
608125-3	PP-3	9.7
608125-4	PP-4	12.3
608125-5	PP-5	8.7
608125-6	PP-6	11.5
608125-7	PP-7	10.8
608125-8	PP-8	7.0
608125-9	PP-9	7.9
608125-10	MC-1	10.0
608125-11	MC-2	9.6
608125-12	MC-3	7.9

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RANGE	SPIKED RESULT	SPIKE ADDED	% REC.
PH	608125-1	7.17	7.19	0.02	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE ANALYZED
MOISTURE	09/03/96

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : %

MAS I.D. #	CLIENT I.D.	MOISTURE
608125-1	PP-1	19
608125-2	PP-2	16
608125-3	PP-3	17
608125-4	PP-4	31
608125-5	PP-5	29
608125-6	PP-6	30
608125-7	PP-7	39
608125-8	PP-8	20
608125-9	PP-9	40
608125-10	MC-1	35
608125-11	MC-2	23
608125-12	MC-3	74

MultiChem Analytical Services

MAS I.D. # 608125

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : %

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
MOISTURE	608128-1	13	13	0	N/A	N/A	N/A
MOISTURE	608129-1	21	20	5	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.
560 Naches Avenue, S.W., Suite 101, Renton, WA 98055 (206) 228-8335

DATE: 8/29/96 Page 1 of 2 ATI ACCESSION # 608125

COMPANY: HART CROWSER
REPORT TO: ROY KUROIWA
ADDRESS: 1910 FAIRVIEW AVE E
SEATTLE, WA 98102
PHONE: (324-9530 FAX: (328-5581
PROJECT MANAGER: ROY KUROIWA
PROJECT NUMBER: 4628
PROJECT NAME: HOLNAM - HUDSON ST.

ATI will DISPOSE / RETURN samples (circle one)

Sample ID	Date	Time	Matrix	LabID
PP-1	8/29		SOIL	1
PP-2				2
PP-3				3
PP-4				4
PP-5				5
PP-6				6
PP-7				7
PP-8				8
PP-9				9
MC-1				10
MC-2				11
MC-3				12

FUELS									
TPH-HCID WA/OR	BETX/TPH-G combo WA/OR	BETX (by 8020) WA/OR	TPH-G WA/OR	TPH-D WA/OR	8015 modified WA/OR	418.1	413.2	AK-GRO	AK-DRO

ORGANIC COMPOUNDS									
8240 GCMS Volatiles	8270 GCMS Semivolatiles	8080 Pesticides/PCBs	PCB only (by 8080) STD/lo level	8010 Halogenated VOCs	8020 Aromatic VOCs	8310 HPLC PAHs	8040 Phenols	8140 OP Pesticides	8150 OC Herbicides

METALS			
Metals (Indicate below *)	Total Lead	Priority Pollutant Metals (13)	TAL Metals (23)

TCLP				
TCLP-Volatiles (ZHE-8240)	TCLP-Semivolatiles (8270)	TCLP-Pesticides (8080)	TCLP-Herbicides (8150)	TCLP-Metals (8 metals)

OTHER						
% Moisture (please indicate)	As, Cd, Pb	pH				Total # of Containers/sample
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1
X	X	X				1

Turnaround Time		Sample Receipt	
STANDARD TAT	X	TOTAL # CONTAINERS RECVD	12
1 WEEK TAT		COC SEALS PRESENT?	N
4 WORK DAY TAT		COC SEALS INTACT?	
3 WORK DAY TAT		RECEIVED COLD?	Y
2 WORK DAY TAT		RECEIVED INTACT?	Y
24 HOUR TAT		RECEIVED VIA:	HAND

Special Instructions:

* Metals needed:

Relinquished By:	Relinquished By:	Relinquished By:
Date: 8/29/96	Date:	Date:
Time: 16:15	Time:	Time:
Received By:	**Received By:**	**Received By:**
Date: 8/29/96	Date:	Date:
Time: 16:15	Time:	Time:

Analytical Technologies, Inc.
560 Naches Avenue, S.W., Suite 101, Renton, WA 98055 (206) 228-8335

