The Boeing Company
P.O. Box 3707
Seattle, WA 98127-2207

January 30, 2024
DAT-2024-032

Li Ma
Washington State Department of Ecology
NWRO PO Box 330316
Shoreline, WA 98133-9716

Subject: Submittal of the Final Engineering Design Report
Boeing Auburn Site
Enforcement Order No. DE_21533

Dear Mr. Ma:

The Boeing Company (Boeing) submits the final Engineering Design Report (EDR) for the Boeing Auburn Site. This report has been finalized with a date of January 25, 2024 based on the approval letter provided by Washington Department of Ecology (Ecology) on January 24, 2024. Copies of this final EDR are also being sent to stakeholders: Primus and Wilsonart (Algona enhanced *in situ* bioremediation focus area stakeholders) and Prologis (restrictive environmental covenant stakeholder).

Please contact me if you have any questions.

Sincerely,

Debbie Taege
The Boeing Company
Environmental Remediation
deborah.a.taege@boeing.com
Mobile (818) 720-5575

CC:
Christa Colouzis, Washington State Department of Ecology
Jim Swortz, The Boeing Company
Sarah Fees, Landau Associates
Brett Richer, Prologis
Kenneth Sorensen, Ron Schulte, Ken Bulcher, Primus/PCC Airframe
Doug Kennedy and Brock Garrett, Wilsonart

LANDAU ASSOCIATES

ENGINEERING DESIGN REPORT

Boeing Auburn Site
Auburn, Washington

January 25, 2024

Prepared for

The Boeing Company
Auburn, Washington

TACOMA
2107 South C Street, Tacoma, WA 98402 T 253.926-2493

landauinc.com

Engineering Design Report
Boeing Auburn Site
Auburn, Washington

This document was prepared by, or under the direct supervision of, the undersigned, whose seal is affixed below.

Name: Clinton L. Jacob, PE
Washington No. 38340

Date: January 25, 2024

Document prepared by: _____ Sarah Fees, LG
Primary Author

Document reviewed by: _____ Clint Jacob, PE, LG
Quality Reviewer

Date: January 25, 2024
Project No.: 0025164.200.303
File path: \\tacoma3\PROJECT\025\164\R\EDR\Landau_BoA EDR_Final 01.25.2024.docx
Project Coordinator: KJG

LANDAU ASSOCIATES

This page intentionally left blank.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

AOC	Area of Concern
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BMP	Best Management Practice
Boeing	The Boeing Company
Boeing Auburn Plant	Boeing's Auburn Fabrication Division Plant
Boeing Auburn Facility	Boeing Auburn Plant and associated properties
CAP	Cleanup Action Plan
CMP	Compliance Monitoring Plan
COC	contaminant of concern
CPOC	conditional point of compliance
CUL	cleanup levels
DRO	diesel-range organics
DWQS	drinking water quality standards
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
EISB	enhanced *in situ* bioremediation
FS	Feasibility Study
ft	foot/feet
GRO	gasoline-range organics
HASP	Health and Safety Plan
ID	Identification
Landau	Landau Associates, Inc.
mg/kg	milligrams per kilogram
MCL	maximum contaminant level
µg/L	micrograms per liter
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
No.	Number
POC	point of compliance
ORC	oxygen-releasing compound
QAPP	Quality Assurance Project Plan
RCW	Revised Code of Washington
RI	Remedial Investigation report
SAP	Sampling and Analysis Plan
Site	The Boeing Auburn Site
SWQS	surface water quality standards
TCE	trichloroethene

TPH ..... total petroleum hydrocarbons
UIC ..... Underground Injection Control
UST ..... underground storage tank
VOC ..... volatile organic compound
VC ..... vinyl chloride
WAC ..... Washington Administrative Code
yd^3 ..... cubic yard(s)

1.0 INTRODUCTION

This Engineering Design Report (EDR), prepared by Landau Associates, Inc. (Landau), describes the objectives and scope of the cleanup actions for environmental releases associated with The Boeing Company's (Boeing's) Auburn Fabrication Division Plant (Boeing Auburn Plant) and associated properties (Boeing Auburn Facility). A vicinity map is shown on Figure 1. The Boeing Auburn Plant is located at 700 15th Street Southwest, Auburn, Washington (State Dangerous Waste Identification [ID] Number [No.] WAD041337130). The location and current extent of property that Boeing owns as part of the Boeing Auburn Plant is shown on Figure 2. The Boeing Auburn Site (Site) includes the Boeing Auburn Facility and all contiguous property affected by releases of hazardous substances that are confirmed or suspected to have originated at the Facility. Cleanup actions to be completed are presented in the Cleanup Action Plan (CAP) in the Enforcement Order No. DE 21533 issued to Boeing by the Washington State Department of Ecology (Ecology), dated January 10, 2023 (Ecology 2023). This EDR has been prepared pursuant to the Enforcement Order, in accordance with the Washington State Model Toxics Control Act (MTCA) regulation (Washington Administrative Code [WAC] 173-340).

The four Areas of Concern (AOCs; AOC A-01, AOC A-09, AOC A-14, and AOC A-15) identified as requiring cleanup and the selected remedial actions for those AOCs are described in the CAP (Ecology 2022). AOC A-01 (former underground storage tanks northwest of Building 17-06) and AOC A-09 (Building 17-07 acid scrubber drain line) are located on property owned and operated by Boeing at the Boeing Auburn Plant. This on-property contamination consists of small discreet areas of contaminated soil and groundwater that do not impact off-property groundwater. AOC A-14 is Site-wide groundwater trichloroethene (TCE) and vinyl chloride (VC) contamination (groundwater plumes) that extends from the current or former Boeing-owned properties to downgradient properties. AOC A-15 is an off-property AOC consisting of stormwater management features that intercept contaminated groundwater. AOC and cleanup action locations are shown on Figure 3. The selected remedy and compliance monitoring requirements for each AOC are listed in Table 1.

The purpose of this EDR is to fulfill the requirements for plans describing the cleanup action for the Site per WAC 173-340-400. The EDR will be implemented using the field methods and procedures documented in the *Sampling Analysis Plan* (Landau 2023d) and analytical methods and quality assurance measures in the *Quality Assurance Project Plan* (QAPP; (Landau 2023c). Protection monitoring will be addressed as described in the Site-specific *Health and Safety Plan* (HASP; Landau 2023b).

This EDR addresses design and cleanup actions and monitoring requirements for AOC A-01 and the enhanced *in situ* bioremediation (EISB) activities in the Algona focus area for AOC A-14. The Compliance Monitoring Plan (CMP; Landau 2023a) addresses performance monitoring for the monitored containment remedy at AOC A-09 and performance monitoring and confirmational monitoring for the monitored natural attenuation (MNA) remedy at AOCs A-14 and A-15. An EDR for future excavation, if necessary, at AOC A-09 will be prepared when the area is available for excavation; however, a short summary of the cleanup action for AOC A-09 is included in Section 2.0 for completeness.

2.0 PLANNED CLEANUP ACTION – CONCEPTUAL OVERVIEW

The cleanup action approach is consistent with procedures that were presented in the Feasibility Study (FS; (Landau 2019, 2020) and CAP. The approach includes institutional controls at the Boeing Auburn Facility, excavation at AOC A-01, future excavation at AOC A-09, and enhanced *in situ* bioremediation and MNA for AOCs A-14 and A-15.

2.1 Institutional Controls and Environmental Covenants

In accordance with MTCA requirements (WAC 173-340-440), institutional controls will be implemented at the Boeing Auburn Facility (parcels owned by Boeing and Prologis) to limit or prohibit activities that may result in exposure to hazardous substances. Soil and groundwater institutional controls will include an environmental covenant to restrict the land use to industrial in order to apply Method C soil cleanup levels (CULs) at affected parcels on the Boeing Auburn Facility and prohibit use of groundwater as a potable water supply at the Boeing Auburn Facility.

Institutional Controls include:

- Establishing environmental covenants to restrict Boeing-owned property to industrial land uses as that term is defined in the rules promulgated under Chapter 70A.305 Revised Code of Washington (RCW).
- Establishing environmental covenants to prohibit the use of groundwater as a potable water supply on Boeing-owned property.
- Restrictions on intrusive activities in areas with impacted groundwater that would put workers in contact with contaminated groundwater on Boeing-owned property.
- Requirements that proper safety measures and construction practices be implemented on Boeing-owned property as part of any project involving disturbance of contaminated soils and/or at depths that may encounter contaminated groundwater.

The environmental restrictive covenants required for affected parcels at the Site will be recorded on the deeds registered with King County, Washington. The covenants may be removed at the property owner's request, once the property owner shows that the conditions at the Site requiring use of institutional controls no longer exist, Ecology holds a public notice and comment opportunity, and Ecology agrees with Boeing's claim. A covenant is already in place on the Prologis portion of the Boeing Auburn Facility that prohibits the extraction, supply, or use of groundwater from the property and limits use of the property to industrial land use; Boeing will work with Prologis to add an appropriate Ecology-reviewed environmental restrictive covenant for the Prologis property. Prologis will be responsible for filing the environmental restrictive covenant with King County. The parcels included in the environmental covenant are shown on Figure 4.

2.2 AOC A-01

AOC A-01 consists of petroleum hydrocarbon contamination in soil and groundwater associated with releases from two former 10,000-gallon fuel underground storage tanks (USTs) that were installed near the northwest corner of Building 17-06 in 1967. UST TAU-01 was a diesel tank used to power emergency generators and UST TAU-02 was a gasoline tank. Historical releases from the AOC A-01 USTs resulted in soil and groundwater petroleum hydrocarbon contamination downgradient (north and northwest) of the USTs. Both tanks and a fuel island were removed in 1990 and approximately 500 cubic yards (yd^3) of contaminated soil was excavated from the former tank areas (Geomatrix 2003). In 2004, an additional 10 yd^3 of soil was removed (Landau 2004). Subsequent investigations indicated that limited soil contamination was left in place primarily between 10 and 20 feet below ground surface and low-level groundwater contamination is still present in a limited area at AOC A-01. The extent of AOC A-01 and associated exploration locations are presented on Figure 5. A cross-section of AOC A-01, including depths of the 1990 and 2004 excavations, is presented on Figure 6.

2.2.1 Cleanup Standards

Cleanup standards for AOC A-01 are based on the nature and extent of contamination and potential current and future complete exposure pathways. CULs for the media of concern consist of the following:

Analyte	Soil CUL (mg/kg)	Regulatory Basis for CUL (WAC 173-340-745)	Groundwater CUL (µg/L)	Regulatory Basis for CUL (WAC 173-340-720)
Ethylbenzene	5.9/350,000 [(a)]	Soil protective of groundwater/Method C non-cancer direct contact [(a)]	700	Federal/State MCL
Total Xylenes	14/350,000 [(a)]	Soil protective of groundwater/Method C non-cancer direct contact [(a)]	1,600	Method B Non-Cancer
TPH	1,500	Generic Method C TPH CUL	500/800/1,000 [(b)]	Method A

Notes:
[(a)] Once the groundwater CUL is met, protection of groundwater will be determined based on an empirical demonstration under WAC 173-340-747(3)(f) and the cleanup level will be adjusted to the Method C direct contact value.
[(b)] 500 µg/L is for DRO, 800 µg/L is for GRO where benzene is present, and 1,000 µg/L is for GRO where no detectable benzene is present in groundwater.

µg/L = micrograms per liter
CUL = cleanup level
DRO = diesel-range organics
GRO = gasoline-range organics
MCL = maximum contaminant level
mg/kg = milligram per kilogram
WAC = Washington Administrative Code

2.2.2 Cleanup Action

The cleanup action at AOC A-01 is being completed as a Model Remedy (Ecology 2017) as described in the FS (Landau 2019). Cleanup action includes near-term excavation of petroleum contamination above CULs to address impacted soil, and emplacement of an oxygen-releasing compound (ORC) in the saturated/seasonally saturated portion of the excavation backfill to stimulate oxidative destruction and

enhance aerobic microbial degradation of residual petroleum in groundwater. If necessary, supplemental MNA will be implemented for treatment of residual petroleum hydrocarbon contamination in groundwater. The planned remedial excavation area is presented on Figure 7. Specifics of the excavation activities, emplacement of ORC/oxidant in the backfill for *in situ* treatment, and potential supplemental MNA are described in Appendix A.

Compliance of the cleanup action is planned to be determined through Model Remedy Number 11 (Method C soil direct contact CULs are met and groundwater CULs are assumed to be met after cleanup) for sites with petroleum impacts to groundwater (Ecology 2017). In the event that not all soil contamination above Method C soil direct contact CULs can be removed, Ecology may approve use of Model Remedy Number 12 (Ecology 2017), which includes an environmental covenant to address soil concentrations that exceed Method C direct contact CULs, instead of Model Remedy Number 11.

2.3 AOC A-09

AOC A-09 is defined as contamination from a former acid scrubber drain line leak located on the south side of Building 17-07 near column C11 (outside of the building). The leak was discovered in 1996 during closure and removal of two waste holding tanks. During excavation activities to remove the waste holding tanks outside the building between scrubbers No. 2 and No. 3, seepage from the acid scrubber drainpipe was noted at about 5 feet below ground surface (ft bgs) near a structural pier along the south wall of Building 17-07. A partial remedial excavation was completed in 1996 to the extent practicable; however, contamination was left in place under the footprint of the building and adjacent scrubber No. 3 pad foundation because of structural concerns. The remaining area of soil contamination has caused an area of groundwater contamination that does not extend past the Building 17-07 area on Boeing property. The 1996 excavation area and exploration locations associated with AOC A-09 are shown on Figure 8. A cross-section of AOC A-09, including the depth of the 1996 excavation, is presented on Figure 9.

Contaminants of concern (COCs) from AOC A-09 are metals (cadmium and copper) in soil and groundwater and cyanide in groundwater. The soil contamination that is currently under structures at AOC A-09 is assumed to be the source of the low-level concentrations of contaminants in groundwater. Soil concentrations do not exceed Method C direct contact values. The area is covered by asphalt pavement or concrete structure for Building 17-07.

2.3.1 Cleanup Standards

Based on the nature and extent of contamination at AOC A-09 and potential current and future complete exposure pathways, CULs for the media of concern for this AOC consist of the following:

Analyte	Soil CUL (mg/kg)	Regulatory Basis for CUL (WAC 173-340-745)	Groundwater CUL (µg/L)	Regulatory Basis for CUL (WAC 173-340-720)
Cadmium	1.0/3,500 [(a)]	Soil protection of groundwater adjusted for natural background/Method C non-cancer direct contact [(a)]	5.0	Federal/State MCL
Copper	280/140,000[(a)]	Soil protective of groundwater/Method C non-cancer direct contact [(a)]	640	Method B Non-Cancer
Cyanide	N/A		10	Method B Non-Cancer

Notes:

[(a)] Once the groundwater CUL is met, protection of groundwater will be determined based on an empirical demonstration under WAC 173-340-747(3)(f) and the cleanup level will be adjusted to the Method C direct contact value.

An environmental covenant will be instated to ensure industrial land use, as required for Method C soil CULs. The soil POC will be throughout the Site and extend from the ground surface to 15 ft bgs once groundwater meets CULs. The groundwater POC will be throughout the Site for COCs related to AOC A-09.

2.3.2 Cleanup Action

The selected cleanup action for AOC A-09 includes future excavation of soil contamination and monitored containment until that time. The cleanup action includes institutional controls to maintain the asphalt/concrete cap and continued monitoring of the groundwater contamination (monitored containment) until future excavation is completed, if necessary. The specifics of the ongoing monitoring are described in the CMP (Landau 2023a). An environmental covenant will be instated to ensure industrial land use, as required for Method C soil CULs.

The excavation (or more feasible remedial action) portion of the remedy is a requirement of the final remedy and will occur when (1) Boeing determines implementation of the remedy will not impact facility operations and (2) Ecology determines excavation is appropriate at that time. Additionally, the remedy must result in either (a) a reduction in post-remedy monitoring, (b) a finding from Ecology that no further remedial action will be necessary after the excavation, or (c) significant reduction in subsurface soil contamination and therefore a reduced threat to human health and the environment.

Boeing will assess its current and projected operations (i.e., operational assessment) in the AOC A-09 area and will provide Ecology with statements describing the results of the operational assessment and implementability of soil excavation in the Site annual report. When the area is available for excavation, Boeing and Ecology will determine the extent of the excavation based on current concentrations in soil and groundwater. The excavation details will be determined in a specific AOC A-09 EDR developed when the area becomes accessible for excavation activities (if excavation is necessary). The contaminated soil exceeding CULs will be removed and transported to an appropriate, licensed, offsite disposal facility. Compliance groundwater monitoring will then be conducted to demonstrate that the removal action has resulted in groundwater COC concentrations being reduced below CULs. The conceptual excavation area is presented on Figure 10.

2.4 AOCs A-14 and A-15

AOC A-14 consists of TCE and VC in Site-wide groundwater and TCE in soil at the Boeing Auburn Facility. The area of soil contamination is located at limited areas on the Boeing Auburn Facility. The localized areas of TCE soil contamination are present at the identified TCE release areas at the Boeing Auburn Facility. Soil TCE concentrations do not exceed Method C direct contact values and the soil in these areas at the Boeing Auburn Facility are covered by pavement or buildings. Contaminated groundwater and stormwater are not being used for drinking water at the Site.

The TCE- and VC-impacted groundwater associated with AOC A-14 are identified as the "Area 1 Plume" (originating from the northern portion of the Boeing Auburn Facility, former Area 1) and the "Western Plume" (originating from the west side of the Boeing Auburn Facility in or near Building 17-07). These two plumes extend about 1 mile northwest of the Boeing Auburn Facility. TCE breakdown product cDCE is also present in groundwater but concentrations are below screening levels described in the Remedial Investigation report (RI; Landau 2017b) and FS. The age/history of the original releases and the aquifer dynamics at the Site have resulted in these large, mature, low concentration groundwater plumes. The current horizontal extent of the Area 1 Plume and Western Plume is affected by aquifer heterogeneity and contaminant transport processes such as sorption, dispersion, and contaminant degradation from TCE to degradation products cDCE and VC. Low-level concentrations of TCE and VC have been detected in groundwater upgradient and cross-gradient of the plume release areas that commingle with AOC A-14 and are the result of non-Facility releases.[1]

AOC A-15 consists of 1) stormwater management, conveyance, and treatment facilities within the Cities of Auburn and Algona (i.e., Chicago Avenue ditch, Auburn 400 north and south stormwater retention basins) where contaminated groundwater from AOC A-14 enters or is present in these features and 2) surface water (i.e., Mill Creek) to where contaminated groundwater may potentially flow. Because concentrations in stormwater are a result of groundwater contamination, conditions at AOC A-15 are directly connected and attributed to conditions in AOC A-14; therefore, AOC A-15 is addressed as part of the cleanup action for AOC A-14.

2.4.1 Cleanup Standards

Groundwater CULs at AOC A-14 are based on groundwater protection of surface water beneficial uses. Ecology required CULs developed for TCE and VC at the Site to be based on the groundwater to surface water pathway and to use surface water quality standards (SWQS) as groundwater cleanup levels. Ecology determined that CULs identified as SWQS for volatile organic compounds (VOCs) in groundwater shall be met at a conditional point of compliance (CPOC) for the Site, specifically the Facility boundary. Although SWQS are the CULs at and downgradient of the CPOC, drinking water quality standards (DWQS) will be used as compliance monitoring criteria for reductions in monitoring as described in the

[1] Upgradient/cross-gradient sources of contamination not associated with the Boeing Auburn Facility have been documented based on data or information collected as part of Remedial Investigation (RI) activities (Landau 2017b). These upgradient, off-Facility sources are commingling with and contributing to the extent of the Area 1 groundwater plume. Ecology acknowledged that some contribution to the Area 1 plume could be coming from other sources (Ecology 2016 and 2021a).

CMP (Landau 2023a). Ecology also required that CULs for both stormwater features and surface water features meet SWQS. CULs for groundwater and stormwater/surface water for AOCs A-14 and A-15 consist of the following:

Analyte	CUL for Drinking Water Beneficial Use (µg/L)	Regulatory Basis for CUL (WAC 173-340-720)	CUL for Surface Water Beneficial Use (µg/L)	Regulatory Basis for CUL (WAC 173-201A)
TCE	4.0	DWQS; Method B Non-Cancer	0.38	SWQS; Human Health Fresh Water
VC	0.29	DWQS; Method B Cancer, adjusted to cancer risk 10-5 based on MCL rule	0.02	SWQS; Human Health Fresh Water

Notes:
DWQS = drinking water quality standards
SWQS = surface water quality standards
TCE = trichloroethene
VC = vinyl chloride

An environmental covenant will be placed on the affected Boeing Auburn Facility parcels upgradient of the CPOC to restrict groundwater use for drinking water. The location for the groundwater CPOC is shown on Figure 3.

A standard POC will be used for surface water at the Site and, as required by Ecology, will also include the stormwater features identified above that intercept contaminated groundwater (Chicago Avenue ditch and Auburn 400 stormwater retention basins).

2.4.2 Cleanup Action

The selected cleanup action for AOC A-14 includes EISB at the Algona Focus Area and Site-Wide MNA. Conditions at AOC A-15 are directly connected and attributed to conditions in AOC A-14. Therefore, cleanup of AOC A-14 will result in achieving cleanup standards in AOC A-15.

The Algona Focus Area is an area in the City of Algona along Milwaukee Avenue where treatment targets groundwater extending to the west beneath the Chicago Avenue ditch and the northeastern portion of the Algona residential neighborhood. Treatment in this area will be an expansion of the enhanced natural attenuation pilot test that occurred in 2015 and is described in the pilot test reports (Landau 2017a, 2018).

The planned EISB cleanup action in the Algona Focus Area is to extend the existing pilot test injection locations to the north to create an approximately 1,000-ft-long injection row. The general area planned for the injection row and existing monitoring and injection wells are shown on Figure 11. Injection events will occur up to a total of three times, each one occurring approximately every 4 years. A work plan presenting detailed design and implementation of the EISB treatment is provided in Appendix B.

Site-wide MNA monitoring will be conducted during and after the Algona EISB injection activities and is described in the CMP (Landau 2023a). Performance monitoring for the Algona Focus Area EISB is described in Section 4.0.

3.0 ENGINEERING BASIS FOR DESIGN

The following sections present the engineering basis and design rationale for the excavation cleanup action at AOC A-01 and the Algona Focus Area EISB cleanup action for AOC A-14 as well as the performance monitoring plans. The monitoring to be performed for MNA cleanup action for AOC A-14 and at AOC A-09 until future excavation can occur is described in the Ecology-approved CMP (Landau 2023a). The future excavation cleanup action for AOC A-09 is not addressed in this engineering basis for design and will be described in a future EDR when excavation in this area is feasible.

The following sub-sections provide typical design criteria, assumptions, MTCA-required design considerations, and the rationale for how the cleanup action will meet cleanup standards in accordance with MTCA requirements. Specifics of remedy implementation are described for AOC A-01 in Appendix A and for AOC A-14 in Appendix B.

3.1 Efficacy of Cleanup Action

As presented in the FS (Landau 2019), the approved cleanup action complies with the provisions of WAC 173-340-360. It will be protective of human health and the environment, comply with cleanup standards and applicable state and federal laws, and provide for compliance monitoring. Contaminated media with hazardous substance concentrations that exceed cleanup levels will be managed based on federal and state requirements. Institutional controls will consist of a restrictive environmental covenant on the Boeing Auburn Facility that will be filed with King County as described in Section 2.1. The restrictive environmental covenant will:

- Require that the property be used only for industrial uses.
- Regulate the disturbance of the cap at AOC A-09 until future excavation occurs, if required.
- Require notification and approval by Ecology for significant changes to buildings or site use in the area above groundwater contamination to minimize the potential exposure to volatile chemicals that may generate harmful vapors.
- Prohibit the extraction of groundwater for human consumption.
- Provide for long-term monitoring of the cleanup action through protection of groundwater monitoring wells.

The selected cleanup action is also considered to use permanent solutions to the maximum extent practicable, and to provide for a reasonable restoration time frame.

For AOC A-01, excavation and proper disposal of the impacted soil above the MTCA CULs is likely the most rapid, efficient, and effective method of attaining the desired cleanup at the Site. Excavation has been demonstrated to be effective at numerous sites under variable conditions. Soil excavation will reduce the risks posed to human health and the environment by removing potential exposure pathways to human and environmental receptors. Institutional controls (if needed) will be implemented to restrict access to contaminated soil that remains following implementation of the cleanup action to prevent unacceptable risk to human health and the environment.

For AOCs A-14 and A-15, the EISB injection activities are expected to enhance the highly effective natural attenuation already occurring in the Algona Focus Area. Complete destruction of TCE through biodegradation to non-toxic end products is expected to continue during the EISB treatment. Site-wide MNA monitoring will continue until CULs are met throughout the Site.

3.2 General Design Criteria

The general design criteria for the excavation at AOC A-01 and the Algona Focus Area EISB at AOC A-14 are described below. In accordance with MTCA, Site cleanup actions will comply with applicable state and federal laws (WAC 173-340-710[1]). MTCA defines applicable state and federal laws to include applicable and relevant and appropriate requirements (ARARs). The ARARs for AOC A-01 and AOCs A-14 and A-15 cleanup actions are described in Table 2.

3.2.1 AOC A-01

The general design and implementation criteria for this cleanup action includes the list below. The specifics of these criteria are provided in Appendix A and will be further developed as part of final construction plans for the excavation activities.

- Temporary erosion and sediment control (TESC) regulations and requirements and best management practices during construction.
- Stability for the temporary excavation, such as sloping or shoring (these plans will be part of final construction plans).
- Minimizing disruptions to property owner operations and preservation of existing utilities nearby the planned excavation area.
- Soil disposal requirements.
- Emplacement of substrate to enhance aerobic microbial degradation processes and chemical destruction to address impacted groundwater.
- Fill material characteristics appropriate for current and future site use.
- Specifications for finish grade, surfacing, pavement, and/or landscape.

Prior to excavation activities, all necessary permits, authorizations, and regulatory requirements will be acquired and/or fulfilled, per Washington State law as described in Appendix A.

3.2.2 AOCs A-14 and A-15

EISB for AOC A-14 will be implemented using the same approach as the Algona Pilot test injections. The general design and implementation criteria for this cleanup action includes the list below. The specifics of these criteria are provided in Appendix B.

- Notice of Intent to Ecology for installation of additional injection and monitoring wells.
- Underground Injection Control (UIC) program rule authorization for injecting materials into groundwater wells.

- Emplacement of substrate to enhance natural attenuation of CVOCs that is already naturally occurring in the Algona Focus Area.
- Minimizing disruption to property owner operations and substrate short-circuiting to the surface or along utilities.

Prior to drilling and implementing EISB, all necessary permits, authorizations, and regulatory requirements will be acquired and/or fulfilled, per Washington State law as described in Appendix A.

3.3 MTCA-Required Design Considerations

This section describes Site-specific design considerations required in WAC 173-340-400(4) pertinent to the design, construction, and operation of the action. Specifically, this section addresses the relationship between the remedial action and the Site geographic features, subsurface conditions, existing structures, and current and future Site operations.

3.3.1 Facility Characteristics Affecting the Cleanup Action

The AOC A-01 excavation is located on the active Boeing Auburn property. The location is in a storing/staging area and extends to an active roadway. There are utilities that will need to be protected in the planned excavation area. Utilities service cannot be shut off during excavation activities to ensure that critical Boeing operations are not disrupted.

The Algona EISB injection area is located in the parking areas of two private commercial properties (Primus Property and Wilsonart Property). The Algona EISB injection area is located directly upgradient of the Chicago Avenue ditch. Access, stormwater, and utility constraints are described in Appendix B.

3.3.2 Controls to Prevent Hazardous Material Releases

The following controls will be implemented to prevent releases of hazardous materials during excavation and handling of contaminated soils at AOC A-01 as described in Appendix A:

- Installation and maintenance of temporary erosion and sediment control structures and implementation of Best Management Practices (BMPs). These controls and BMPs include wetting of soil, as necessary, during excavation to control dust; silt fencing; and installing filter fabric on top of catch basins that could receive drainage from the excavation area.
- Properly covering and securing loads during hauling operations.

The following controls will be implemented to prevent releases of hazardous materials during implementation of EISB injection at the Algona Focus area and ongoing groundwater monitoring as described in Appendix B:

- Proper handling of investigation derived waste.
- Injection and mixing station will be contained within secondary containment.
- Monitoring for potential infiltration of injection fluid to leaky sections of storm drains.
- Use of storm drain plugs in strategic locations to contain potential infiltration to storm drains and prevent potential discharge to the Chicago Avenue ditch.

3.3.3 Flooding

Both the AOC A-01 excavation and the Algona Focus Area EISB injections are planned during the dry season (August to September) to minimize impacts of both high-water table and flooding during the cleanup actions.

For AOC A-01 excavation, BMPs and TESC will be in place to minimize potential impacts from stormwater. After excavation and backfilling at AOC A-01 is complete, the final grade will be restored to the area's original elevation and surface material (asphalt). Site restoration will not cause an increase in the risk for flooding because the areas are being restored to their original conditions and no stormwater infrastructure will be impacted.

Algona EISB injection activities may require temporary blockages of stormwater drainage systems as described above and in Appendix B. If rain events occur during injections, stormwater will be rerouted around plugged sections or the temporary plugs will be removed to allow for stormwater to drain.

3.3.4 Seismic Activities

The Site is located in a seismically active zone. However, the cleanup actions do not involve structural components that would need to be designed to anticipate seismic forces.

3.3.5 Temperature Extremes

The cleanup actions are occurring in the generally mild climate of the Pacific Northwest. Excavation and injection activities will occur in the summer months, therefore cold temperature extremes will not affect the cleanup actions. Higher temperatures (i.e., above 80 degrees Fahrenheit) may affect the health and safety of the construction workers; therefore, a Site-specific HASP will be prepared by the contractor that will include provisions to address hydration and rest breaks to keep workers cool.

Monitoring of the cleanup actions could take place in winter months and colder temperatures. Cold temperatures will also impact the safety of the workers and will also be addressed in the HASP.

3.3.6 Existing and Future Site Uses

The AOC A-01 excavation will be limited to the Boeing Auburn property, which is currently used and is planned for continued use in the future for industrial manufacturing. The planned cleanup action is compatible with current and future uses.

The Algona EISB injection area is located on commercial properties. Injection and monitoring wells will be located as approved by Ecology and agreed to by the property owners. If injection wells are located at an unacceptable location in the future due to future development, they may be relocated as agreed to by Ecology and property owners. The planned cleanup is compatible with current and future uses.

3.3.7 Local Planning and Development Issues

The locations where remedial actions are planned are zoned for industrial/commercial use. There are no known development issues that would impact the proposed cleanup action. If locations of injection

wells or monitoring wells cause concerns for future development activities, wells may be decommissioned or relocated as necessary.

3.3.8 Public Access

The AOC A-01 excavation area is located on the Boeing Auburn property which is secured and fenced for no public access. The local excavation area will be separated from other activities by temporary construction fencing. Construction plans and specifications will ensure that the cleanup activities can be staged and implemented in a manner that maintains vehicle traffic a safe distance from the excavation.

The injection activities at the Algona Focus area are planned in a way that will use limited areas of the commercial property. Active working areas will be barricaded to prevent public access.

4.0 COMPLIANCE MONITORING

Compliance monitoring is a required element of any MTCA cleanup action. Compliance monitoring will be conducted in accordance with WAC 173-340-410 to confirm that cleanup standards have been achieved and to confirm the long-term effectiveness of cleanup actions at the Site. Compliance monitoring for the cleanup actions at AOC A-01 and AOC A-14 are summarized below and detailed in the work plan for AOC A-01 (Appendix A) and the Algona Focus Area EISB work plan (Appendix B) and in the Compliance Monitoring Plan (Landau 2023a).

The three types of compliance monitoring to be conducted are:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during the construction period of the cleanup action.
- **Performance Monitoring** to confirm that the cleanup action has attained cleanup standards or other performance standards.
- **Confirmation Groundwater Monitoring** to confirm the long-term effectiveness of the cleanup action once cleanup standards and performance standards have been attained.

Compliance monitoring will be implemented using the field methods and procedures documented in the *Sampling Analysis Plan* (Landau 2023d) and analytical methods and quality assurance measures in the *Quality Assurance Project Plan* (Landau 2023c). Protection monitoring will be addressed as described in the Site-specific *Health and Safety Plan* and implementation of environmental protection plans as described in the area-specific Work Plans (Appendices A and B); performance monitoring and confirmational monitoring are discussed in the following sections.

4.1 AOC A-01

Compliance monitoring will be conducted for COCs at AOC A-01 in soil and groundwater during and following excavation activities to confirm the effectiveness of the cleanup action.

4.1.1 Performance Monitoring

Soil field monitoring will occur as excavation activities are carried out to ensure that contaminated soil is removed to the maximum extent practicable. Groundwater performance monitoring will include ongoing groundwater sampling until CULs are met near AOC A-01, as described in Appendix A.

4.1.2 Confirmational Monitoring

Confirmational monitoring will include final excavation soil sampling, as described in Appendix A. Final soil samples will be collected from the bottom and sidewalls of the excavation to determine soil conditions remaining in place. Once groundwater CULs are met, soil CULs will be required to meet the Method C direct contact CUL, since soil concentrations will be empirically demonstrated to be protective of groundwater. If soil Method C CULs and/or Method A groundwater CULs are not met, a restrictive environmental covenant may be used to satisfy the requirements of the applicable model remedy.

A monitoring well or wells installed near AOC A-01 will be used to demonstrate compliance with groundwater CULs. Groundwater confirmational monitoring will include 4 quarters of TPH monitoring at representative monitoring well(s) near AOC A-01 after CULs are met in groundwater, as described in Appendix A.

4.2 AOCs A-14 and A-15

Compliance monitoring will be conducted at AOCs A-14 and A-15 for COCs and MNA parameters to confirm effectiveness of the cleanup action. Performance monitoring will be conducted to evaluate the operation of EISB at the Algona Focus Area. Performance monitoring also includes MNA monitoring throughout the Site as described in the CMP (Landau 2023a). Confirmational monitoring to confirm the long-term effectiveness of the cleanup action for AOCs A-14 and A-15 will occur after MNA monitoring (described in the CMP [Landau 2023a]) demonstrates achievement of CULs.

4.2.1 Algona Focus Area Performance Monitoring

Performance monitoring will be conducted to evaluate the operation of EISB at the Algona Focus Area and will be followed by MNA monitoring after the EISB is completed. MNA monitoring is described in the CMP (Landau 2023a). EISB monitoring is summarized below and detailed in Appendix B.

EISB monitoring will include quarterly groundwater monitoring for the year after each injection, transitioning to semiannual monitoring between injection events. After the final injection event, annual monitoring will be performed for 2 years followed by monitoring every 2 years to track sustained treatment. The monitoring frequency may be adjusted based on conditions in the Algona Focus Area and with Ecology's concurrence.

4.2.2 MNA Performance Monitoring

An outline of the general plan for selecting groundwater monitoring locations and the rationale for changes over time as monitoring progresses are described below. A conceptual long-term monitoring plan (Landau 2021) was approved by Ecology (Ecology 2021b) and was followed by a detailed long-term MNA monitoring plan described in the Ecology-approved CMP (Landau 2023a). Monitoring frequency will be adjusted in the future based on data and with Ecology's concurrence. The monitoring described in the CMP is summarized below.

- Boeing Auburn Facility monitoring:
  - Select locations on the Boeing Auburn Facility will be monitored for CVOCs (TCE and breakdown products cDCE, tDCE, 1,1-DCE, and VC) every 5 years.
  - Select locations along the Boeing Auburn Facility CPOC boundary will be monitored for CVOCs every 2 years.
- The following general rules apply for groundwater monitoring downgradient of the CPOC:
  - Annual groundwater monitoring will occur in the Algona Focus Area except where more frequent monitoring will occur as part of the Algona Focus Area EISB.

  - Select locations with concentrations greater than DWQS and selected plume boundary locations will be monitored annually.
  - Select locations with exceedances of SWQS will be monitored every 5 years.
  - MNA parameters will be monitored at select wells every 5 years (except where more frequent monitoring will occur in the Algona area as part of the Algona Focus Area EISB).
  - Once a monitoring location reaches CULs, the location will be sampled one additional time to ensure CULs are met and then that location will be removed from the monitoring program (unless it is identified as a plume boundary well).
- Once concentrations decrease below DWQS at all wells monitored downgradient of the CPOC, monitoring and reporting will be reduced to every 5 years until CULs (SWQS) are met and confirmational monitoring will then be conducted.

4.2.3 Confirmational Monitoring

Confirmational monitoring will be initiated after completion of performance monitoring. The confirmational monitoring well network and sample event timing will be determined in consultation with Ecology when performance monitoring is completed. Specifics of confirmational monitoring are described in the CMP (Landau 2023a).

5.0 PROJECT SCHEDULE

The proposed schedule for implementation of the Site cleanup actions has been developed to meet the requirements of Enforcement Order No. DE-21533 with Ecology (Ecology 2023) and the CAP, and is presented below, contingent upon Ecology approval of this EDR. However, implementation of the EDR may be revised in consultation with and approval from Ecology due to weather delays, access agreements with private properties, coordination with Boeing Facility requirements, or other unforeseen circumstances.

Activity	Planned Schedule	Schedule Requirements
Excavation at AOC A-01	August to September 2024	The first dry season (July – September), at least 3 months after Ecology-approval of the final EDR.
Groundwater Performance Monitoring at AOC A-01	June/July 2025 until CULs are met	Will occur at the same time as Site-wide MNA performance monitoring.
EISB Implementation and Performance Monitoring at Algona Focus Area	2024 to 2032	The first dry season (July – September), at least 3 months after Ecology-approval of the final EDR. Occurs approximately every 4 years for up to three injection events based on results of injection events (Total of 12 years)
Installation of Injection and Monitoring Wells	2nd Quarter 2024	Contingent on Ecology approval of final EDR and approval from private property owners
1st Injection Event	July to September 2024	Contingent on Ecology approval of final EDR and approval from private property owners
2nd Injection Event	July to September 2028	Contingent on monitoring results following 1st injection event and approval from private property owners
3rd Injection Event	July to September 2032	Contingent on monitoring results following previous injection events and approval from private property owners
MNA for Site-wide Groundwater CVOC Contamination	July 2023 until CULs are met	Began July 2023 and will continue as described in the Compliance Monitoring Plan (Landau 2023a)
Submit Engineering Design Report to Ecology for AOC A-09 remedy	TBD	When building is removed/demolished or Boeing property operations allows access for excavation, See section 2.2
Perform Future Excavation at AOC A-09	TBD	The first dry season (July – September), at least 6 months after Ecology's approval of the final EDR for AOC A-09

6.0 USE OF THIS REPORT

This Engineering Design Report has been prepared for the exclusive use of Boeing and applicable regulatory agencies for specific application to the Boeing of Auburn site in Auburn, Washington. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. 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, shall be at the user's sole risk. Landau 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. Landau makes no other warranty, either express or implied.

7.0 REFERENCES

Ecology. 2016. Ecology Comment regarding the Draft Remedial Investigation Report, Boeing Auburn Facility, Auburn, WA; prepared for The Boeing Company by Landau Associates; August 5, 2016; FS #2018; CS #5049; EPA WAD041337130. edited by Robin Harrover LHG.

Ecology. 2017. Model Remedies for Sites with Petroleum Impacts to Groundwater. edited by Toxics Cleanup Program. Olympia, WA: Washington State Department of Ecology.

Ecology. 2021a. Ecology Comments of Draft Feasibility Study Boeing Auburn Facility, Auburn, Washington by Landau Associates, Inc. for the Boeing Company, dated October 30, 2019, and Draft Supplemental Feasibility Study Report, Boeing Auburn Facility, Auburn, Washington by Landau Associates, Inc. for the Boeing Company, dated December 11, 2020; FS #2018; CS #5049; EPA #WAD041337130. edited by Li Ma Washington State Department of Ecology. Seattle, Washington.

Ecology. 2021b. Groundwater Monitoring Plan, status of FS, and dCAP Schedule, Boeing Auburn Facility, Agreed Order No. 01HWTRNR-3345. edited by Li Ma. Seattle, WA.

Ecology. 2022. Cleanup Action Plan, Boeing Auburn Facility, Auburn, Washington. Olympia, Washington: Washington Department of Ecology.

Ecology. 2023. Enforcement Order No. DE-21533: In the Matter of Remedial Action by: The Boeing company TO: The Boeing Company. edited by Washington State Department of Ecology.

