Work Plan
RE22-2 Soil TPH Investigation
Boeing Frederickson Fabrication Facility
Pierce County, Washington

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Prepared for

The Boeing Company
Frederickson, Washington

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LIST OF ABBREVIATIONS AND ACRONYMS

BGS	Below Ground Surface
CTC	Carbon Tetrachloride
CUL	Cleanup Level
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ft	Feet
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
RI/FS	Remedial Investigation/Feasibility Study
TPH	Total Petroleum Hydrocarbons
TPH-Dx	Diesel-range Petroleum Hydrocarbons

1.0 INTRODUCTION

This document presents a work plan to investigate residual petroleum hydrocarbon contamination in soil near the former RE22-2 excavation (GeoEngineers 1991) at the Boeing Frederickson Fabrication facility (site) located in Pierce County, Washington (Figure 1). The site is approximately 527 acres and has been used since the 1930s for a variety of industrial applications including nitroglycerin and explosive powder manufacturing, sawmill and log yard operations, storage of fireworks, and currently, fabrication of aerospace-related materials. The site is currently owned and operated by The Boeing Company (Boeing).

A remedial investigation and feasibility study (RI/FS) is currently being conducted for the site under an Agreed Order (Order) between the Washington Department of Ecology (Ecology), the Olin Corporation, and Mallinckrodt US LLC. Remedial activities have been conducted at the site since 1987, and have included removal or onsite treatment of soil and groundwater contaminated with petroleum hydrocarbons, carbon tetrachloride (CTC), and trichloroethene (GeoEngineers 1990). Prior to finalizing the RI/FS, Ecology requested that total petroleum hydrocarbon (TPH) soil contamination be delineated at one location (near the RE22-2 excavation) which was historically reported to contain diesel-range TPH (TPH-Dx) concentrations above state cleanup levels (GeoEngineers 1991; Geosyntec 2012). The objective of the investigation is to assess whether TPH-Dx concentrations in the soil exceed the current Model Toxics Control Act (MTCA) Method A cleanup level (CUL) of 2,000 milligrams per kilogram (mg/kg). Soil samples will also be collected for CTC analysis since this compound is a primary constituent of concern at the site. A 2011 aerial photograph showing current site features is provided on Figure 2.

1.1 BACKGROUND

During July and August of 1990, GeoEngineers performed an environmental site assessment which included 33 test pit excavations; 11 soil borings and monitoring well installations;[1] soil and groundwater sampling; and an electromagnetic survey of the subsurface. The assessment concluded that the site soil contained TPH concentrations which locally exceeded the MTCA industrial CUL for soil (in 1991, the CUL was 200 mg/kg for soil in the absence of gasoline; GeoEngineers 1990, 1991). Total petroleum hydrocarbon concentrations above CULs were found at 12 locations where surface soils were stained, underground storage tanks had been located, magnetic anomalies were identified, or where stormwater runoff had drained to the soil.

[1] The report text indicates 12 borings and monitoring wells were completed, but figures and tables indicate 11 borings and wells (GeoEngineers 1991).

In October and November of 1990, GeoEngineers performed remedial excavations of TPH-impacted soil at 20 locations across the site, excavating approximately 7,120 cubic yards of soil (GeoEngineers 1990). Soil samples were collected from surface soil, test pits, and soil borings and submitted for analytical testing. Soil samples were analyzed for TPH by U.S. Environmental Protection Agency (EPA) Method 418.1 and Modified EPA Method 8015. Laboratory chromatograms indicated that the petroleum in soil consisted of hydrocarbons in the diesel range; gasoline was not detected. GeoEngineers reported that of the 20 remedial excavations completed, three were unsuccessful in completely removing all TPH-impacted soil with concentrations above 200 mg/kg. The three excavations were located in Lot 22 of the site and were named RE22-1, RE22-2, and RE22-3; details about concentration exceedances per excavation are presented below:

- RE22-1: TPH concentrations exceeded 200 mg/kg in four locations, with a maximum TPH concentration of 690 mg/kg
- RE22-2: TPH concentrations exceeded 200 mg/kg in two locations, with a maximum TPH concentration of 12,000 mg/kg
- RE22-3: TPH concentrations exceeded 200 mg/kg in two locations, with a maximum concentration of 300 mg/kg.

Of these three excavations, only RE22-2 contained a TPH concentration which would exceed the current MTCA CUL for soil (2,000 mg/kg).