DATE: 8/29/96 Page 2 of 2 ATI ACCESSION # 608125

COMPANY: Hart Crowser
REPORT TO: Roy Kuroiwa
ADDRESS: 1910 Fairview Ave E.
Seattle WA 98102
PHONE: ( ) - FAX: ( ) -
PROJECT MANAGER:
PROJECT NUMBER:
PROJECT NAME: Holman-Hudson St.
ATI will DISPOSE / RETURN samples (circle one)

Sample ID	Date	Time	Matrix	LabID
SW-1 *	8/29		H_2O	12
SW-2 *	8/29		↓	14
PP-SEEP	8/29		↓	15

	FUELS										ORGANIC COMPOUNDS										METALS				TCLP					OTHER						
	TPH-HCID	BETX/TPH-G combo WA/OR	BETX (by 8020) WA/OR	TPH-G WA/OR	TPH-D WA/OR	8015 modified	418.1 WA/OR	413.2	AK-GRO	~~AK-DRO~~ HAZANIESS	8240 GCMS Volatiles	8270 GCMS Semivolatiles	8080 Pesticides/PCBs	PCB only (by 8080) STD/lo level	8010 Halogenated VOCs	8020 Aromatic VOCs	8310 HPLC PAHs	8040 Phenols	8140 OP Pesticides	8150 OC Herbicides	Metals (Indicate below *)	Total Lead	Priority Pollutant Metals (13)	TAL Metals (23)	TCLP-Volatiles (ZHE-8240)	TCLP-Semivolatiles (8270)	TCLP-Pesticides (8080)	TCLP-Herbicides (8150)	TCLP-Metals (8 metals)	% Moisture (please indicate)	Total Metals: As, Cd, Pb	Diss Metals: As, Cd, Pb	TSS/TDS	pH	Total # of Containers/sample
SW-1 *										X																				✓	X	X	X	X	2
SW-2 *										X																				X	X	X	X	2
PP-SEEP										X																				X	X	X	X	2

Turnaround Time		Sample Receipt	
STANDARD TAT	X	TOTAL # CONTAINERS RECVD	6
1 WEEK TAT		COC SEALS PRESENT?	N/A
4 WORK DAY TAT		COC SEALS INTACT?	N/A
3 WORK DAY TAT		RECEIVED COLD?	✓
2 WORK DAY TAT		RECEIVED INTACT?	✓
24 HOUR TAT		RECEIVED VIA:	hand

Special Instructions:
* Need to filter for Dissolved Metals.

* Metals needed:

Relinquished By:	Relinquished By:	Relinquished By:
Date: 8/29/96	Date:	Date:
Time: 16:25	Time:	Time:
Received By:	Received By:	Received By:
Date: 8/29/96	Date:	Date:
Time: 1625	Time:	Time:

MultiChem Analytical Services 560 Naches Avenue S.W., Suite 101, Renton, WA 98055
(Formerly Analytical Technologies, Inc.-Washington) (800) 609-0580 ◆ (206) 228-8335 ◆ Fax (206) 363-1742

MAS I.D. # 610008

October 28, 1996

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle WA 98102-3699

Attention : Roy Kuroiwa

Project Number : 4628

Project Name : Holnam - Hudson St.

Dear Mr. Kuroiwa:

On October 4, 1996, MultiChem Analytical Services received one sample for analysis. The sample was analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Stina B. Kensler
Project Manager

SBK/hal/mrj

Enclosure

MultiChem Analytical Services

MAS I.D. # 610008

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

MAS #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
610008-1	PP-SEEP-2	10/04/96	WATER

----- TOTALS -----

MATRIX	# SAMPLES
WATER	1

MAS STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

MultiChem Analytical Services

MAS I.D. # 610008

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ANALYSIS	TECHNIQUE	REFERENCE	LAB
ARSENIC	AA/GF	EPA 7060	R
CADMIUM	ICAP	EPA 6010	R
LEAD	AA/GF	EPA 7421	R
HARDNESS	CALCULATION	EPA 6010	R
PH	ELECTRODE	EPA 150.1	R
TOTAL DISSOLVED SOLIDS	GRAVIMETRIC	EPA 160.1	R
TOTAL SUSPENDED SOLIDS	GRAVIMETRIC	EPA 160.2	R