Geomatrix. 2003. Remedial Investigation Work Plan, Boeing Auburn Plant, Auburn, Washington. Geomatrix Consultants.

Landau. 2004. Soil Excavation Near Area of Concern A-01. edited by Eric Weber. Edmonds, WA: Landau Associates, Inc.

Landau. 2017a. Algona Pilot Test Report, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc.

Landau. 2017b. Remedial Investigation Report, Boeing Auburn Facility, Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

Landau. 2018. Algona Pilot Test - Second Year of Monitoring, Boeing Auburn Facility, Auburn, Washington. edited by LG Sarah Fees and Jennifer Wynkoop: Landau Associates, Inc.

Landau. 2019. Draft Feasibility Study Boeing Auburn Facility, Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

Landau. 2020. Draft Supplemental Feasibility Study, Boeing Auburn Facility; Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

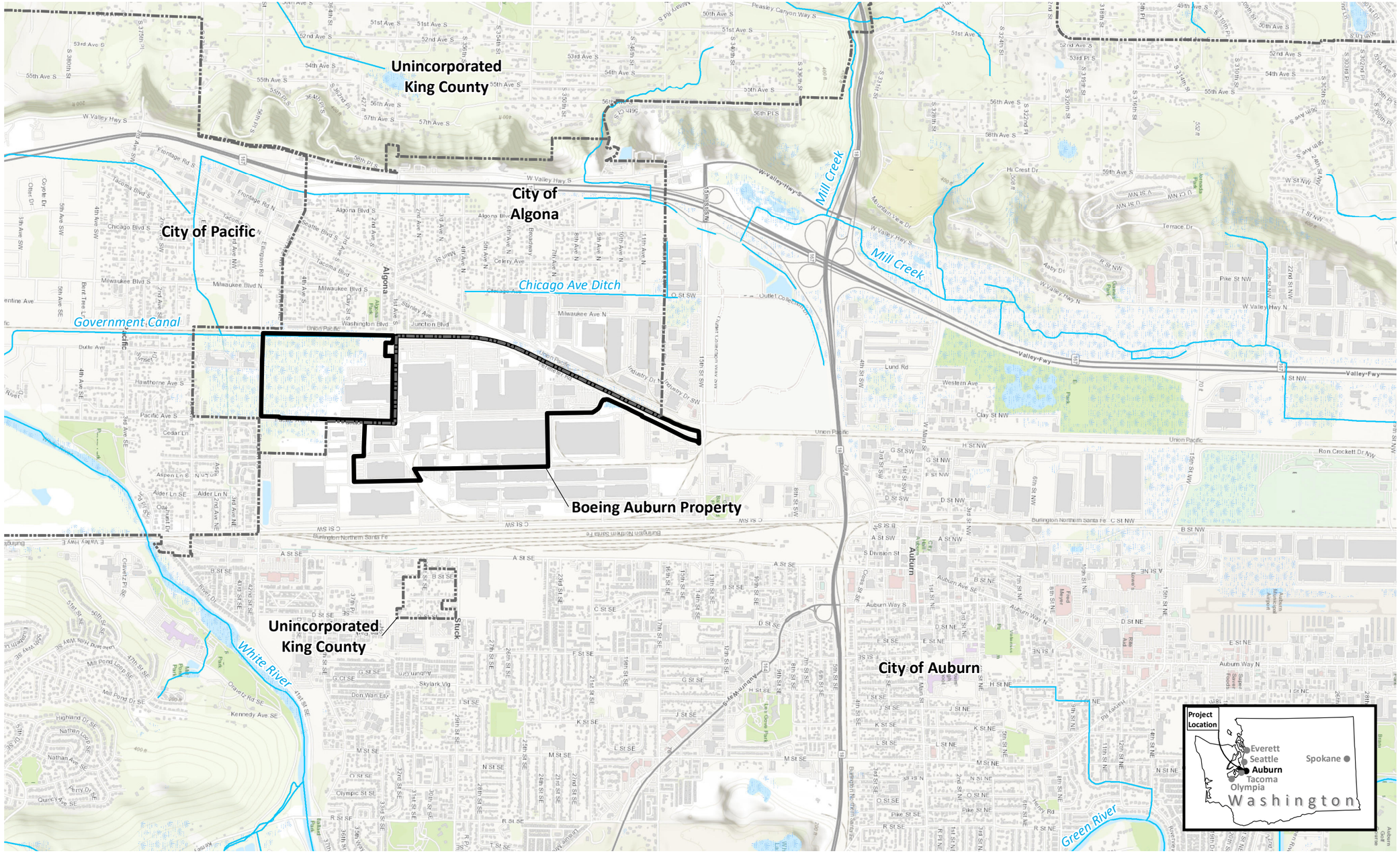
Landau. 2021. AOC A-14: Conceptual Long-Term Groundwater Monitoring Plan, Boeing Auburn Facility; Auburn, Washington. edited by Sarah Fees. Tacoma, Washington: Landau Associates, inc.

Landau. 2023a. Compliance Monitoring Plan, Boeing Auburn Facility; Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

Landau. 2023b. Health and Safety Plan, Boeing Auburn Facility, Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

Landau. 2023c. Quality Assurance Project Plan, Boeing Auburn Facility, Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.

Landau. 2023d. Sampling and Analysis Plan, Boeing Auburn Facility; Auburn, Washington. Tacoma, Washington: Landau Associates, Inc.



Legend

- Boeing Property
- City Limits
- Waterways
- Water Bodies
- Wetland Areas

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 2,000 4,000

Scale in Feet

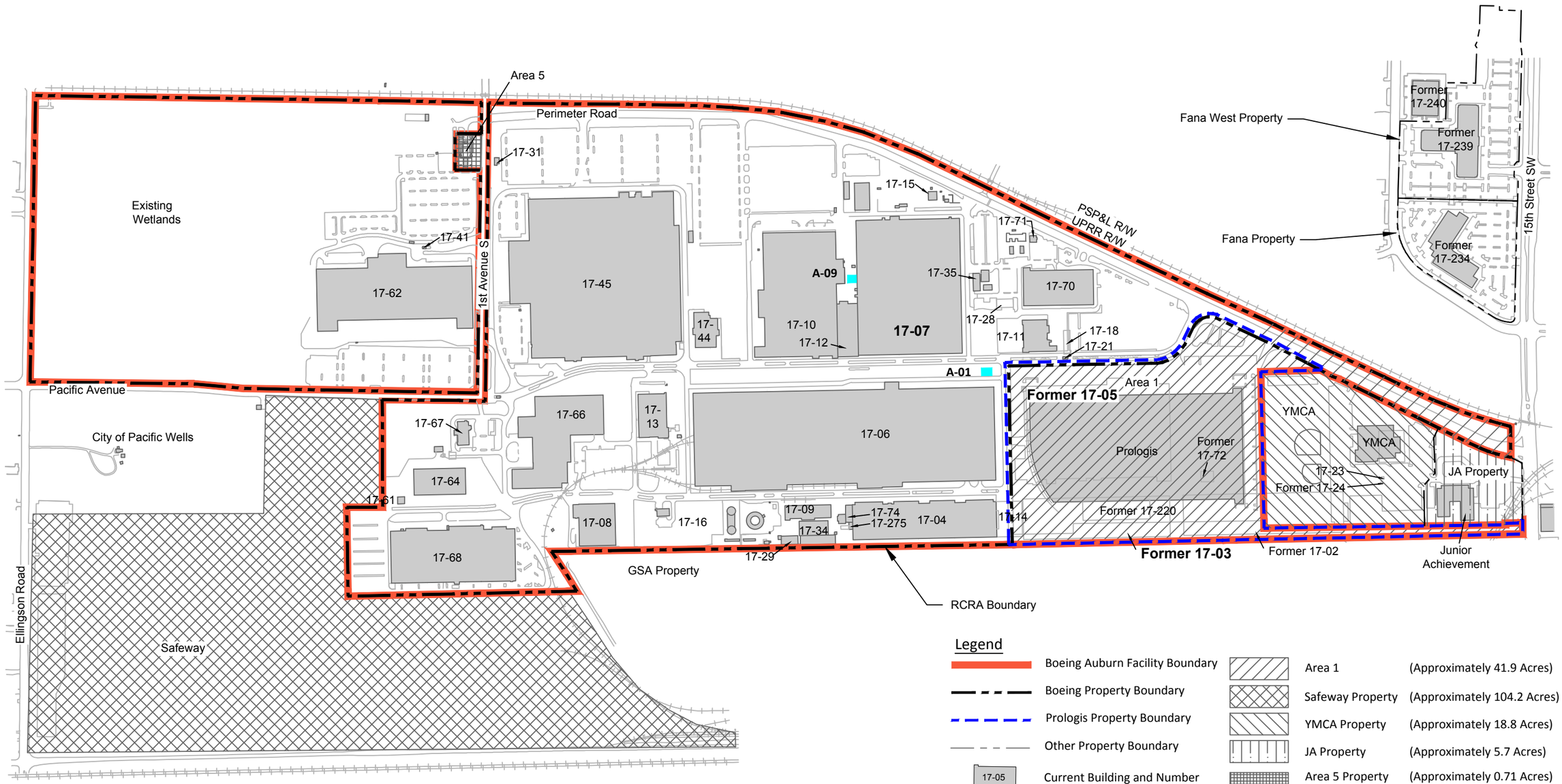
N

Data Source:Esri World Topo Map

Boeing Auburn Auburn, Washington	**Vicinity Map**	Figure 1

LANDAU ASSOCIATES

G:\Projects\025\164\200303\EDR\F01VicMapLandscape.mxd 9/19/2023



Legend

- Boeing Auburn Facility Boundary
- Boeing Property Boundary
- Prologis Property Boundary
- Other Property Boundary
- 17-05 — Current Building and Number
- A-01 — Area of Concern (AOC)

Area 1	(Approximately 41.9 Acres)
Safeway Property	(Approximately 104.2 Acres)
YMCA Property	(Approximately 18.8 Acres)
JA Property	(Approximately 5.7 Acres)
Area 5 Property (PSE Property)	(Approximately 0.71 Acres)

Notes

1. Former Building Numbers 17-234, 17-239 and 17-240 are currently owned by Fana.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

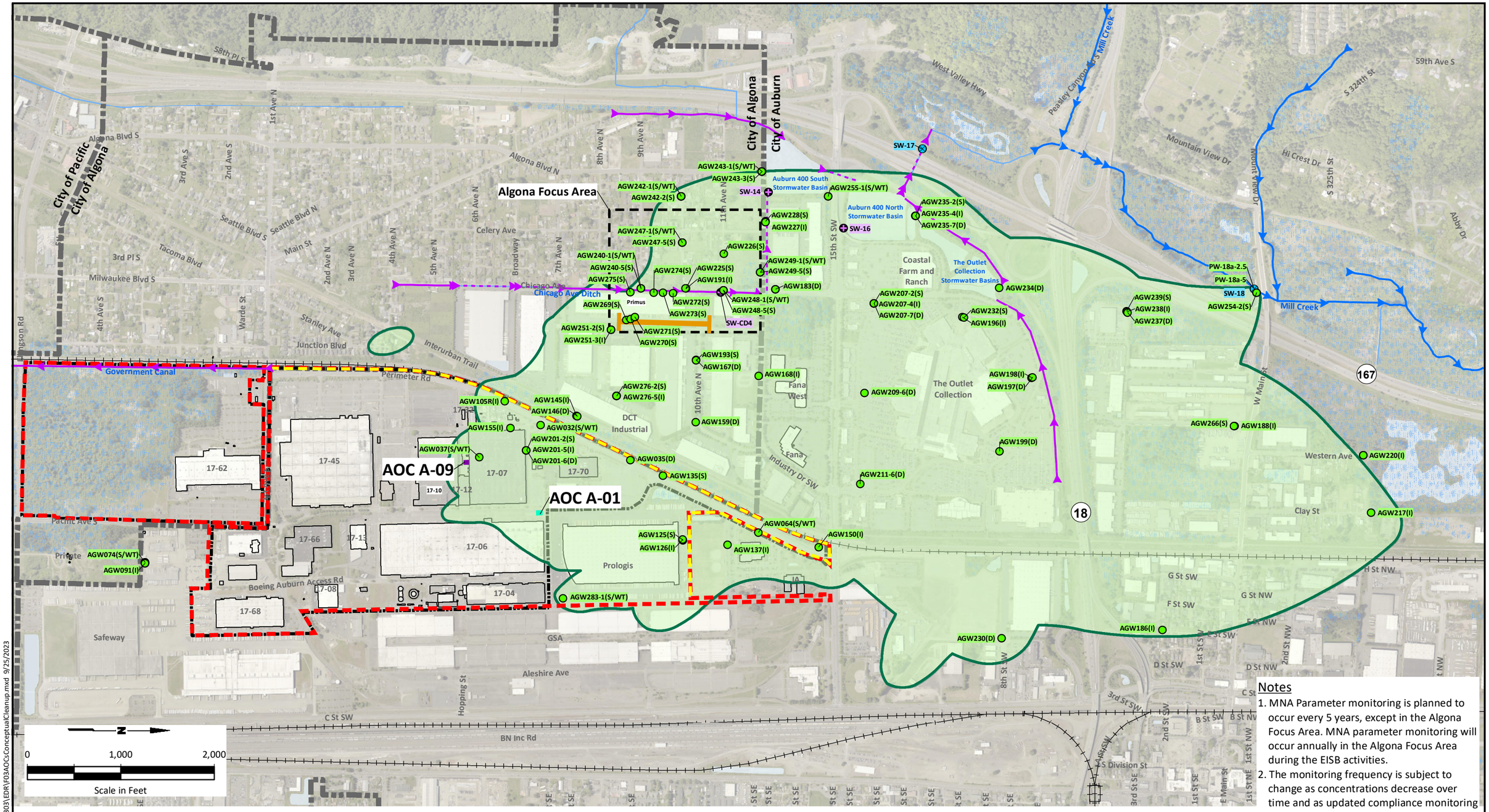
0 600 1200

Scale in Feet

Base map source: Geomatrix 2003

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Boeing Auburn Facility Map**	Figure 2



Legend

- MNA Remedy Monitoring Well
- MNA Remedy Stormwater Sample Location
- MNA Remedy Surface Water Sample Location
- AOC A-01: Near Term Excavation
- AOC A-09: Future Excavation
- AOC A-14: TCE/VC Plume Extent - June 2021
- City Limits
- Boeing Property
- Wetland Areas
- Water Bodies
- Waterways
- Open Surface Water Waterway
- Open Stormwater Waterway
- Piped Surface Water Waterway
- Piped Stormwater Waterway
- Algona Focus Area Conceptual Enhanced In Situ Bioremediation (EISB) Injection Row
- Boeing Auburn Facility Boundary
- Boeing Auburn Facility Boundary Conditional Point of Compliance

Data Source: King County GIS.

Notes

1. MNA Parameter monitoring is planned to occur every 5 years, except in the Algona Focus Area. MNA parameter monitoring will occur annually in the Algona Focus Area during the EISB activities.
2. The monitoring frequency is subject to change as concentrations decrease over time and as updated compliance monitoring plans are approved by Ecology.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

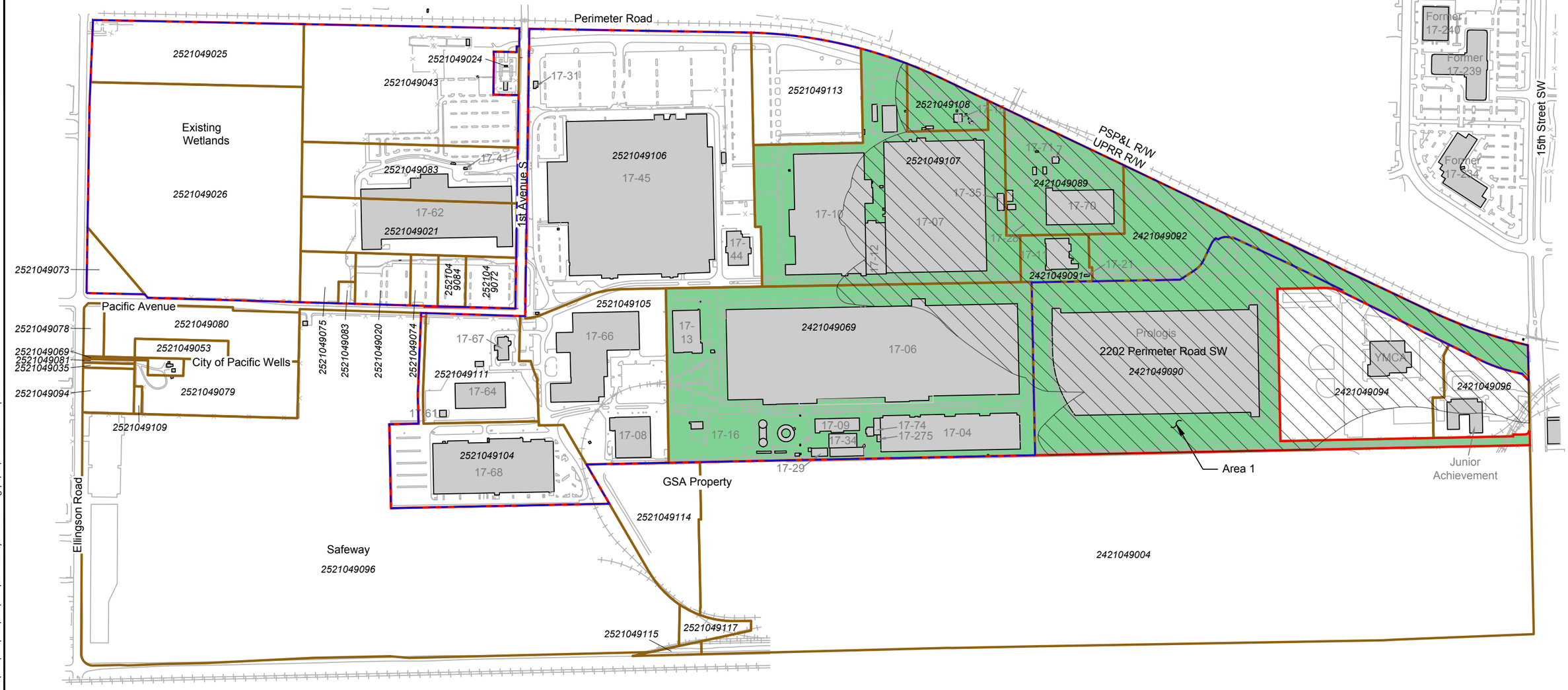
LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

Areas of Concern and Cleanup Action

Figure 3

G:\Projects\025\164\200\303\EDR\F03AOCsConceptualCleanup.mxd 9/25/2023



Legend

- A-01 — Parcels where an Environmental Covenant will be Applied
- TCE/VC Plume Extent - June 2021
- 17-68 — Current Building and Number
- Property Boundary
- Boeing Auburn Facility Boundary
- Parcel Boundary

Notes:

1. Specific restrictions and requirements will be defined in the Environmental Covenants.
2. Buildings formerly identified as 17-234, 17-239, and 17-240 are currently owned by Fana.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 600 1200

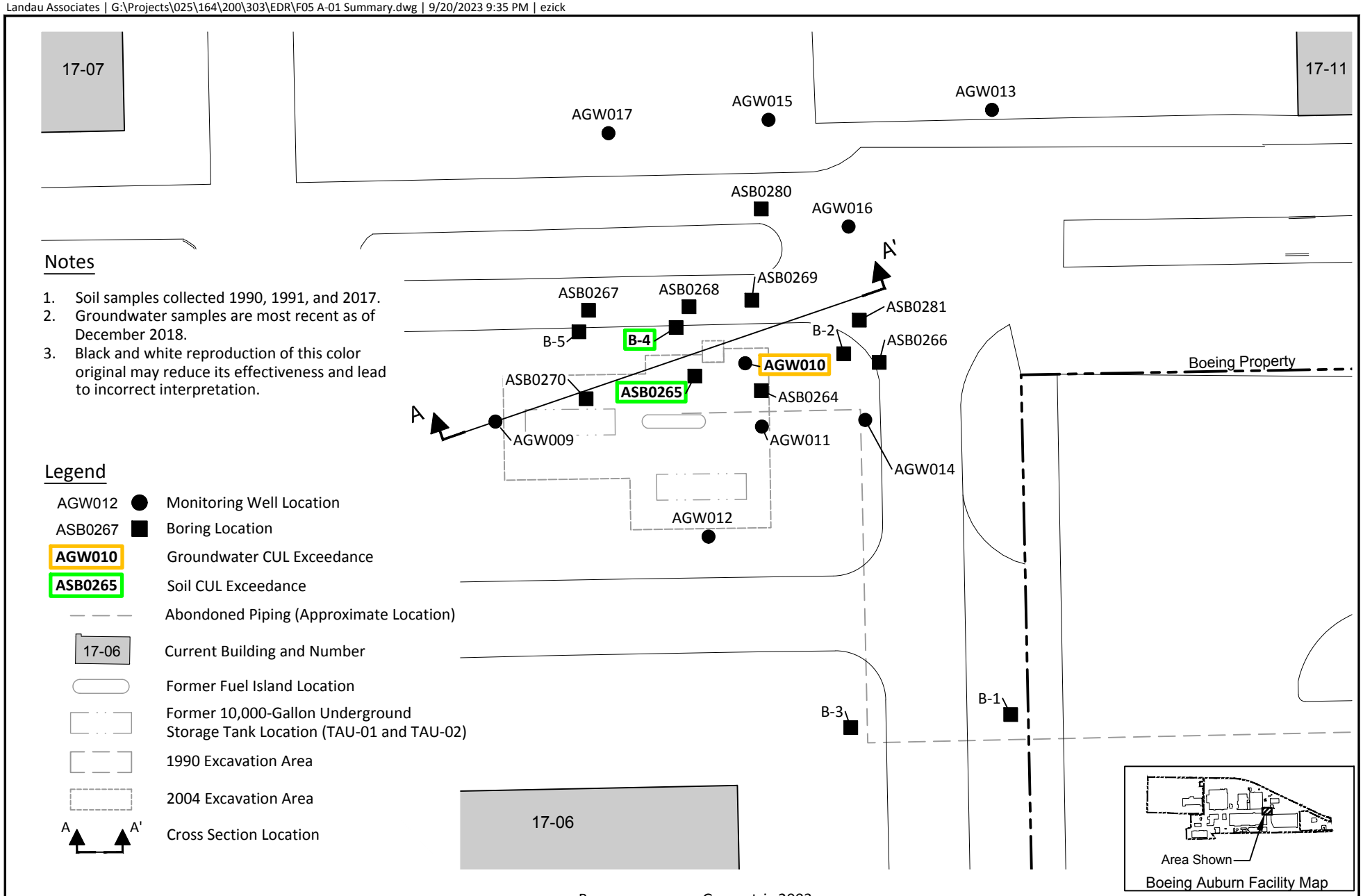
Scale in Feet

Base map source: Geomatrix 2003

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Boeing Auburn Facility Environmental Covenant Area**	Figure 4

Landau Associates | G:\Projects\025\164\200\303\EDR\F04 Facility RC Area.dwg | 9/20/2023 9:32 PM | ezick

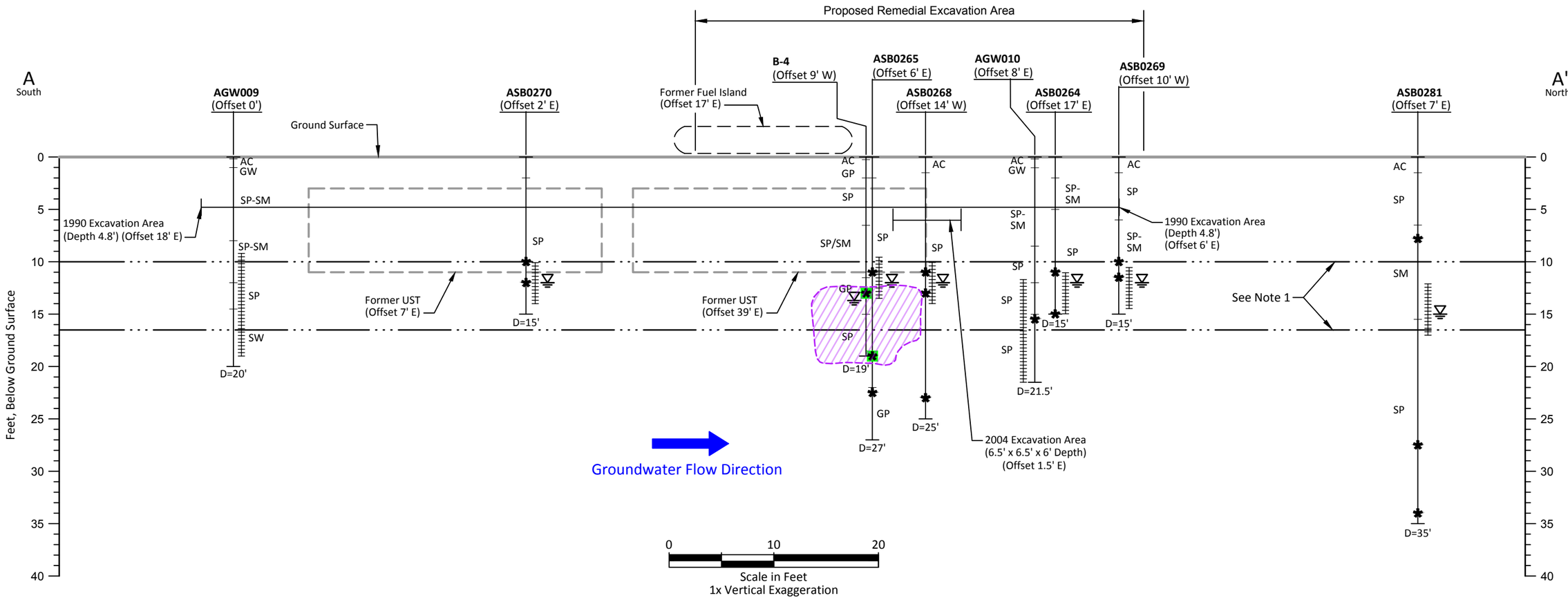


LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01: Building 17-06 Former Underground Storage Tanks (TAU-01 and TAU-02) Exploration Summary

Figure 5



0 10 20

Scale in Feet
1x Vertical Exaggeration

Legend

ASB0281 (offset: 7' E) — Exploration Designation

Top of Exploration

✱ = Soil sample (Analytes = Not detected above CULs)

✱ = Soil sample (Analytes = Detected above CULs)

SM — Unified Soil Classification Symbol (USCS)

Water Level (At Time of Drilling)

Screen Interval

D=35' — Depth of Exploration (feet)

= Analytes detected above CULs in soil

USCS Soil Legend

- AC = asphalt/concrete pavement
- GP = poorly graded gravel; gravel/sand mixture(s); little or no fines
- GW = well-graded gravel; gravel/sand mixture(s); little or no fines
- SM = silty sand; sand/silt mixture(s)
- SP = poorly graded sand; gravelly sand; little or no fines
- SW = well-graded sand; gravelly sand; little or no fines

Acronyms / Abbreviations

AOC	=	area of concern
DRO	=	diesel-range organics
GRO	=	gasoline-range organics
mg/kg	=	milligrams per kilogram
CUL	=	cleanup level
µg/L	=	micrograms per liter
UST	=	underground storage tank

Notes

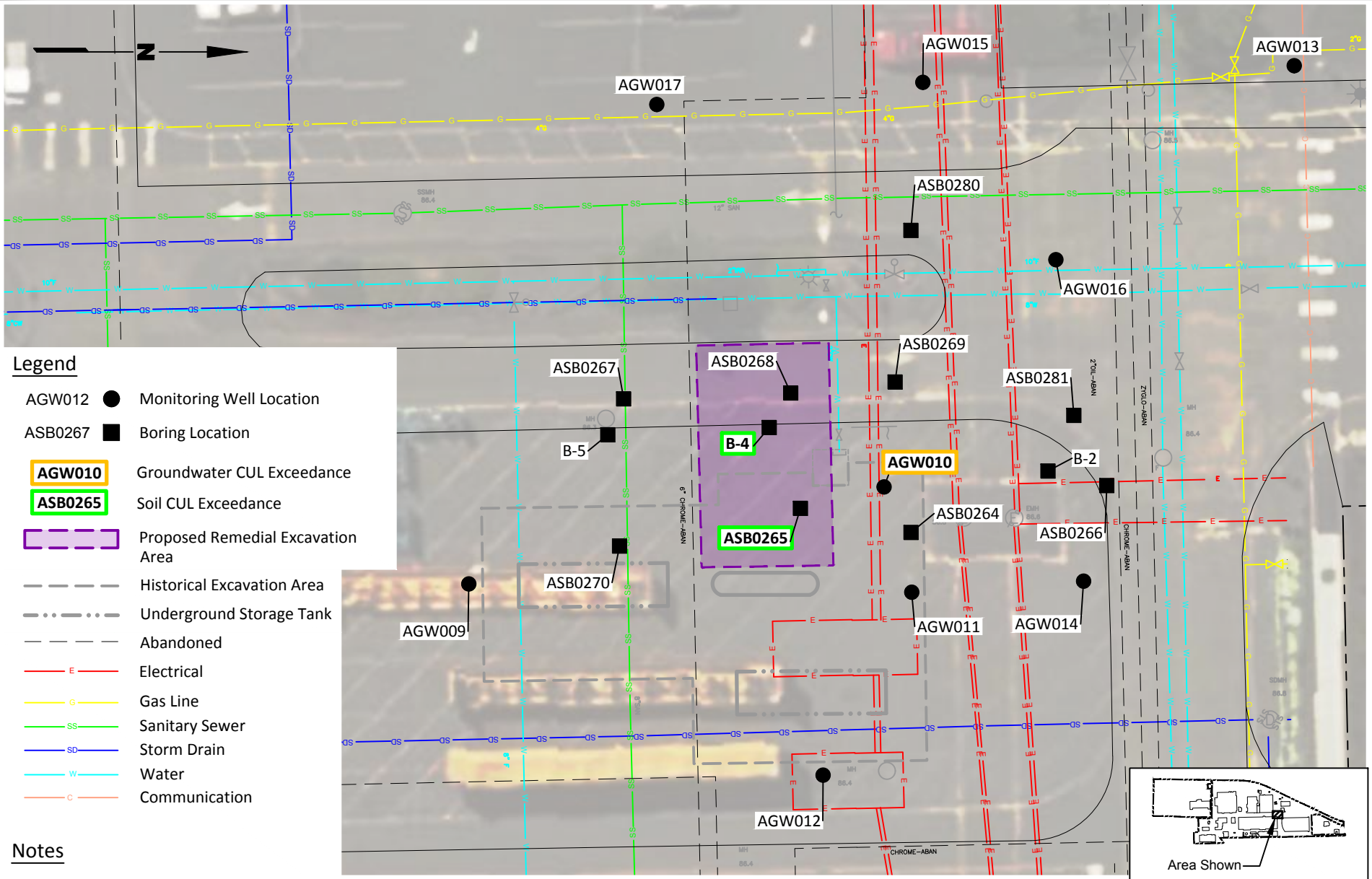
1. Lines indicated show the maximum and minimum water level elevation measured from AGW009 or AGW010 from December 2003 to December 2018.
2. B-4, AGW009, and AGW010 were completed August 1991, and borings in the "ASB" series were completed June or August 2017.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01: Building 17-06 Former Underground Storage Tanks (TAU-01 and TAU-02) Exploration Cross-Section

Figure
6



Legend

- AGW012 — Monitoring Well Location
- ASB0267 — Boring Location
- **AGW010** — Groundwater CUL Exceedance
- **ASB0265** — Soil CUL Exceedance
- Proposed Remedial Excavation Area
- Historical Excavation Area
- Underground Storage Tank
- Abandoned
- Electrical
- Gas Line
- Sanitary Sewer
- Storm Drain
- Water
- Communication

Notes

1. Pre-FS Boring Locations (Identified with B) are approximate.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Base map source: Geomatrix 2003, ©Bing Imagery, 2018

0 25 50
Scale in Feet

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01: Planned Excavation Area

Figure 7

Legend

AGW016 ●	Monitoring Well Location
AGR07HA1 ◎	Soil Grab Sample Location (Locations are Approximate)
AGW050	Groundwater CUL Exceedance
AGR07HA1	Soil CUL Exceedance
AGW050	Groundwater and Soil CUL Exceedance
1	Scrubber
17-07	Current Building and Number
B 11	Building 17-07 Column Designations
A A'	Cross Section Location

Notes

1. Soil grab samples collected in 1996
2. Groundwater samples are most recent as of December 2018.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

11 10 9

1 2 3 4

B C

A A'

1996 Excavation Area

AGW037

AGW050

AGW278

AGW047

AGW046

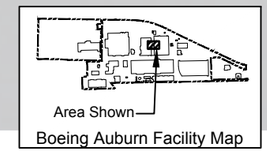
AGW049

AGW048

PAU/17-07-24
PAU/17-07-40
PAU/17-07-25
PAU/17-07-39
CB2-AU/17-07-22
CS2-AU/17-07-11
S2-AU/17-07-12
ARG07HA2
P2-AU/17-07-16
PAU/17-07-42
PAU/17-07-41
PAU/17-07-44
PAU/17-07-43
CS2-AU/17-07-19
PAU/17-07-47
VS2-AU/17-07-18
PAU/17-07-46
AGR07HA1
VS2-AU/17-07-21
VS2-AU/17-07-20
VS2-AU/17-07-17
AGR07HA3
PAU/17-07-45
AGR07-SC4D
AGR07-SC4A
AGR07-SC4C
AGR07-SC4E
AGR07-SC4B

17-10

17-07



N

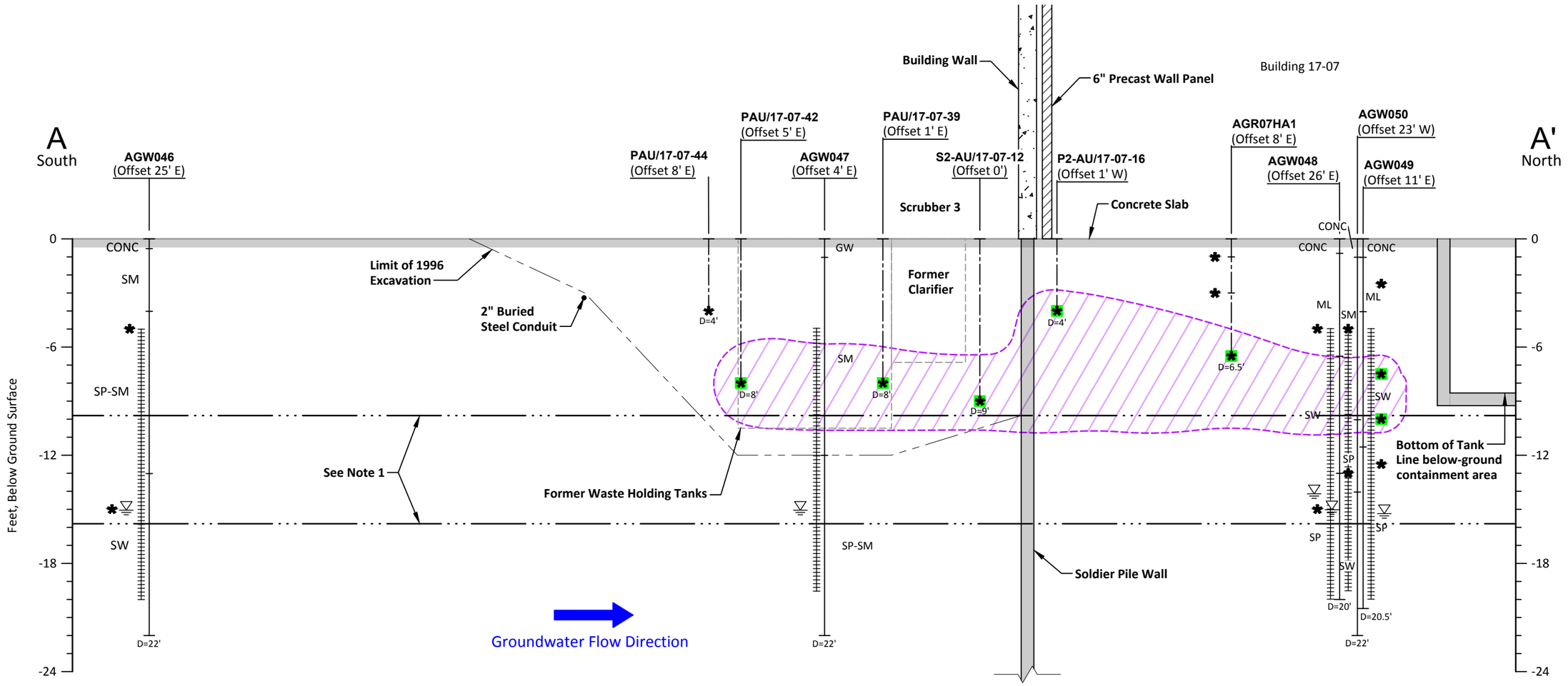
0 20 40

Scale in Feet

Sources: AGI Technologies, Figure 4, 1996; ©Bing, 2019

Boeing Auburn Auburn, Washington	**AOC A-09: Building 17-07 Acid Scrubber Drain Line Exploration Summary**	Figure 8

LANDAU ASSOCIATES



Legend

- **AGW046** (Offset: 25' E) — Exploration Designation
- Top of Exploration
- Grab Sample
- ✱ = Soil sample (Analytes = Not detected above CULs)
- ✱ = Soil sample (Analytes = Detected above CULs)
- SM — Unified Soil Classification Symbol (USCS)
- Water Level (At Time of Drilling)
- Screen Interval / Sampling Interval
- D=4' — Depth of Exploration (feet)
- = Analytes detected above CULs in soil

USCS Soil Legend

Conc	=	Concrete
GW	=	Well-graded gravel; gravel/sand mixture(s); little or no fines
ML	=	Silt
SM	=	Silty sand; sand/silt mixture(s)
SP	=	Poorly graded sand; gravelly sand; little or no fines
SW	=	Well-graded sand; gravelly sand; little or no fines

Acronyms / Abbreviations

AOC	=	area of concern
mg/kg	=	milligrams per kilogram
CUL	=	cleanup level
µg/L	=	micrograms per liter

Notes

1. Lines indicated show the maximum and minimum water level elevation measured from AGW047-AGW050 from August 2004 to December 2018.
2. All borings and wells shown on this figure were completed in July, August, and September 1996.
3. The limits of the 1996 excavation may not extend to 12 feet below ground surface at all locations. Soil samples shown were collected from soil remaining in place.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 6 12
Scale in Feet
1x Vertical Exaggeration