At RE22-2, the maximum TPH concentration of 12,000 mg/kg was obtained from a depth of 2.5 feet (ft) along the northern wall of the excavation. The next highest concentrations (1,400 and 1,100 mg/kg) were also located along the northern wall, at depths of 2 ft and 6 ft, respectively. All other soil samples from the excavation contained concentrations less than 200 mg/kg. The RE22-2 excavation could not be extended northward due to the presence of an asphalt concrete pad. The analytical results for soil samples collected from RE22-2 are presented in Table 1.

Excavated TPH-impacted soil was stockpiled on the southeastern edge of the asphalt concrete pad; the pad was associated with the sawmill building formerly located on Lot 22 (GeoEngineers 1991; SEACOR 1993). An asphalt berm was constructed along a portion of the asphalt concrete pad prior to stockpiling to contain stormwater runoff from the stockpile (GeoEngineers 1991). Bioremediation of the stockpiled soil was attempted from September 1991 to March 1992 by AWD Technologies, but was discontinued in 1992 because TPH concentrations did not appear to decrease (SEACOR 1993). In October 1992, SEACOR and RCI Environmental began remediating stockpiled soil using a mechanical separation method where the soil was separated into three size categories: undersized (<2 inches in diameter); oversized (>2 inches in diameter); and debris (included plastic, metal, and wood scraps).

During SEACOR's stockpile remediation, undersized material was contained on the asphalt concrete pad, while oversized material was placed off the pad, south of the southwest corner. Undersized material was classified as TPH-impacted based on results of analyses performed by AWD Technologies, and was disposed of in the Columbia Ridge Landfill in Arlington, Oregon. Thirty-six samples of oversized material were analyzed on site for TPH concentrations using solid-liquid thin-layer chromatography. The analyses determined that TPH concentrations in the oversized material were below the MTCA Method A soil CUL of 200 mg/kg. Therefore, it was decided that the oversized material would be stockpiled on the Boeing Frederickson property for future use (SEACOR 1993). After removal of the soil stockpiles from the asphalt concrete pad, SEACOR reports that the pad was pressure washed, broken apart, and transported to a stockpile managed by Segale, Inc. on the Frederickson property for final transport to Renton Recyclers.

At present, neither the sawmill building nor the asphalt concrete pad remain at the site. The sawmill and asphalt concrete pad are shown on a July 1990 aerial photograph, and are represented on site maps in GeoEngineers' 1991 *Report of Geoenvironmental Services, Remedial Excavation of Soil, Frederickson Site, Frederickson, Washington*. However, neither structure is included in the site plan presented in SEACOR's 1993 report, *Stockpile Remediation Activities for Boeing Frederickson Industrial Park*. The SEACOR report suggests that only the bermed section of pad beneath the stockpile remained in place when stockpile remediation began in October 1992, indicating that the portion of the pad to the north had been removed by that time. Presently, a large pile of gravelly material (approximately 130 ft x 70 ft x 15 ft) is located in the vicinity of the former stockpile remediation area as shown on Figure 2. The pile appears to be the oversized material left in place by SEACOR.

2.0 FIELD INVESTIGATION

The objective of the current field investigation is to assess whether TPH-Dx and CTC concentrations above current MTCA CULs are present in site soil at the former RE22-2 excavation area. Field activities will be conducted in accordance with the recent Boeing Auburn health and safety plan that was prepared for related field work (Landau Associates 2011).

2.1 LOCATION SELECTION

The first step of the field investigation is to accurately identify the RE22-2 excavation location, using site plans from reports by GeoEngineers (1990, 1991) and SEACOR (1993), and aerial photographs from 1990 and 2011 (obtained from Google Earth). A site map included in the 1991 GeoEngineers report identifies the location of the RE22-2 excavation relative to the asphalt concrete pad south of the sawmill building. The site map was overlain onto an aerial photograph from 1990, and geo-referenced using the sawmill building and pad which were present in 1990. The base image was then overlain onto a 2011 aerial photograph, providing a good estimate of the RE22-2 excavation location relative to current site features. Based on this evaluation, an approximate 40 ft by 40 ft area is proposed for investigation in the vicinity of the estimated RE22-2 excavation location, as shown on Figure 2. Geographic coordinates of the investigation area will be determined in the field using a handheld global positioning system (GPS) device.