R = MAS - Renton
ANC = MAS - Anchorage
SUB = Subcontract

MultiChem Analytical Services

MAS I.D. # 610008

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

CASE NARRATIVE: INORGANICS ANALYSIS

The following anomalies were associated with the samples for this accession:

The matrix spike (MS) percent recovery of hardness in the associated quality control (QC) for sample 610008-1 (PP-SEEP-2) total was within the required control limits of 75-125% but was flagged with a "G" due to high hardness concentration. The hardness content in the QC sample was greater than four (4) times the amount of spike added. The total hardness MS recovery was flagged with a "G".

The MS percent recovery of lead in the associated QC was outside the required control limits of 65-142%. The lead content in the QC sample was greater than four (4) times the amount of spike added. The total lead MS recovery was flagged with a "G".

All other corresponding quality assurance/quality control (QA/QC) parameters were within established MAS control limits.

MultiChem Analytical Services

MAS I.D. # 610008

TOTAL
METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	10/14/96	10/16/96
CADMIUM	10/14/96	10/16/96
LEAD	10/14/96	10/17/96

MultiChem Analytical Services

MAS I.D. # 610008

TOTAL
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D.#	CLIENT I.D.	ARSENIC	CADMIUM	LEAD
610008-1	PP-SEEP-2	<0.0050	<0.0050	1.3 D6
METHOD BLANK	-	<0.0050	<0.0050	<0.0030
FILTER BLANK	-	<0.0050	-	<0.0030

D6 = Value from a 50 fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 610008

TOTAL METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.00500	N/A	N/A	0.0227	0.0250	91
ARSENIC	610008-1	<0.00500	<0.00500	NC	0.0228	0.0250	91
CADMIUM	BLANK	<0.00500	N/A	N/A	0.979	1.00	98
CADMIUM	609096-6	<0.00500	<0.00500	NC	0.957	1.00	96
LEAD	BLANK	<0.00300	N/A	N/A	0.0230	0.0250	92
LEAD	610008-1	1.26	1.26	0	1.30	0.0250	G

NC = Not Calculable.
G = Out of limits due to high levels of target analytes in sample.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 610008

DISSOLVED
METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	10/14/96	10/16/96
CADMIUM	10/14/96	10/16/96
LEAD	10/14/96	10/17/96

MultiChem Analytical Services

MAS I.D. # 610008

DISSOLVED
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	ARSENIC	CADMIUM	LEAD
610008-1	PP-SEEP-2	<0.0050	<0.0050	1.1 D6
METHOD BLANK	-	<0.0050	<0.0050	<0.0030
FILTER BLANK	-	<0.0050	-	<0.0030

D6 = Value from a 50 fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 610008

DISSOLVED METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.00500	N/A	N/A	0.0227	0.0250	91
ARSENIC	609096-6	<0.00500	<0.00500	NC	0.0228	0.0250	91
CADMIUM	BLANK	<0.00500	N/A	N/A	0.979	1.00	98
CADMIUM	609096-6	<0.00500	<0.00500	NC	0.957	1.00	96
LEAD	BLANK	<0.00300	N/A	N/A	0.0230	0.0250	92
LEAD	610008-1	1.26	1.26	0	1.30	0.0250	G

NC = Not Calculable.
G = Out of limits due to high levels of target analytes in sample.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 610008

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE PREPARED	DATE ANALYZED
HARDNESS	10/14/96	10/16/96
PH	-	10/04/96
TOTAL DISSOLVED SOLIDS	10/08/96	10/09/96
TOTAL SUSPENDED SOLIDS	10/08/96	10/09/96

MultiChem Analytical Services

MAS I.D. # 610008

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	HARDNESS	TOTAL DISSOLVED SOLIDS	TOTAL SUSPENDED SOLIDS
610008-1	PP-SEEP-2	1000	2400	36
METHOD BLANK	-	<0.50	<10.0	<10