Boeing Auburn
Auburn, Washington

AOC A-09: Building 17-07 Acid Scrubber Drain Line Exploration Cross-Section

Figure 9

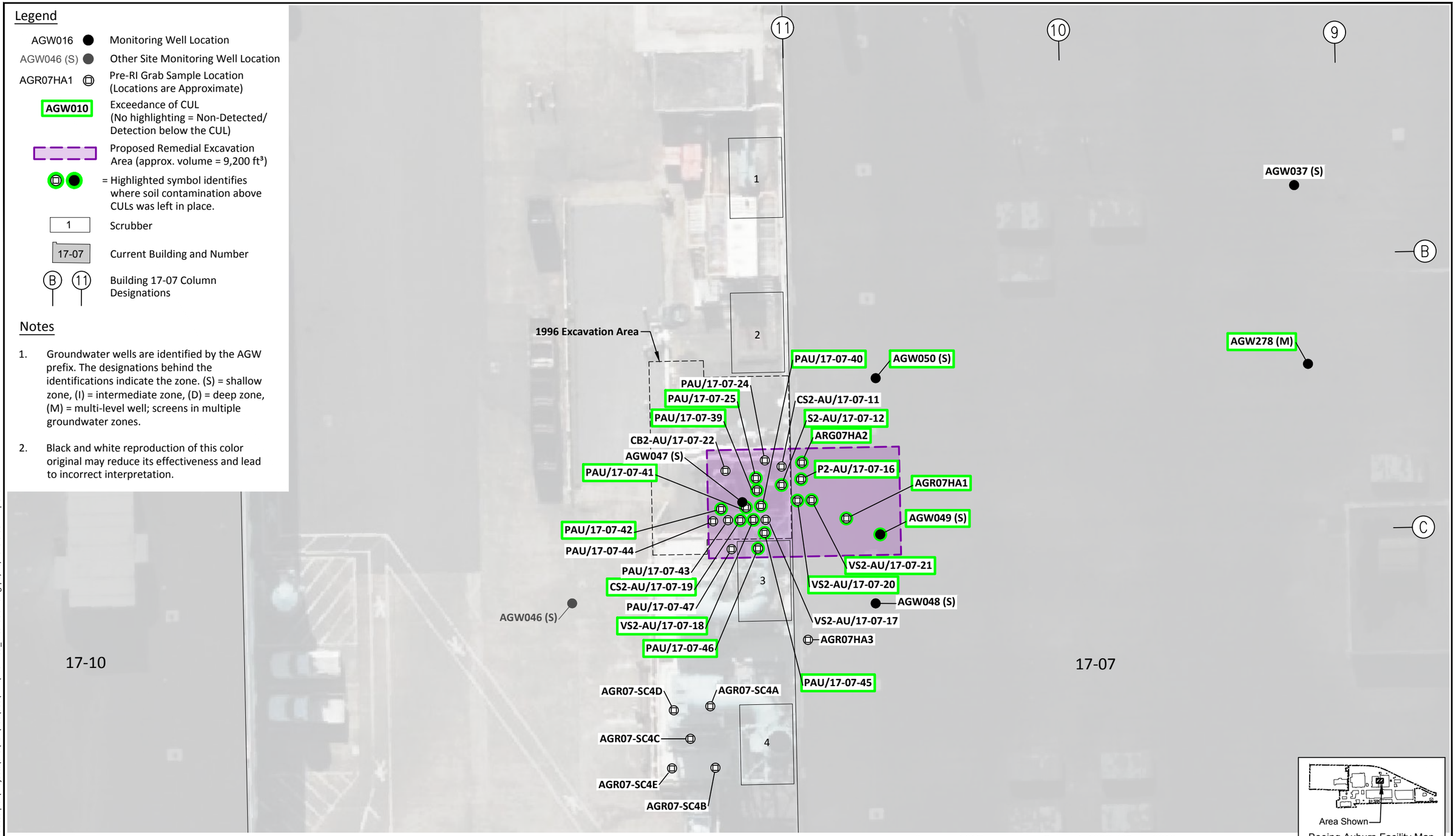
LANDAU ASSOCIATES

Legend

- AGW016 — Monitoring Well Location
- AGW046 (S) — Other Site Monitoring Well Location
- AGR07HA1 — Pre-RI Grab Sample Location (Locations are Approximate)
- **AGW010** — Exceedance of CUL (No highlighting = Non-Detected/ Detection below the CUL)
- Proposed Remedial Excavation Area (approx. volume = 9,200 ft³)
- = Highlighted symbol identifies where soil contamination above CULs was left in place.
- 1 — Scrubber
- 17-07 — Current Building and Number
- B, 11 — Building 17-07 Column Designations

Notes

1. Groundwater wells are identified by the AGW prefix. The designations behind the identifications indicate the zone. (S) = shallow zone, (I) = intermediate zone, (D) = deep zone, (M) = multi-level well; screens in multiple groundwater zones.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Sources: AGI Technologies, Figure 4, 1996; ©Bing, 2019

N

0 20 40

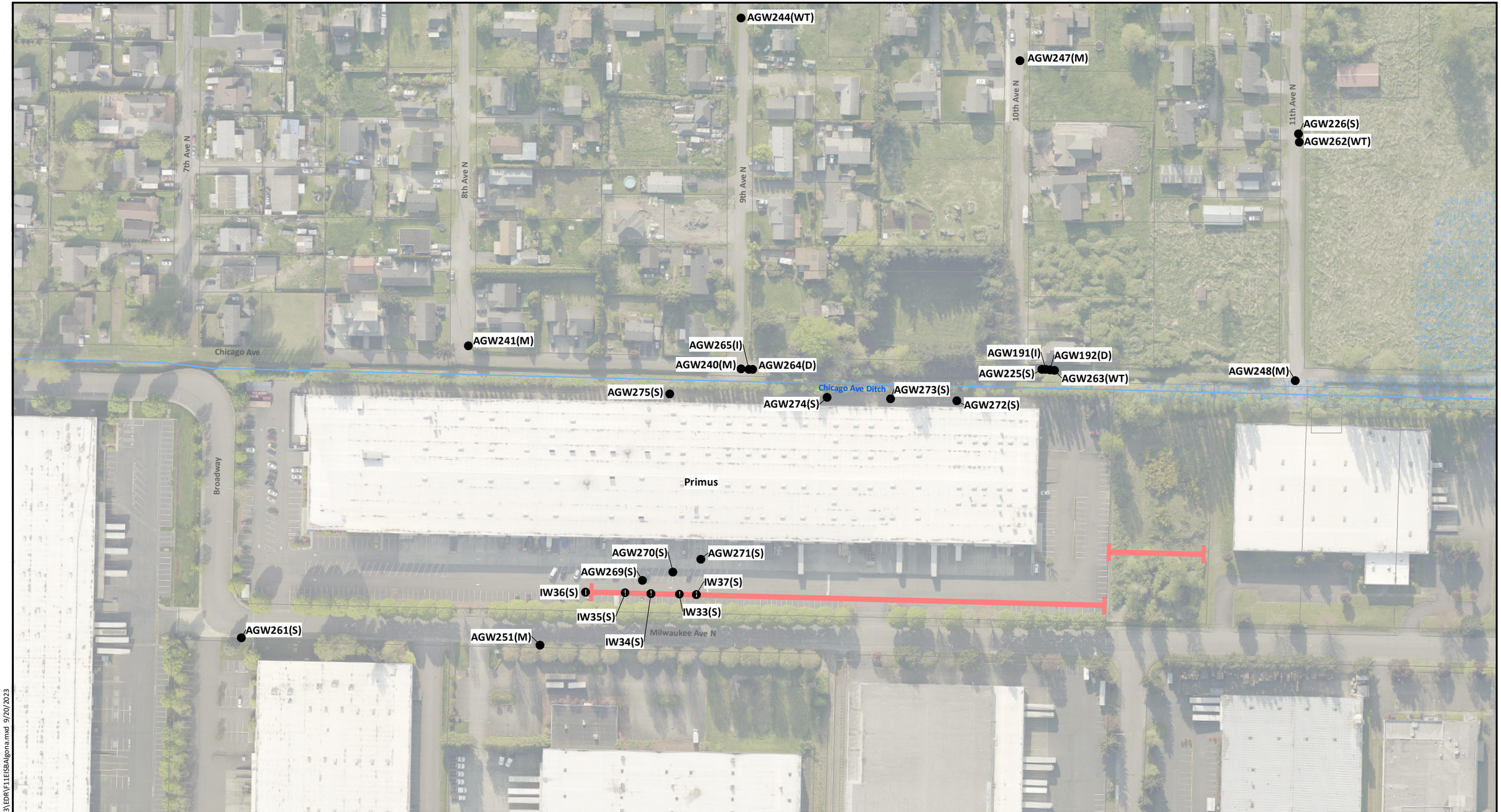
Scale in Feet

Boeing Auburn
Auburn, Washington

AOC A-09: Conceptual Future Excavation Area

Figure 10

LANDAU ASSOCIATES



Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. The designations behind the well identifications indicate the zone.
   (WT) = water table
   (S) = shallow zone (water table to 35 ft bgs)
   (I) = intermediate zone (35 to 75 ft bgs)
   (D) = deep zone (75 to 100 ft bgs).

Legend

- Existing Monitoring Well
- Existing Injection Well
- Wetland Areas
- Water Bodies
- Waterways
- Algona Injection Row

0 150 300

Scale in Feet

N

Data Source: King County GIS.

G:\Projects\025\164\200\303\EDR\F11EISBAlgona.mxd 9/20/2023

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**AOC A-14: Planned EISB Algona Focus Area**	Figure 11

Table 1
Descriptions of Areas of Concern, Remedies, and Compliance Monitoring
Boeing Auburn Facility
Auburn, Washington

Area of Concern		Description	COCs	Selected Cleanup Remedy	Compliance Monitoring	
					Performance Monitoring	Confirmational Monitoring
A-01	USTs TAU-01 and TAU-01 Northwest of Building 17-06	Petroleum hydrocarbon contamination in soil and groundwater associated with releases from the former USTs northwest of Building 17-06	**Soil:** TPH, ethylbenzene, xylenes **Groundwater:** TPH, ethylbenzene, xylenes	Excavation of pertroleum contamination above CULs to address impacted soil, and emplacement of ORC (or similar), into the excvation backfill to address impacted groundwater. If necessary, supplemental MNA, will be performed to treat residual petroleum hydrocarbon contamination in groundwater.	**Soil:** field monitoring to ensure contaminated soil removal to extent practicable. **Groundwater:** ongoing monitoring until CULs are met near AOC A-01.	**Soil:** Final excavation soil sampling **Groundwater:** monitoring to demonstrate compliance with groundwater CULs.
A-09	Building 17-07 Acid Scrubber Drain Line	Contamination resulting from a leak from the acid scrubber drain line located on the south side of Building 17-07 near column C11 (outside of the building).	**Soil:** Cadmium and copper **Groundwater:** Cadmium, copper, and cyanide	Institutional controls to maintain the asphalt/concrete cap and continued monitoring of the groundwater contamination (monitored containment) until future excavation (if still necessary) is completed.	**Groundwater:** ongoing monitoring for COCs until groundwater CULs are met or the cleanup action (if necessary) can occur.	**Soil:** Final excavation soil sampling (if excavation is required) **Groundwater:** monitoring to demonstrate compliance with groundwater CULs.
A-14	Site-wide TCE and VC Groundwater Contamination and TCE in soil at the Boeing Auburn Facility	Area 1 and Western groundwater plumes comprised of TCE and its breakdown products cDCE and VC. Some localized areas of TCE soil contamination are present at the identified TCE release areas at the Boeing Auburn Facility.	**Soil:** TCE **Groundwater:** TCE and VC	EISB at the Algona Focus Area and MNA.	**Groundwater (EISB):** ongoing monitoring for COC and injection parameters to monitor injection progress. **Groundwater (MNA):** ongoing monitoring for COCs and MNA parameters until CULs are met.	**Groundwater/stormwater feature/Surface water:** CULs will be considered met when monitoring wells and stormwater feature/surface water monitoring locations achieve CUL or as applicable using statistical analysis evaluation of groundwater data in compliance with MTCA (WAC 173-340-720[9][d]).
A-15	Site-wide TCE and VC contamination in surface water and stormwater collection, treatment, and conveyance features	Stormwater management, conveyance, and treatment features within the Cities of Auburn and Algona (i.e., Chicago Avenue ditch, Auburn 400 north, and south stormwater retention basins), where contaminated groundwater enters or is present in these features and surface water (i.e., Mill Creek), to where contaminated groundwater may potentially flow.	**Stormwater Features and Surface Water:** TCE and VC	Conditions at AOC A-15 are directly connected and attributed to conditions in AOC A-14. Therefore, cleanup of AOC A-14 will result in achieving cleanup standards in AOC A-15.	**Stormwater Feature/Surface Water:** ongoing monitoring for COCs until CULs are met.	

Abbreviations and Acronyms:

AOC = Area of Concern
cDCE = cis-1,2-dichloroethene
COC = contaminant of concern
CUL = cleanup level
EISB = enhanced *in situ* bioremediation
MNA = Monitored Natural Attenuation
MTCA = Model Toxics Control Act
ORC = oxygen-releasing compound
TCE = trichloroethene
TPH = total petroleum hydrocarbons
UST = underground storage tank
VC = vinyl chloride
WAC = Washington Administrative Code

Table 2
Summary of Cleanup Action ARARs
Boeing Auburn
Auburn, Washington

		Chemical-Specific ARARs				Location-Specific ARARs		Action-Specific ARARs							
		Soil	Groundwater		Surface Water										
AOC	Description	MTCA Method C	MTCA Method A	MTCA Method B	MTCA Method B	WAC 173-201A, Water Quality Standards for Surface Waters of State of Washington	Uniform Environmental Covenants Act	Washington Hazardous Waste Management Act and implementing regulations: Dangerous Waste Regulations	Washington Solid Waste Management Act and its implementing regulation: Criteria for Municipal Solid Waste Landfills	Hazardous Waste Operations	State Environmental Policy Act	Washington Minimum Standards for Construction and Decommissioning	Underground Injection Control Program	Right-of-Way Use and Construction	Fire Hydrant Access
A-01	Former USTs (TAU-01 and TAU-02)	X	X				X	X	X	X	X	X			
A-14/A-15	Site-wide TCE and VC contamination in soil and groundwater and stormwater and/or surface water	X		X	X	X	X			X	X	X	X	X	X

Abbreviations and Acronyms:

AOC = area of concern
ARARs = applicable or relevant and appropriate requirements
MTCA = Model Toxics Control Act
TCE = trichloroethene
UST = underground storage tank
VC = vinyl chloride
WAC = Washington Administrative Code

APPENDIX A

AOC A-01 Excavation Work Plan

LANDAU ASSOCIATES

AOC A-01EXCAVATION WORK PLAN

Boeing Auburn Site
Auburn, Washington

January 25, 2024

Prepared for

The Boeing Company
Auburn, Washington

TACOMA
2107 South C Street, Tacoma, WA 98402 T 253.926-2493

AOC A-01 Excavation Work Plan
Boeing Auburn Site
Auburn, Washington

This document was prepared by, or under the direct supervision of, the technical professionals noted below.

Document prepared by: Sarah Fees — Primary Author — Sarah Fees, LG

Document reviewed by: Clint Jacob — Quality Reviewer — Clint Jacob, PE, LG

Date:	January 25, 2024
Project No.:	0025164.200.303
File path:	\\tacoma3\PROJECT\025\164\R\EDR\AOC A-01\Landau_BoA_AOC A-01 Excavation Work Plan_Final 01.25.2024
Project Coordinator:	KJG

LANDAU ASSOCIATES

This page intentionally left blank.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

µg/L ..... micrograms per liter
AOC ..... area of concern
bgs ..... below ground surface
Boeing ..... The Boeing Company
Boeing Auburn Plant ..... Auburn Fabrication Division Plant
BMP ..... Best Management Practice
CAP ..... Cleanup Action Plan
cDCE cis-1,2-dichloroethene
COC ..... Contaminant of Concern
CUL ..... Cleanup Level
DRO ..... diesel-range organics
Ecology ..... Washington State Department of Ecology
EDR ..... Engineering Design Report
EPA ..... US Environmental Protection Agency
FS ..... feasibility study
ft ..... foot/feet
GRO ..... gasoline-range organics
HASP ..... Health and Safety Plan
Landau ..... Landau Associates, Inc.
MCL ..... maximum contaminant level
mg/kg ..... milligrams per kilogram
mg/L ..... milligrams per Liter
MNA ..... monitored natural attenuation
MTCA ..... Model Toxics Control Act
NPDES ..... National Pollutant Discharge Elimination System
ORC ..... oxygen release compound
PID ..... photoionization detector
RI ..... remedial investigation
SAP ..... Sampling and Analysis Plan
Site ..... Boeing Auburn Site
TPH ..... total petroleum hydrocarbons
UST ..... underground storage tank
WAC ..... Washington Administrative Code
yd^3 ..... cubic yard

This page intentionally left blank.

1.0 INTRODUCTION

This document, prepared by Landau Associates, Inc. (Landau), presents a work plan for the excavation cleanup action for Area of Concern (AOC) A-01 at The Boeing Company's (Boeing's) Auburn Fabrication Division Plant (Boeing Auburn Plant). This work plan supplements—and is appended to—the engineering design for the cleanup action at AOC A-01 in the Engineering Design Report (EDR) for the Boeing Auburn Site (Site).[1] AOC A-01 is defined as petroleum hydrocarbon contamination in soil and groundwater associated with historical releases from former underground storage tanks (USTs) located northwest of the Boeing Auburn Plant Building 17-06. The locations of AOC A-01 and the Boeing Auburn Plant are shown on Figure 1.

1.1 Background

AOC A-01 is defined by petroleum hydrocarbon contamination in soil and groundwater associated with releases from two former 10,000-gallon fuel USTs (TAU-01 and TAU-02) that were installed near the northwest corner of Building 17-06 in 1967. UST TAU-01 contained diesel used to power emergency generators and UST TAU-02 contained gasoline. Historical releases from the A-01 USTs resulted in soil and groundwater petroleum hydrocarbon contamination downgradient (north and northwest) of the USTs. Both tanks and a fuel island were removed in 1990 and approximately 500 cubic yards (yd^3) of contaminated soil was excavated from the former tank areas (Geomatrix 2003). An additional 10 yd^3 of soil was removed In 2004 (Landau 2004). Subsequent site characterization investigations indicated that limited soil contamination remained in place, primarily between 10 and 20 feet below ground surface (bgs), and low-level groundwater contamination is still present in a limited area at AOC A-01.

Contaminants of concern (COCs) at AOC A-01 include total petroleum hydrocarbons (TPH) consisting mainly of gasoline-range organics (GRO) and some diesel-range organics (DRO), ethylbenzene, and total xylenes as defined in the *Cleanup Action Plan* (CAP; Ecology 2022). AOC A-01 consists of small discreet areas of contaminated soil and groundwater and does not impact off-property groundwater. There are no current complete exposure pathways to contamination for this AOC. The extent of AOC A-01 and all exploration locations are presented on Figure 2. A cross-section of AOC A-01, including depths of the 1990 and 2004 excavations, is presented on Figure 3.

1.1.1 Summary of Investigation Activities

Remedial investigations (RI) at AOC-01 included collecting soil samples at 14 boring locations, nine of which were converted to groundwater monitoring wells (AGW009 through AGW017). Groundwater samples were collected at all nine wells. One well, AGW010, was selected for sampling as part of the interim Site-wide groundwater monitoring for TPH and BTEX.[2] A complete summary of RI activities is provided in the RI report (Landau 2017c).

[1] The Boeing Auburn Site includes the Boeing Auburn Plant and associated properties (Boeing Auburn Facility) and all contiguous property affected by releases of hazardous substances that are confirmed or suspected to have originated at the Boeing Auburn Facility.

[2] Benzene, toluene, ethylbenzene, and xylenes.

Feasibility Study (FS) investigations were completed to refine the extent of remaining petroleum hydrocarbon contamination in soil and groundwater. Two subsurface drilling investigations included advancing nine soil borings (ASB0264 through ASB0270, ASB0280, and ASB0281) and the collection of soil and groundwater grab samples. One-time groundwater sampling was conducted at six existing groundwater monitoring wells (AGW009, AGW010, AGW011, AGW014, AGW015, and AGW016). Soil samples were analyzed for TPH and BTEX. Groundwater samples were collected from wells and borings screened across the water table and analyzed for TPH and BTEX. Additionally, sampling for aquifer redox parameters was conducted at five existing groundwater monitoring wells including measurement of field parameters (dissolved oxygen, oxidation reduction potential, and ferrous iron) and laboratory analysis (nitrate, sulfate, and total organic carbon). Redox parameters are used to evaluate the aerobic/anaerobic nature of the aquifer (Section 1.1.2) and to evaluate potential effectiveness of monitored natural attenuation (MNA) or *in situ* treatment technologies. Additional information about the FS investigations is provided in the 2017 FS Data Submittals (Landau 2017a, b) and FS report (Landau 2019, 2020).

1.1.2 Hydrogeology and Geochemistry at AOC A-01

Groundwater flow at AOC A-01 is generally north-northwest consistent with Site-wide groundwater flow. Depth to groundwater varies seasonally and is typically between 10 and 16 feet bgs. Groundwater elevations from June 2017 are shown on Figure 2.

Aquifer redox parameters indicate that groundwater conditions in the general AOC A-01 area are aerobic to mildly reducing. The groundwater area impacted by petroleum hydrocarbons (AGW010) is more moderately reducing (iron- to sulfate-reducing) as would be expected in an area impacted by hydrocarbons.[3] Groundwater samples collected at well AGW016 (downgradient to the northwest of the petroleum hydrocarbon contamination) exhibited mixed conditions (aerobic to sulfate-reducing), indicative of a mix of naturally aerobic to mildly reducing conditions mixing with upgradient moderately reducing conditions (caused by the petroleum hydrocarbon impacts). Aquifer redox parameters are presented in Table 1.

1.1.3 Soil and Groundwater Contamination at AOC A-01

Following prior removal actions, the remaining soil contamination is limited in depth and lateral extent. COCs detected in soil above cleanup levels (CULs) include TPH, ethylbenzene, and total xylenes. Soil contamination above CULs was detected at two site borings (B-4 and ASB0265). This contaminated soil is located northwest of the former USTs in an area measuring approximately 15 feet (ft) by 30 ft. The depth of impacted soil is 19 ft bgs at boring ASB0265 and is 13 ft bgs at borings B-4. The approximate vertical extent of soil contamination is shown on Figure 3. Soil results are presented in Table 2.

Current conditions at AOC A-01 indicate that groundwater contamination is also limited in lateral extent. COCs detected in groundwater above CULs include TPH (GRO and DRO), benzene, ethylbenzene, and total xylenes. Groundwater contamination above CULs is detected at only one site monitoring well

[3] Petroleum hydrocarbons are utilized as electron donor by native aquifer bacteria. This results in the consumption of available dissolved oxygen and transition to an anaerobic and reduced aquifer redox condition.

(AGW010); concentrations at wells upgradient and downgradient of the former USTs have not been detected at concentrations greater than laboratory reporting limits or have been detected at concentrations less than CULs.

Groundwater grab samples were collected from borings during the FS investigation to inform the potential extent of groundwater contamination for evaluation of cleanup actions. Groundwater concentrations from temporary boring grab samples were for delineation purposes only and not considered a reliable estimate of actual groundwater concentrations; grab samples typically overestimate actual concentrations because of disturbance during drilling and samples collected from an undeveloped temporary well without a sand pack. Groundwater contamination is present at the water table, which fluctuates from about 10 to 16 ft bgs. The groundwater contamination is associated with remaining soil contamination and is distributed over a small area (approximately 30 ft by 30 ft). Groundwater contamination is stable (not moving downgradient). Groundwater results collected from 2016 through 2022 or the most recent results for historical locations are presented in Table 3.

1.2 Objective

The objective of the cleanup at AOC A-01 is to achieve CULs in soil and groundwater as defined in the CAP (Ecology 2022). Compliance of the cleanup action is planned to be determined through Model Remedy Number 11 (Method C soil direct contact CULs are met and groundwater CULs are assumed to be met after cleanup) for sites with petroleum impacts to groundwater (Ecology 2017). If removal of all soil contamination is not feasible, this will be documented in the cleanup action completion report and Boeing will request the Washington State Department of Ecology (Ecology) approve use of Model Remedy Number 12 (Ecology 2017), which includes an environmental covenant to address soil concentrations that exceed Method C direct contact CULs, instead of Model Remedy Number 11 as documented in the CAP (Ecology 2022).

Cleanup standards for AOC A-01 are based on the nature and extent of contamination and potential current and future complete exposure pathways. CULs for the media of concern consist of the following:

Analyte	Soil CUL (mg/kg)	Regulatory Basis for CUL (WAC 173-340-745)	Groundwater CUL (µg/L)	Regulatory Basis for CUL (WAC 173-340-720)
Ethylbenzene	5.9/350,000 [a]	Soil protective of groundwater/Method C non-cancer direct contact [a]	700	Federal/State MCL
Total Xylenes	14/350,000 [a]	Soil protective of groundwater/Method C non-cancer direct contact [a]	1,600	Method B Non-Cancer
TPH [b]	1,500	Generic Method C TPH CUL	500/800/1,000 [c]	Method A

Notes:

[a] Once the groundwater CUL is met, protection of groundwater will be determined based on an empirical demonstration under WAC 173-340-747(3)(f) and the soil cleanup level will be adjusted to the Method C direct contact value.

[b] TPH is the sum of GRO, DRO, and ORO.

[c] 500 µg/L is for DRO, 800 µg/L is for GRO where benzene is present, and 1,000 µg/L is for GRO where no detectable benzene is present in groundwater.

µg/L = micrograms per liter
CUL = cleanup level
ORO = oil-range hydrocarbon
DRO = diesel-range hydrocarbon
MCL = maximum contaminant level
TPH = total petroleum hydrocarbons
mg/kg = milligram per kilogram
GRO = gasoline-range hydrocarbon
WAC = Washington Administrative Code

1.3 Approach

Cleanup action includes excavation of petroleum contamination above CULs to the maximum extent feasible to address impacted soil and emplacement of oxygen release compound (ORC) in the saturated/seasonally saturated portion of the excavation backfill. Emplacement of these substrates is planned to enhance aerobic microbial degradation processes and chemical destruction to address impacted groundwater. The planned excavation area is presented in plan-view on Figure 4 and cross-section on Figure 5. A period of MNA may be required to achieve CULs in groundwater.

2.0 CLEANUP ACTION IMPLEMENTATION

Excavation of contaminated soil will be completed as presented in the CAP (Ecology 2022) and described herein, to the maximum extent practicable. Exceptions to the planned excavation area may include areas where soil contamination occurs near or beneath utilities whose integrity could be compromised by excavation, where excavation would create health and safety concerns that could not be controlled or reasonably mitigated, and where excavation would impact critical Boeing operations. If any of these exceptions occur, Boeing will communicate with Ecology as soon as possible and obtain approval for future actions. In addition, the depth of the excavation will depend on the depth of the water table at the time of excavation. Excavation performed in the dry season will extend as deep as practicable, which is expected to be to a depth of approximately 1 to 2 ft below the water table. The following sections describe the selected cleanup remedy for AOC A-01. Descriptions of pre-construction activities and project plans are detailed below.

2.1 Pre-Construction Activities

Pre-construction activities include development of engineering design plans, completion of associated project plans to address substantive permitting and Boeing Auburn Plant requirements, and utilities management.

2.1.1 Engineering Design Plans

Preliminary engineering design plans prepared for this cleanup action are provided as Appendix A. Design plans will be updated with additional input from with Boeing Auburn Plant personnel about protection of utilities, shoring and or sloping of excavation side walls, and specific requirements for backfill and site restoration. The design plans are prepared in conformance with currently accepted engineering practices and Washington Administrative Code (WAC) 173-340-400(4)(b) and the final designs will provide:

- A general description of the project that details the cleanup action, including work to be done, a summary of site environmental conditions, a summary of design criteria, and an existing facility map.
- Detailed plans and specifications necessary for construction, construction materials storage, construction waste storage and management, utility locations within cleanup areas, surface stormwater drainage during construction activities, and backfill and surface restoration materials.
- A description of construction impact controls (including dust, stormwater, traffic, and noise).
- Construction documentation including specific quality control tests such as soil density/in-place compaction, moisture content, material gradation, subgrade strength, depth measurements, frequency of tests, and acceptable results.

2.1.2 Project Permitting

The cleanup will include earthwork and restoration activities that typically require regulatory permitting. In accordance with the Model Toxics Control Act (MTCA), because this is a cleanup action under an

Enforcement Order, the project is not expected to obtain all of the permits that would be required for a normal construction project. However, the excavation will be conducted in substantive compliance with all local and state requirements and in accordance with applicable federal regulations. Applicable, relevant, and appropriate regulatory requirements include:

- MTCA Method C protective of soil and MTCA Method A protective of groundwater.
- Uniform Environmental Covenants Act.
- Washington Hazardous Waste Management Act and Implementing regulations: Dangerous Waste Regulations.
- Washington Solid Waste Management Act and its implementing regulation: Criteria for Municipal Solid Waste Landfills.
- Hazardous Waste Operations.
- State Environmental Policy Act.
- Washington Minimum Standards for Construction and Decommissioning.

The disturbed area associated with the project is not of sufficient acreage to require a construction stormwater National Pollutant Discharge Elimination System (NPDES) permit, but a temporary erosion and sediment control plan consistent with NPDES construction stormwater permit requirements will be prepared prior to construction activities.

2.1.3 Access Agreements and Notifications

As all work will be performed on property owned by Boeing, access agreements will not be required. Boeing Auburn Plant personnel will be notified as required by Boeing.

2.1.4 Utility Locate

Boeing has provided maps of known utilities in the project area. Locations of utilities will be confirmed prior to start of work. Utility locates will include public "One Call" and a private utility locate service to mark locations of utilities in the project area.

2.2 Construction Activities

Construction activities will involve mobilization and site preparation, excavation, stockpiling and management of excavated clean soil, handling and disposal of wastewater and contaminated soil, soil compliance monitoring, backfilling and grading the excavation area, and site restoration.

2.2.1 Mobilization and Site Preparation

The site will be prepared for the cleanup action. Site preparations include:

1) Contractor submittals and work plans will be reviewed and approved with changes, as needed.

2) Import fill material evaluation will include geotechnical and potentially chemical testing[4] and will be conducted as described in Appendix A.

3) Preparation of equipment storage area, soil stockpile area, and area for loading excavated soil for offsite disposal will be conducted.

4) Coordination with Boeing Auburn Plant personnel will take place to establish traffic control plans to re-route traffic around the excavation activities and establish a truck haul route.

5) Temporary erosion and stormwater control devices will be implemented.

6) Asphalt and/or concrete saw cutting will be conducted.

2.2.2 Excavation and Disposal

Approximately 17,300 cubic feet of soil will be excavated from an approximate 960 square-foot area, including both assumed clean overburden and contaminated soil. The planned extent of excavation will be presented in final design plans and the planned excavation extent may be limited by shoring/sloping requirements, presence of utilities, considerations for health and safety, impacts to operations, and the depth to groundwater at the time of excavation. The depth of the excavation will be limited by the feasibility of conducting excavation activities without dewatering. Approximately 1 to 2 ft of excavation below the water table is expected to be feasible without dewatering. The anticipated lateral extent of excavation is shown on Figure 4, and an anticipated cross-section is presented on Figure 5.

The excavation will be conducted with standard construction equipment (e.g., track hoes and front-end loaders). During the excavation, clean soil will be segregated from contaminated soil and reused as feasible to minimize the quantity of backfill needed; based on soil characterization data, clean overburden is anticipated to be encountered from the surface to approximately 10 ft bgs. Excavated saturated soil from below the water table will be placed in dewatering boxes and allowed to drain before loading for transport and disposal. Contaminated soil will be temporarily stockpiled onsite or direct loaded into dump trucks or intermodal containers. Surfaces where stockpiles are placed will be adequately protected to prevent surface contamination (e.g., placed on plastic sheeting and covered with plastic sheeting held down with rope-connected sandbags or tires, if necessary). Contaminated soil and drainage water from dewatering boxes will be disposed of in accordance with Washington State solid waste regulations.

During excavation, geographical coordinates for each corner of the excavation will be collected using a portable Global Positioning System unit and reference to Site features. To the extent possible, construction will be scheduled during a period forecasted to have little or no precipitation to minimize

[4] Certified test results of the chemical constituents for imported fill materials will be provided to Boeing and Ecology, either through documentation of exiting chemical analyses or by project-specific testing and analysis. Analytical data are anticipated to be provided at a rate of 10 samples per 2,000 cubic yards and one supplementary sample for each additional 500 cubic yards. Analysis will include constituents TPH, BTEX, arsenic, and lead. Analytical results for analyzed chemicals in imported fill shall have concentrations below Site CULs; in addition, concentrations of diesel- and oil-range hydrocarbons shall be below 200 mg/kg, concentrations of gasoline-range hydrocarbons shall be below the laboratory reporting limit (these criteria are all below Site CULs), and lead and arsenic will be below MTCA Method A values of 250 mg/kg and 20 mg/kg, respectively.

the potential for erosion and soil caving. Shoring or sloping will be utilized to prevent cave-ins and utilities encountered in the excavation will be stabilized.

2.2.2.1 Identifying and Stockpiling Clean Soil

Based on the results of the previous soil investigations, the upper approximately 10 feet are expected to be uncontaminated and suitable for reuse. Excavated soil from 0 to 10 ft bgs will be field screened to confirm clean conditions. Clean conditions will be assumed if field screening indicates no odor, no sheen, no detections under headspace analysis using a photoionization detector, and no other visual indications of contamination. Clean soil will be stockpiled and analyzed for geotechnical and chemical analysis for determination of reuse as backfill to the completed excavation. Following receipt of laboratory results confirming clean conditions, soil will be returned to the completed excavation as backfill.

Stockpile samples will be collected at representative locations beneath the surface of the assumed clean overburden stockpile. The number of samples collected will depend on the size of the stockpile, based on Ecology's UST guidance (Ecology 2021).

Cubic Yards of Soil	Minimum Number of Samples
0 to 25	1
26 to 50	2
51 to 100	3
101 to 500	5
501 to 1000	7
1001 to 2000	10
Greater than 2000	10 plus 1 additional sample for each additional 500 cubic yards of soil

2.2.2.2 Handling and Disposal of Contaminated Soil

Excavated contaminated soil will be loaded directly into bins and transported by truck to a proper disposal facility. Saturated soil from below the water table will be placed in dewatering boxes and allowed to drain before loading for transport and disposal. In the event that direct same-day loading cannot be completed, excavated soil will be temporarily stockpiled onsite and adequately protected (i.e., contained by and covered with plastic sheeting).

2.2.3 Backfilling and Site Restoration

After excavation is complete and compliance monitoring samples have been collected as described in Section 3.2, the excavation will be backfilled with clean excavated soil and clean imported fill material comparable to surrounding soil as described in final design plans. The fill will be placed in approximately 8- to 12-inch lifts and compacted to specifications as required by Boeing Auburn Plant personnel and detailed in the plans provided in Appendix A.

Approximately 5,000 pounds of powdered ORC will be placed in the bottom of the excavation in contact with groundwater prior to placement of granular fill. ORC will be applied to promote aerobic

biodegradation and/or chemical oxidation of residual petroleum hydrocarbons that may remain below the water table and the achievable depth of excavation.

Filling and compacting will continue until the final site grade is approximately equivalent to the existing site grades. After completion of excavation and filling/grading activities, the site will be restored to similar surface conditions as found prior to excavation activities and approved by Boeing Auburn Plant personnel.

2.2.4 Handling and Disposal of Wastewater

Wastewater is anticipated to be produced from well purging during groundwater sampling and equipment decontamination and will be disposed of as required by Boeing Auburn Plant personnel. Dewatering of the excavation area is not planned; instead, soil will be removed from 1 to 2 feet below the groundwater table to the maximum extent possible. Dewatering boxes will be employed to remove excess water from soil removed below the water table prior to soil disposal. Water drained from dewatering boxes will be managed for disposal appropriately, as directed by Boeing Auburn Plant personnel.

2.3 Construction Requirements

The following section provides a description of the quality assurance and control procedures that will be implemented to monitor and document the implementation of the cleanup action, the procedures that will be implemented to prevent releases of hazardous substances during construction, and the health and safety requirements that will be applied during implementation of the cleanup action.

2.3.1 Construction Quality Control/Quality Assurance

Day-to-day construction quality control and construction-related testing (e.g., compaction testing) will be performed by the contractor, consistent with the requirements of the construction contract specifications for the cleanup action. A qualified environmental technician, under the supervision of a Washington State licensed professional engineer or licensed geologist, will provide construction oversight and perform excavation and stockpile sampling. During construction, detailed notes of the work performed will be kept by the contractor and the environmental technician, including construction activities; quantities of materials removed, transported, stockpiled, and imported to the site; and tests and measurements performed. As needed, a geotechnical engineer may oversee excavation shoring, sloping, benching, and backfilling requirements.

2.3.2 Control of Hazardous Materials, Accidental Discharges, and Stormwater

Procedures to control and, as appropriate, respond to spills from construction equipment and fueling activities will be incorporated into the construction plans and specifications. The materials most likely to be spilled during site cleanup include equipment fuel and oil, or contaminated soil. Additionally, stormwater runoff has the potential to convey water and soil out of the excavation area. The contractor will prepare construction, equipment decontamination, and stormwater management plans in

accordance with project- and site-specific requirements set forth in the plans and specifications that adequately address environmental protection measures. The contractor will be required to perform work involving the handling of the above-noted materials in accordance with these plans. These plans will be subject to review and comment by Boeing's construction quality assurance representative prior to initiating the work.

The contractor's project construction plan will describe the overall sequence and construction methods that will be used to complete the cleanup action. The plan will include detailed procedures for controlling, collecting, handling, and disposing of contaminated soil and debris, and any liquids (e.g., decontamination liquids) generated during disposal operations.

The contractor's stormwater management plan will provide construction details and operational procedures for collection, conveyance, and treatment and disposal of stormwater runoff, and for erosion and sediment control measures, as required to ensure that materials are properly managed and maintained within the site boundary. This plan will also address procedures for handling and storage of hazardous materials used for construction purposes (e.g., fuel, oil, etc.), and for prevention and response to hazardous material spills or accidental discharges.

2.3.3 Health and Safety

The Site-specific *Health and Safety Plan* (HASP; Landau 2023a) addresses monitoring for protection of human health. The HASP addresses potential physical and chemical hazards associated with Site cleanup activities, consistent with the requirements of WAC 173-340-810. Anticipated potential physical hazards include working in proximity to heavy equipment and open excavations. Potential human exposure pathways include inhalation of airborne dust and contamination and contact with, or ingestion of, contaminated soil and groundwater. Contractors retained for remedial activities will be required to prepare a HASP that is at least as stringent as the Site-specific HASP and contractors should add their own health and safety procedures for the specific hazards of their work.

The following health and safety measures will be implemented as part of the remedial action:

- **Safety Fences and Signs:** The Boeing Auburn Plant is a secure facility with limited access. However, signs and safety fencing will be installed, as necessary, around open excavations to prevent unauthorized entry. Activities in areas where contaminated soil will be handled will be performed within a taped-off or fenced area (exclusion area) to restrict access and raise awareness in the work zone.
- **Load Covering**: All loads of excavated soil will be properly secured and covered to prevent release and exposure of hazardous materials during hauling operations.
- **Stockpile Covering:** Temporary soil stockpiles will be lined and covered with heavy plastic sheeting, or equivalent, at the end of each workday. Plastic will be weighed down with sandbags or similar.
- **Air/Dust Monitoring**: Airborne particulate dust will be monitored using the no visible dust standard. If dust is visible, onsite water may be used to wet the soil for dust suppression. Photoionization detector (PID) monitoring will be conducted to monitor for the presence of volatile organic carbons in the workers' breathing space.

- **Excavation Safety**: Any areas of the excavation that exceed 4 ft (or deeper depending on geotechnical evaluation) in depth will be sloped, benched, or shored to reduce the potential for sidewall collapse. Workers will not be allowed within excavations until the width of the excavation exceeds the depth to avoid sidewall cave-in hazards. Utilities within the excavation area will be stabilized and protected as required by Boeing Auburn Plant personnel.

3.0 COMPLIANCE MONITORING

Compliance monitoring is a required element of any MTCA cleanup action. Compliance monitoring will be conducted in accordance with WAC 173-340-410 to confirm that cleanup standards have been achieved and to confirm the long-term effectiveness of cleanup actions.

The three types of compliance monitoring to be conducted are:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during the construction period of the cleanup action.
- **Performance Monitoring** to confirm that the cleanup action has attained cleanup standards or other performance standards.
- **Confirmation Monitoring** to confirm the long-term effectiveness of the cleanup action once cleanup standards and performance standards have been attained.

Compliance monitoring will be implemented using the field methods and procedures documented in the *Sampling Analysis Plan* (SAP; Landau 2023c) and analytical methods and quality assurance measures in the *Quality Assurance Project Plan* (Landau 2023b).

3.1 Protection Monitoring

Protection monitoring will be performed during excavation construction implementation to monitor and mitigate health and safety risks for workers during construction and monitoring events, as provided through appropriate health and safety protocols outlined under the Site-specific HASP (Landau 2023a). The Site-specific HASP addresses potential physical and chemical hazards associated with Site activities, consistent with the requirements of WAC 173-340-810. Anticipated potential physical hazards include working in proximity to heavy equipment, open excavation, and contaminated soil and/or water. Exposure to Site contaminants in the soil or groundwater could occur through various exposure pathways including direct contact, ingestion, and inhalation. Environmental protection monitoring will include observation for visible dust and PID measurements in worker breathing space.

Best management practices (BMPs) to minimize and control stormwater runoff from contaminated soil during construction will be implemented and monitored. During construction, the contractor and/or Boeing Auburn Plant personnel will monitor performance of the BMPs and recommend changes in approach or application, if required.