2.2 SOIL SAMPLING

The next step of the field investigation will be to excavate approximately six, 3-ft deep[2] test pits in the proposed investigation area using a backhoe. Final test pit locations will be determined by the field geologist or engineer. A total of six soil samples will be collected from the proposed investigation area to determine TPH-Dx and CTC concentrations in soil. Each sample location will be staked with a flag marked with the pit number. A site map of the investigation area and sample locations will be prepared in the field. The texture of soil samples will be classified in general accordance with the ASTM *Standard Practice for Description and Identification of Soils*. It is not anticipated that groundwater will be encountered at the proposed exploration depths.

Although GeoEngineers (1991) found that sheen testing and headspace analysis were not reliable indicators of TPH in soil at the site, field screening (including visual examination for staining and sheen, odor detection, and headspace analysis with a photoionization detector) will be conducted to estimate the

[2] A TPH concentration of 12,000 mg/kg was present at 2.5 ft depth, but concentrations above (at 2 ft) were 1,400 mg/kg, and below (at 6 ft) were 1,100 mg/kg. Thus, it is expected that TPH concentrations exceeding CUL, if present, would occur between 2 ft and 3 ft below ground surface (BGS).

potential presence of TPH or CTC in soil. If field screening indicates the presence of contamination, a soil sample will be collected at the location from the depth at which contamination appears to be greatest. If no evidence of contamination is observed through field screening, then a sample will be collected from the excavation sidewall at a depth between approximately 2 ft and 2.5 ft BGS.

Quality assurance/quality control procedures will follow the Quality Assurance Project Plan for the Boeing Auburn Facility (Landau 2012). One field trip blank will be included in each cooler that contains samples collected for CTC analysis. The trip blank will be analyzed for CTC. Blind field duplicates will not be collected due to the inherent heterogeneity of soil. Equipment blanks will not be collected. Soil screening equipment will be decontaminated between samples using an Alconox® wash followed by a tap water rinse.

The name of each soil sample will include the pit number, the sample depth interval (ft BGS), and the date (year, month, day). For example, sample P1(2-2.5)-20120430 would identify a soil sample collected from Pit 1 at 2 ft to 2.5 ft BGS on April 30, 2012.

2.3 WASTE HANDLING

After the initial exploration and sample collection, each test pit will be backfilled with the excavated soil from the pit it was initially removed from. Decontamination water generated during excavation and sampling will be contained in an appropriate waste container provided by Boeing. If all soil sample results are less than MTCA CULs, the decontamination water may be disposed of on the ground; otherwise it will be disposed of appropriately by Boeing.

3.0 LABORATORY ANALYSES

Soil samples will be submitted to Lancaster Laboratories, Inc. in Lancaster, Pennsylvania under chain-of-custody procedures for analytical testing. Samples will be submitted on a standard two-week turnaround. Soil samples will be analyzed for TPH-Dx by analytical method NWTPH-Dx, and for CTC by EPA Method 8260C. Soil samples will be collected in clean, laboratory-provided sampling containers using disposable stainless steel spoons (for TPH-Dx) or laboratory-provided disposable syringes (for CTC).

4.0 REPORTING

Upon completion of the field investigation, a map will be prepared documenting the investigation area and sample locations. Analytical data will be reviewed for data validation purposes and tabulated to compare with relevant MTCA CULs. A technical memorandum detailing the field investigation and findings will be produced and submitted for review by Boeing and Ecology.

5.0 SCHEDULE

A private utility locate will be arranged by a Boeing representative. Field work will be conducted after the utility locate and approval of the work plan by Ecology. As discussed in Section 3.0, samples will be submitted on standard two-week turnaround. A draft technical memorandum detailing the findings of the investigation will be completed within approximately 21 days of receipt of the analytical results and will be submitted to Ecology for review. A final technical memorandum will be provided within about one week of receipt of final comments from Ecology.

6.0 USE OF THIS REPORT

This work plan has been prepared for the exclusive use of The Boeing Company for specific application to the Boeing Frederickson Fabrication facility remedial investigation. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