MultiChem Analytical Services

MAS I.D. # 610008

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
HARDNESS	BLANK	<0.500	N/A	N/A	6.54	6.62	99
HARDNESS	609096-6	169	171	1	176	6.62	106G
TOTAL DISSOLVED SOLIDS	LCS	<10.0	N/A	N/A	477	480	99
TOTAL DISSOLVED SOLIDS	610008-1	2390	2460	3	N/A	N/A	N/A
TOTAL SUSPENDED SOLIDS	LCS	<10.0	N/A	N/A	38.0	43.6	87
TOTAL SUSPENDED SOLIDS	610008-1	36.0	38.0	6	N/A	N/A	N/A

G = Out of limits due to high levels of target analytes in sample.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 610008

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

MAS I.D. #	CLIENT I.D.	PH
610008-1	PP-SEEP-2	12.3

MultiChem Analytical Services

MAS I.D. # 610008

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RANGE	SPIKED RESULT	SPIKE ADDED	% REC.
PH	610008-1	12.28	12.31	0.03	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

Sample Custody Record

DATE 10/4/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4628 LAB NUMBER 61000 *-8 BC

PROJECT MANAGER Roy Kuroiwa

PROJECT NAME Holnam Hudson

SAMPLED BY: James L Fender

LAB NO.	SAMPLE	TIME	STATION	MATRIX
1	10/4	13:45	PP-SEEP - #2	H_2O
		13:55	PP-SEEP - 2	H_2O

10/4/96 TESTING

Hardness	Total Metals (As, Cd, Pb)	Diss. Metals * (As, Cd, Pb)	TSS/TDS	pH	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
X	X	X	X	X	2	
					2	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	10/4 1996	SIGNATURE	10/4/96
PRINTED NAME J Fender	TIME 1650 by HC	PRINTED NAME GINA KENDER	TIME 1650
COMPANY HC-SEA	10/5/96	COMPANY MAS-WA	10/4/96

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINTED NAME	TIME	PRINTED NAME	TIME
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS 2

METHOD OF SHIPMENT

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS

* LAB NEEDS TO FILTER for Dissolved Metals.

Normal.

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

MultiChem
ANALYTICAL SERVICES

MAS I.D. # 707095

August 15, 1997

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle WA 98102-3699

Attention : Roy Kuroiwa

Project Number : 4628-01

Project Name : Holnam - Hudson ST.

Dear Mr. Kuroiwa:

On July 25, 1997, MultiChem Analytical Services received two samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Kim M. Lofgren
Project Manager

KML/hal/sms

Enclosure

560 Naches Avenue SW, Suite 101, Renton, Washington 98055-2200 • 425-228-8335 • FAX 425-228-8336 • 1-800-609-0580 • info@multichem.com

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

MAS #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
707095-1	SW-1(2)	07/25/97	WATER
707095-2	SW-2(2)	07/25/97	WATER

----- TOTALS -----

MATRIX	# SAMPLES
WATER	2

MAS STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

ANALYSIS	TECHNIQUE	REFERENCE	LAB
ARSENIC	AA/GF	EPA 7060	R
CADMIUM	AA/GF	EPA 77131	R
HARDNESS	ICAP	EPA 6010	R
LEAD	AA/GF	EPA 7421	R
HARDNESS	CALCULATION	EPA 6010	R
PH	ELECTRODE	EPA 9040B	R
TOTAL DISSOLVED SOLIDS	GRAVIMETRIC	EPA 160.1	R
TOTAL SUSPENDED SOLIDS	GRAVIMETRIC	EPA 160.2	R

R = MAS - Renton
ANC = MAS - Anchorage
SUB = Subcontract

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

CASE NARRATIVE: **METALS ANALYSIS**

There were no anomalies associated with the preparation and/or analysis of the samples in this accession.