3.2 Excavation Performance Monitoring

Performance monitoring will include verifying the physical limits of planned excavation are attained and verifying the concentrations of COCs in soil remaining in place after excavation. Confirmation sampling for soil is described in Section 3.3. The confirmation soil sampling results may be used as performance monitoring to verify attainment of cleanup or whether additional excavation is necessary. However, physical limitations on the excavation extent caused by utilities in the area, impacts to Boeing Plant operations, or health and safety concerns related to expanding the excavation may prevent soil contamination from being “chased” during excavation. Survey control points are provided in the

preliminary construction plans (Appendix A), which will be used by the contractor to guide excavation efforts and check that excavation is conducted as planned. Soil field monitoring will occur as excavation activities are carried out to ensure that contaminated soil is removed to the maximum extent practicable. Field monitoring will include visual observation (e.g., soil discoloration or sheen testing) or detection of petroleum-like odor. A sheen test is performed by placing a handful of soil in a container, saturating the soil with water, and observing the water surface for signs of petroleum sheen. Soil will also be field inspected for indications of contamination by olfactory and visual observation. The container for sheen testing may be disposable or will be decontaminated between uses for reuse. If field observations of the soil at the limits of the excavation indicate evidence of potential contamination, additional excavation may occur, if feasible.

3.3 Soil Confirmation Monitoring

Soil confirmation sampling will be used to confirm conditions along excavation sidewalls and bottoms. Excavation confirmation samples will be collected along the bottom and sidewalls of the final excavation extent. Samples will be collected approximately every 20 linear feet along the sidewalls and for each approximately 20-ft by 20-ft area of the bottom of the excavation. Bottom and sidewall samples are shown conceptually on Figure 6.

Soil samples will be collected following methods outlined in the SAP (Landau 2023c). Soil will be field screened during sampling for evidence of contamination using visual and olfactory observation, headspace analysis using a PID, and sheen testing methods. Sampling equipment will be decontaminated between each sample collection. Soil samples for volatile constituents (GRO and BTEX), will be collected using US Environmental Protection Agency (EPA) Method 5035A procedures. Soil samples will be collected in laboratory-supplied containers and submitted under proper chain-of-custody procedures to the subcontracted analytical laboratory. Visual classification of soil type will be noted on the sample collection form.

Soil samples will be analyzed for the following:

- Gasoline-range petroleum hydrocarbons by Method Northwest gasoline-range total petroleum hydrocarbon extended (NWTPH-Gx).
- BTEX by EPA Method 8260.
- Diesel-range and oil-range petroleum hydrocarbons by Method Northwest diesel-range total petroleum hydrocarbon extended (NWTPH-Dx).

3.4 Groundwater Performance and Confirmation Monitoring

Following excavation and site restoration, groundwater performance monitoring will be conducted annually at three monitoring wells until groundwater CULs are met. These three wells include existing downgradient wells AGW010, AGW014, and AGW016. Groundwater monitoring wells are shown on Figure 6 and a groundwater monitoring matrix is provided in Table 4.

Once groundwater CULs are met, groundwater confirmational monitoring will consist of two years of semiannual TPH sampling at the same three wells identified for performance monitoring, or at select wells in the AOC A-01 area, as determined prior to confirmation monitoring and as approved by Ecology.

4.0 SCHEDULE AND REPORTING

The proposed schedule and reporting for the AOC A-01 cleanup action has been developed to meet the requirements of the Enforcement Order.

4.1 Cleanup Action Schedule

Excavation at AOC A-01 will occur the first dry season (July to September) at least 3 months after Ecology-approval of the final EDR. The excavation activities are tentatively planned for August to September 2024, pending approval of the EDR. Groundwater performance monitoring would then begin in July 2025 and continue until Boeing can demonstrate compliance with cleanup standards. Performance monitoring will be performed in conjunction with other Site-wide groundwater monitoring. Confirmation monitoring will begin when CULs have been met at performance monitoring well locations, in consultation with Ecology. Boeing will provide Ecology with updates to the schedule as needed.

4.2 Cleanup Action Reporting

Cleanup action reporting will include a construction completion report and a cleanup action completion report.

4.2.1 Construction Completion Report

Upon completion of site restoration, a construction completion report for the AOC A-01 excavation will be prepared in accordance with WAC 173-400 (6)(b). The construction completion report will include:

- A narrative describing the aspects of the work performed including construction techniques and materials used, items installed, and tests and measurements performed.
- Results of the compliance monitoring documenting the contaminated soil that has been removed, with testing results and locations.
- As-built drawings documenting the extent of excavation performed at the site, including the following details:
  - Excavation elevations
  - Backfill material type and depth
  - Field changes to dimensions and details on the construction plans.
- Documentation of soil disposal.
- A statement that the construction was performed under the oversight of a professional engineer licensed in the State of Washington, or by qualified technicians under the engineer's direct supervision.
- A statement from the engineer, based on testing results and inspections, as to whether the cleanup action has been constructed in substantial compliance with the plans and specifications and related documents.

4.2.2 Cleanup Action Completion Report

When final confirmation groundwater sampling at AOC A-01 has been completed, Boeing will submit a draft Cleanup Action Completion report to Ecology for review. The Cleanup Action Completion report will include a request for a no further action determination at AOC A-01. Prior to the completion report, groundwater monitoring results will be reported to Ecology in the Boeing Auburn Site annual reports.

5.0 USE OF THIS WORK PLAN

This AOC A-01 Excavation Work Plan has been prepared for the exclusive use of Boeing and applicable regulatory agencies for specific application to the Boeing of Auburn Site in Auburn, Washington. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. 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, shall be at the user's sole risk. Landau 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. Landau makes no other warranty, either express or implied.

6.0 REFERENCES

Ecology. 2017. *Model Remedies for Sites with Petroleum Impacts to Groundwater*. Publication No. Publication No. 16-09-057. Toxics Cleanup Program, Washington State Department of Ecology. Revised December.

Ecology. 2021. *Site Assessment Guidance for Underground Storage Tank Systems*. Publication No. 21-09-050. Toxics Cleanup Program, Washington State Department of Ecology. January. Revised October 2022. https://apps.ecology.wa.gov/publications/documents/2109050.pdf.

Ecology. 2022. Final Report: *Cleanup Action Plan*, Boeing Auburn Facility, Auburn, Washington. Washington Department of Ecology. November 30.

Geomatrix. 2003. Final Report: *Remedial Investigation Work Plan*, Boeing Auburn Plant, Auburn, Washington. Geomatrix Consultants. October.

Landau. 2004. Memorandum: Soil Excavation Near Area of Concern A-01. From Eric Weber, Landau Associates, Inc., to James Bet and Ken MacNair, The Boeing Company. May 3.

Landau. 2017a. Letter: 2017 Feasibility Study Additional Field Activities Data Submittal, Former Building 17-03 and AOC A-01, Boeing Auburn Facility, Auburn, Washington. From Sarah Fees and Jennifer Wynkoop, Landau Associates, Inc., to Robin Harrover, Washington State Department of Ecology; Neal Hines, Washington State Department of Ecology. December 15.

Landau. 2017b. Letter: 2017 Feasibility Study Field Activities Data Submittal and Recommendations, Boeing Auburn Facility, Auburn, Washington. From Sarah Fees and Jennifer Wynkoop, Landau Associates, Inc., to Robin Harrover and Neal Hines, Washington State Department of Ecology. August 9.

Landau. 2017c. *Remedial Investigation Report*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. September 15.

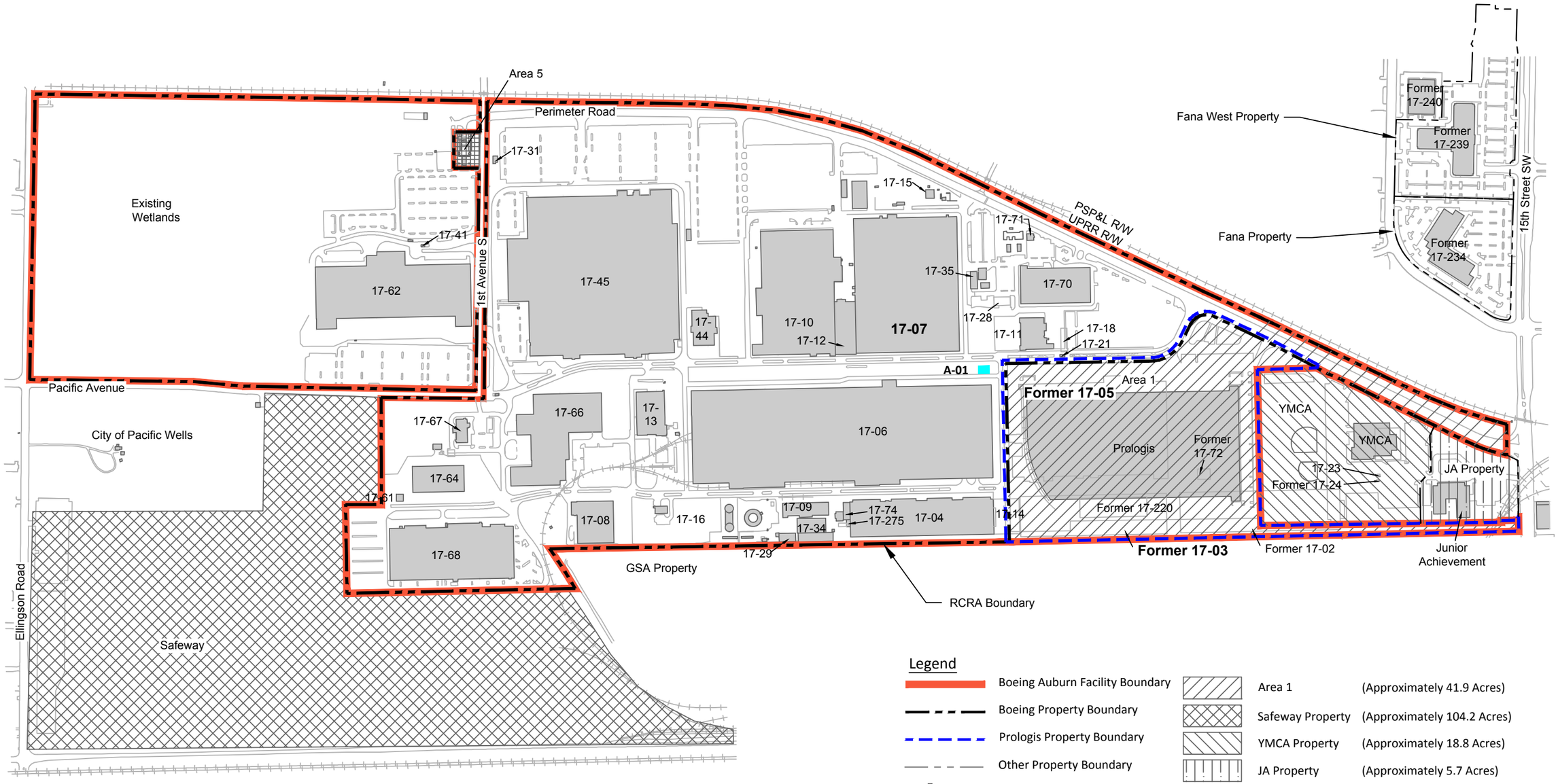
Landau. 2019. Draft *Feasibility Study* Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. October 30.

Landau. 2020. Draft *Supplemental Feasibility Study*, Boeing Auburn Facility; Auburn, Washington. Landau Associates, Inc. December 11.

Landau. 2023a. Final Report: *Health and Safety Plan*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. April 20.

Landau. 2023b. Agency Review Draft Report: *Quality Assurance Project Plan*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. March 31.

Landau. 2023c. Agency Review Draft Report: *Sampling and Analysis Plan*, Boeing Auburn Facility; Auburn, Washington. Landau Associates, Inc. March 31.



Legend

- Boeing Auburn Facility Boundary
- Boeing Property Boundary
- Prologis Property Boundary
- Other Property Boundary
- 17-05 — Current Building and Number
- A-01 — Area of Concern (AOC)

Area 1	(Approximately 41.9 Acres)
Safeway Property	(Approximately 104.2 Acres)
YMCA Property	(Approximately 18.8 Acres)
JA Property	(Approximately 5.7 Acres)
Area 5 Property (PSE Property)	(Approximately 0.71 Acres)

Notes

1. Former Building Numbers 17-234, 17-239 and 17-240 are currently owned by Fana.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

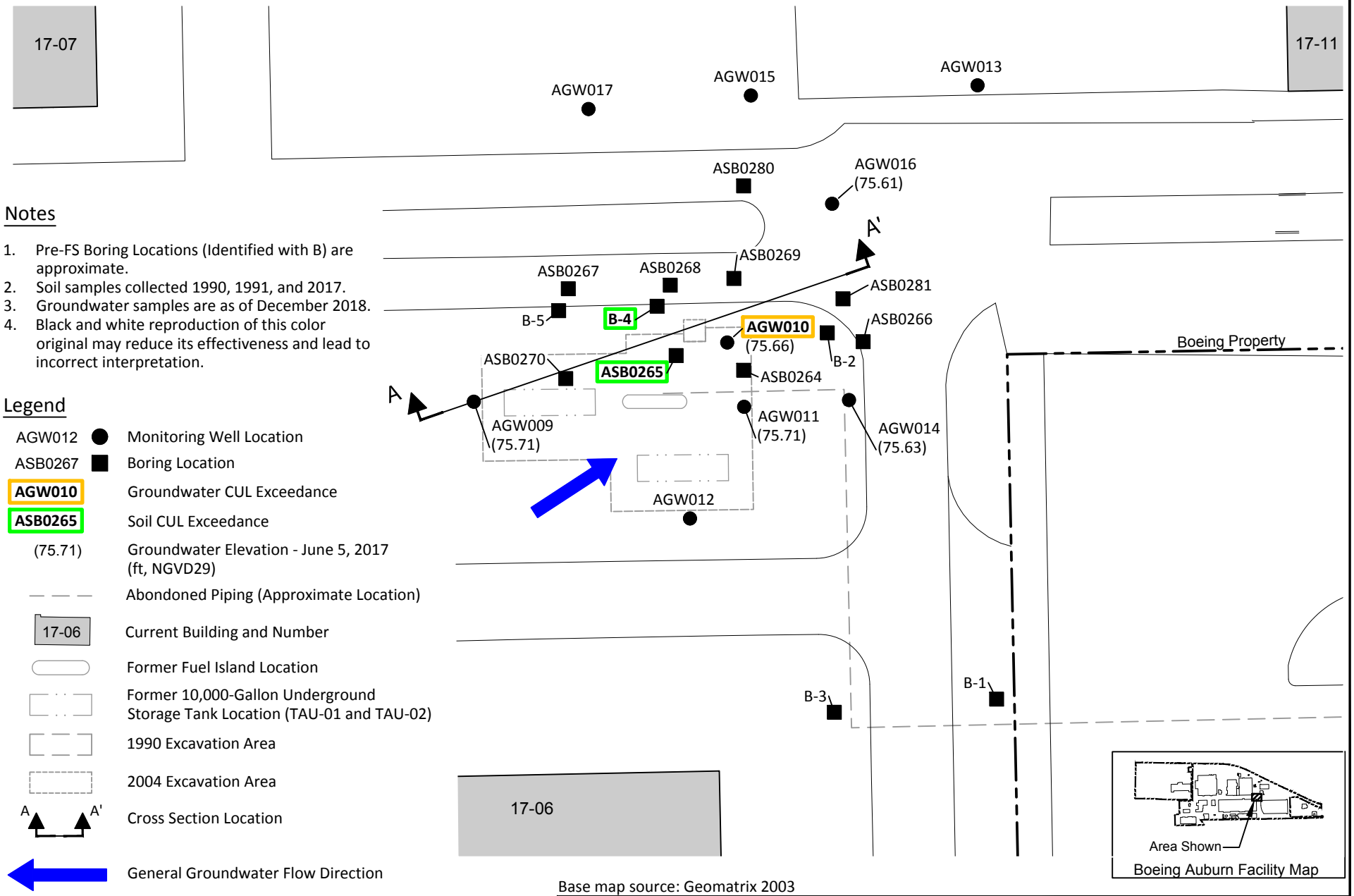
0 600 1200

Scale in Feet

Base map source: Geomatrix 2003

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Boeing Auburn Facility Map**	Figure 1



Notes

1. Pre-FS Boring Locations (Identified with B) are approximate.
2. Soil samples collected 1990, 1991, and 2017.
3. Groundwater samples are as of December 2018.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Legend

- AGW012 — Monitoring Well Location
- ASB0267 — Boring Location
- **AGW010** — Groundwater CUL Exceedance
- **ASB0265** — Soil CUL Exceedance
- (75.71) — Groundwater Elevation - June 5, 2017 (ft, NGVD29)
- Abondoned Piping (Approximate Location)
- 17-06 — Current Building and Number
- Former Fuel Island Location
- Former 10,000-Gallon Underground Storage Tank Location (TAU-01 and TAU-02)
- 1990 Excavation Area
- 2004 Excavation Area
- A — A' Cross Section Location
- General Groundwater Flow Direction

Base map source: Geomatrix 2003

N

0 40 80

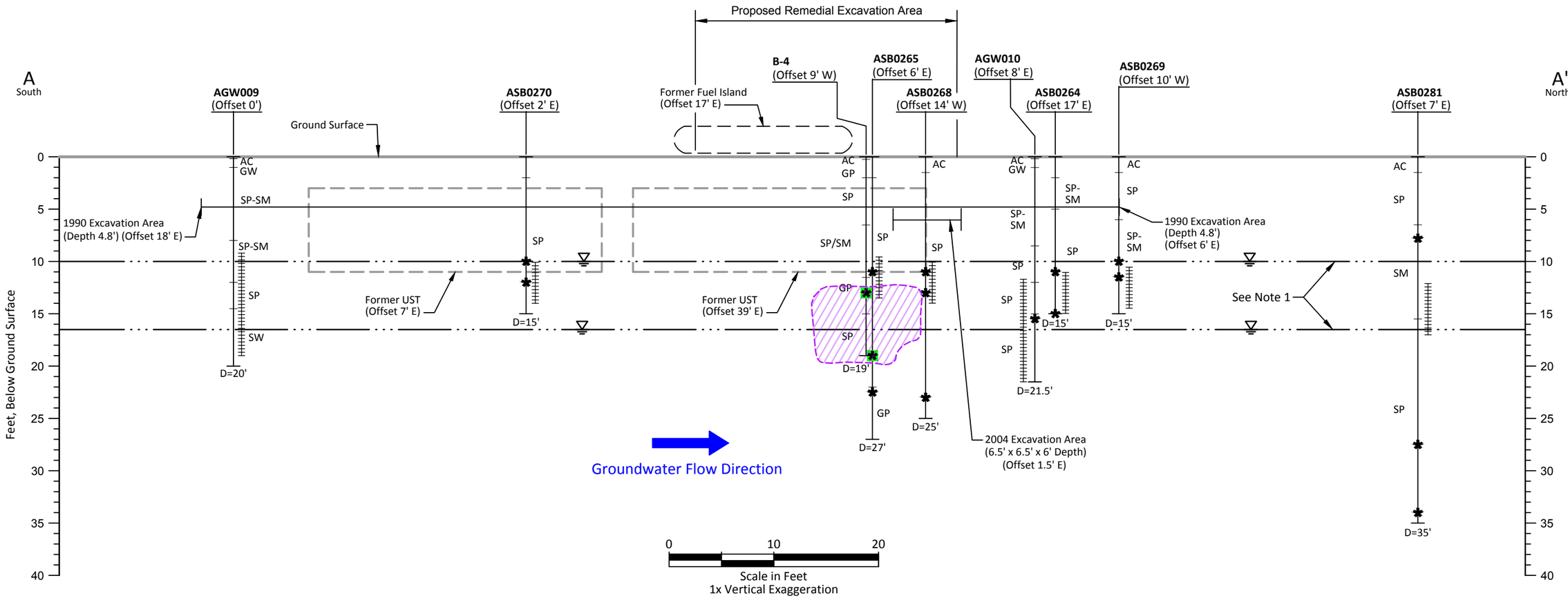
Scale in Feet

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01: Building 17-06 Former Underground Storage Tanks (TAU-01 and TAU-02) Exploration Summary

Figure 2



0 10 20

Scale in Feet
1x Vertical Exaggeration

Legend

ASB0281 (offset: 7' E) — Exploration Designation

Top of Exploration

✱ = Soil sample (Analytes = Not detected above CULs)

✱ = Soil sample (Analytes = Detected above CULs)

SM — Unified Soil Classification Symbol (USCS)

Water Table Elevation (See Note 1)

Screen Interval

D=35' — Depth of Exploration (feet)

= Analytes detected above CULs in soil

USCS Soil Legend

AC = asphalt/concrete pavement
GP = poorly graded gravel; gravel/sand mixture(s); little or no fines
GW = well-graded gravel; gravel/sand mixture(s); little or no fines
SM = silty sand; sand/silt mixture(s)
SP = poorly graded sand; gravelly sand; little or no fines
SW = well-graded sand; gravelly sand; little or no fines

Acronyms / Abbreviations

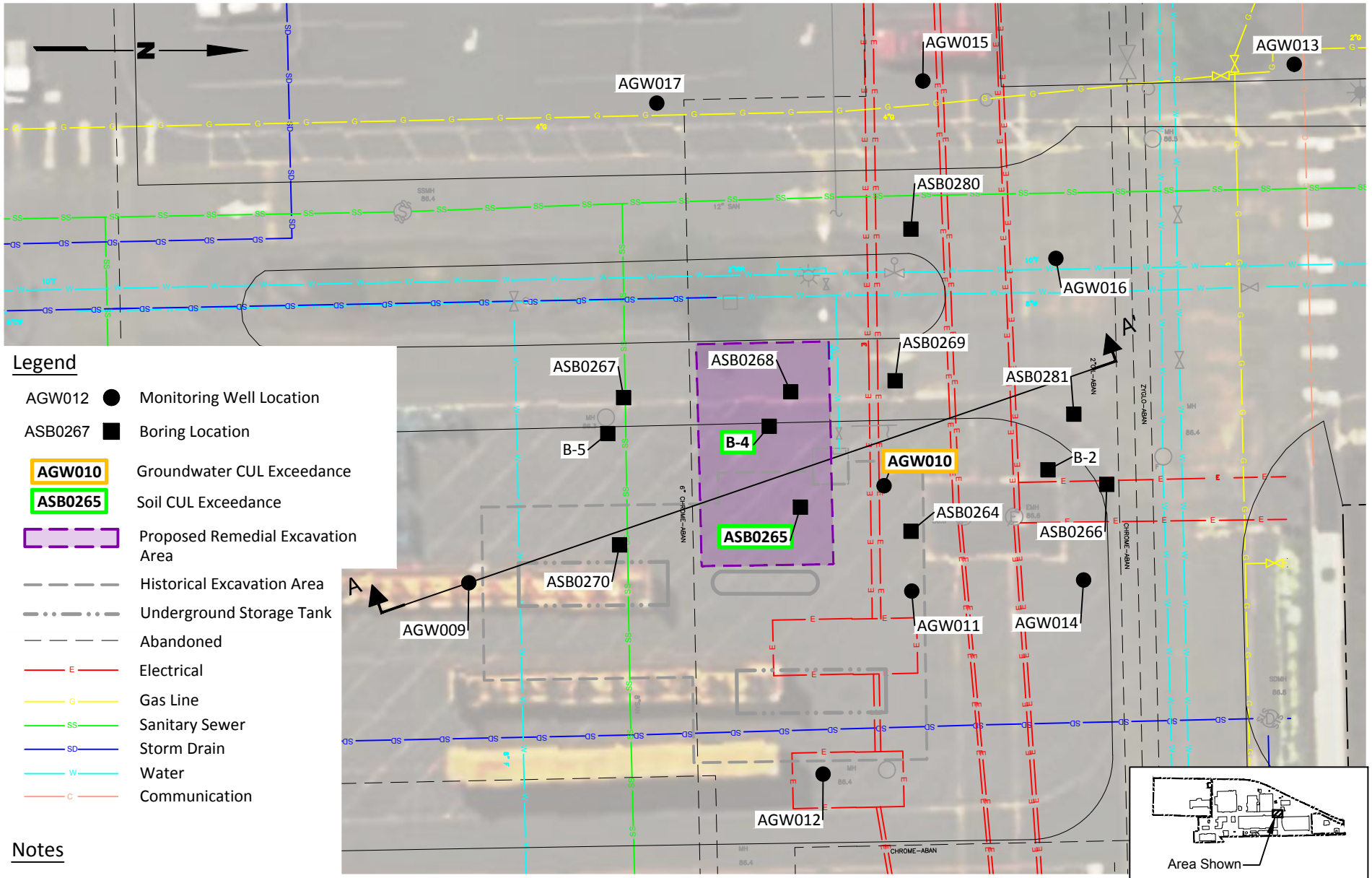
AOC = area of concern
DRO = diesel-range organics
GRO = gasoline-range organics
mg/kg = milligrams per kilogram
CUL = cleanup level
µg/L = micrograms per liter
UST = underground storage tank

Notes

1. Lines indicated show the maximum and minimum water level elevation measured from AGW009 or AGW010 from December 2003 to December 2018.
2. B-4, AGW009, and AGW010 were completed August 1991, and borings in the "ASB" series were completed June or August 2017.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**AOC A-01: Building 17-06 Former Underground Storage Tanks (TAU-01 and TAU-02) Exploration Cross-Section**	Figure 3



Legend

- AGW012 — Monitoring Well Location
- ASB0267 — Boring Location
- **AGW010** — Groundwater CUL Exceedance
- **ASB0265** — Soil CUL Exceedance
- Proposed Remedial Excavation Area
- Historical Excavation Area
- Underground Storage Tank
- Abandoned
- Electrical
- Gas Line
- Sanitary Sewer
- Storm Drain
- Water
- Communication

Notes

1. Pre-FS Boring Locations (Identified with B) are approximate.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Base map source: Geomatrix 2003, ©Bing Imagery, 2018

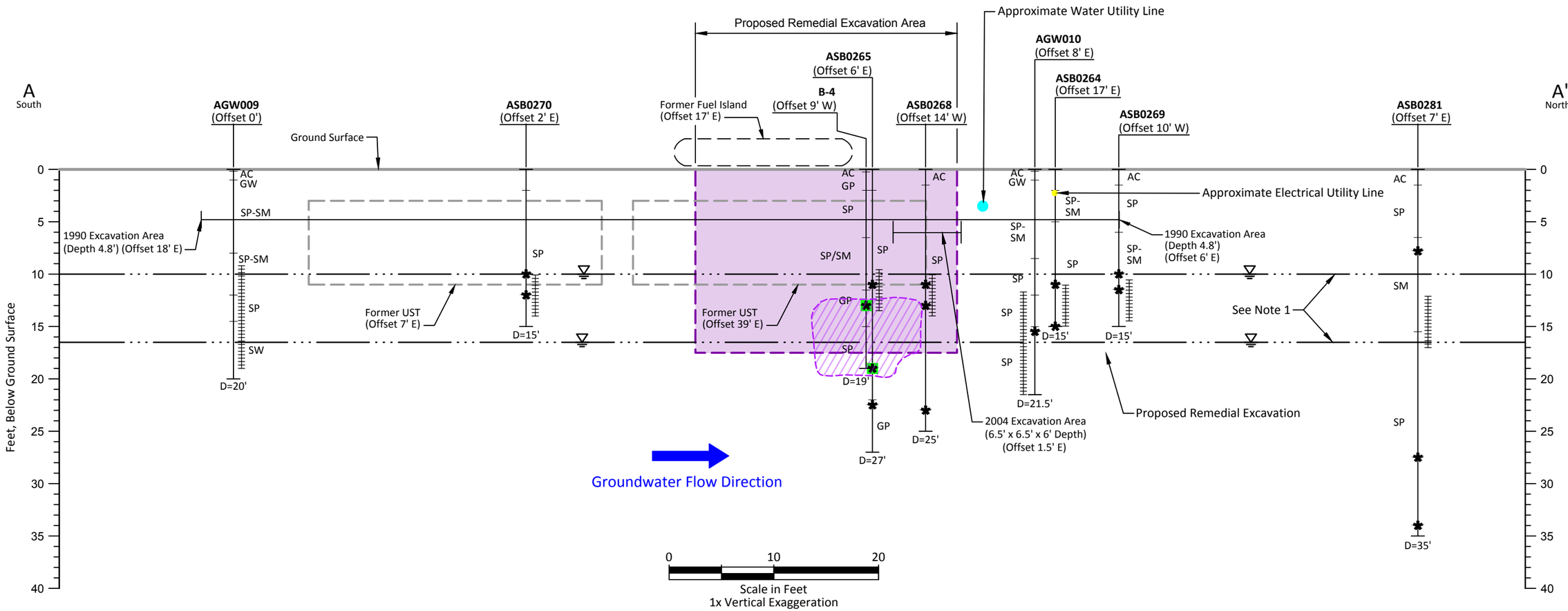
0 25 50
Scale in Feet

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01: Planned Excavation Area

Figure
4



Legend

ASB0281 (offset: 7' E) — Exploration Designation

Top of Exploration

= Soil sample (Analytes = Not detected above CULs)

= Soil sample (Analytes = Detected above CULs)

SM — Unified Soil Classification Symbol (USCS)

Water Table Elevation (See Note 1)

Screen Interval

D=35' — Depth of Exploration (feet)

= Analytes detected above CULs in soil

USCS Soil Legend

AC = asphalt/concrete pavement
GP = poorly graded gravel; gravel/sand mixture(s); little or no fines
GW = well-graded gravel; gravel/sand mixture(s); little or no fines
SM = silty sand; sand/silt mixture(s)
SP = poorly graded sand; gravelly sand; little or no fines
SW = well-graded sand; gravelly sand; little or no fines

Acronyms / Abbreviations

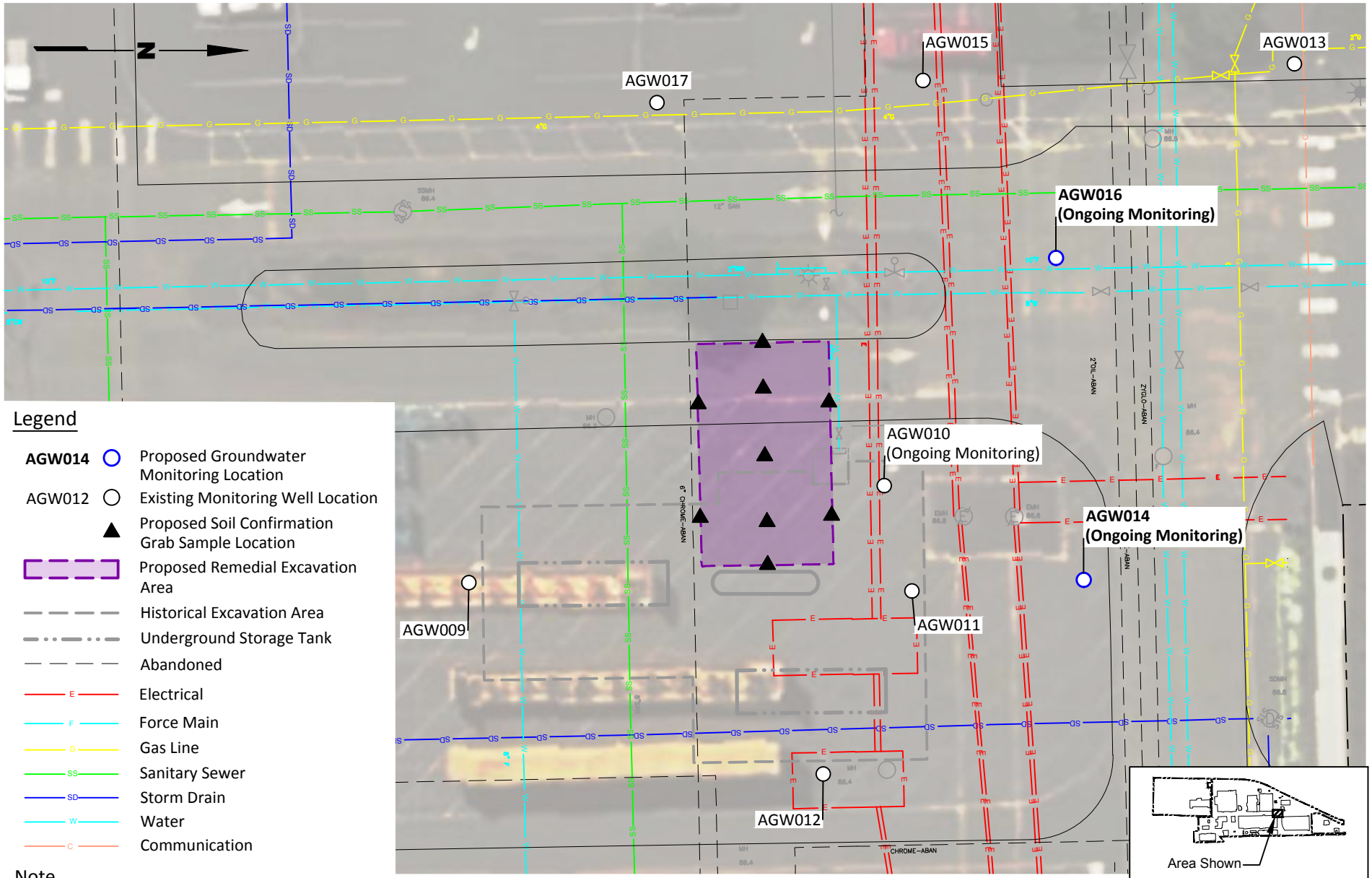
AOC = area of concern
DRO = diesel-range organics
GRO = gasoline-range organics
mg/kg = milligrams per kilogram
CUL = cleanup level
µg/L = micrograms per liter
UST = underground storage tank

Notes

1. Lines indicated show the maximum and minimum water level elevation measured from AGW009 or AGW010 from December 2003 to December 2018.
2. B-4, AGW009, and AGW010 were completed August 1991, and borings in the "ASB" series were completed June or August 2017.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**AOC A-01:** **Planned Excavation Cross-Section**	Figure 5



Legend

- **AGW014** — Proposed Groundwater Monitoring Location
- AGW012 — Existing Monitoring Well Location
- Proposed Soil Confirmation Grab Sample Location
- Proposed Remedial Excavation Area
- Historical Excavation Area
- Underground Storage Tank
- Abandoned
- E — Electrical
- F — Force Main
- G — Gas Line
- SS — Sanitary Sewer
- SD — Storm Drain
- W — Water
- C — Communication

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 25 50

Scale in Feet

Base map source: Geomatrix 2003, ©Bing Imagery, 2018

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

AOC A-01:
Confirmation Monitoring Plan

Figure
6

Table 1
AOC A-01 Aquifer Redox Parameter Results
Boeing Auburn Facility
Auburn, Washington

Sample Location	Sample Date	Water Levels		Aquifer Redox Conditions						Baseline Electron Donor Indicator	Notes
		Depth to Water (ft below TOC)	Groundwater Elevation (ft NGVD29)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Ferrous Iron (mg/L)	Sulfate (mg/L)	Aquifer Redox State	Total Organic Carbon (mg/L)	
AGW009	6/5/2017	10.66	75.71	1.44	-23.2	0.25	2.0	12	Aerobic to Iron-Reducing	3.6	
AGW010	6/5/2017	10.59	75.66	0.77	-89.9	< 0.10	4.0	11.9	Iron- to Sulfate-Reducing	5.3	Petroleum Hydrocarbons detected
AGW011	6/5/2017	10.57	75.71	1.39	-24.7	19.0	4.0	35.5	Aerobic to Iron-Reducing	3.9	
AGW014	6/5/2017	10.28	75.63	4.20	-18.5	22.1	2.0	24.9	Aerobic to Iron-Reducing	2.9	
AGW016	6/5/2017	10.15	75.61	1.30	-21.1	0.13	1.0	5.3	Aerobic to Sulfate-Reducing	1.3	

Abbreviations and Acronyms:

DO = dissolved oxygen
ft = feet
mg/L = milligrams per liter
mV = millivolts
NGVD20 = National Geodetic Vertical Datum of 1929
ORP = oxidation reduction potential
TOC = top of casing

Table 2
AOC A-01 Soil Results
Boeing Auburn Facility
Auburn, Washington

Sample Location	Sample Depth (ft)	Sample Date	Petroleum Hydrocarbons (mg/kg) (a)				BTEX by SW-846 8260C (mg/kg) (a)					
			Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics	Total Petroleum Hydrocarbons	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Total Xylenes
		Soil CUL	N/A	N/A	N/A	1,500	2,400	280,000	5.9/350,000 (b)	N/A	N/A	14/700,000 (b)
AGW009	10.5	8/22/1990	--	--	--	**41**	--	--	--	--	--	--
	13.0	8/22/1990	--	--	--	**14**	--	--	--	--	--	--
AGW010	15.5	8/23/1990	--	**240**	--	**240**	--	**0.039**	**0.25**	--	--	**1.2**
AGW011	13.0	8/23/1990	--	--	--	--	--	--	--	--	--	**0.034**
AGW012	6.5	8/23/1990	--	--	--	--	--	--	--	--	--	**0.048**
AGW013	13.0	7/31/1991	10 U	10 U	--	10 U	**0.0014**	**0.011**	**0.0016**	--	--	**0.0098**
AGW014	13.0	7/31/1991	10 U	10 U	--	10 U	0.0012 U	**0.0032**	0.0012 U	--	--	**0.0009 J**
AGW015	9.0	8/2/1991	--	--	--	--	**0.0009 J**	**0.0079**	**0.0006 J**	--	--	**0.0038 J**
AGW016	9.5	8/2/1991	10 U	10 U	--	10 U	**0.0019**	**0.014**	**0.0008 J**	--	--	**0.0053**
AGW017	1.0	8/6/1991	10 U	10 U	--	10 U	0.0011 U	0.0011 U	0.0011 U	--	--	0.0022 U
	5.0	8/6/1991	10 U	**10**	--	**10**	0.0012 U	0.0012 U	0.0012 U	--	--	0.0012 U
	13.0	8/5/1991	--	**10**	--	**10**	--	--	--	--	--	--
ASB0264	11.0	6/28/2017	7.6 U	8.6 U	37 U	37 U	**0.006**	0.006 U	0.006 U	0.006 U	0.006 U	--
	15.0	6/28/2017	5.1 U	7.9 U	34 U	34 U	0.0009 U	0.005 U	0.005 U	0.005 U	0.005 U	--
ASB0265	11.0	6/28/2017	**490**	**100 J**	**42**	**632 J**	0.099 U	0.5 U	**1.4**	**4.2**	**1.3**	**5.5**
	19.0	6/28/2017	**12,000 J**	**820**	76 U	**12,820 J**	0.21 U	1.1 U	**130**	**600**	**120**	**720**
	22.5	6/28/2017	**970 J**	**50**	33 U	**1,020 J**	0.072 U	0.36 U	**1.9**	**9**	**0.96**	**9.96**
ASB0266	11.0	6/29/2017	5.4 U	7.9 U	34 U	34 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	--
	15.0	6/29/2017	5.8 U	7.8 U	33 U	33 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	--
ASB0267	11.0	6/29/2017	5.3 U	7.9 U	34 U	34 U	0.0009 U	0.004 U	0.004 U	0.004 U	0.004 U	--
	15.0	6/29/2017	6.4 U	8.3 U	36 U	36 U	0.001 U	0.006 U	0.006 U	0.006 U	0.006 U	--
ASB0268	11.0	6/29/2017	5.3 U	8.1 U	35 U	35 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	--
	13.0	6/29/2017	**380**	7.6 U	32 U	**380**	0.042 U	0.21 U	0.21 U	0.21 U	0.21 U	--
	23.0	6/29/2017	5.3 U	8.1 U	35 U	35 U	0.0009 U	0.005 U	0.005 U	0.005 U	0.005 U	--
ASB0269	10.0	6/29/2017	**7.3**	8.5 U	37 U	**7.3**	0.0009 U	0.005 U	0.005 U	0.005 U	0.005 U	--
	11.5	6/29/2017	6.5 U	8.8 U	38 U	38 U	**0.001**	0.005 U	0.005 U	0.005 U	0.005 U	--

Table 2
AOC A-01 Soil Results
Boeing Auburn Facility
Auburn, Washington

Sample Location	Sample Depth (ft)	Sample Date	Petroleum Hydrocarbons (mg/kg) (a)				BTEX by SW-846 8260C (mg/kg) (a)					
			Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics	Total Petroleum Hydrocarbons	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Total Xylenes
		Soil CUL	N/A	N/A	N/A	1,500	2,400	280,000	5.9/350,000 (b)	N/A	N/A	14/700,000 (b)
ASB0270	10.0	6/29/2017	4.4 U	7.4 U	32 U	32 U	**0.002**	0.004 U	0.004 U	0.004 U	0.004 U	--
	12.0	6/29/2017	4.4 U	7.6 U	33 U	33 U	0.0008 U	0.004 U	0.004 U	0.004 U	0.004 U	--
ASB0280	2.0	8/31/2017	4.2 U	45 U	45 U	45 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	--
	6.0	8/31/2017	4.2 U	53 U	53 U	53 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	--
	17.5	8/31/2017	4.3 U	54 U	54 U	54 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	--
	24.0	8/31/2017	5.7 U	59 U	59 U	59 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--
ASB0281	7.8	8/31/2017	**18**	54 U	54 U	**18**	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	--
	27.5	8/31/2017	**6.3 J**	52 U	52 U	**6.3 J**	0.0018 UJ	0.0018 UJ	**0.0029 J**	0.0018 UJ	0.0018 UJ	--
	34.0	8/31/2017	**3.4 J**	48 U	48 U	**3.4 J**	0.0016 UJ	0.0016 UJ	**0.0041 J**	0.0016 UJ	0.0016 UJ	--
B-1	3.0	7/30/1991	10 U	10 U	--	10 U	0.0011 U	**0.012**	0.0011 U	--	--	**0.0031**
B-2	10.5	7/30/1991	10 U	10 U	--	10 U	0.001 U	0.001 U	0.001 U	--	--	0.0021 U
	15.0	7/30/1991	--	--	--	--	**0.0025**	**0.0007 J**	**0.0007 J**	--	--	0.0022 U
B-3	5.5	7/30/1991	10 U	10 U	--	10 U	0.0011 U	**0.0017**	0.0011 U	--	--	**0.0009 J**
B-4	13.0	8/1/1991	**1,300**	**250**	--	**1,550**	0.63 U	**4.2**	**9.4**	--	--	**64**
B-5	7.0	8/6/1991	**12**	10 U	--	**12**	0.011 U	0.011 U	0.011 U	--	--	**0.18**

Notes:

Bold text indicates detected analyte.