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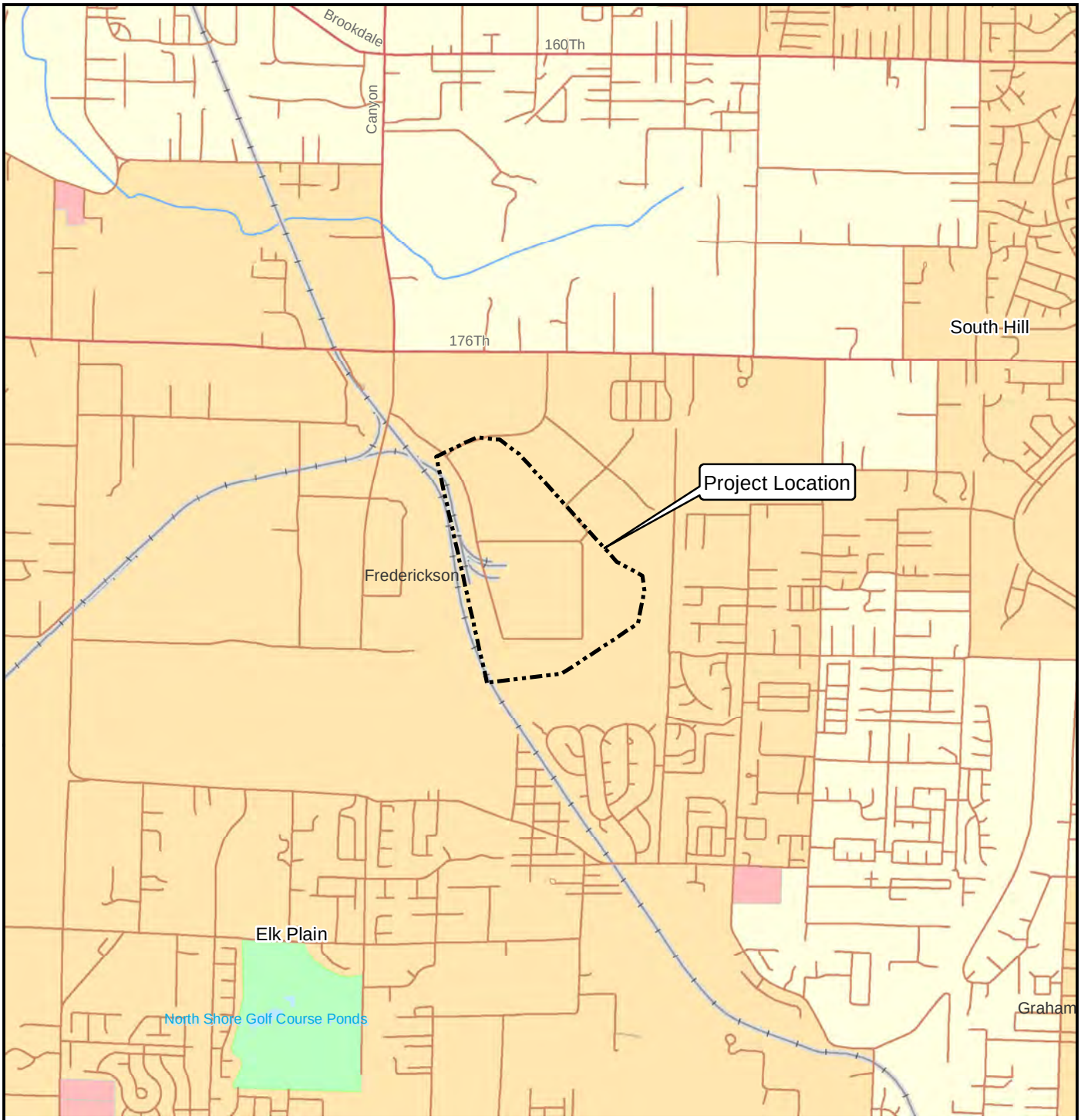

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Boeing Frederickson Pierce County, Washington	**Vicinity Map**	Figure 1