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

DISSOLVED METALS ANALYSIS DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : ARSENIC
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/07/97	<0.0050	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/07/97	<0.0050	1.0	RW7395F
BLANK	-	07/28/97	08/07/97	<0.0050	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

DISSOLVED
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : CADMIUM
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/06/97	<0.00050	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/06/97	<0.00050	1.0	RW7395F
BLANK	-	07/28/97	08/06/97	<0.00050	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

DISSOLVED
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : LEAD
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/06/97	<0.0030	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/06/97	<0.0030	1.0	RW7395F
BLANK	-	07/28/97	08/06/97	<0.0030	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

DISSOLVED
METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. UNITS : mg/L
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC	BATCH NUMBER
ARSENIC	BLANK	<0.00500	N/A	N/A	0.0259	0.0250	104	RW7395F
ARSENIC	707095-2	<0.00500	<0.00500	NC	0.0296	0.0250	118	RW7395F
CADMIUM	BLANK	<0.000500	N/A	N/A	0.000900	0.00100	90	RW7395F
CADMIUM	707095-2	<0.000500	<0.000500	NC	0.000900	0.00100	90	RW7395F
LEAD	BLANK	<0.00300	N/A	N/A	0.0242	0.0250	97	RW7395F
LEAD	707095-2	<0.00300	<0.00300	NC	0.0250	0.0250	100	RW7395F

NC = Not Calculable.

CONTROL LIMITS

ELEMENT	BLANK SPIKE %RECOVERY	BLANK SPIKE RPD	MATRIX SPIKE %RECOVERY	MATRIX SPIKE RPD	MATRIX DUPLICATE RPD
ARSENICS	76-118	N/A	64-137	N/A	20
CADMIUM	74-121	N/A	41-144	N/A	20
LEAD	77-117	N/A	74-124	N/A	20

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

TOTAL
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : ARSENIC
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/07/97	<0.0050	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/07/97	<0.0050	1.0	RW7395F
BLANK	-	07/28/97	08/07/97	<0.0050	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

TOTAL
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : CADMIUM
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/06/97	<0.00050	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/06/97	<0.00050	1.0	RW7395F
BLANK	-	07/28/97	08/06/97	<0.00050	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

TOTAL
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

ELEMENT : LEAD
MATRIX : WATER
UNITS : mg/L

MAS ID#	CLIENT ID#	DATE PREPARED	DATE ANALYZED	RESULT	DIL	BATCH
707095-1	SW-1(2)	07/28/97	08/06/97	0.0037	1.0	RW7395F
707095-2	SW-2(2)	07/28/97	08/06/97	<0.0030	1.0	RW7395F
BLANK	-	07/28/97	08/06/97	<0.0030	1.0	RW7395F

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

CASE NARRATIVE: GENERAL CHEMISTRY ANALYSIS

There were no anomalies associated with the preparation and/or analysis of the samples in this accession.

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE ANALYZED
pH	07/25/97

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

MAS I.D. #	CLIENT I.D.	pH
707095-1	SW-1(2)	8.2
707095-2	SW-2(2)	6.2

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : -

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
pH	707095-1	8.15	8.17	0.02	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE PREPARED	DATE ANALYZED
TOTAL DISSOLVED SOLIDS	07/29/97	07/30/97

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	TOTAL DISSOLVED SOLIDS
BLANK	-	<10
707095-1	SW-1(2)	450.0
707095-2	SW-2(2)	370

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
TOTAL DISSOLVED SOLIDS	BLANK	<10.0	N/A	N/A	232	233	100
TOTAL DISSOLVED SOLIDS	707095-2	366	342	7	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE PREPARED	DATE ANALYZED
TOTAL SUSPENDED SOLIDS	07/29/97	07/30/97

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	TOTAL SUSPENDED SOLIDS
BLANK	-	<10
707095-1	SW-1(2)	12
707095-2	SW-2(2)	<10

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
TOTAL SUSPENDED SOLIDS	BLANK	<10.0	N/A	N/A	44.0	53.1	83
TOTAL SUSPENDED SOLIDS	707095-2	<10.0	<10.0	NC	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST.