Green shading indicates detected analyte exceeds applicable soil CUL

Soil borings are identified by the ASB prefix.

(a) Petroleum hydrocarbons analyzed by NWTPH-dx, -Gx, and SW-846 8015.
VOCs were analyzed by SW-846 8260, 8260 SIM, and 8015. In the event total xylenes were calculated, the sum consists of detections of m,p-xylene and o-xylene.

(b) Once the groundwater CUL is met, protection of groundwater will be determined based on an empirical demonstration under WAC 173-340-747(3)(f) and the cleanup level will be adjusted to the Method C direct contact value.

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Acronyms/Abbreviations:

-- = not analyzed
BTEX = benzene, toluene, ethylbenzene, and xylenes
ft = feet
mg/kg = milligrams per kilogram
N/A = not applicable
CUL = cleanup level
VOC = volatile organic compound

Table 3
AOC A-01 Groundwater Results
Boeing Auburn Facility
Auburn, Washington

Sample Location	Sample Date	Petroleum Hydrocarbons (µg/L) (a)			BTEX (µg/L) (a)					
		Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Total Xylenes
	Groundwater CUL	800/1,000 (b)	500	500	5	640	700	N/A	N/A	1,600
AGW009	6/20/2016	--	--	--	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
	6/5/2017	250 U	99 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
AGW010	6/20/2016	**6,100**	**1,200**	240 U	2.0 U	**4.7**	**290**	**96**	**20**	**116**
	11/29/2016	**10,000**	**530**	240 U	2.0 U	**5.9**	**630**	**460**	**66**	**526**
	6/5/2017	**1,500**	**300**	240 U	**0.3**	**0.5**	**42**	**16 J**	**2.0 J**	**18.0 J**
	12/1/2017	**8,700 J**	**330**	250 U	**0.76 J**	**3.9 J**	**570**	**490**	**77**	**567**
	5/31/2018	**2,000 J**	**330**	350 U	**0.85**	**1.4**	**190**	**37**	**7.1**	**44.1**
	12/12/2018	**41,500**	**733**	200 U	**1.35**	**11.4 J**	**1,150**	**2150**	**453**	**2,600**
	5/30/2019	**9,750 J**	**346**	200 U	**1.58**	**1.98**	**387**	**48.6**	**6.88**	**55.4**
	12/3/2019	**38,800**	**684**	200 U	**1.09**	**3.55**	**926**	**1360**	**249**	**1,610**
	5/27/2020	**5,530**	**488 J**	**814 J**	**0.71**	**0.58**	**230 J**	**13.6**	**1.11**	**14.7**
	12/7/2020	**18,800**	**441**	200 U	**0.63 J**	**1.88 J**	**436**	**438**	**45.7**	**484**
	6/3/2021	**3,250**	**353**	200 U	**1.16**	**1.29**	**124**	**6.11**	**0.87**	**6.98**
	12/1/2021	**16,900**	**281 J**	200 U	**0.76**	**2.23**	**323**	**98.4**	**13.5**	**112 J**
	6/13/2022	**2,700**	**284**	200 UJ	**0.28**	0.20 U	**39.9 J**	**1.41 J**	0.20 U	**1.55 J**
	12/6/2022	100 U	100 U	200 U	**0.30**	0.20 U	0.20 U	0.40 U	0.20 U	0.60 U
AGW011	6/5/2017	250 U	100 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
AGW012	12/5/2004	250 U	250 U	500 U	1 U	1 U	1 U	1 U	1 U	ND
AGW013	12/5/2004	250 U	250 U	500 U	1 U	1 U	1 U	1 U	1 U	ND
AGW014	6/5/2017	250 U	100 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
AGW015	9/7/2017	250 U	**130 J**	260 U	0.20 U	0.20 U	0.50 U	0.50 U	0.50 U	ND
AGW016	6/5/2017	250 U	100 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
AGW017	12/5/2004	250 U	250 U	500 U	1 U	1 U	1 U	1 U	1 U	ND
	6/9/2009	--	--	--	0.2 U	0.2 U	0.2 U	0.4 U	0.2 U	ND
ASB0264-15	6/28/2017	**1,900**	**440**	250 U	**0.7**	**0.6**	**17**	**8.3**	**1.4**	**9.7**
ASB0265-13.5	6/28/2017	**70,000**	**1,900 J**	250 U	**7.0**	**150**	**2,000**	**6,300**	**1,800**	**8,100**
ASB0266-15	6/29/2017	250 U	100 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
ASB0267-15	6/29/2017	250 U	100 U	250 U	0.2 U	**1.4**	0.5 U	0.5 U	0.5 U	ND
ASB0268-15	6/29/2017	**2,000**	**500**	250 U	**0.2**	0.2 U	**5.0**	0.5 U	0.5 U	ND
ASB0269-14.5	6/29/2017	**3,900**	**840**	250 U	1.0 U	1.0 U	**54**	**4.6**	2.5 U	**4.6**
ASB0270-14	6/29/2017	250 U	100 U	250 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	ND
ASB0280-18	8/31/2017	250 U	100 U	260 U	0.20 U	0.20 U	0.50 U	0.50 U	0.50 U	ND
ASB0281-17	8/31/2017	250 U	100 U	**310**	0.20 U	0.20 U	0.50 U	0.50 U	0.50 U	ND

Table 3
AOC A-01 Groundwater Results
Boeing Auburn Facility
Auburn, Washington

Notes:

Bold text indicates detected analyte

Green shading indicates detected analyte exceeds applicable groundwater CUL.

Groundwater monitoring locations are identified by the AGW prefix.

Boring sample designations include the location name followed by the depth at which the sample was collected.

Groundwater concentrations from temporary boring grab samples are not considered a reliable estimate of actual groundwater concentrations and are, therefore, not compared to pCULs.

(a) Petroleum hydrocarbons were analyzed by NWTPH-dx, -Gx, and SW-846 8015. VOCs were analyzed by SW-846 8260, 8260 Selected Ion Monitoring (SIM), and 8015. In the event total xylenes were calculated, the sum consists of detections of m,p-xylene and o-xylene.

(b) 800 µg/L is used if benzene is detected; 1,000 µg/L is used if benzene is not detected.

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.

Acronyms/Abbreviations:

-- = not analyzed
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
CUL = cleanup level
N/A = not applicable
ND = not detected
VOC = volatile organic compound

Table 4
AOC A-01 Sampling Matrix
Boeing Auburn Site
Auburn, Washington

Sample ID	Groundwater Zone	Sampling Method	Description	Location	Recommended Sampling Frequency		
					TPH-D NWTPH-Dx with Silica Gel Cleanup	TPH-G NWTPH-Gx	BTEX 8260
AGW010	S	Low Flow	AOC A-01	NW of Bldg 17-06	A	A	A
AGW014	S	Low Flow	AOC A-01	NW of Bldg 17-06	A	A	A
AGW016	S	Low Flow	AOC A-01	NW of Bldg 17-06	A	A	A

Notes:
MS/MSDs will be collected at least 1 per 20 samples per analysis. A field duplicate will be collected at least 1 per 20 samples per analysis. One trip blank per cooler will be run for volatile organic carbons.

Abbreviations and Acronyms:

A = Annually (June/July)
AOC = Area of Concern
Bldg = Building
BTEX = benzene, toluene, ethylbenzene, and xylenes
ID = Identification
MS/MSD = matrix spike/matrix spike duplicate
NW = northwest
S = Shallow
TPH = total petroleum hydrocarbon

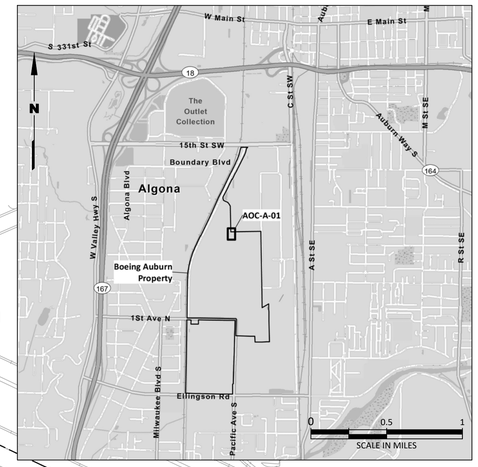
APPENDIX A

Preliminary Design Set

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON
PRELIMINARY DESIGN

NOT FOR CONSTRUCTION

VICINITY MAP



SITE MAP

SHEET INDEX

DWG. NO.	SHEET NO.	TITLE
G-1	1	COVER SHEET
G-2	2	GENERAL NOTES
C-1	3	TESC PLAN
C-2	4	EXCAVATION PLAN
C-3	5	EXCAVATION PROFILES
C-4	6	TESC DETAILS

BOEING PROJECT LEAD:

ENVIRONMENTAL & CIVIL ENGINEER:
LANDAU ASSOCIATES INC.
155 NE 100TH STREET, SUITE 302
SEATTLE, WASHINGTON 98125

FACILITY CONTACT:
BOEING EHS FOR WASTE DISPOSAL:
JIM SWORTZ

SITE ADDRESS:
BOEING AUBURN

KATHERINE MARIE SALTANOVITZ
STATE OF WASHINGTON
47594
REGISTERED PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

COVER SHEET

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 1 OF 6
DRAWING NO. **G-1**

NOT FOR CONSTRUCTION

PROJECT DESCRIPTION:

THE PROJECT SHOWN ON THESE DRAWINGS CONSISTS OF EXCAVATION OF CONTAMINATED SOIL AND BACKFILLING AND REPAIR OF SURFACE CONDITIONS WITH CLEAN MATERIAL. THE WORK REQUIRES SITE PREPARATION, EARTHWORK, TEMPORARY EROSION AND SEDIMENT CONTROL MANAGEMENT AND SUB-GRADE PREPARATION FOR PAVING, AND PAVING. TESTING OF SOIL BY ENVIRONMENTAL AND GEOTECHNICAL PROFESSIONALS IDENTIFIED BY OWNER WILL BE REQUIRED DURING CONSTRUCTION. THE WORK IS SUBJECT TO THE OWNER, AGENCY, AND/OR PERMIT CONDITIONS.

COORDINATE SYSTEM:

NAD83 WASHINGTON STATE PLANES, NORTH ZONE, US FOOT

EXISTING CONDITIONS COMPILED FROM:

1. BOEING AUBURN FACILITIES BASE, 2023
2. BOEING FACILITIES PROVIDED UTILITIES
3. LIDAR; KING COUNTY WEST, 2021

GENERAL NOTE:

1. THESE DRAWINGS MAY NOT SHOW ALL UTILITIES LOCATED IN THE PROJECT SITE. UNDER NO CIRCUMSTANCE SHOULD THESE DRAWINGS BE USED FOR UTILITY LOCATION NOR SHOULD THEY BE USED IN LIEU OF MANDATORY UTILITY LOCATES BY CALLING 811 OR OTHER COMMONLY-USED FIELD-VERIFICATION METHODS TO OBTAIN UTILITY LOCATIONS. IN ADDITION TO 811, CONTRACTOR SHALL HIRE A PRIVATE UTILITY LOCATOR TO VERIFY UTILITIES PRIOR TO WORK.

ABBREVIATIONS	
ABBR	ABBREVIATION
AC-FT	ACRE-FEET
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BGS	BELOW GROUND SURFACE
BTM	BOTTOM
CO	CLEAN-OUT
CQA	CONSTRUCTION QUALITY ASSURANCE
DIA	DIAMETER
DWG	DRAWING
EA	EACH
EL, ELEV	ELEVATION
ESC	EROSION AND SEDIMENT CONTROL
EX	EXISTING
FT	FEET
GA	GAUGE
H, HORIZ	HORIZONTAL
HDPE	HIGH DENSITY POLYETHYLINE
HMA	HOT MIX ASPHALT
IE	INVERT ELEVATION
IPS	IRON PIPE SIZE
LF	LINEAR FEET
MAX	MAXIMUM
MG	MILLION GALLONS
MIL	0.001 INCH
MIN	MINIMUM
NAD 83	NORTH AMERICAN DATUM, 1983
NAVD 88	NORTH AMERICAN VERTICAL DATUM, 1988
NIC	NOT IN CONTRACT
NO.	NUMBER
NTS	NOT TO SCALE
NW	NORTHWEST
O.C.	ON CENTER
PP	POWER POLE
PROP.	PROPOSED
PVC	POLYVINYL CHLORIDE
R/W	RIGHT-OF-WAY
SCH	SCHEDULE
SF	SQUARE FEET
SY	SQUARE YARDS
TBD	TO BE DETERMINED
UG	UNDERGROUND
US	UNITED STATES
V, VERT	VERTICAL

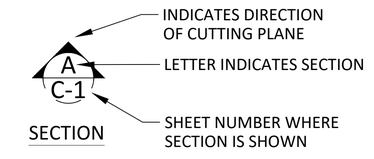
SYMBOLS

SYMBOL: EXISTING	SYMBOL: PROPOSED	DESCRIPTION
		CATCH BASIN
		CATCH BASIN INLET PROTECTION PER DETAIL ON SHEET C-4
	CP-1	CONTROL POINT
		PROPERTY BOUNDARY
P		BURIED POWER
SS		SANITARY SEWER
SD		STORM DRAIN
15		CONTOUR ELEVATION (EXISTING)
		CONTRACTOR SITE ACCESS
		SURFACE WATER CONTAINMENT BARRIER PER DETAIL ON SHEET C-4
		LIMITS OF WORK
		LIMITS OF EXCAVATION
X	x	EXST FENCE / TEMP CONSTRUCTION FENCE
	o	SILT FENCE PER DETAIL ON SHEET C-4
		HMA
		GRASS/GRAVEL
		CONCRETE
		BUILDING
1 / C-3		CROSS SECTION

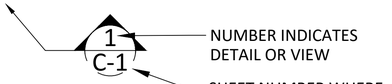
TEXT

∠	ANGLE
Ø	DIAMETER
&	AND
'	FEET, MINUTES
C	INCHES, SECONDS
P	DEGREE
@	AT
L	CENTERLINE
L	PROPERTY LINE
#	NUMBER
%	PERCENT

TITLES

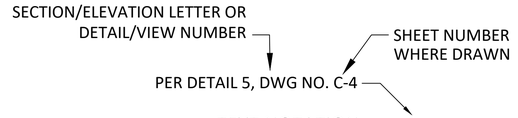


SECTION

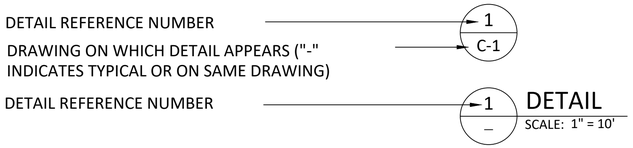


DETAIL

DETAIL/VIEW TITLE



TEXT NOTATION



DETAIL TITLE & CALL BACK

Know what's **below.** **Call** before you dig.

KATHERINE MARIE SALTANOVITZ STATE OF WASHINGTON 47594 REGISTERED PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

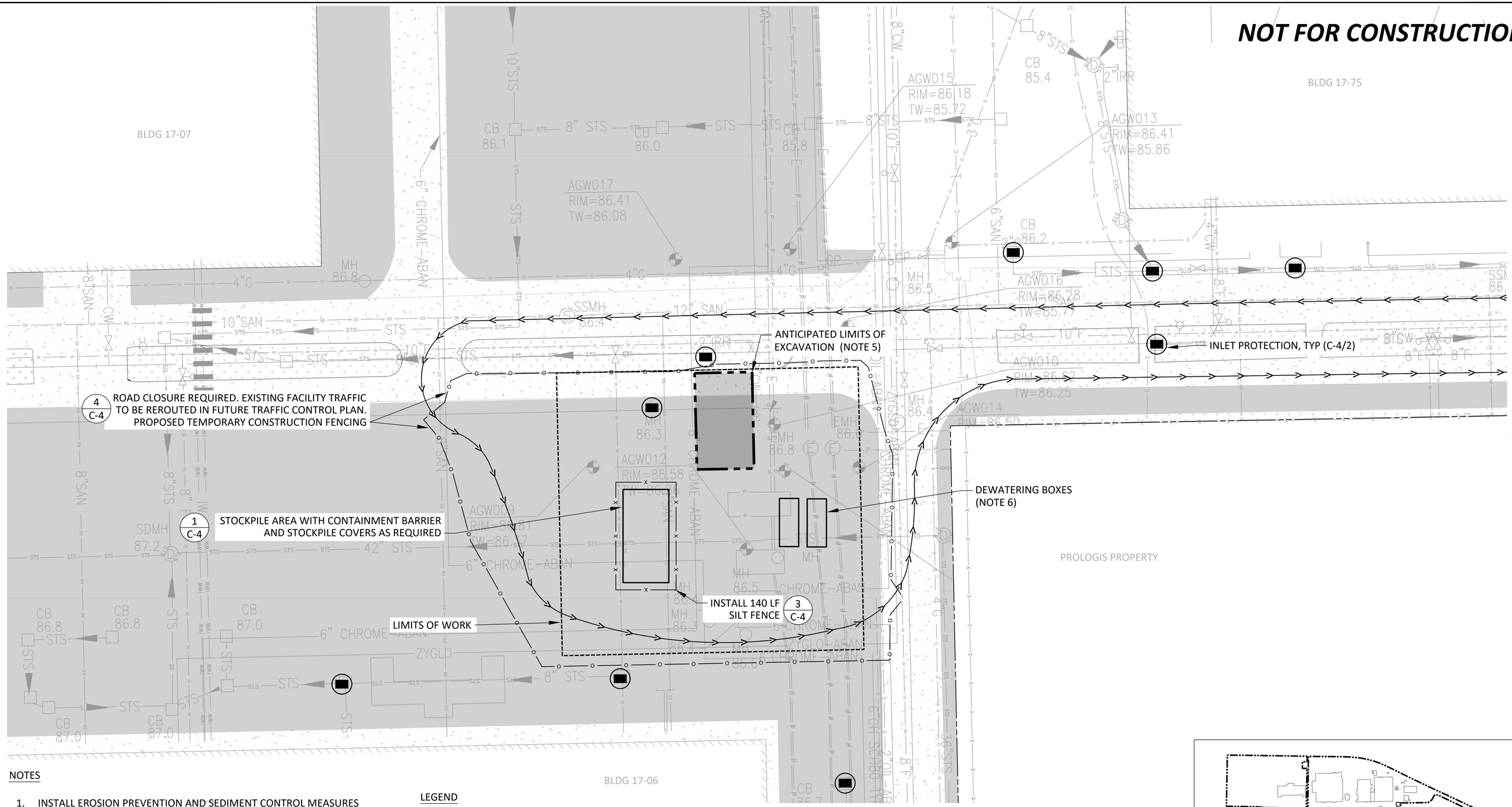
LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

GENERAL NOTES

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 2 OF 6
DRAWING NO. **G-2**

NOT FOR CONSTRUCTION



NOTES

1. INSTALL EROSION PREVENTION AND SEDIMENT CONTROL MEASURES PRIOR TO START OF CONSTRUCTION. KEEP SUFFICIENT SUPPLY OF EROSION CONTROL MATERIALS ON SITE AT ALL TIMES DURING CONSTRUCTION.
2. STORMWATER AND GROUNDWATER DISPOSAL OPTIONS TO BE COORDINATED WITH FACILITY.
3. ALL PUBLIC ROADS, ACCESS ROUTES, AND PARKING AREAS OUTSIDE OF THE LIMITS OF WORK TO BE KEPT CLEAN FROM CONSTRUCTION DEBRIS AT ALL TIMES.
4. PREVENT WIND TRANSPORT OF DUST FROM DISTURBED SOIL SURFACES ONTO ROADWAYS, DRAINAGE WAYS AND SURFACE WATERS.
5. INSTALL SURFACE WATER BARRIER PER DETAIL 5/C-4.
6. USE DEWATERING BOXES (PROVIDED BY BOEING) FOR WET SOIL EXCAVATED FROM BELOW THE WATER TABLE. DISPOSE OF WASTEWATER AS DIRECTED BY BOEING.

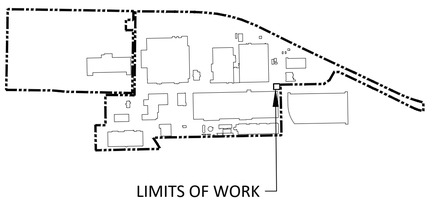
LEGEND

- LIMITS OF WORK
- PROPERTY LINE
- EXISTING HMA
- EXISTING GRASS/GRAVEL
- EXISTING CONCRETE
- EXISTING BUILDING
- SILT FENCE (DET 3/C-4)
- CONSTRUCTION ACCESS ROUTE
- LIMITS OF EXCAVATION

SITE MAP

0 20 40
SCALE IN FEET

N



BOEING AUBURN FACILITY MAP KEY

KATHERINE MARIE SALTANOVITZ
STATE OF WASHINGTON
47594
REGISTERED
PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

TESC PLAN

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 3 OF 6
DRAWING NO. **C-1**

NOT FOR CONSTRUCTION

Point Table			
NAME	**NORTHING**	**EASTING**	**ELEVATION**
CP-1	107975.8728	1291225.2523	90.26
CP-2	107952.1100	1291225.4970	90.27
CP-3	107951.2733	1291185.4834	89.79
CP-4	107975.0258	1291184.9868	89.75

NOTES

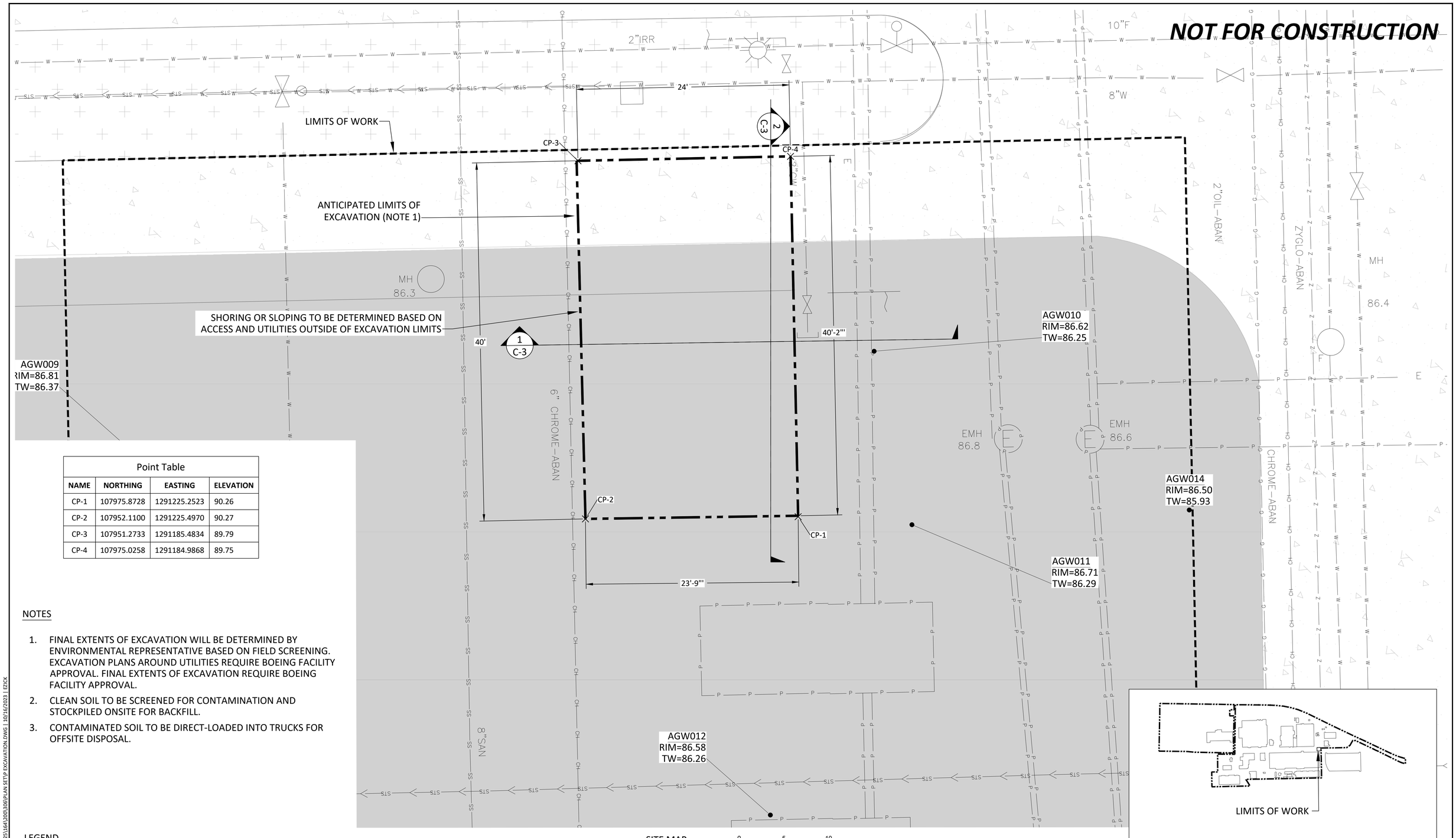
1. FINAL EXTENTS OF EXCAVATION WILL BE DETERMINED BY ENVIRONMENTAL REPRESENTATIVE BASED ON FIELD SCREENING. EXCAVATION PLANS AROUND UTILITIES REQUIRE BOEING FACILITY APPROVAL. FINAL EXTENTS OF EXCAVATION REQUIRE BOEING FACILITY APPROVAL.
2. CLEAN SOIL TO BE SCREENED FOR CONTAMINATION AND STOCKPILED ONSITE FOR BACKFILL.
3. CONTAMINATED SOIL TO BE DIRECT-LOADED INTO TRUCKS FOR OFFSITE DISPOSAL.

LEGEND

CONTROL POINT ⊗ CP-01

LIMITS OF EXCAVATION

CROSS SECTION LOCATION 2 / C-3



SITE MAP

0 5 10

SCALE IN FEET

BOEING AUBURN FACILITY MAP KEY

KATHERINE MARIE SALTANOVITZ
STATE OF WASHINGTON
47594
REGISTERED
PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

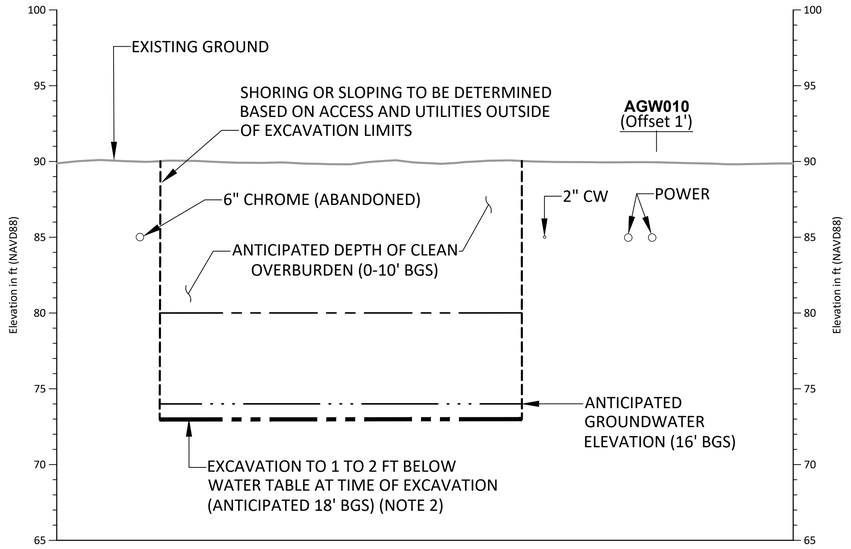
LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

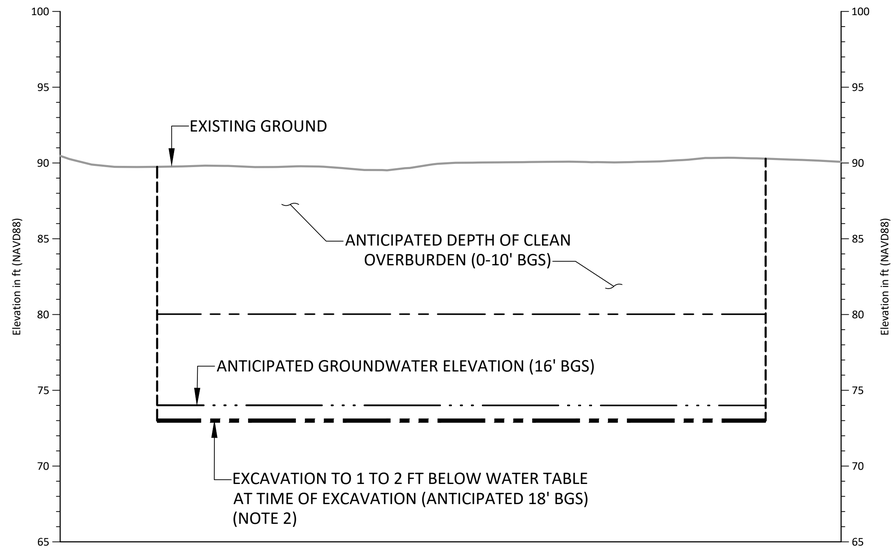
EXCAVATION PLAN

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 4 OF 6
DRAWING NO. **C-2**

NOT FOR CONSTRUCTION



1 / C-3 Profile Alignment 1
Horizontal Scale in Feet: 1"=5'
Vertical Scale in Feet: 1"=5'
0 5 10
SCALE IN FEET



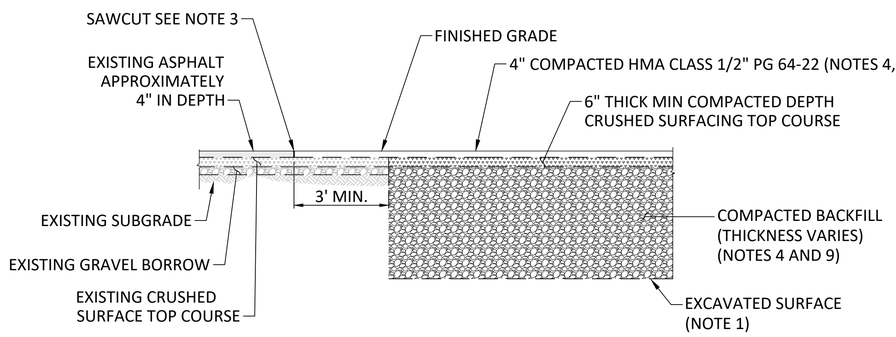
2 / C-3 Profile Alignment 2
Horizontal Scale in Feet: 1"=5'
Vertical Scale in Feet: 1"=5'
0 5 10
SCALE IN FEET

LEGEND

LIMITS OF EXCAVATION
SHORING / SLOPING

NOTES:

1. SOIL FROM GROUND SURFACE TO 10 FT BGS ANTICIPATED TO BE CLEAN OVERBURDEN SUITABLE FOR REUSE; TO BE VERIFIED BY ENVIRONMENTAL PERSONNEL BY FIELD SCREENING.
2. FINAL EXTENT OF EXCAVATION WILL BE DETERMINED BY ENVIRONMENTAL REPRESENTATIVE BASED ON RESULTS OF FIELD SCREENING. FINAL EXTENT OF EXCAVATION LIMITS REQUIRE BOEING FACILITY APPROVAL.



3 / C-3 BACKFILL AND SURFACING REPLACEMENT
NOT TO SCALE

DETAIL NOTES:

1. EXCAVATED ASPHALT AND CONTAMINATED SOIL TO BE DISPOSED OF AT PERMITTED DISPOSAL FACILITIES APPROVED BY BOEING.
2. SOIL EXCAVATED FROM BELOW THE WATER TABLE WILL BE PLACED IN DEWATERING BOXES FOR REMOVAL OF WATER PRIOR TO HAULING OFFSITE FOR DISPOSAL.
3. BACKFILL WILL INCLUDE ADDITION OF 5,000 POUNDS OF POWDERED ORC PLACED IN THE BOTTOM OF THE EXCAVATION. THEN QUARRY SPALLS (OR APPROVED APPROPRIATE MATERIAL) WILL BE USED FOR BACKFILL BELOW THE WATER TABLE.
4. BACKFILL TO BE PLACED AND COMPACTED IN 12" LIFTS TO 95% MAXIMUM DRY DENSITY (OR ADJUST PER BOEING PREFERENCE). BACKFILL MATERIAL TO MEET IMPORT FILL REQUIREMENTS SPECIFIED IN NOTE 9.
5. TACK ASPHALT FACES OF SAW CUTS AND SEAL SAW CUTS WITH PG 64-22 OIL. SPRINKLE THE HOT SEALED SEAM WITH FINE, DRY, CLEAN SAND.
6. NEW ASPHALT PAVEMENT THAT EXHIBITS INCORRECT GRADES, EXCESSIVE UNEVENNESS, DEPRESSIONS, HUMPS, OR JOINT MISALIGNMENTS SHALL BE REMOVED AND REPLACED AT NO ADDITIONAL COST TO THE OWNER.
7. NEW ASPHALT PAVEMENT SHALL BE SLOPED TO PROPERLY DRAIN TO NEW AND/OR EXISTING STORM DRAINS WITHOUT PUDDLING.
8. NEW ASPHALT PAVEMENT SHALL MATCH EXISTING PAVEMENT AT ALL EDGES. FINISH GRADE SHALL MATCH EXACTLY WITHOUT BUMPS, DEPRESSIONS, OR OTHER IRREGULARITIES.
9. IMPORTED BACKFILL AND/OR CLEAN EXCAVATED OVERBURDEN TO MEET WSDOT STANDARD SPECIFICATIONS SECTION 9-03.14(1) FOR STRUCTURAL FILL. IN ADDITION, CONTRACTOR TO PROVIDE CERTIFIED TEST RESULTS OF MOISTURE CONTENT AND CHEMICAL CONSTITUENTS FOR THE IMPORTED FILL MATERIALS, EITHER THROUGH DOCUMENTATION OF EXISTING CHEMICAL ANALYSES OR BY PROJECT-SPECIFIC TESTING AND ANALYSIS, AS DIRECTED BY THE ENGINEER. AT MINIMUM, MATERIALS OBTAINED FROM PERMITTED COMMERCIAL QUARRIES SHALL HAVE A TOTAL ARSENIC LEVEL LESS THAN 20 MG/KG AND TOTAL PETROLEUM LEVEL LESS THAN 200 MG/KG FOR DIESEL AND OIL RANGE HYDROCARBONS AND BELOW LABORATORY REPORTING LIMITS FOR GASOLINE. MATERIAL FROM A SOURCE OTHER THAN A COMMERCIAL QUARRY IS SUBJECT TO ANALYSIS FOR ALL SITE COCS, PLUS ANY OTHER ANALYSES AS DETERMINED BY THE ENGINEER.

KATHERINE MARIE SALTANOVITZ
STATE OF WASHINGTON
47594
REGISTERED PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

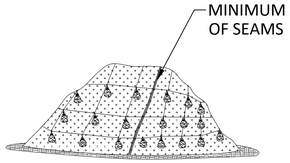
LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

EXCAVATION PROFILES

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 5 OF 6
DRAWING NO. **C-3**

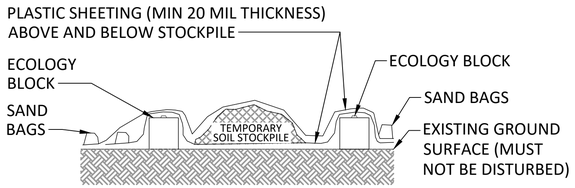
NOT FOR CONSTRUCTION



A. CLEAN OVERBURDEN AND RUBBLE

NOTE:

1. MINIMUM 12" OVERLAP OF ALL SEAMS REQUIRED.
2. BARRIER REQUIRED AT TOE OF STOCKPILE.
3. COVERING MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10' GRID SPACING IN ALL DIRECTIONS.

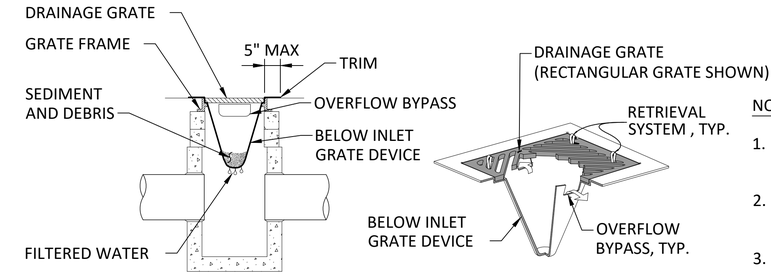


B. SOIL OVERBURDEN STOCKPILE AREA

NOTE:

1. STOCKPILED SOIL WILL BE COVERED AND SECURED FROM WIND, RAIN, AND OTHER DISTURBANCES AT ALL TIMES EXCEPT DURING ACTIVE SOIL LOADING AND UNLOADING.
2. CONTRACTOR SHALL REMOVE WATER WITHIN THE STOCKPILE AREAS BY PUMPING TO A CONTAINMENT VESSEL FOR ANALYSIS TO DETERMINE ITS PROPER DISPOSAL. CONTRACTOR SHALL BE RESPONSIBLE FOR DISPOSAL OF COLLECTED WATER IN THE STOCKPILE AREA.

1 / C-1 STOCKPILE COVERS
NOT TO SCALE



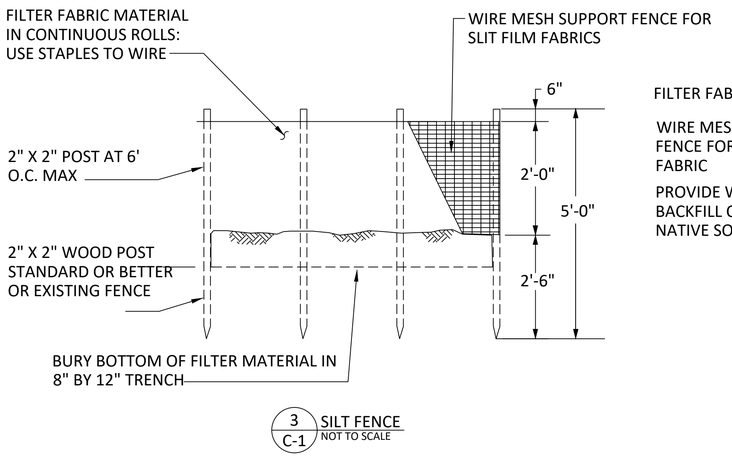
SECTION VIEW

ISOMETRIC VIEW

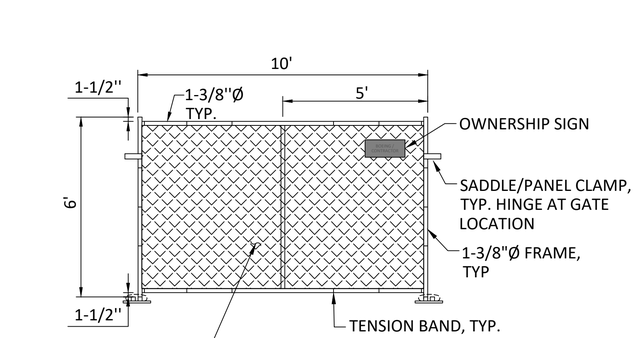
NOTE:

1. SIZE THE INLET GRATE DEVICE FOR THE STORMWATER STRUCTURE IT WILL SERVICE.
2. THE INLET GRATE DEVICE SHALL HAVE A BUILT-IN HIGH-FLOW RELIEF SYSTEM (OVERFLOW BYPASS).
3. THE RETRIEVAL SYSTEM MUST ALLOW REMOVAL OF THE INLET GRATE DEVICE WITHOUT SPILLING THE COLLECTED MATERIAL.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION 8-01.3(15).