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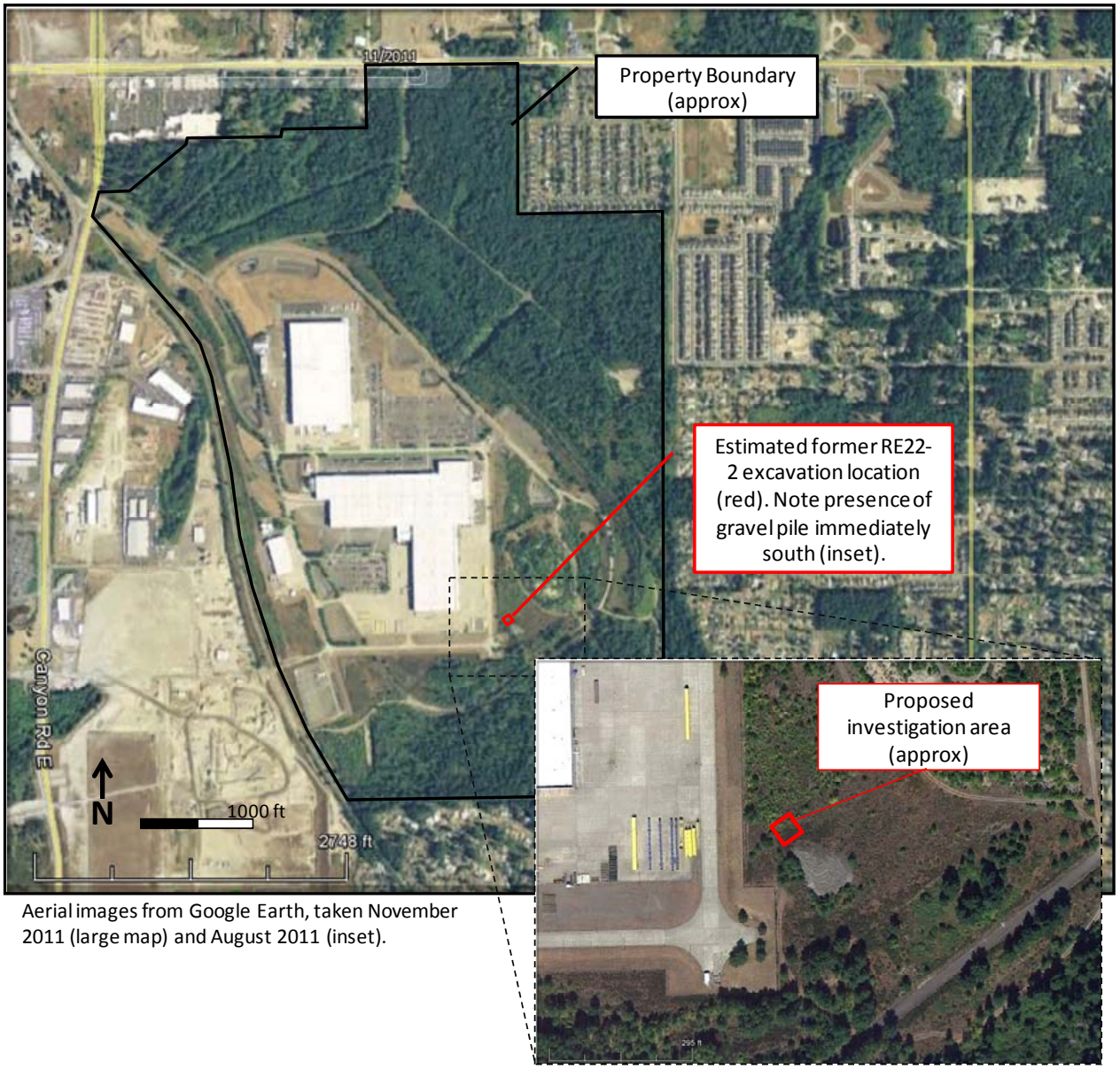

Aerial images from Google Earth, taken November 2011 (large map) and August 2011 (inset).

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Boeing Frederickson
Pierce County, Washington

Current Site Features

Figure
2

TABLE 1
REMEDIAL EXCAVATION RE22-2
SOIL CHEMICAL ANALYTICAL RESULTS (TPH)

Sample Number	Sample Location	Sample Depth (feet)	TPH Analytical Results (mg/kg) (a)	
			EPA Method 418.1	Modified EPA Method 8015
RE22-2-1	North wall	2	1,400	<25
RE22-2-2	East wall	2	190	<25
RE22-2-3	South wall	2	<10	<25
RE22-2-4	South wall	4	--	--
RE22-2-5	Central base	7	150	<25
RE22-2-6	North wall	2.5	12,000	35
RE22-2-7	West wall	3	<10	97
RE22-2-8	Central base	8	64	<25
RE22-2-9	RE22-2-7(b)	3	<10	34
RE22-2-10	North wall	6	1,100	<25

Table adapted from: GeoEngineers. 1991. *Report of Geoenvironmental Services, Remedial Excavation of Soil, Frederickson Site, Frederickson, Washington.* For The Boeing Company. January 10.

-- = not tested
CCL = Compliance Cleanup Level from July 18, 1990
mg/kg = milligrams per kilogram
MTCA =Model Toxics Control Act
TPH = Total Petroleum Hydrocarbons

(a) Chemical analysis conducted by Analytical Resources, Inc.
(b) Duplicate sample.