PARAMETER	DATE PREPARED	DATE ANALYZED
HARDNESS	07/28/97	07/29/97

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

MAS I.D. #	CLIENT I.D.	HARDNESS
BLANK	-	<0.50
707095-1	SW-1(2)	220
707095-2	SW-2(2)	180

MAS I.D. # 707095

MultiChem
ANALYTICAL SERVICES

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4628-01
PROJECT NAME : HOLNAM - HUDSON ST. UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
HARDNESS	BLANK	<0.500	N/A	N/A	6.31	6.62	95
HARDNESS	707095-2	182	180	1	240	66.2	88

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

MultiChem Analytical Services 560 Naches Avenue S.W. Suite 101, Renton, WA 98055
(800) 609-0580 ◇ (206) 228-8335 ◇ Fax (206) 353-1742 DATE: 7/25/97 PAGE: 1 OF: 1 LABORATORY NUMBER: 707095

COMPANY: HART CROWSER, INC
ADDRESS:
PHONE: ( ) - FAX: ( ) -
PROJ. MNGR. / REPORT TO: ROY KUPELIAN
PROJECT NUMBER: 4628-01
PROJECT NAME: HOLNAM HUDSON ST.
☒ MAS DISPOSAL ☐ RETURN

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	FUELS: TPH-HCID	BETX/TPH-G	BETX (BY 8020)	TPH-G	TPH-D	8015 modified	418.1	413.2	AK-GRO	AK-DRO	ORGANIC COMPOUNDS: 8240 / 8260 GCMS Volatiles	8270 GCMS Semivolatiles	8080 Pesticides/PCBs	PCB only (by 8080) STD/low level	8010 Halogenated VOCs	8020 Aromatic VOCs	8310 HPLC PAHs	8040 Phenols	8140 OP Pesticides	8150 OC Herbicides	METALS: Metals indicate below (Pb, As, Cd)	Total Lead	PP Metals (13)	TAL Metals (23)	TCLP: TCLP 8240 (ZHE)	TCLP 8270 Semivolatiles	TCLP 8080 Pesticide	OTHER: % MOISTURE	NSS_metals As,Pb,Cd	TSS/TDS	HARDNESS	pH	Total # of Containers
SW-1 (2)	7/25/97		H_2O	1																					X							X	X	X	X	3
SW-2 (2)			H_2O	2																					X							X	X	X	X	3

SAMPLE RECEIPT		TAT	
TOTAL # OF CONTAINERS		1 WORK DAY TAT	
COC SEALS PRESENT?		2 WORK DAY TAT	
COC SEALS INTACT?		3 WORK DAY TAT	
RECEIVED COLD?		4 WORK DAY TAT	
RECEIVED INTACT?		1 WEEK TAT	
RECEIVED VIA:		STANDARD TAT	X

SPECIAL INSTRUCTIONS:
Metals @ low detection limits - See Sally HL
*Metals needed As, Cd, Pb

MAS USE ONLY:
SUBCONTRACT INFO:
PO #
VERBALS:
H.C. DUE:

Relinquished By:	Relinquished By:	Relinquished By:
James L. Fetter		
Company: HC	Company:	Company:
Received By:	Received By:	Received By:
DATE: 7-25-97	DATE:	DATE:
TIME: 1105	TIME:	TIME:
Company: M CAS WA	Company:	Company:

FOR MULTICHEM ONLY: SUBCONTRACT LAB:

NON-CONFORMANCES?
(Y) N ( )
(if Y see other side)

MultiChem Analytical Services

SAMPLE LOG-IN CHECKLIST

DATE: 7/25/97
TIME: 1210
INITIALS: DJ

ACCESSION NO. 707095
CLIENT: HCI
PROJECT: Holman Hudson St.