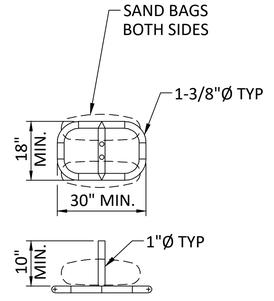
2 / C-1 CATCH BASIN INLET PROTECTION
NOT TO SCALE



3 / C-1 SILT FENCE
NOT TO SCALE

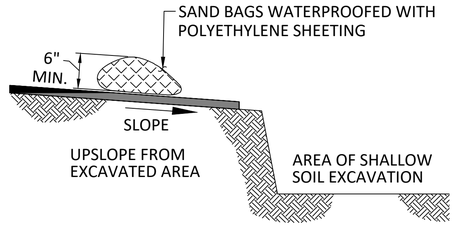


FENCE PANEL



FENCE PANEL STAND

4 / C-1 TEMPORARY CONSTRUCTION FENCING
NOT TO SCALE



NOTE:

1. PLASTIC SHEETING SHALL HAVE MINIMUM THICKNESS OF 6 MILS PER WSDOT 9-14.5(3).
2. THE CONTRACTOR SHALL ADD ADDITIONAL SHEETING AS REQUIRED AROUND THE BARRIER WHEN DEGRADATION OF SHEETING IS NOTICEABLE.

5 / C-1 SURFACE WATER BARRIER
NOT TO SCALE

KATHERINE MARIE SALTANOVITZ
STATE OF WASHINGTON
47594
REGISTERED
PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	DESIGNED	REVIEWED	APPROVED

DRAFTED BY:	C. CARLSTROM	CQC	10-13-2023
DESIGNED BY:	S. FEES	SEF	10-13-2023
REVIEWED BY:	D. FRAZER	DHF	10-13-2023
APPROVED BY:	K. SALTANOVITZ	KMS	10-13-2023
STATUS:	ISSUED FOR EDR	INITIAL	DATE

LANDAU ASSOCIATES
155 NE 100TH STREET, STE 302
SEATTLE, WASHINGTON 98125
(206) 631-8680

BOEING AUBURN
AOC A-01 EXCAVATION
AUBURN, WASHINGTON

TESC DETAILS

PROJECT NO. 0025164.200.306
DATE OCTOBER 2023
SHEET 6 OF 6
DRAWING NO. **C-4**

APPENDIX B

Algona Enhanced *In Situ* Bioremediation Work Plan

ALGONA ENHANCED *IN SITU* BIOREMEDIATION WORK PLAN

Boeing Auburn Site
Auburn, Washington

January 25, 2024

Prepared for

The Boeing Company
Auburn, Washington

TACOMA
2107 South C Street, Tacoma, WA 98402 T 253.926-2493

landauinc.com

Algona Enhanced *In Situ* Bioremediation Work Plan
Boeing Auburn Site
Auburn, Washington

This document was prepared by, or under the direct supervision of, the technical professionals noted below.

Document prepared by: Sarah Fees
Primary Author
Sarah Fees, LG

Document reviewed by: Clint Jacob
Quality Reviewer
Clint Jacob, PE, LG

Date:	January 25, 2024
Project No.:	0025164.200.303
File path:	\\tacoma3\PROJECT\025\164\R\EDR\Algona EISB\Landau_BoA_Algona EISB Work Plan_Final 01.25.2024
Project Coordinator:	KJG

LANDAU ASSOCIATES

This page intentionally left blank.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
Algona	City of Algona
AOC	area of concern
bgs	below ground surface
Boeing	The Boeing Company
Boeing Auburn Facility	Boeing Auburn Plant and associated properties
Boeing Auburn Plant	Auburn Fabrication Division Plant
CAP	Cleanup Action Plan
cDCE	cis-1,2-dichloroethene
City Water	City of Algona water
CUL	Cleanup Level
CVOC	chlorinated volatile organic compound
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
EISB	enhanced *in situ* bioremediation
FS	feasibility study
ft	foot/feet
gpm	gallons per minute
HASP	Health and Safety Plan
IRA	interim remedial action
Landau	Landau Associates, Inc.
mg/L	milligrams per liter
PVC	polyvinyl chloride
RI	remedial investigation
ROW	right-of-way
SAP	Sampling and Analysis Plan
Site	Boeing Auburn Site
STA	control stations
TCE	trichloroethene
TOC	total organic carbon
UIC	underground injection control
VC	vinyl chloride

This page intentionally left blank.

1.0 INTRODUCTION

This document, prepared by Landau Associates, Inc. (Landau), presents a work plan for the enhanced *in situ* bioremediation (EISB) cleanup action for environmental releases associated with The Boeing Company's (Boeing's) Auburn Fabrication Division Plant (Boeing Auburn Plant) and associated properties (Boeing Auburn Facility). The Boeing Auburn Site (Site) includes the Boeing Auburn Facility and all contiguous property affected by releases of hazardous substances that are confirmed or suspected to have originated at the Facility. The cleanup action presented in this work plan describes EISB injection activities at the Algona Focus Area for treatment of Area of Concern (AOC) A-14. AOC A-14 consists of Site-wide groundwater trichloroethene (TCE) and vinyl chloride (VC) contamination (groundwater plumes) that extends from the current or former Boeing owned properties to downgradient properties. This work plan supplements the engineering design for the cleanup action at AOC A-14 in the Engineering Design Report (EDR) for the Boeing Auburn Site. The extent of AOC A-14 and the Algona Focus Area are presented on Figure 1.

1.1 Background

Boeing completed various investigation activities at the Boeing Auburn Facility as part of the comprehensive Remedial Investigation (RI; Landau 2017b) conducted to investigate AOCs at the Boeing Auburn Facility. During the RI, Boeing investigated two comingled groundwater plumes caused by chlorinated volatile organic compounds (CVOCs) coming from the Boeing Auburn Facility and extending off Boeing property to the north (Area 1 Plume) and northwest (Western Plume). These two plumes extend about 1 mile northwest of the Boeing Auburn Facility. The plumes are primarily comprised of TCE and its breakdown products cis-1,2-dichloroethene (cDCE) and VC. The Algona Focus Area is located in a downgradient portion of the Western Plume, which extends northwest from the Boeing Auburn property and through the northeast portion of residential Algona.

The groundwater plumes are located in the uppermost aquifer, which consists of saturated portions of modern and recent alluvium deposited by the Green and White rivers. The Osceola Mudflow serves as a regional aquitard between the uppermost aquifer and deeper aquifers. Locally, beneath the Boeing property and off Boeing property to the north and northwest, the uppermost aquifer is approximately 100 feet (ft) thick. For the purposes of Site discussion, groundwater within the upper aquifer is divided into three hydraulically interconnected zones, based on depth below ground surface (bgs):

- A shallow zone, from the water table to 35 ft bgs. The shallowest wells within this zone are screened at or near the water table; water table data is considered a subset of the shallow zone data.
- An intermediate zone, from 35 to 75 ft bgs.
- A deep zone, from 75 ft bgs to contact with the Osceola Mudflow (typically 85 to 105 ft bgs).

Contributions to groundwater in the upper aquifer primarily consist of infiltration from the White River with a smaller contribution from precipitation. Groundwater flow in the Auburn valley is generally northward, parallel to the valley walls (PGG 1999), and recharges the Green River. There is a

northwesterly component to groundwater flow at the Site as a result of features on the west side of the valley that capture shallow groundwater. These features include stormwater and surface water features along the western portion of the Auburn valley, including wetland features, Mill Creek, and stormwater features like the Chicago Avenue ditch and the Auburn 400 stormwater retention basins. The Chicago Avenue ditch and Auburn 400 stormwater retention basins collect stormwater from local roadways and parking lots but also intercept shallow groundwater. Locally, in the Algona Focus Area, shallow zone groundwater flow directions are northwest to westerly as groundwater is intercepted by the Chicago Avenue ditch (Figure 2).

CVOC degradation is a significant factor in attenuation of the plumes at the Site. The main degradation process occurring at the Site is microbially-mediated reductive dechlorination with concurrent and complementary abiotic degradation that occurs in anaerobic portions of the aquifer. Anaerobic aquifer conditions are present throughout most of the Site and reductive dechlorination is a well-documented process at the Site (Landau 2019). Abiotic degradation is a chemical reaction of CVOCs with reactive iron minerals formed under these same anaerobic aquifer conditions.

In 2015, a bioremediation pilot test was conducted in the Algona Focus Area to evaluate possible enhancement of natural attenuation already occurring in that area (Landau 2017a). The pilot test was performed in an area where low concentrations (less than 5 micrograms per liter [µg/L]) of CVOCs in groundwater extend beneath the northeast corner of the Algona residential neighborhood. The purpose of the pilot test was to evaluate whether degradation of the low concentrations of CVOCs was enhanced through injection of electron donor substrates into the shallow aquifer and to evaluate substrate injection design in preparation for the forthcoming Feasibility Study (FS) and possible implementation. A full description of the pilot test is provided in the pilot test reports (Landau 2017a, 2018) and a brief summary is presented in the section below.

1.2 Summary of Algona Pilot Test

The pilot test injection was conducted in August and September 2015. Approximately 80,000 gallons of electron donor solution was injected into the shallow groundwater zone in five injection/extraction wells. Electron donor consisted of a combination of fast release lactate and slow release emulsified vegetable oil. Injection was performed to enhance the availability of electron donor and reduced aquifer redox conditions in this area where substantial natural attenuation was already occurring.

Pilot test monitoring continued through June 2023. Total CVOC concentrations initially increased following the injection because of enhanced desorption, then decreased substantially below baseline concentrations through enhanced biotic and abiotic destruction. Reduction of total CVOC concentrations related to the pilot test injection occurred up to 385 ft downgradient of the injection wells. As of 2022, TCE and cDCE concentrations are mostly below laboratory reporting limits at wells in the treatment area of the Algona pilot test injection. VC concentration trends increased following the injection due to sequential reductive dechlorination; however, concentrations are currently decreasing. The decreasing VC trends are expected to continue as cDCE concentrations decrease further. The pilot test was successful in reducing total CVOC concentrations in a limited area around the injection area; however, concentrations of VC in the injection area and downgradient continue to be up to two orders

of magnitude above stormwater quality standards in groundwater. Degradation rates were approximately doubled by the pilot test injection.

1.3 Cleanup Action Objective

The objective of the EISB injections in the Algona Focus Area is to enhance the highly effective natural attenuation treatment already occurring in the Algona Focus Area. Injections are planned to shorten the restoration time frame required to meet cleanup levels (CULs) in the Algona Focus Area. The treatment area is intended to extend from the row of injection wells, beneath the Chicago Avenue ditch, and into the northern portion of Algona residential neighborhood. Effectiveness of treatment will be evaluated based on enhanced redox and enhanced degradation/concentration reduction.

1.4 Cleanup Action Approach

The EISB design for the cleanup action extends the existing pilot test injection row to the north to create a continuous row of injection wells approximately 1,000-ft-long in the Algona Focus Area. As described in the Cleanup Action Plan (CAP; Ecology 2022), injections will occur up to three times approximately every 4 years with actual timing based on performance data collected. Less than three injections may occur if groundwater CULs are met in Algona Focus Area monitoring wells or if a point of diminishing returns of treatment is reached in consultation with Washington State Department of Ecology (Ecology).

The injection design includes a total of 27 injection wells[1] installed on approximate 35-ft centers to target the shallow groundwater zone. Both new and existing monitoring wells located downgradient of the injection area will be used to monitor the injection remedy. The anticipated layout of the injection row and monitoring wells within the groundwater plume is shown on Figure 3.

The locations of injection and monitoring wells are preliminary pending resolution of property access, locations of utilities, and further evaluation of storm drain locations and depths. Storm drainpipe joints are often leaky and there is always some risk of injection fluid entering storm drains when injection occurs nearby. These constraints are discussed further in Section 2. Any required modifications will be discussed with Ecology and the property owners prior to well installation.

Injection wells will be screened from 20 to 40 ft bgs to enhance biodegradation over the aquifer interval from the water table (5 to 15 ft bgs) to approximately 50 ft bgs. Injection fluid will be distributed above and below the screened interval with preferential distribution upward toward the water table where hydrostatic pressure is lower than at depth. This target treatment interval contains the highest contaminant concentrations in this area and includes the shallow and water table intervals and extends into the intermediation zone (beginning at 35 ft bgs).

Injection fluid will consist of electron donor substrate mixed with potable water and/or extracted groundwater. As fluid is injected to a given well, groundwater will be extracted from the next well in line to draw the injected fluid toward it and more uniformly distribute donor between injection wells.

[1] Five of the injection wells were already installed during the pilot test; an additional 22 wells will be installed for full-scale implementation.

Extracted groundwater (with potable water added as needed) will then be mixed with donor substrate and reinjected at the well from which it was extracted. Donor substrates will consist of a combination of fast release lactate and slow-release emulsified vegetable oil (e.g., LactOil®).

It is anticipated that three EISB injections will enhance biotic and abiotic degradation for approximately 20 years, based on pilot testing (Landau 2017a, 2018) and the EISB interim remedial action (IRA) that was completed at former Building 17-05. A full description of the IRA is provided in the IRA reports (Landau 2004a, b, 2005a, b, 2008) and the RI report (Landau 2017b). This enhanced degradation consists of a 12-year active treatment period resulting from three injection events performed every four years, followed by up to 6 to 10 years of sustained enhancement. Donor injections at the former Building 17-05 IRA created highly reducing conditions that have persisted more than 10 years post-injection at some locations (Landau 2004a, b, 2005a, b, 2008). This extended period of enhanced bioremediation treatment following cessation of active treatment is also well documented in literature (Adamson et al. 2011; Adamson and Newell 2009; Jacob et al. 2010; Sleep et al. 2005). This persistence of biotreatment is due to matrix back-diffusion (i.e., slow release) of electron donor from aquifer pore spaces and the recycling of electron donor through endogenous decay of bacteria developed in the aquifer during the injection period.

2.0 CLEANUP ACTION SETUP

The setup for the EISB cleanup action consists of site preparations, evaluation of site constraints, drilling and installation of injection wells and monitoring wells, and baseline groundwater sampling.

2.1 Site Preparations

Site preparation activities will include access agreements, permitting, and utility locating. Access agreements with the Primus and Wilsonart property owners will be developed before any on-property work commences.

2.1.1 Access Agreements

Access agreements will be required for Primus and Wilsonart properties for the installation of injection wells and monitoring wells, injection activities, and ongoing monitoring. Access agreements will be obtained prior to initiation of site activities.

The Algona right-of-way (ROW) will be accessed in order to install additional observation and monitoring wells and monitor the existing observation well (OW-1) and downgradient monitoring wells. Access to the ROW has been obtained through existing permit C15-25. Additional permits for doing work in the Algona ROW will be obtained if access to the ROW is needed for installation of additional observation and/or monitoring wells.

2.1.2 Permits

All existing and new injection wells will be registered with the Washington State Underground Injection Control (UIC) program. Registration will be completed prior to injection. A fire hydrant permit from the City of Algona will also be required to obtain potable groundwater for injection activities.

2.1.3 Utility Locates

Appendix A presents a map of Milwaukee Avenue North utilities between 7th Avenue North and 10th Avenue North. These utility maps were created from prior “One Call” utility locate markings in the field. Injection well locations on the Primus property are shown on the utility map between control stations (STA) 680 and 860; station numbering is based on feet extending south from the centerline of 10th Avenue North. Additional One Call and private utility locates will be conducted once access agreements are completed and prior to drilling.

The injection wells shown on Figure 3 are located west of Milwaukee Avenue North between utility map stations 1+60 and 11+70. Primus injection wells are between stations 3+40 and 11+70. Wilsonart injection wells are between stations 1+60 and 3+40.

2.1.4 Health and Safety

Protection monitoring will be performed during EISB implementation to monitor and mitigate health and safety risks for workers during construction, donor refresh events, and subsequent groundwater

performance monitoring events, provided through appropriate health and safety protocols outlined under the Site-specific health and safety plan (HASP; Landau 2023a) The project HASP addresses potential physical and chemical hazards associated with Site activities, consistent with the requirements of Washington Administrative Code 173-340-810. Anticipated potential physical hazards include working in proximity to heavy equipment during drilling or when moving injection equipment, weather hazards from heat exposure, and exposure to contaminated soil and/or groundwater. Exposure to Site contaminants in the soil or groundwater could occur through various exposure pathways including direct contact, ingestion, and inhalation. The existing project HASP will be updated (if needed) for use by the engineering team during construction oversight, and the selected drilling contractor will be required to prepare and submit a HASP for use by its workers and subcontractors. Additional environmental protection monitoring is described in Section 3.2.

2.2 Constraints

Primary constraints to implementing EISB activities are injection rates, potential infiltration of injection fluid to storm drains and surface stormwater features, and minimizing disruption to the properties where injection wells are located. Possible locations for injection and monitoring wells are further constrained by the presence of underground utilities, which may require adjustment of injection locations.

2.2.1 Injection Rates

Injection rates may vary from well to well due to subsurface conditions. It may not be feasible to deliver the full designed injection amount for each well in some locations due to tight aquifer conditions or due to short circuiting of injection fluid to the ground surface. Where achievable injection rates are significantly lower than planned, the remaining injection volume will be delivered to adjacent wells. Any short-circuited fluid will be contained and recovered for reuse or disposal.

2.2.2 Stormwater

To minimize the possibility of injection fluid infiltration to stormwater, it is desirable to locate injection wells as far as practical from existing storm drains and to complete injection activities during dry summer months when the water table is lowest. A large main storm drain line (36-inch-diameter) is located beneath Milwaukee Avenue North transitioning from the east to west side of the road (Milwaukee Avenue storm drain). The Milwaukee Avenue storm drain connects westward to the Chicago Avenue ditch near the north end of the Primus property. In addition, smaller and shallower storm drain systems are present on the Primus property (Primus storm drain) and Wilsonart property (Wilsonart storm drain). Property access and additional information is needed to further evaluate the Primus and Wilsonart storm drains to prevent infiltration of injection fluid to them. Certain sections of the Primus and Wilsonart storm drains may be temporarily plugged during injection using inflatable plugs. A contingency plan may be prepared to address pre-emptive actions to prevent donor fluid discharge to storm drains, if required based on further site evaluation. The current understanding of stormwater in the injection area is described below.

The main 36-inch storm line drains all the commercial properties adjacent to Milwaukee Avenue North (See Appendix A). The 36-inch line is constructed of concrete pipe and the invert depths at service manholes indicate the line is deeper than the dry season water table. Concrete storm drains are commonly leaky, allowing infiltration of groundwater at pipe joints. To avoid infiltration of injection fluid into the main 36-inch storm drain, injection wells will be located as far as practical to the west (hydraulically downgradient) on the Primus and Wilsonart properties. Installation of injection wells within the row of parking against the east Primus property fence provides an offset of about 75 ft from the Milwaukee Avenue storm drain on the south side of the injection area and about 40 ft from the Milwaukee Avenue storm drain where it moves to the west side of the road (Appendix A Station 9+20). The 75-ft offset is the same as that for the pilot test wells and no storm drain infiltration of injection fluid occurred during pilot test injection. The storm line crosses west to connect to the Chicago Avenue ditch at the northern part of the Primus property. Injection locations may need to be adjusted to be at least 30 to 40 ft from the large storm lines. Based on further evaluation, a temporary plug or other means of collecting fluid may need to be placed prior to the outfall of the westward connection to the Chicago Avenue ditch and will be described in a contingency plan as needed.

Observation wells (OB-1 and OB2) were installed for the pilot test between the injection wells and the Milwaukee Avenue storm line. These wells were observed during injection for presence of injection fluid as an early warning that injection fluid was moving hydraulically upgradient toward the storm line. Injection fluid was not observed in the observation wells during the pilot test injection and therefore additional contingency measures were not required. Additional observation wells will be installed similarly for the cleanup action (Figure 4).

Primus property storm drain system constraints are anticipated to be similar to constraints during the Algona Pilot Test injection activities. The pilot test injection wells are located about 75 ft hydraulically downgradient (west) of the Milwaukee Avenue North storm line and 55 ft upgradient (east) of the nearest Primus storm lines. Given the downgradient proximity to some of the Primus storm drain system, select locations were temporarily plugged or observed for injection fluid during injection; injection fluid was not observed. The Primus system is shallower than the Milwaukee Avenue storm line. Site access and utility locating work is needed to determine Wilsonart stormwater constraints. Similar to the Primus property, temporary storm drain plugs may be utilized at selected locations.

2.2.3 Minimizing Disruption to Local Properties

Efforts to minimize disruption to Primus and Wilsonart property operations will be conducted as described below. Primus and Wilsonart property activities include injection and monitoring well installation, injection activities with possible plugging of storm lines during injection, and periodic groundwater monitoring. Disruptive activities may be performed during off-peak hours, as needed.

Monitoring wells and injection wells will be completed during a single mobilization and at a time acceptable to Primus and Wilsonart. The work will be completed with a limited access sonic drilling rig to minimize the size of the work area and noise. Monitoring well and injection locations will be adjusted with property owner input, as needed, to minimize the disruption of injection and monitoring.

To minimize facility disruptions during injection, injection fluid mixing and injection stations will be contained within a discrete footprint of approximately 20 ft by 60 ft. It is anticipated that this station will be moved three times to inject four approximately 250-ft-long segments of the total 1,000-ft alignment from four locations. Injection and extraction hoses will extend north and south from each station location to nearby wells. The approximate well locations and footprint locations of the mixing station are shown on Figure 4.

2.3 Drilling and Well Construction

The 22 new injection wells, four new monitoring wells, and at least one observation well will be installed using a limited access rotosonic drilling rig. Rotosonic drilling collects a continuous soil core in a 6-inch-diameter core barrel, which is placed in a polyethylene "core bag" liner. The core sampler and all sampling equipment, including sampling points and rods, will be decontaminated between drilling locations. Subsurface soil cores will be collected for field observation and an environmental professional from Landau will prepare a descriptive log of each soil boring. All samples collected will be visually described in the field in general accordance with ASTM International D2488-17, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*.

Eighteen of the 22 new injection wells and the three new monitoring wells will be located in the east parking area of the Primus property. Four of the 23 new injection wells and one new monitoring well will be located in the grassy area in the southeast portion of the Wilsonart property. At least one additional observation well will be installed upgradient of the injection wells. Proposed injection and monitoring well locations are shown on Figure 4.

The wells will be constructed in accordance with *Washington State Minimum Standards for Construction and Maintenance of Wells* (Chapter 173-160 of the Washington Administrative Code). A drilling matrix is provided in Table 1. Well depths and screened intervals will be as follows:

- Injection Wells: Wells IW-38 to IW-59 will be installed to 40 ft bgs with a screened interval from 20 to 40 ft. This places the top of the screen about 15 ft below the water table, which is at about 5 ft bgs. Injected donor solution will extend above and below the well screen for a distribution that is expected to extend from the water table to approximately 45 ft bgs. Injection fluid is preferentially distributed upward towards lower hydrostatic pressure near the water table.
- Downgradient monitoring wells: four downgradient monitoring wells will be installed to 30 ft bgs with a screened interval from 20 to 30 ft bgs, coinciding with typical screened intervals of other shallow zone monitoring wells and located within the treatment interval targeted by injection wells.
- Upgradient observation wells: upgradient observations wells (two currently planned, additional may be needed as proposed in a contingency plan) may be installed and screened across the water table to monitor for injection fluid that could potentially migrate toward the Milwaukee Avenue North storm drain. The wells will generally be constructed with 10-ft screens.

Well construction details are described below and presented on Figure 5 for injection wells and Figure 7 for monitoring and observation wells. Wells will be constructed as follows:

- 2-inch-diameter polyvinyl chloride (PVC) casings and screens.
- 0.020-inch slot size PVC screen with threaded end cap.
- 10 to 20 Colorado sand packs (or equivalent) extending from the bottom of the well to 2 ft above well screen.
- For the injection wells and the closest downgradient monitoring well (AGW285), the well seal will consist of cement/bentonite grout extending to the surface completion. Approximately 1 ft of bentonite pellets will be placed immediately on top of the sand pack prior to grout placement to prevent grout incursion into the sand pack. The cement/bentonite grout is resistant to shrinkage and cracking and creates a high-strength seal resistant to injection pressures.
- The well seal at the remaining monitoring wells, where injection pressures are not a concern, will consist of bentonite chips from the top of the sand pack to the surface completion.
- Wells will be completed in 8-inch-diameter flush-mounted monuments with gasketed lids and bolts. Monuments will be heavy-duty rated for truck and forklift loads.
- Within the monument, injection wells will be completed with a 2-inch, PVC, male pipe thread adapter connected to a 2-inch, galvanized steel, threaded coupler. A lockable, expanding plug will be used to close the well casing. A 2-inch galvanized steel nipple with an aluminum female cam lock (by female threads) will be threaded into the coupler for injection. Well casings must be centered within the monuments. The pipe thread adaptor will be glued to the well casing to create a pressure-tight connection for injection; both surfaces should be primed, but the glue should only be applied to the outside of the casing (not inside of fitting) to avoid dripping of excess glue down the well casing.

2.3.1 Well Development

At least 24 hours after construction, wells will be developed to remove formation material and drilling water (if added) from the well boring and the filter pack prior to groundwater sampling. All downhole development tools will be decontaminated prior to use in each well. During development, wells will be surged using a surge block or stainless-steel bailer to assist in removal of fines from the sand pack. A 12-volt submersible pump, centrifugal pump, or other appropriate pump will be used to remove water from the well. Wells will be developed by purging until reaching a turbidity of 50 nephelometric turbidity units (or until a minimum of 10 casing volumes is removed). Where drilling water is added, the volume of water removed during development will be a minimum of 200 percent of the volume added. Wells will be developed as described in the Sampling and Analysis Plan (Landau 2023b).

Baseline groundwater samples will be collected from each newly installed injection and monitoring well as described in Section 2.4. Former pilot test injection wells will be redeveloped and sampled along with the newly installed wells.

2.3.2 Waste Management

Plastic sheeting will be used to protect the ground surface and contain drill cuttings at each well location, which will then be placed into the waste containers. All soil cuttings, decontamination water, and purge water will be contained and placed into 55-gallon steel drums or a temporary receptacle for transport back to the Boeing Auburn Property for appropriate disposal. Soil and water waste will be

segregated. Once at the facility, waste will be placed into appropriate containers for storage. Boeing-provided labels will be attached to each container. If drums are used, they will be placed on Boeing pallets at the facility. Boeing will be responsible for banding, transporting, and disposing of the containers.

2.3.3 Well Locations and Elevations

After completion of the drilling and well installation activities, the horizontal location and vertical elevation of each new well will be measured or surveyed. The elevation of the top of each well casing will be measured to an accuracy of 0.01 ft National Geodetic Vertical Datum of 1929 in order to accurately determine groundwater elevations. Existing monitoring wells on the Primus property previously surveyed will be used as the reference points for a level loop using auto-level survey equipment. Well locations will be measured from existing wells and site features and will reference the Washington State Plane Coordinate System North Zone 83.

2.4 Baseline Groundwater Sampling

A groundwater sample will be collected from each injection well and newly installed monitoring well after well development is completed. The baseline sampling of injection wells prior to electron donor injection will show the distribution of cVOCs along the injection well alignment and may inform focused injection and monitoring.

Baseline groundwater sampling will be conducted via low-flow sampling techniques following procedures as described in the SAP. The samples will be submitted to the laboratory for analysis of CVOCs (tetrachloroethene, TCE, cDCE, 1,1-DCE, trans-1,2-DCE, and VC) by US Environmental Protection Agency (EPA) method 8260D and total organic carbon (TOC) by Method SM 5310 C-2000. If possible, baseline groundwater sampling will be timed to occur along with annual MNA Site-wide groundwater sampling.

3.0 BIOREMEDIATION INJECTION

This section describes the bioremediation design and implementation procedures for the Algona Focus Area EISB cleanup action.

3.1 Injection Design

Design elements include injection volumes and the types and volumes of electron donor substrate and other amendments.

3.1.1 Injection Well Spacing and Injection Volume

Injection well spacing and injection volumes for the cleanup action are based on the results of the 2015 Pilot Test (Landau 2017a). As was conducted during the pilot test, donor fluid injection will occur while groundwater is extracted from the adjacent injection well to draw fluid toward it and enhance the distribution of donor fluid between injection wells. The well used for groundwater extraction will be the next well injected, moving from one end of the injection row to the other.

The pilot test determined that optimal well spacing for the injection wells is 35 ft and the new injection wells will be installed using this spacing. An additional injection well will be installed midway between pilot test injection wells IW-35 and IW-36, currently spaced 65 ft apart.

The design injection volume for the cleanup action will be approximately 10,000 gallons per well. This is based on pilot test results for the injection well/extraction well pair of IW34 and IW35, located 41 ft apart and the IW37 and IW33 pair, located 27 ft apart.

- During injection at IW34, visual breakthrough of electron donor and 69 milligrams per liter (mg/L) of measured total organic carbon (TOC) occurred at IW35 after 4,700 gallons. After completing 7,850 gallons injected at IW-34, TOC measured 218 mg/L at IW35, indicating substantial and adequate distribution of donor substrate between the injection and extraction wells. After completion of the full injection volume (15,700 gallons), TOC had increased to 611 mg/L.
- During injection at IW37, visual breakthrough of electron donor and 233 mg/L of measured TOC occurred at IW33 after 10,830 gallons, indicating substantial and adequate distribution of donor substrate between the injection and extraction wells. After completing the full injection volume of 11,100 gallons, TOC was approximately the same (266 mg/L) at IW35.
- Based on pilot test results, the 10,000-gallon design injection volume for the cleanup action will result in greater than 200 mg/L TOC breakthrough at the adjacent well. The adjacent well will then be injected with electron donor, providing continuous and overlapping distribution of electron donor along the injection row alignment.

The total design injection volume for all 27 wells is 270,000 gallons. The total volume injected to each well will likely vary somewhat from the design volume due to field conditions. An additional volume of clear water will be injected to flush the wells before and after the electron donor injection solution.

3.1.2 Injection Fluid Components

Injection fluid will consist of water mixed with electron donors ethyl lactate and vegetable oil, and micronutrients. Both electron donors will be provided by the remediation electron donor substrate LactOil. Injection quantities are detailed in Table 2.

3.1.2.1 Mix Water

City of Algona water (City water) and extracted groundwater will be used for mixing injection fluid. Water from a nearby hydrant or other high flow-rate source will be added to each batch tank at the mixing station. A pond dechlorinator product (sodium thiosulfate) will be used to remove (chemically reduce) residual chlorine before batching in other injection fluid components. Approximately 260,000 gallons of City water and groundwater will be used for mixing injection fluid.

3.1.2.2 Electron Donors

The LactOil-98 substrate will provide both soluble ethyl lactate and insoluble vegetable oil electron donor. This is a newer and more concentrated product than the LactOil-80 product used for the pilot test and contains 18 percent more electron donor (98 percent by weight vs 80 percent by weight), with the balance composed of surfactants and water. LactOil-98 contains approximately 43 percent weight ethyl lactate and 55 percent weight emulsified soybean oil.

The combined use of fast-release (soluble) ethyl lactate and slow-release (insoluble) vegetable oil is intended to optimize the distribution and longevity of injected donor. Soluble lactate is transported further from injection wells and is used more quickly by bacteria. Insoluble vegetable oil moves a shorter distance from the wells and ferments more slowly than soluble organic acids providing a longer-term source of donor to aquifer bacteria. Combined use of soluble and insoluble donor is a beneficial strategy to rapidly achieve enhanced aquifer redox conditions over an extended area and an extended treatment period between injection events (Jonsson et al. 2007; Suthersan et al. 2003).

The injection design volume, totaling 270,000 gallons for the 27 injection wells, will include 4 percent LactOil-98 by volume. The use of LactOil-98 will emplace approximately 20 percent more electron donor than the 4 percent LactOil-80 used in the pilot test. This donor application rate requires a total of 40 totes of LactOil-98.

3.1.2.3 Micro-nutrients

Yeast extract will be provided as a source of micronutrients. Yeast extract serves as an electron donor and, more importantly, has been shown to provide the micronutrients important to bacterial growth (Major et al. 2003). Yeast extract will be provided at approximately 1 pound per 1,000 gallons of design injection volume. This corresponds to 10 pounds per well and a total of 270 pounds.

3.2 Procedures

This section describes procedures for mixing and injection of electron donor to the aquifer and for monitoring the distribution of donor between injection wells. The components of the injection fluid will

be batch mixed and then injected to a selected well while groundwater is extracted concurrently from the next well to be injected. Wells will be injected from south (IW-36) to north (IW-60). There will be no concurrent extraction during injection of the last (northernmost) well on the Primus property (IW-55) or the last (northernmost) well on the Wilsonart property (IW-60). Samples for TOC laboratory analysis will be collected from representative injection fluid batches and from extracted groundwater to evaluate the distribution and relative strength of electron donor between the 28 injection wells (Section 3.2.5).

3.2.1 Mixing and Injection Station

A mixing and injection station will be located in a convenient location between the injection wells. It is anticipated that the station will consist of two, 6,500-gallon Baker tanks, three gasoline-powered centrifugal pumps, a hose connection to City water (i.e., fire hydrant), and drums of electron donor substrate on pallets. Both tanks will be used alternately for storing extracted groundwater and for mixing batches of electron donor injection substrate with City water. Extracted groundwater will be mixed with donor substrate and reinjected as described in the following sections. The tanks and pumps will be located within temporary secondary spill containment.

Due to the length of the injection row, the mixing and injection station will be moved approximately three times during the injection activities.

3.2.2 Batch Mixing

Water, LactOil, and yeast extract will be mixed together in a 6,500-gallon batch tank. Half of an injection dose (5,000 gallons) will be batched at a time. Approximately 4,800 gallons of water will be added to the tank for each batch. Residual chlorine will be removed from City water by adding a pond dechlorinator product (sodium thiosulfate) to the tank, per product instructions. To achieve thorough mixing, a gasoline powered, 3-inch inlet/outlet centrifugal pump (i.e., trash pump) will be used to re-circulate water within the tank while adding LactOil and yeast extract through a hose connected to the suction side of the pump. Approximately 200 gallons (0.75 tote) of LactOil and 5 pounds of powdered yeast extract will be added to each tank batch; yeast extract will first be mixed as slurry with water in a bucket.

For wells where groundwater was extracted during injection of the adjacent well and collected in a Baker Tank, the extracted water will be amended with LactOil and yeast extract in batch mixing; additional City water will be used, as needed. Amended groundwater will primarily be reinjected to the same well from which it was extracted. The EPA allows for reinjection of groundwater extracted from a contaminated area, provided groundwater is treated to substantially reduce hazardous constituents prior to reinjection, with reduction of hazardous constituents occurring prior to or following injection (EPA 2000). The amendment of LactOil and yeast extract to the extracted groundwater will allow for reduction of TCE and VC following injection, as permitted through the UIC program, and completed previously during the Algona Pilot Test (Ecology 2015).

3.2.3 Injection

The procedure at each injection well will consist of injecting donor fluid followed by a final clear water flush. A gasoline powered, 3-inch inlet/outlet centrifugal pump (i.e., trash pump) will be used for injection. The pump speed and injection valves will be controlled to maintain well head injection pressures near or below 10 pounds per square inch. Approximately 10,000 gallons will be injected to each well as indicated in Table 2.

After the donor fluid injection is completed at each well, approximately 200 gallons of unamended City water (treated to remove residual chlorine) will be injected to each well. This post-injection flush serves to remove donor from the well and sand pack to minimize subsequent biofouling.

Field notes will document times, batch numbers, observations, injection volumes, flow rates, and pressures pertaining to each injection well. Breakthrough of electron donor at each extraction well, based on visual and olfactory observation, will be noted, including the injection and extraction volume at the time of breakthrough.

3.2.4 Concurrent Groundwater Extraction

Concurrent groundwater extraction will take place at the next adjacent well during injection. The final well will be injected without extraction at the adjacent well, which will have been injected prior. Depending on the east to west offset required for wells located on the Primus and Wilsonart properties, the last well on each property may be injected without concurrent adjacent extraction. Groundwater extraction will be performed according to the following guidelines:

- An initial extraction rate of 5 to 10 gallons per minutes (gpm) will be targeted.
- In the event that breakthrough has not been observed at the extraction well by the time that half of the design injection volume has been delivered to the adjacent injection well, attempts will be made increase the extraction flow rate to 10 to 20 gpm for the remaining period of injection.
- If injection fluid is observed at the extraction well prior to half of the design injection volume, the extraction pump may be operated at a lower rate and/or intermittently for the remainder of the injection period.
- Extraction rates and the timing and corresponding injection volume and extraction volume at the time of breakthrough will be documented in field notes.

3.2.5 Observations During Injection

Prior to injection, baseline samples will be collected from various locations and analyzed for TOC. A sample from each observation location will also be reserved in a clear jar for visual comparison to subsequent observations. The baseline samples are necessary because groundwater or stormwater may have ambient cloudiness or coloring not associated with injection activities. Sample locations will include:

- Each observation well.

- Two locations on the Milwaukee Avenue main storm drain.
- The outfall of the westward storm line to the Chicago Avenue ditch.
- Two locations in the Chicago Avenue ditch, 100 ft upstream and downstream of the storm drain outfall.
- Any other locations where a plug will be placed in the storm drain system.
- Additionally, the outfall and two locations on Chicago Avenue ditch will be analyzed for biological oxygen demand.

Visual observations and sampling will occur during injection to monitor the distribution of injected fluid. Periodic visual observations for evidence of injection fluid will be made at the operating extraction well, at upgradient observation wells, and at storm drain catch basins, every 30 to 60 minutes. The nearest upgradient observation well to the injected well and nearby storm drain catch basins on the west of side of Milwaukee Avenue North will be observed, along with storm drain catch basins on Primus and Wilsonart properties. Observations at the catch basin or manhole may be made through the grated cover and/or using a peristaltic pump and purging to a bucket. The presence of injection fluid is indicated by yellow or milky liquid or distinctive LactOil odor.

In the event that injection fluid is observed at the upgradient observation wells, injection rates will be slowed, and more frequent observations made at nearby storm drain manholes.

If injection fluid is observed in catch basins on Milwaukee Avenue North, injection will be suspended at the current well and plugs installed and inflated to prevent discharge to the Chicago Avenue ditch. The City and Ecology will be notified. Depending on the degree of infiltration, samples of fluids in the drain system may be collected for TOC analysis and/or fluids may be recovered from the storm drain. Fluid recovery may be accomplished with a vacuum truck or by using a pump to move fluid to a storage tank.

Following further evaluation of the nearness of injection wells to the various storm drains, it may be decided to place plugs at strategic locations on each property or in the storm drain main. Plugs may be placed prior to injection in certain areas or may be kept on site and ready to deploy. Emplaced plugs may be inflated or left uninflated until needed, depending on the volume of storm drain base flow. Plug locations to be evaluated include catch basins/manholes on each property, the Milwaukee Avenue storm drain, the west-trending storm drain, and outfall to the Chicago Avenue ditch.

3.2.6 Spill Prevention

Discharges to the ground surface that may occur will be prevented from entering the storm drain system. Incidental spills at the mixing station will be contained within secondary containment that will be installed around the tanks and pumps and on plastic sheeting placed beneath LactOil drums as a drip pad. Given the shallow water table (approximately 5 ft bgs), groundwater mounding during injection may result in some injection fluid discharge to the ground surface through cracks in the pavement or in landscaped areas. If this occurs, injection rates will be lowered to stop or minimize this discharge. The fluid will be contained to prevent infiltration to the nearby storm drain and allowed to infiltrate back into the ground or recovered using a shop vacuum.

4.0 PERFORMANCE MONITORING

Performance monitoring will be conducted to evaluate operation of EISB at the Algona Focus Area. Baseline sampling will be conducted prior to injection. Performance monitoring of the EISB remediation activities will be accomplished by monitoring groundwater parameters and collecting groundwater samples from selected representative wells within and downgradient of the treatment area. The monitoring schedule is planned to include quarterly groundwater monitoring for the year after each injection, transitioning to semiannual monitoring between injection events, annual monitoring for 2 years, and biannual monitoring to track sustained treatment after active treatment ends. Modifications, including changes to the number of wells, parameters, or monitoring frequency, may be recommended based on monitoring results and with concurrence from Ecology.

Groundwater monitoring will be conducted at 22 wells, consisting of 2 representative injection wells and 20 downgradient monitoring wells. Upgradient observation wells are used to observe potential movement of injection fluid toward the Milwaukee Avenue North storm line are not included in groundwater monitoring for laboratory analysis. Samples from downgradient wells will monitor the distribution, effectiveness, and longevity of enhanced natural attenuation resulting from electron donor injection. Performance monitoring wells are listed in Table 3 and highlighted on Figure 7.

Groundwater monitoring parameters will include aquifer redox conditions and other indicators of biologically mediated reductive dechlorination (as evidenced by monitoring of dissolved oxygen; oxidation reduction potential; and dissolved iron, nitrate, sulfate, methane, pH, temperature); TOC concentrations; and concentrations of TCE, breakdown products (cDCE, tDCE, and VC), and end products (ethene/ethane).

5.0 SCHEDULE AND REPORTING

Performance monitoring results will be evaluated to assess the performance and efficacy of the remedial action after the initial injection. Boeing will evaluate whether future injections of electron donor are necessary to further reduce contaminant concentrations to meet EISB remediation objectives and make a recommendation to Ecology for consideration and approval. A maximum of three injections occurring every four years are planned. Future injection events and timing may be modified based on the results of the initial injection.

The following is the proposed schedule for implementation of the initial EISB injection activities:

- Second/Third quarter 2024: Installation of injection and monitoring wells and baseline groundwater monitoring
- August to September 2024: initial injection
- EISB Performance Monitoring:
  - Quarterly monitoring: 4th Quarter 2024, 1st Quarter 2025, 2nd Quarter 2025, 3rd Quarter 2025
  - Semiannual Monitoring: 4th Quarter 2025, 2nd Quarter 2026, 4th Quarter 2026, 2nd Quarter 2027, 4th Quarter 2027, 2nd Quarter 2028
- August to September 2028: Second injection, if necessary, or recommendations for ongoing monitoring.

It is anticipated that baseline monitoring results and subsequent performance monitoring data will be incorporated into an initial report covering the first year following injection. Monitoring activities will be included in annual reports. Recommendations for potential additional injections will be recommended to Ecology.

6.0 USE OF THIS WORK PLAN

This Enhanced *In-Situ* Bioremediation Work Plan has been prepared for the exclusive use of Boeing and applicable regulatory agencies for specific application to the Boeing of Auburn site in Auburn, Washington. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. 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, shall be at the user's sole risk. Landau 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. Landau makes no other warranty, either express or implied.

7.0 REFERENCES

Adamson, D.T., T.M. McGuire, C.J. Newell, and H. Stroo. 2011. Sustained Treatment: Implications for Treatment Timescales Associated with Source-Depletion Technologies. *Remediation Journal.* 21 (2):27-50. doi: 10.1002/rem.20280. March 8.

Adamson, D.T., and C.J. Newell. 2009. Support of Source Zone Bioremediation through Endogenous Biomass Decay and Electron Donor Recycling. *Bioremediation Journal.* 13 (1):29-40.

Ecology. 2015. Letter: Registration with the Underground Injection Control (UIC) Program, Primus International, 851 Milwaukee Ave N., Algona, WA. From Mary Shaleen-Hansen, Water Quality Program, Washington State Department of Ecology, to James Bet, The Boeing Company; Jennifer Wynkoop, Landau Associates, Inc.; Robin Harrover, Washington State Department of Ecology. July 15.

Ecology. 2022. Final Report: *Cleanup Action Plan*, Boeing Auburn Facility, Auburn, Washington. Washington Department of Ecology. November 30.

EPA. 2000. Technical Memorandum: To RCRA Senior Policy Advisors, RCRA Enforcement Managers, Superfund Regional Policy Managers: *Applicability of RCRA Section 3020 to In-Situ Treatment of Ground Water*. US Environmental Protection Agency. December 2000.

Jacob, C.L., C.N. Venot, E.F. Weber, C.M. Bach, and J.N. Bet. 2010. *Implications of Complete Reductive Dechlorination Persisting Years after Electron Donor Injection - Two Case Studies*. Proceedings of the Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, CA. May.

Jonsson, B., C.L. Jacob, J.R. Ninteman, C.M. Bach, and D.C. McCormack. 2007. *Complete Reductive Dechlorination after Five Years of cDCE Stall: Biostimulation and Bioaugmentation Pilot Test Results*. Proceedings of the Ninth International In Situ and On-Site Bioremediation Symposium. Baltimore, MD. May 7-10.

Landau. 2004a. Agency Review Draft Report, *Interim Remedial Action* Boeing Auburn Area 1 (Building 17-05) 700 15th Street SW, Auburn, Washington. Landau Associates, inc. December 20.

Landau. 2004b. *Interim Remedial Action Work Plan*, Boeing Auburn Area 1 700 15th Street SW, Auburn, Washington. Landau Associates, Inc. May 7.

Landau. 2005a. Draft (2nd Report): *Interim Remedial Action*, Boeing Auburn Area I (Building 17-05) 700 15th Street SW, Auburn, Washington. Landau Associates, Inc. June 7.

Landau. 2005b. Draft: *Supplement to Final Interim Remedial Action Work Plan*. Landau Associates, Inc. October 11.

Landau. 2008. *Interim Remedial Action* Boeing Auburn Area 1, Auburn, Washington. Landau Associates, Inc. April 22.

Landau. 2017a. *Algona Pilot Test Report*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. September 22.

Landau. 2017b. *Remedial Investigation Report*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. September 15.

Landau. 2018. Technical Memorandum: *Algona Pilot Test - Second Year of Monitoring*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. October 1.

Landau. 2019. Final: *Site-Wide Natural Attenuation Assessment Report*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. July 16.

Landau. 2023a. Final Report: *Health and Safety Plan*, Boeing Auburn Facility, Auburn, Washington. Landau Associates, Inc. April 20.

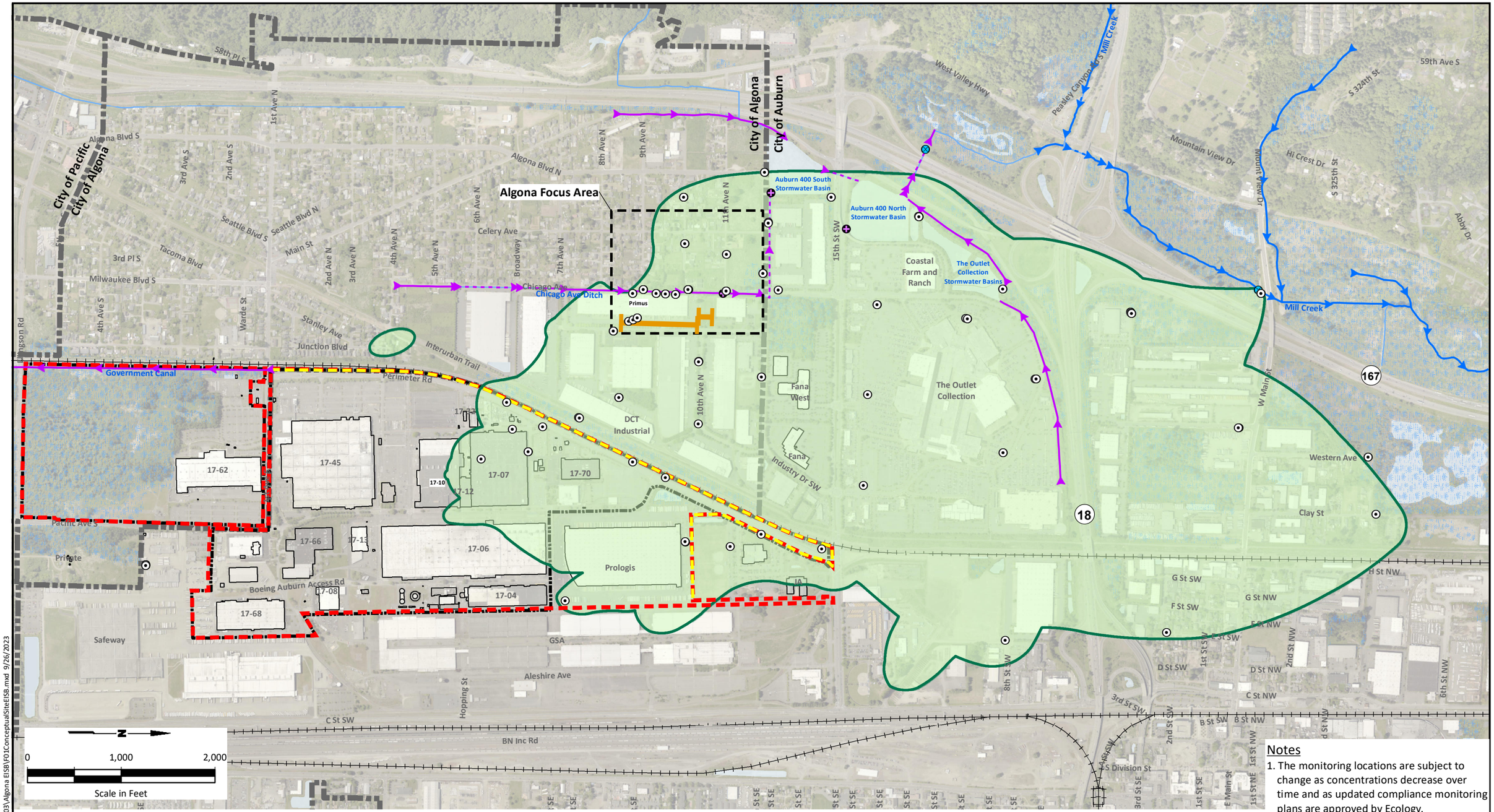
Landau. 2023b. Agency Review Draft Report: *Sampling and Analysis Plan*, Boeing Auburn Facility; Auburn, Washington. Landau Associates, Inc. March 31.

Major, D.W., E. Cox, D. Ellis, E. Lutz, C. Acheson, and P. Hadley. 2003. *Accelerated Bioremediation of Chlorinated Solvents - Short Course*. The Seventh International In Situ and On-Site Bioremediation Symposium, Orlando, FL, June 2-5.

PGG. 1999. *1999 Hydrogeologic Characterization Report*, City of Auburn, Volume 1. Pacific Groundwater Group.

Sleep, B.E., A.J. Brown, and B.S. Lollar. 2005. Long-Term Tetrachloroethene Degradation Sustained by Endogenous Cell Decay. *Journal of Environmental Engineering and Science.* 4 (1):11-17. doi: 10.1139/s04-038.

Suthersan, Suthan S., Christopher C. Lutes, Peter L. Palmer, Frank Lenzo, Fredrick C. Payne, David S. Liles, and Jeffrey Burdick. 2003. Final: *Technical Protocol for Using Soluble Carbohydrates to Enhance Reductive Dechlorination of Chlorinated Aliphatic Hydrocarbons*. ARCADIS G&M, Inc. December 19.



Legend

- Groundwater Compliance Monitoring Location
- Stormwater Compliance Monitoring Location
- Surface Water Compliance Monitoring Location
- TCE/VC Plume Extent - June 2021
- City Limits
- Boeing Property
- Wetland Areas
- Water Bodies
- Waterways
- Open Surface Water Waterway
- Open Stormwater Waterway
- Piped Surface Water Waterway
- Piped Stormwater Waterway
- Algona Focus Area Conceptual Enhanced In Situ Bioremediation (EISB) Injection Row
- Boeing Auburn Facility Boundary
- Boeing Auburn Facility Boundary Conditional Point of Compliance

Notes

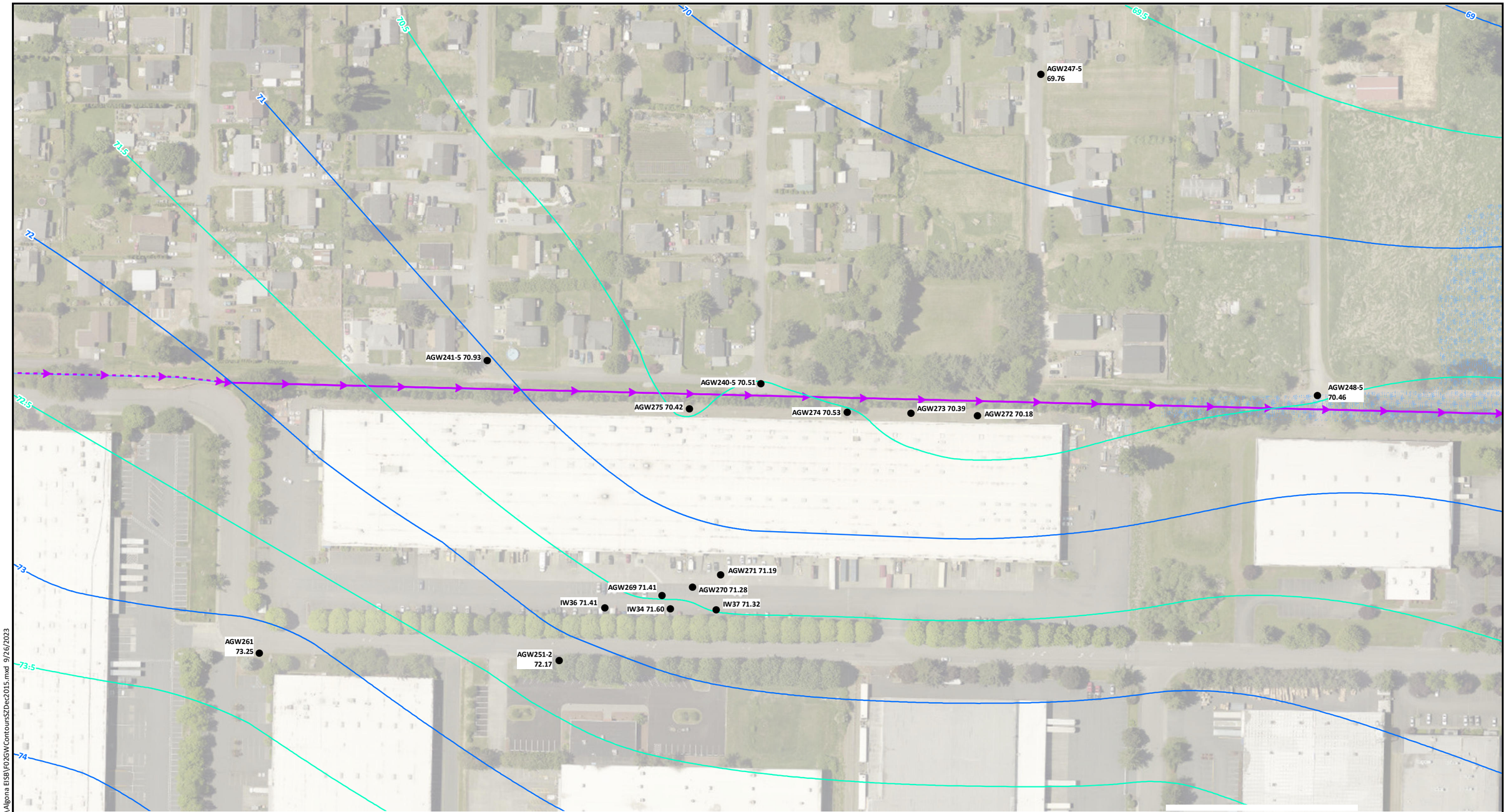
1. The monitoring locations are subject to change as concentrations decrease over time and as updated compliance monitoring plans are approved by Ecology.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: King County GIS.

G:\Projects\025\164\200\303\Algona EISB\F01ConceptualSiteEISB.mxd 9/26/2023

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**AOC A-14: Cleanup Action (Monitored Natural Attenuation and Algona Focus Area EISB)**	Figure 1



Legend

- AGW121 80.50 — Monitoring Well Designation, Groundwater Elevation (ft, MSL)
- 72 — Groundwater Elevation Contours
- 72.5 — Groundwater Elevation Contours
- Open Stormwater Ditch
- Piped Stormwater Conveyance
- Boeing Property
- City Limits
- Wetland Areas
- Water Bodies
- Waterways

Notes

1. All water level data in ft, MSL. Vertical datum is NGVD29. Data collected in December 2015.
2. Multilevel wells have multiple channels. Channel designations are included in the well ID (ex: AGW208-2). Groundwater elevations listed are for the channel closest to 30 ft below ground surface.
3. Wells installed specifically as water table wells are not included.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 150 300

Scale in Feet

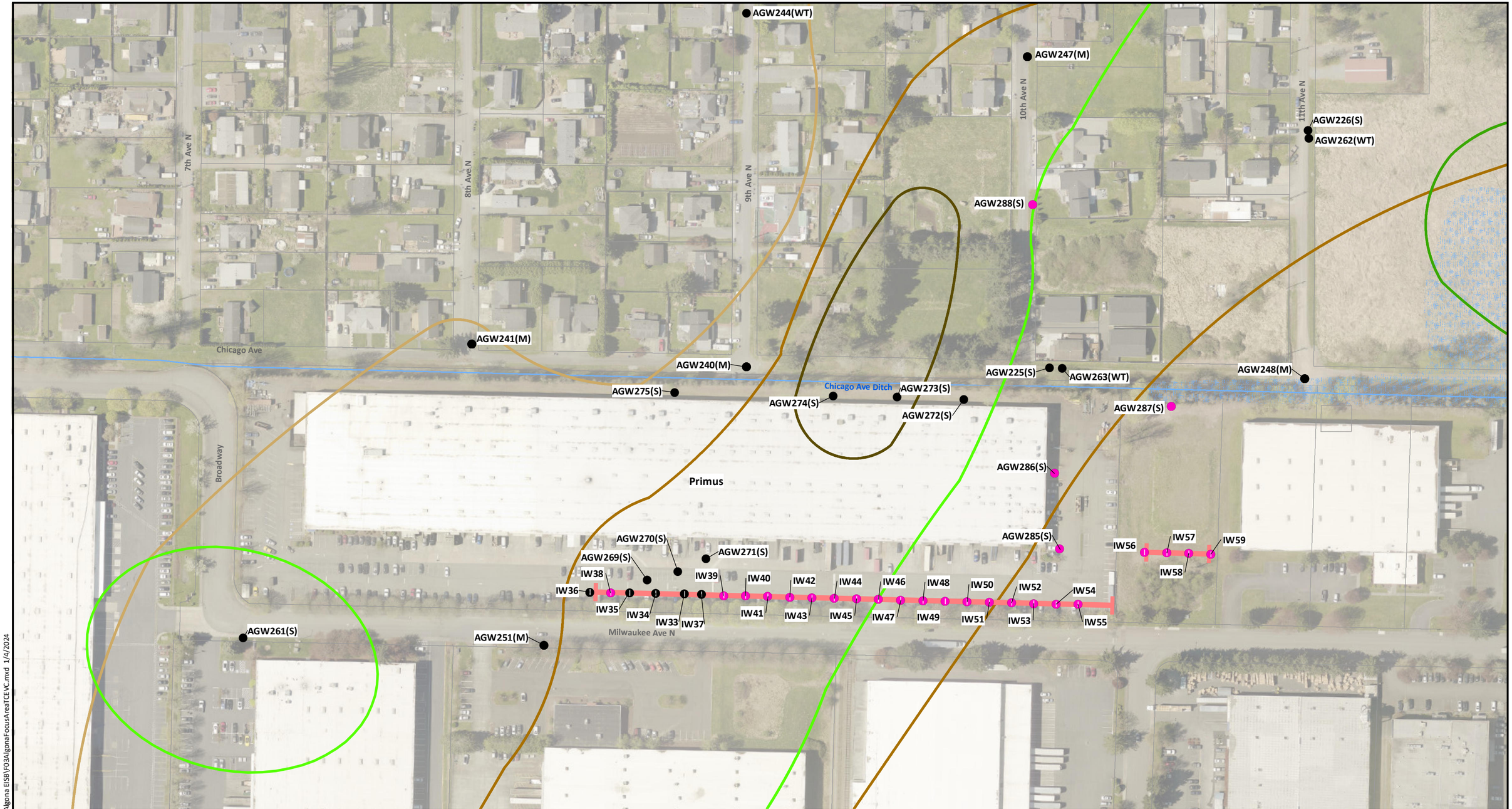
N

Data Source: King County GIS.

LANDAU ASSOCIATES

G:\Projects\025\164\200\303\Algona EISB\FO2GWContoursSZDec2015.mxd 9/26/2023

Boeing Auburn Auburn, Washington	**Algona Focus Area Shallow Zone Groundwater Elevation Contours - December 2015**	Figure 2



Notes

1. Proposed well locations may be adjusted based on utilities and property owner requirements.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
3. The designations behind the well identifications indicate the zone.
   (WT) = water table
   (S) = shallow zone (water table to 35 ft bgs)

Legend

- Proposed Monitoring Well
- Proposed Injection Well
- Existing Monitoring Well
- Existing Injection Well
- Algona Injection Row
- Wetland Areas
- Water Bodies
- Waterways

June 2021 Shallow Zone Concentrations

- TCE Contour (0.38 µg/L)
- TCE Contour (4.0 µg/L)
- Vinyl Chloride Contour (0.020 µg/L)
- Vinyl Chloride Contour (0.20 µg/L)
- Vinyl Chloride Contour (2.0 µg/L)

0 150 300

Scale in Feet

N

Data Source: King County GIS.

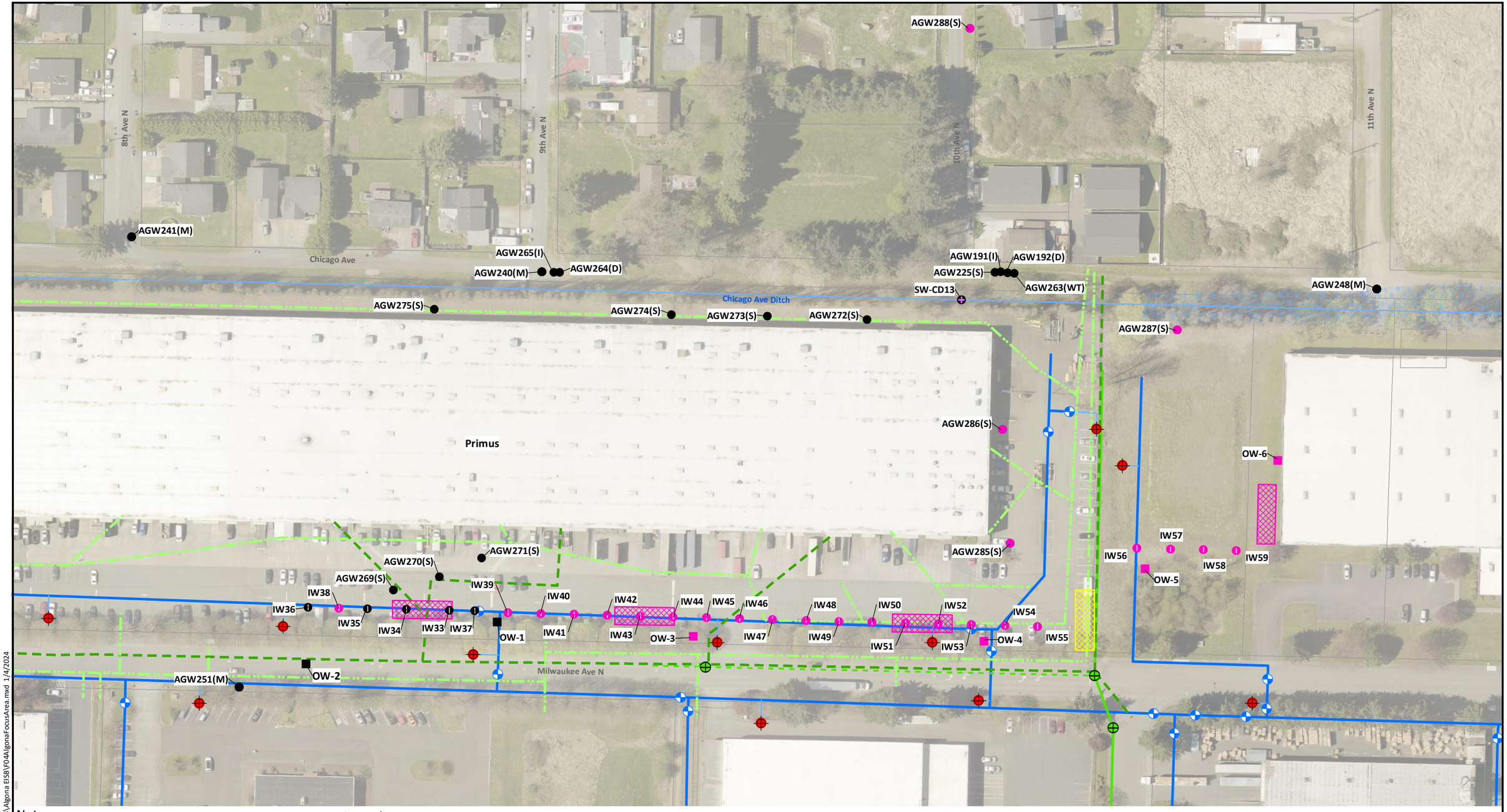
LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

Algona Focus Area - June 2021 Shallow Zone TCE and VC Concentrations

Figure 3

G:\Projects\025\t64\200\303\Algona EIS\F03AlgonaFocusAreaTCEVC.mxd 1/4/2024



G:\Projects\025\1641200\303\Algona EISB\F04A\AlgonaFocusArea.mxd 1/4/2024

Notes

1. Proposed Injection, Monitoring, and Observation Well Location may be adjusted based on utilities and property owner requirements.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
3. The designations behind the well identifications indicate the zone.
   (WT) = water table
   (S) = shallow zone (water table to 35 ft bgs)

Legend

- Proposed Monitoring Well
- Proposed Observation Well
- Proposed Injection Well
- Existing Monitoring Well
- Existing Observation Well
- Existing Injection Well
- Stormwater Sample Location
- Mixing Station Location
- Donor Storage Area
- Wetland Areas
- Water Bodies
- Waterways
- Hydrant
- Intertie
- Manhole
- Valve
- Sanitary Sewer Line
- Storm Sewer Line
- 6" Water Line
- 8" Water Line
- 8" Sewer Line
- Forcemain
- Unknown Sewer Line

0 100 200

Scale in Feet

N

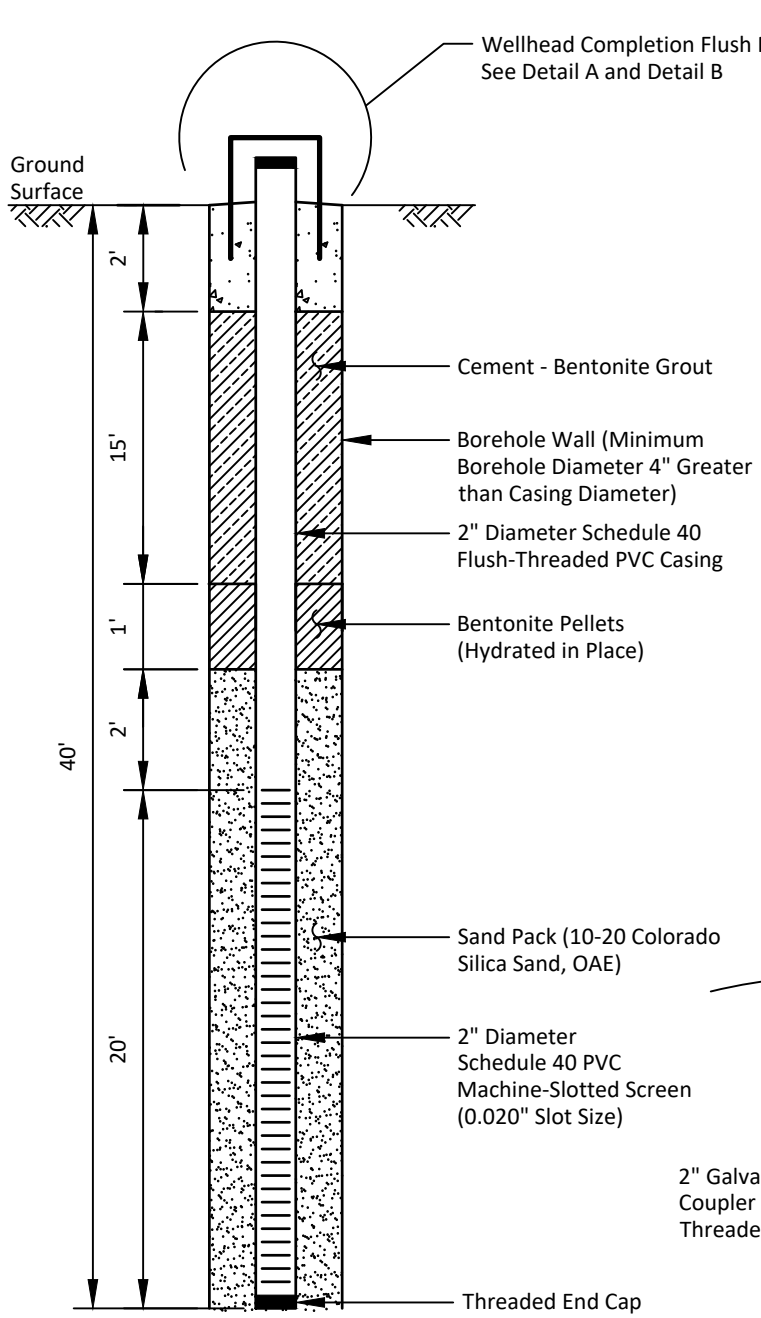
Data Source: King County GIS.

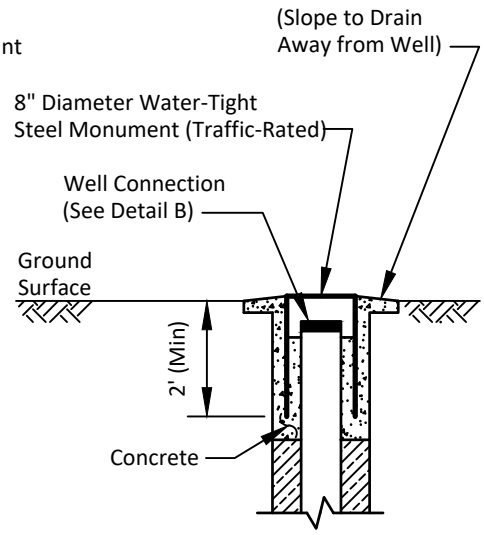
LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

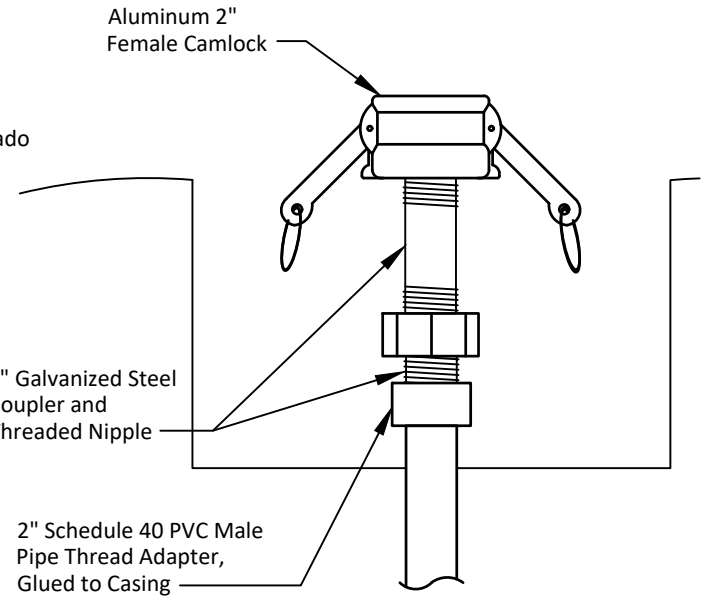
Algona Focus Area Enhanced In Situ Bioremediation Plan

Figure 4





Detail A
Flush-Mount
Wellhead Completion



Detail B
Well Casing Connection

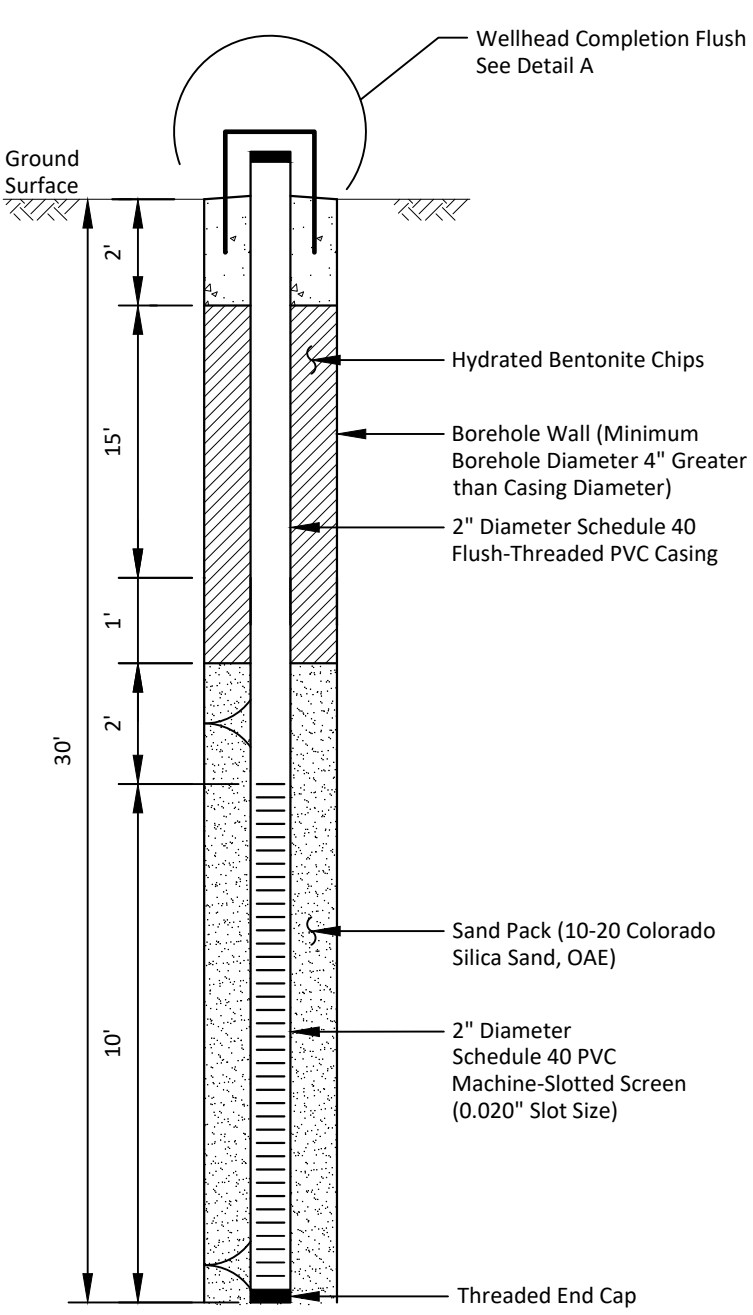
Notes

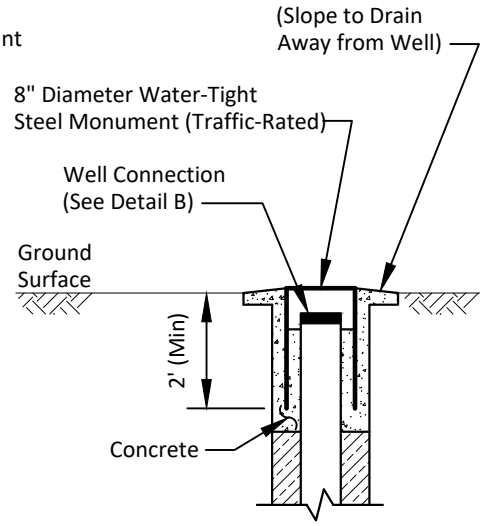
1. OAE = Or Approved Equal
2. Actual well design specifications may vary.

Not to Scale

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Injection Well Construction Details**	Figure B-5





Detail A
Flush-Mount
Wellhead Completion

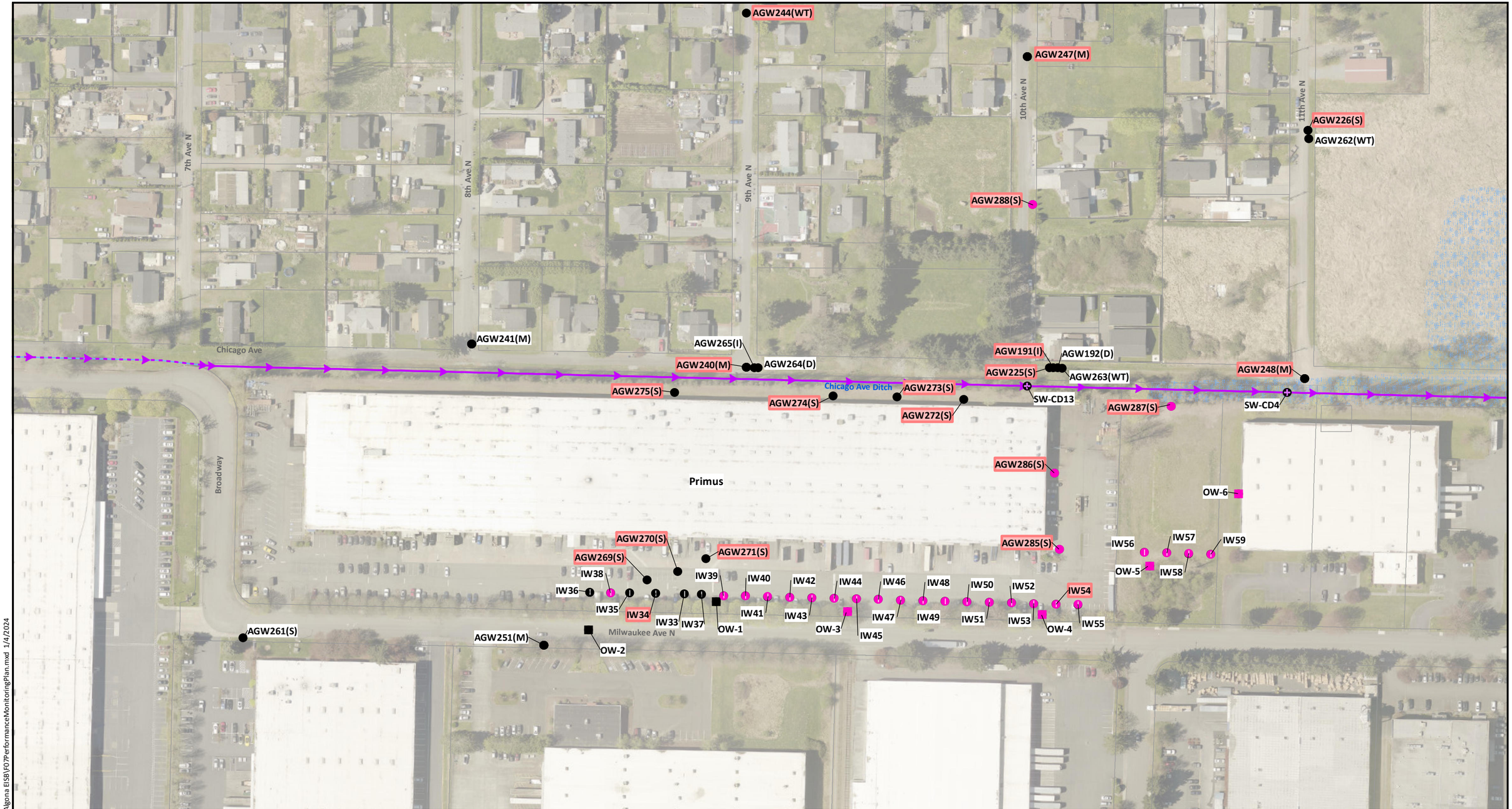
Notes

1. OAE = Or Approved Equal
2. Actual well design specifications may vary.

Not to Scale

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Monitoring Well Construction Detail**	Figure B-6



Notes

1. Proposed Injection, Monitoring, and Observation Well Location may be adjusted based on utilities and property owner requirements.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
3. The designations behind the well identifications indicate the zone.
   (WT) = water table
   (S) = shallow zone (water table to 35 ft bgs)

Legend

- Proposed Monitoring Well
- Proposed Observation Well
- Proposed Injection Well
- Existing Monitoring Well
- Existing Observation Well
- Existing Injection Well
- Stormwater Sample Location
- Wetland Areas
- Water Bodies
- Open Stormwater Waterway
- Piped Stormwater Waterway
- AGW251 Proposed EISB Monitoring Locations

0 150 300

Scale in Feet

Data Source: King County GIS.