Shipping:

Type:
- ✓ Cooler
- ___ Box
- ___ Other

COC Seals:
- ___ Ship. Cont.
- ___ On Bottles
- ___ None

Intact?
- (Y) N
- Y N

Packing Material:
- ___ Styrofoam
- - Bubble Bags
- ___ Foam Vial Packs
- ___ Other none

Refrigerant:
- ✓ Gel Ice Pack
- ___ Loose Ice
- ___ Other
- ___ None

Frozen?
- (Y) N
- Y N
- Y N

Received Via:
- ___ Hand Delivery
- ___ Federal Express
- ___ Airborne
- ___ Other: ___
- ___ Courier
- ___ UPS
- ___ Taxi
- ___ Goldstreak

Sample Information:

Samp. #	Bottle #	Type			
		Soil	Soil VOAs	0 headspace	Y N N/A
2	6	Water	Water VOAs	0 headspace	Y N N/A
		Product		Preserved?	Y N
		Other		Trip blanks?	Y N

Condition of Samples:
Containers: (Y) N
Intact? (Bottle/Lid) (Y) N
Correct Type? (Y) N

CA #
___
___

Waters Preserved? (Y) N N ___
(if needed)

ID's Match C.O.C. (Y) N N ___

Temperature: 7.8 C 1 **CA NO.**
(See corrective action on reverse side for explanation if temperature is outside of the MAS recommended range.)

LAB USE ONLY: ☐ NO NOTICE ☐ SENDOUTS NEEDED BY:
☐ COC/TAT DOES NOT MATCH NOTICE ☐ NEED TEST(S) VERIFIED BY CLIENT

COMMENTS: ___

NON-CONFORMANCES?
(Y) N 1
(if Y see other side)

MultiChem Analytical Services
Corrective Action Sheet

ACCESSION # 707095

CORRECTIVE ACTION AREA

EXPLAIN CORRECTIVE ACTION:

CA NO.	CA NO.	CA NO.
_____Salvaged Sample	_____Replaced Bottle	_____Verified Id w/Client
_____Replaced Lid	_____Notified P.M.	_____Notified Client
_____Preserved Sample w/_____		

Comments:_____

Temperature: 7.8 C _____ CA NO.

_____Comments: Samples were received outside of the MAS recommended temperature range (4 C+/- 2 C). Samples were received within 5 hours of collection and may not have had sufficient time to equilibrate with coolant. A temperature range from 2 to 15 degrees Celsius is considered acceptable. The samples will be analyzed as scheduled unless directed otherwise by client.

_____Comments: Samples were received outside of the MAS recommended temperature range (4 C+/- 2 C). The samples will be analyzed as scheduled unless directed otherwise by client.

Tech.Signature/Date: [signature] 7/25/97 P.M. Signature/Date: 8/7/97

CORRECTIVE ACTION TAKEN:

Explain Action Taken:

ATTACHMENT B
DETAILS OF COST ESTIMATES

Table B-1 - Order-of-Magnitude Cost Estimate for Institutional Controls

Item and Description	Quantity	Units	Unit Cost	Total Cost	
Engineering Design and Permitting	1	ls	$ 85,000	$ 85,000	
Site Preparation					
-Mobilization	1	ls	$ 1,000	$ 1,000	
-Clear and Grub	1	ls	$ 1,500	$ 1,500	
Institutional Controls					
-Perimeter Fence	2,500	feet	$ 17.5	$ 43,750	6-foot-high chain-link fence with barbed wire
-Access Controls	2	each	$ 1,500	$ 3,000	2 - double swing security gates
-Signage	1	ls	$ 500	$ 500	Warning and information signs
Operation and Maintenance					
-Annual inspections	10	yr	$ 1,500	$ 15,000	Annual inspections with minor repairs
Total Estimated Cost				$ 149,750	

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Table B-2 - Order-of-Magnitude Cost Estimate for Soil Capping, Revegetation, and Precipitate Management

	Item and Description	Quantity	Units	Unit Cost	Total Cost
Engineering Design and Permitting		1	ls	$ 85,000	$ 85,000
Site Preparation					
	-Mobilization	1	ls	$ 5,000	$ 5,000
	-Clear and Grub	2	acres	$ 3,500	$ 7,000
	-Solid Waste Disposal	50	tons	$ 75	$ 3,750
	-CKD Cut and Fill	4,500	sy	$ 2.5	$ 11,250
Steep Slope Protection					
	-Topsoil Placement	20,000	sf	$ 1.25	$ 25,000
	-Hydroseed				
Soil Capping					
	-Soil Fill Cover	4,000	tons	$ 15	$ 60,000
	-Grading and Compaction	8,000	sy	$ 1	$ 8,000
	-Revegetation	8,000	sy	$ 3.5	$ 28,000
Drainage Improvements					
	-Culver Installation	1	ls	$ 10,000	$ 10,000
	-Ravine Reinforcement	1	ls	$ 5,000	$ 5,000
Precipitate Management					
	Excavation and Relocation	150	cy	$ 10	$ 1,500
	-Rock Media	200	tons	$ 12	$ 2,400
	-Geotextile	300	sy	$ 5	$ 1,500
	-Topsoil and Vegetation	1	ls	$ 2,500	$ 2,500
Operation and Monitoring					
	-Annual Inspections and Maintenance	10	yr	$ 10,000	$ 100,000
Total Estimated Cost					$ 355,900

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Table B-3 - Order-of-Magnitude Cost Estimate for Stabilization and Capping of CKD Fill

Item and Description	Quantity	Units	Unit Cost	Total Cost	
Engineering Design and					
Permitting	1	ls	$ 85,000	$ 85,000	
Site Preparation					
-Mobilization	1	ls	$ 10,000	$ 10,000	
-Clear and Grub	3	acre	$ 3,000	$ 9,000	
-Solid Waste Disposal	50	tons	$ 75	$ 3,750	
-Regrade Soil Cover	2,963	cy	$ 5	$ 14,815	Regrade existing soil cover to access CKD
CKD Stabilization					
-Portland Cement	1,000	tons	$ 60	$ 60,000	Type II Portland Cement
-Aggregate	2,803	tons	$ 12	$ 33,636	Clean gravel for stabilization mix design
-Stabilization	16,667	sy	$ 7.0	$ 116,667	Spreading, Blending, Water, and Compaction
Capping					
-Geoweb and Installation	40,000	sf	$ 2.5	$ 100,000	For steep slope protection
-Soil Fill	8,333	tons	$ 12	$ 100,000	Soil fill for geoweb and top of fill areas
BMPs and Site Improvements					
-Revegetation	3	acre	$ 3,500	$ 10,500	Revegetate with select grasses and shrubs
-Silt Fence	500	lf	$ 12	$ 6,000	Erosion and sediment control
-Drainage Control	1	ls	$ 9,379	$ 9,379	
Precipitate and Seep Control					
Unit	1	ls	$ 15,000	$ 15,000	
Piping and Pump	1,000	ft	$ 12	$ 12,000	
Total Capital Cost				$ 573,747	

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Table B-4 - Order-of-Magnitude Cost Estimate for Excavation and Off-Site Disposal of CKD Fill

Item and Description	Quantity	Units	Unit Cost	Total Cost	
Site Preparation					
-Mobilization	1	ls	$ 10,000	$ 10,000	
-Clear and Grub	3	acres	$ 3,000	$ 9,000	
-Solid Waste Disposal	100	tons	$ 75	$ 7,500	
Removal of CKD					
-Excavate CKD	51,000	cy	$ 5	$ 255,000	
-Disposal of CKD	76,500	tons	$ 65	$ 4,972,500	Haul and dispose of at Roosevelt Regional Landfill (S. Seattle Transfer Station)
Cap					
-Soil Cover	8,500	tons	$ 12	$ 102,000	Topsoil for fill, grade and revegetation
Regrading					
-Cut and Fill	2,000	cy	$ 5	$ 10,000	Maintain Hudson Street
BMPs and Site Improvements					
-Revegetation	3	acres	$ 3,500	$ 10,500	Native grasses, shrubs, small trees
-Silt Fence	500	lf	$ 12	$ 6,000	Erosion and sediment control
-Drainage Control	1	ls	$ 10,000	$ 10,000	Armored drainage channels
Total Capital Cost				$ 5,392,500	

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