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Performance Monitoring Plan**	Figure 7

G:\Projects\025\164\200.303\Algona EISB\R07PerformanceMonitoringPlan.mxd 1/4/2024

Table 1
Algona EISB Well Installation Matirx
Boeing Auburn
Auburn, Washington

Location ID	Property Location	Description	Well Type	Total Exploration Depth	Screen Depth(s)	Cement Bentonite Grout
IW38	Primus	Between pilot test wells IW36 and IW35	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW39	Primus	North of pilot test well IW37	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW40	Primus	North of new injection well IW39	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW41	Primus	North of new injection well IW40	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW42	Primus	North of new injection well IW41	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW43	Primus	North of new injection well IW42	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW44	Primus	North of new injection well IW43	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW45	Primus	North of new injection well IW44	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW46	Primus	North of new injection well IW45	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW47	Primus	North of new injection well IW46	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW48	Primus	North of new injection well IW47	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW49	Primus	North of new injection well IW48	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW50	Primus	North of new injection well IW49	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW51	Primus	North of new injection well IW50	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW52	Primus	North of new injection well IW51	Injection SZ/IZ	40 ft	20 ft to 40 ft	X

Table 1
Algona EISB Well Installation Matirx
Boeing Auburn
Auburn, Washington

Location ID	Property Location	Description	Well Type	Total Exploration Depth	Screen Depth(s)	Cement Bentonite Grout
IW53	Primus	North of new injection well IW52	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW54	Primus	North of new injection well IW53	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW55	Primus	North of new injection well IW54	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW56	Wilsonart	Southernmost well on Wilsonart property	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW57	Wilsonart	North of new injection well IW56	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW58	Wilsonart	North of new injection well IW57	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
IW59	Wilsonart	North of new injection well IW58	Injection SZ/IZ	40 ft	20 ft to 40 ft	X
OW-3	Algona ROW	East of injection wells near IW45	Observation SZ	15 ft	5 ft to 15 ft	X
OW-4	Algona ROW	East of injection wells near IW53	Observation SZ	15 ft	5 ft to 15 ft	X
AGW285	Primus	Northeast side of Primus warehouse, closest to injection row	Monitoring SZ	30 ft	20 ft to 30 ft	X
AGW286	Primus	Northeast side of Primus warehouse, W of AGW285	Monitoring SZ	30 ft	20 ft to 30 ft	
AGW287	Primus	Northeast side of Primus warehouse, W of AGW286	Monitoring SZ	30 ft	20 ft to 30 ft	
AGW288	Wilsonart	West side of Wilsonart Property, West of injection wells	Monitoring SZ	30 ft	20 ft to 30 ft	

Notes:

Monitoring well designations and locations may be adjusted in the field.

Abbreviations and Acronyms:

EISB = Enhanced *in-situ* bioremediation
ft = feet
ID = identification
IZ = intermediate zone
SZ = shallow zone

Table 2
Injection Design Details
Boeing Auburn Facility
Auburn, Washington

Well	INJECTION FLUID COMPONENTS					
	LactOil-98 (gallons) (a)	LactOil-98 (totes)	Yeast Extract (pounds) (b)	Mix Water (gallons)	Combined Injection Volume (gallons) (c)	LactOil-98 (percent volume)
Each IW	400	1.48	10	9,600	**10,000**	4.0%
Total for 27 IW	10,800	40	270	259,200	270,000	

Notes:

(a) The LactOil 98 product contains approximately 43 percent weight ethyl lactate and 55 percent weight soybean oil, with the balance composed of surfactants and water. Each 450-pound drum contains approximately 53.75 gallons. Each 2,060-pound tote contains approximatly 270 gallons.

(b) Approximately 1 pound per 1,000 gallons of design injection volume.

(c) Includes LactOil and mix water. Does not include post-injection clear water flushes of approximately 200 gallons at each well.

Abbreviations and Acronyms:

% = percent

IW = injection well

Table 3
Performance Monitoring Matrix
Boeing Auburn Facility
Auburn, Washington

Monitoring Purpose	Sample ID	Groundwater Zone	Sampling Method (c)	Location	Wells Sampled Annually for VOCs and MNA as part of CMP
Southern Injection Row Monitoring	IW34	S	Low Flow	Primus, East of Warehouse	
	AGW269	S	Low Flow	Primus, East of Warehouse	X
	AGW270	S	Low Flow	Primus, East of Warehouse	X
	AGW271	S	Low Flow	Primus, East of Warehouse	X
Northern Injection Row Monitoring	IW54	S	Low Flow	Primus, East of Warehouse	
	AGW285	S	Low Flow	Primus, East of Warehouse	
	AGW286	S	Low Flow	Primus, East of Warehouse	
	AGW287	S	Low Flow	Primus, East of Warehouse	
Downgradient Injection Property Monitoring	AGW272	S	Low Flow	Primus, West of Warehouse	X
	AGW273	S	Low Flow	Primus, West of Warehouse	X
	AGW274	S	Low Flow	Primus, West of Warehouse	X
	AGW275	S	Low Flow	Primus, West of Warehouse	X
	AGW288	S	Low Flow	Wilsonart, West of Building	
Chicago Avenue Ditch Monitoring	SW-CD13	Stormwater Feature Grab Sample		Chicage Avenue Ditch	
Downgradient Residential Algona Monitoring	AGW191	I	PDB	Chicago Avenue and 10th Avenue, Algona	X
	AGW225	S (WT)	Low Flow	Chicago Avenue and 10th Avenue, Algona	X
	AGW226	S (WT)	Low Flow	11th Avenue, Algona	X
	AGW240-1	S (WT)	Low Flow	Chicago Avenue and 9th Avenue, Algona	X
	AGW240-5	S	Low Flow	Chicago Avenue and 9th Avenue, Algona	X
	AGW247-1	S (WT)	Low Flow	10th Avenue East of Algona Boulevard, Algona	X
	AGW247-5	S	Low Flow	10th Avenue East of Algona Boulevard, Algona	X
	AGW248-1	S (WT)	Low Flow	Chicago Avenue and 11th Avenue, Algona	X
	AGW248-5	S	Low Flow	Chicago Avenue and 11th Avenue, Algona	X

Notes:

(a) VOCs by Method 8260D; collect three 40-mL VOAs (HCl); Method 8260 LL or SIM may alternatively be used. VOC analyte list will include: 1,1-DCE, cis-1,2-DCE, PCE, trans-1,2-DCE, TCE, and VC.

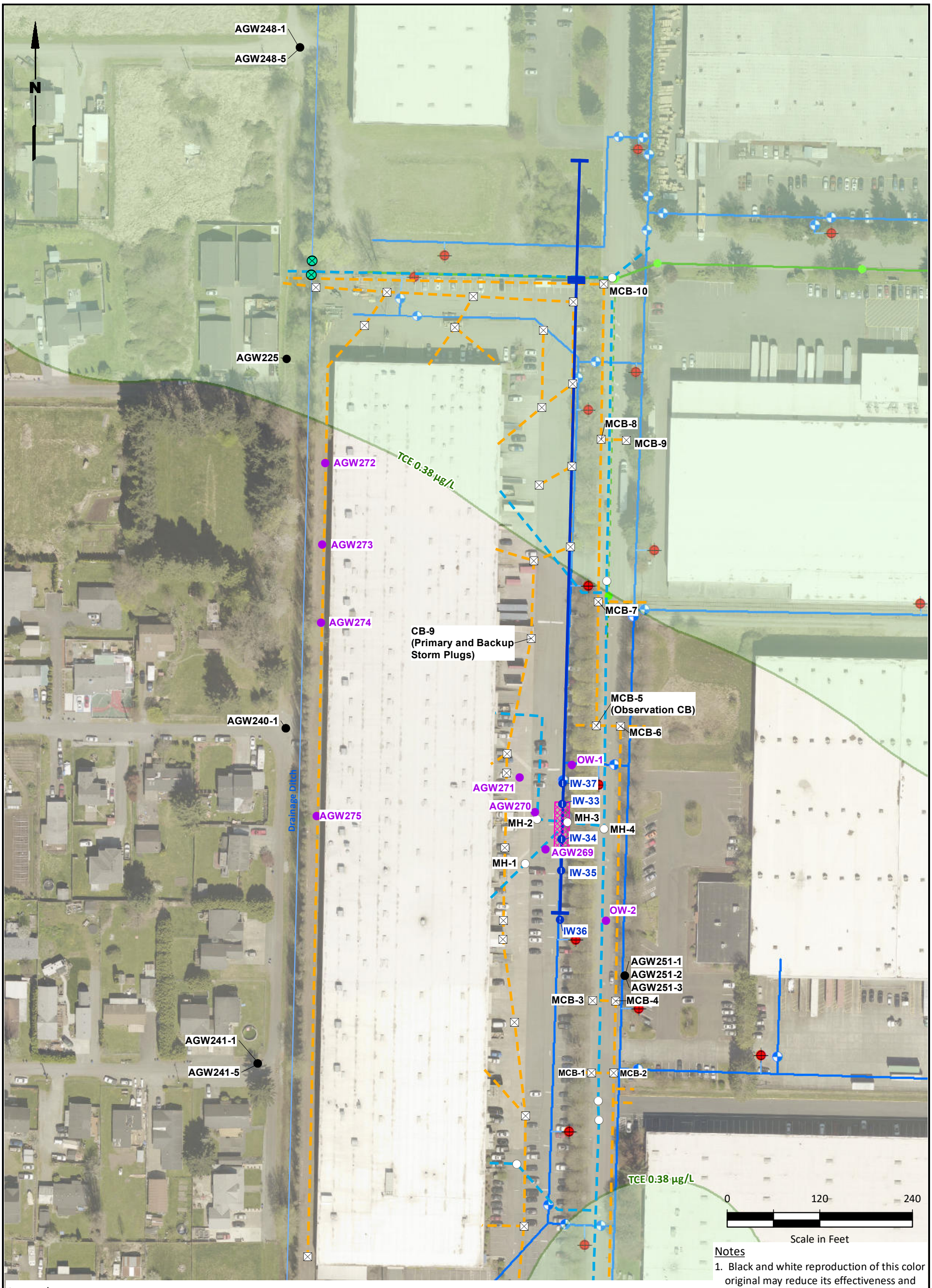
(b) MNA Parameters include Ethene/Ethane/Methane by RSKSOP-175 modified, Sulfate By EPA Method 300.0, TOC by SM 5310 C-2000, and DO/ORP/Iron II field measurements.

Abbreviations and Acronyms:

EPA = US Environmental Protection Agency
CMP = Compliance Monitoring Plan
DCE = dichloroethene
ID = Identification
I = Intermediate
MNA = Monitored Natural Attenuation
PDB = passive diffusion bag
S = Shallow
SIM = select ion monitoring
TCE = trichloroethene
TOC = total organic carbon
VC = vinyl chloride
VOC = volatile organic compound
WT = Water Table

APPENDIX A

Primus and Milwaukee Avenue North Preliminary Utility Maps



Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Legend

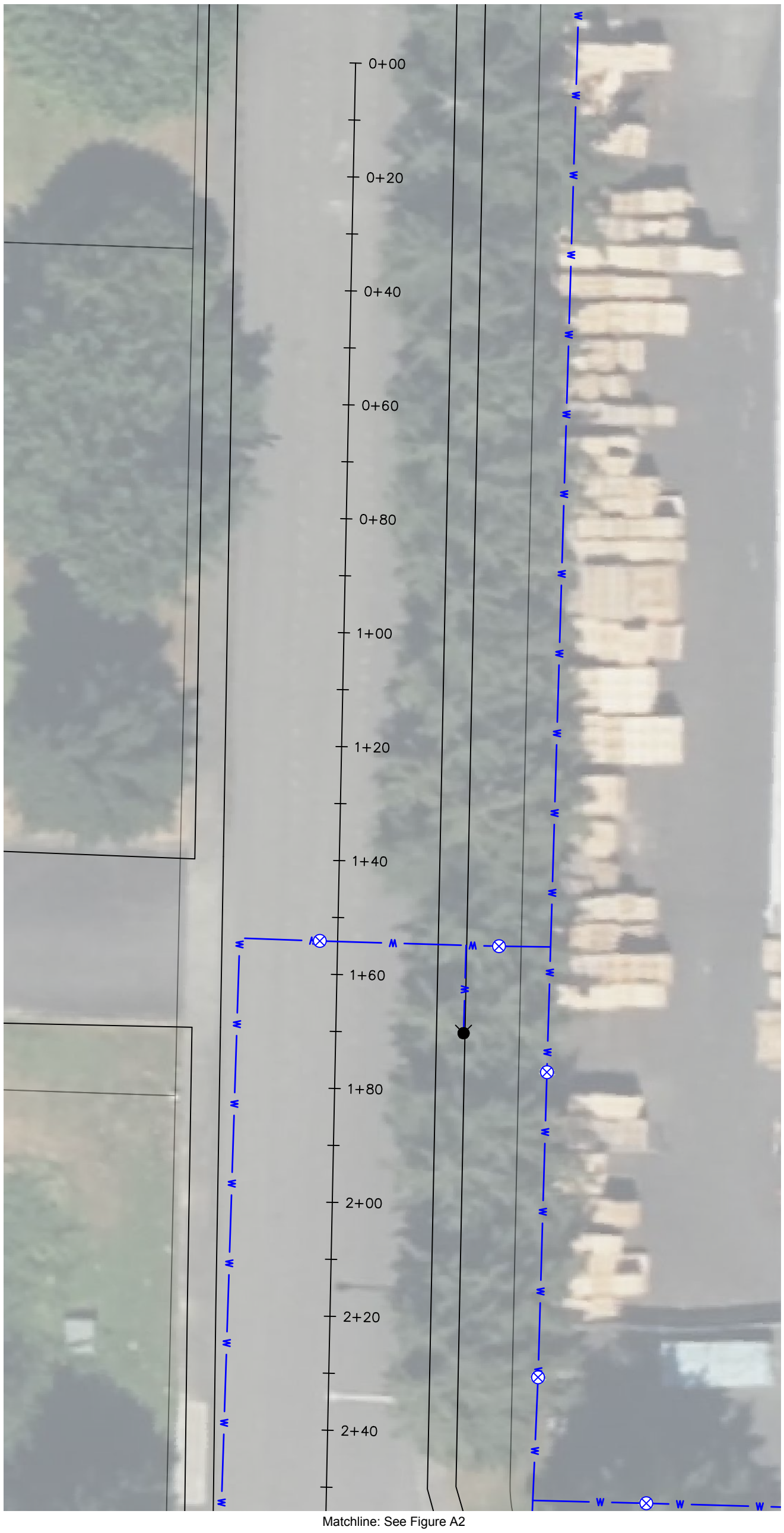
- Pilot Test Monitoring or Observation Well Location
- Pilot Test Injection Well Location
- Monitoring Well Location
- Surface Water Grab Sample
- Catch Basin
- Sanitary Manhole
- TCE Contour (0.38 µg/L)
- Sanitary Sewer Line
- Storm Sewer Line
- Mixing Station Location
- Injection Row
- Hydrant
- Intertie
- Manhole
- Valve
- 6" Water Line
- 8" Water Line
- 8" Sewer Line
- Forcemain
- Unknown Sewer Line

LANDAU ASSOCIATES

Data Source: Esri World Imagery.

Proposed EISB

Figure 2



Matchline: See Figure A2

Legend

- Tree
- Sanitary Sewer Manhole
- Grated Stormdrain
- Stormdrain Manhole
- Valve
- Hydrant
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

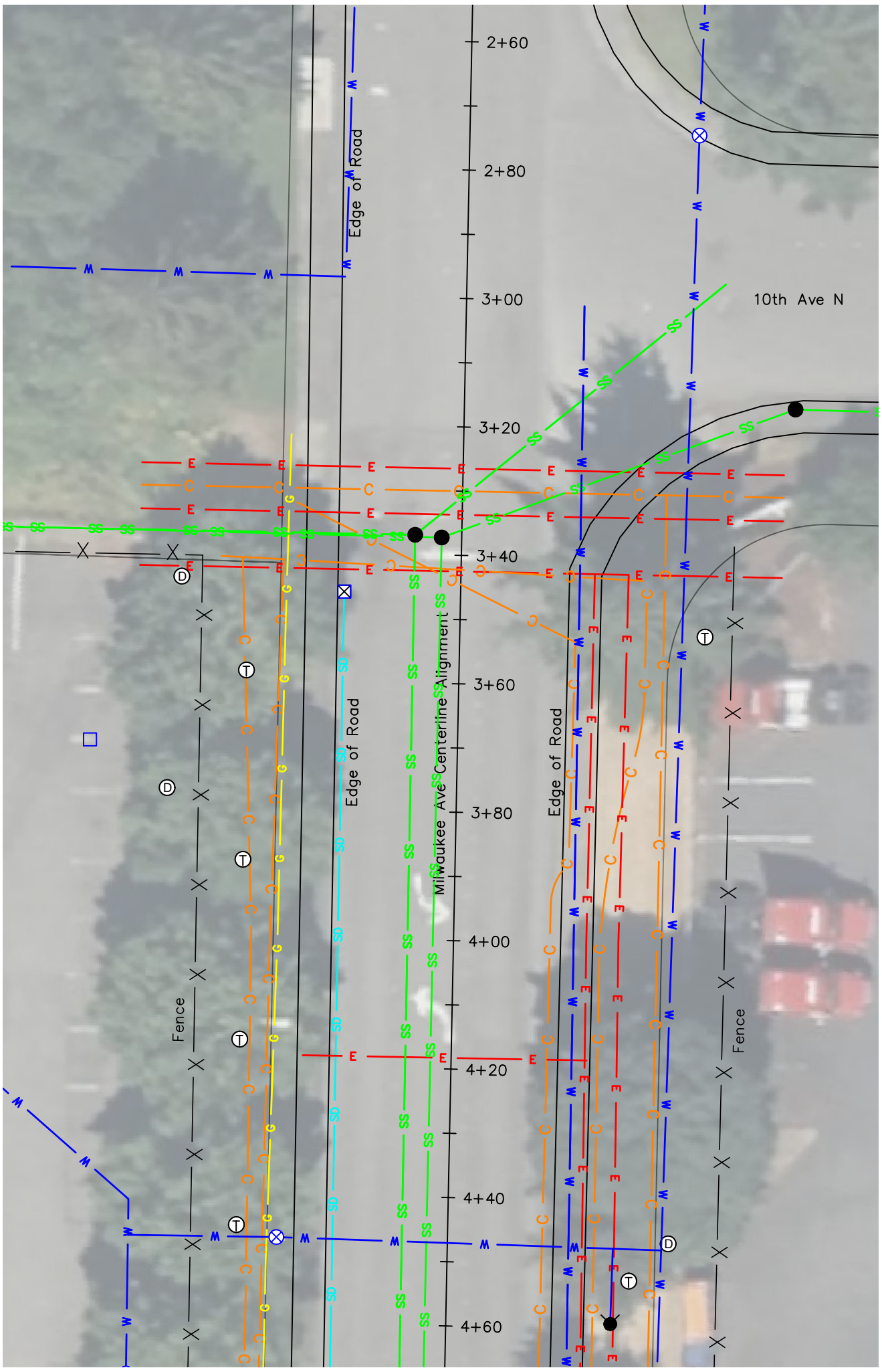
Source: King County GIS; © Bing Maps

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Milwaukee Avenue Utilities**	Figure A1

N

Matchline: See Figure A1



Matchline: See Figure A3

Legend

- Tree
- Sanitary Sewer Manhole
- Grated Stormdrain
- Stormdrain Manhole
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: King County GIS; © Bing Maps

LANDAU ASSOCIATES

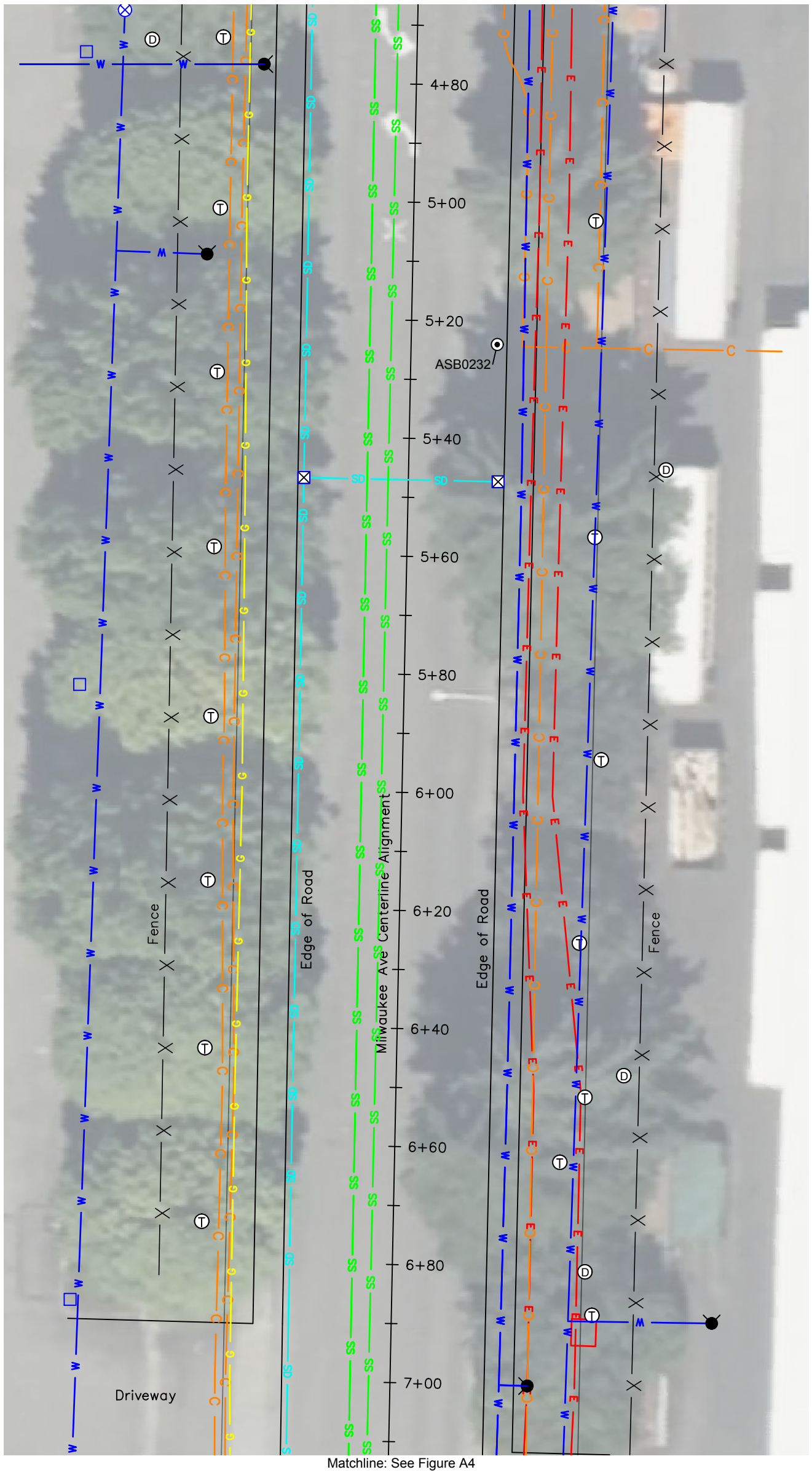
Boeing Auburn
Auburn, Washington

Milwaukee Avenue Utilities

Figure
A2

N

Matchline: See Figure A2



Matchline: See Figure A4

Legend

- Tree
- Hydrant
- Grated Storm Drain
- Storm Drain Manhole
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

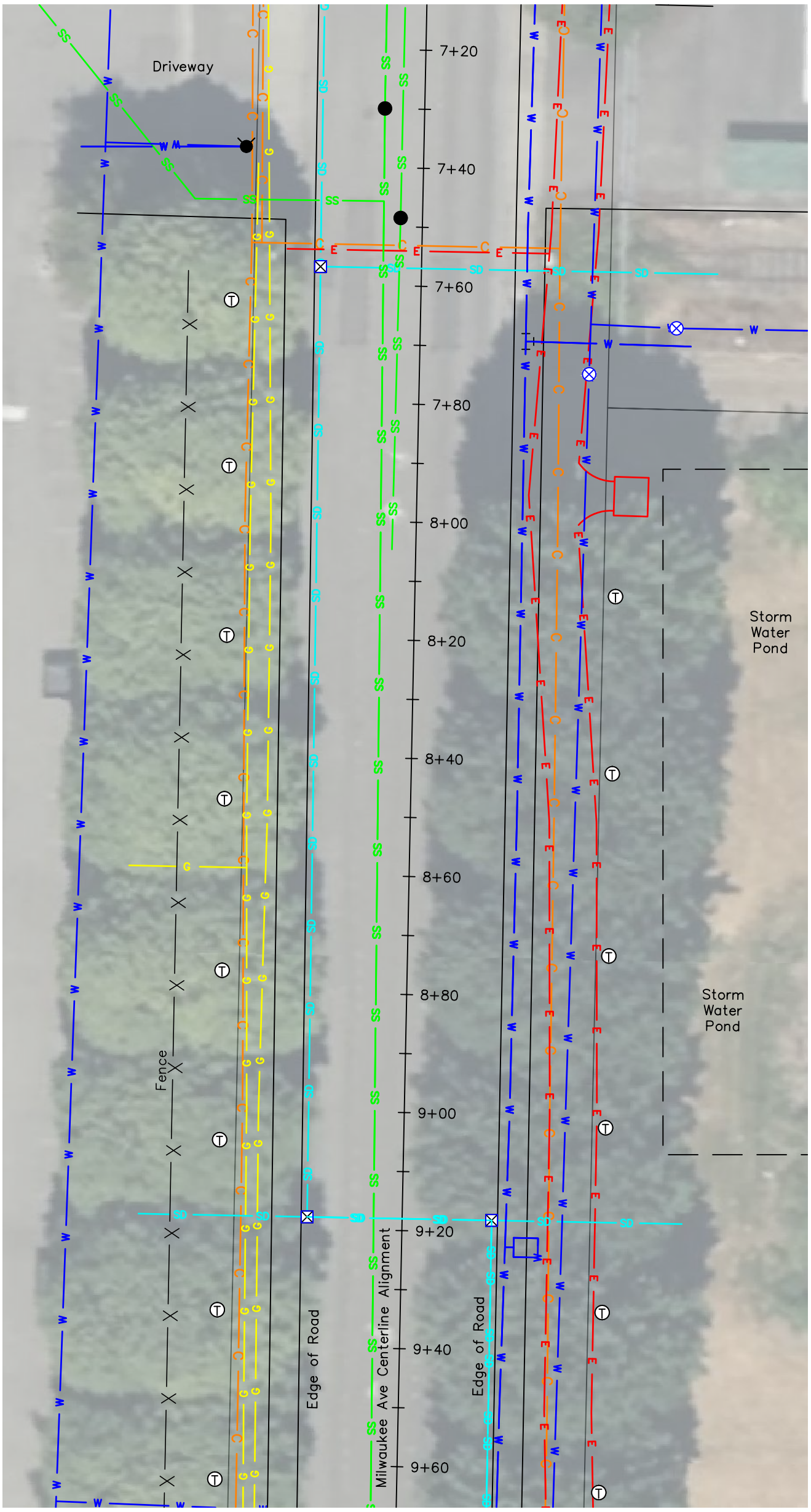
Source: King County GIS; © Bing Maps

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Milwaukee Avenue Utilities**	Figure A3

N

Matchline: See Figure A3



Matchline: See Figure A5

Legend

- Tree
- Hydrant
- Storm Drain Manhole
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

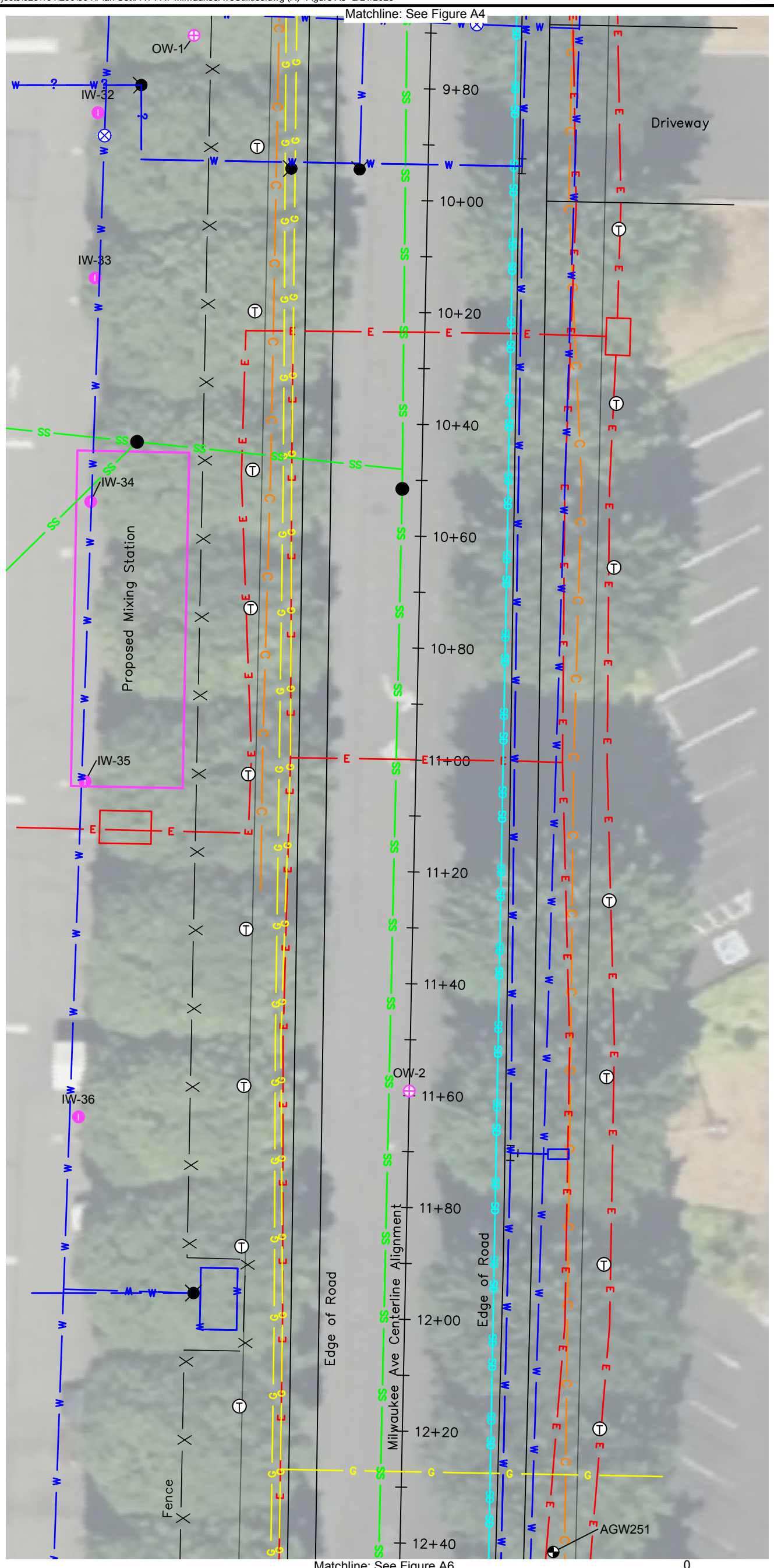
Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: King County GIS; © Bing Maps

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Milwaukee Avenue Utilities**	Figure A4



Legend

- Tree
- Hydrant
- Grated Storm Drain
- Sanitary Sewer Manhole
- Proposed Injection Well
- Proposed Monitoring Well
- Existing Monitoring Well
- W Water Line
- G Gas Line
- SD Storm Line
- SS Sewer Line
- E Electric Line
- C Communication Line
- Parcel

0 20 40
Scale in Feet

Source: King County GIS; © Bing Maps

Note

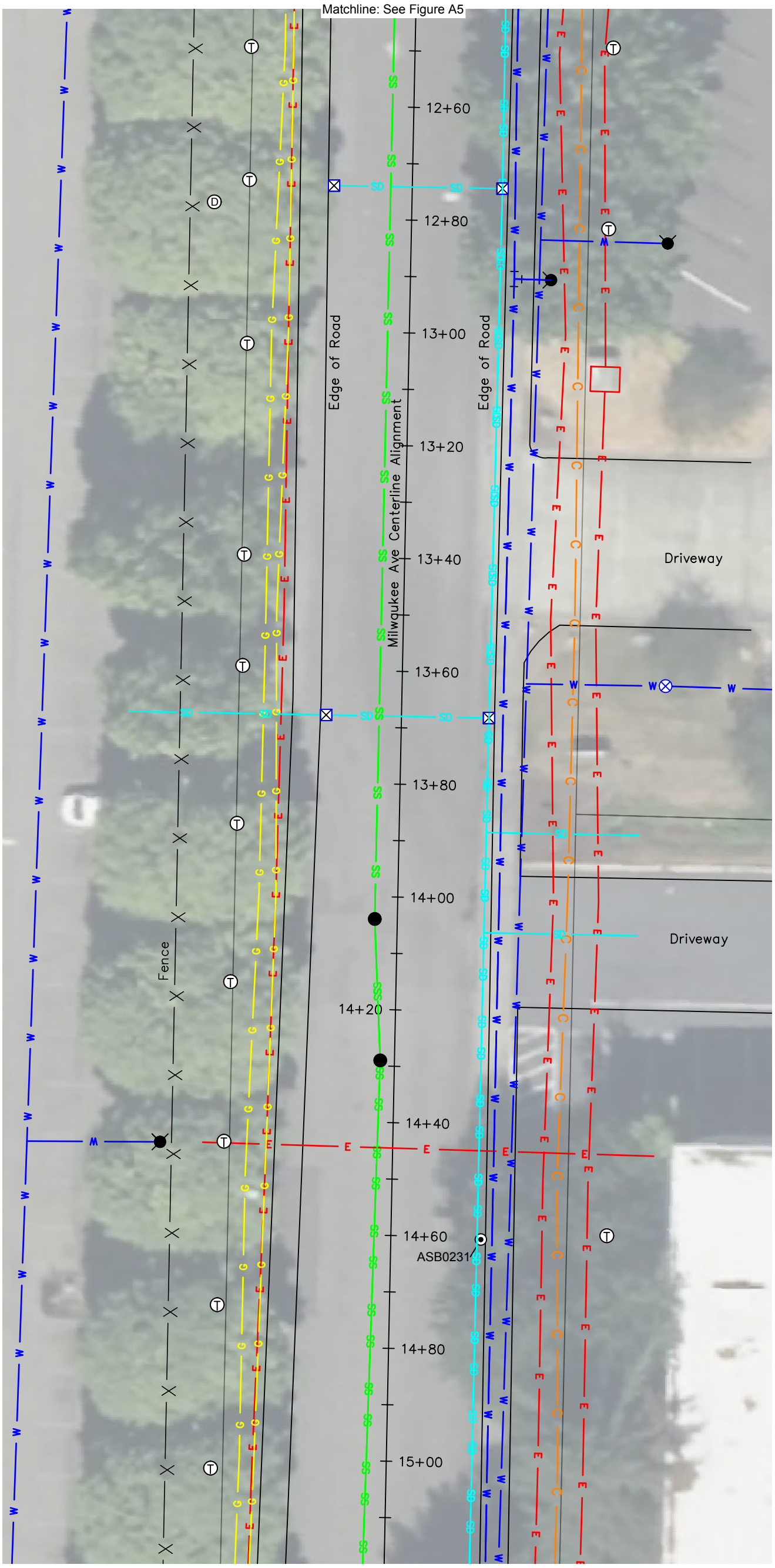
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

Milwaukee Avenue Utilities

Figure
A5



Legend

- Tree
- Hydrant
- Grated Storm Drain
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

Note

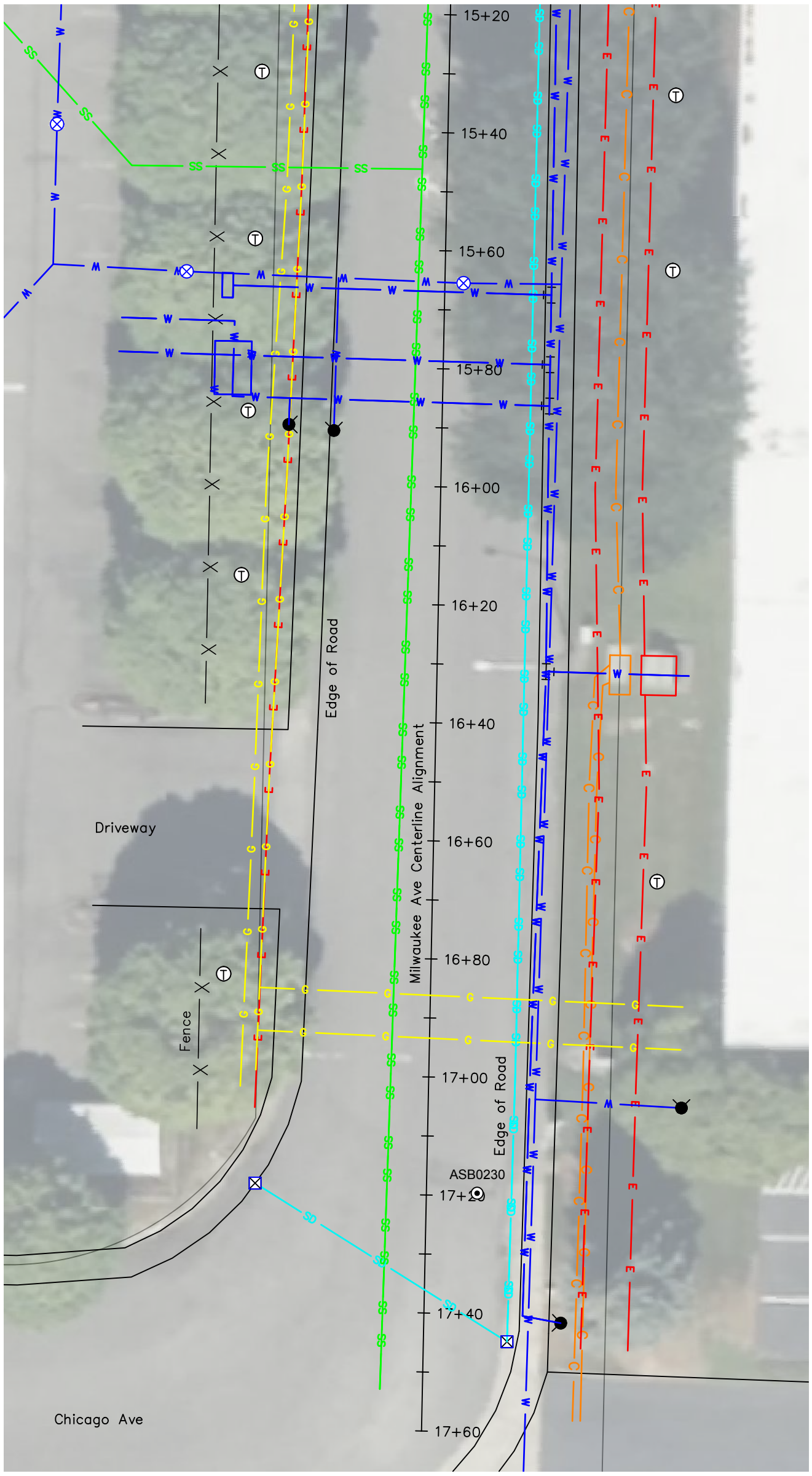
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: King County GIS; © Bing Maps

LANDAU ASSOCIATES

Boeing Auburn Auburn, Washington	**Milwaukee Avenue Utilities**	Figure A6

Matchline: See Figure A6



Legend

- Tree
- Sanitary Sewer Manhole
- W — Water Line
- G — Gas Line
- SD — Storm Line
- SS — Sewer Line
- E — Electric Line
- C — Communication Line
- Parcel

0 20 40

Scale in Feet

Source: King County GIS; © Bing Maps

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

Boeing Auburn
Auburn, Washington

Milwaukee Avenue Utilities

Figure
A7