
11.0 DISCUSSION AND RECOMMENDATIONS

All SWMUs and AOCs designated for evaluation in the RI work plan (Geomatrix 2003b) have been addressed as part of pre-RI activities, the RI, or as part of the Area 1 expedited RI. In addition, Site-wide groundwater, surface water, and vapor intrusion investigations were conducted. The primary constituents of concern related to releases from the Facility are chlorinated solvent-related VOCs (TCE and VC); petroleum hydrocarbons; and select metals. There is no evidence of ongoing releases of contamination. Data collected during the RI and Area 1 expedited RI is sufficient to evaluate SWMUs and AOCs and develop and evaluate remedial action alternatives in the FS for those SWMUs and AOCs that require further action. A summary of SWMUs and AOCs is presented on Table 11-1.

RI activities at the Facility included evaluation of Column IA and IB SWMUs and AOCs identified in the Agreed Order as needing additional investigation. Two SWMUs (S-15a and S-16) were later combined and are collectively designated with petroleum hydrocarbon contamination in the area as AOC A-13. Soil and groundwater data collected at all but three of the Facility SWMUs and AOCs either did not indicate a significant release or a release did occur but was successfully remediated. At these SWMUs and AOCs further investigation and cleanup is not required. Consequently, Boeing requests Ecology issue a letter of determination that no further action is required for these SWMUs and AOCs. These SWMUs and AOCs will not be carried forward into the FS. Site-wide evaluation of groundwater indicates that widespread detections of TCE and VC are present both at the Facility and in downgradient areas. Site-wide groundwater impacts from TCE and VC will be addressed as AOC A-14, which is recommended for further evaluation in the FS.

At three Facility AOCs, evidence of a release was encountered during the RI, which will require further evaluation in the FS. In some instances, additional wells or borings may be required to support remedy development, evaluation, and selection during the FS; however, any additional investigation for these AOCs will be identified in the FS work plan. AOCs being carried forward to the FS based on evidence of release and residual source area contamination include:

- A-01: Former USTs (TAU-01 and TAU-02)
- A-09: Acid scrubber drain line leak
- A-13: Petroleum hydrocarbon contamination on the east side of Building 17-06.

The Site-wide groundwater AOC (A-14) comprises the two groundwater plumes as well as detections of TCE and VC in groundwater upgradient of the sources of the plumes. Although the plumes have identified source areas that include other SWMUs and AOCs, contamination in the plume source areas is depleted and does not appear to be making significant ongoing contributions to the plumes (due to IRAs, the age of the releases, and significant flushing that occurs in the aquifer). Additionally, the plume areas are large and require a Site-wide strategy to address the contamination as a whole. Detections of TCE and VC in groundwater upgradient of the plume sources do not have identified source areas (presumably, because they are related to minor releases); however, these areas will also

be addressed through a Site-wide groundwater remediation strategy. AOC A-14 is recommended to be carried forward to the FS.

The Site-wide surface water AOC (A-15) comprises surface water features with detections of TCE and VC and the area of Mill Creek directly downgradient of the groundwater plumes. Surface water quality was evaluated at all types of surface water features (stormwater collection and control, wetlands, and streams) present in and near the Site. The investigation included both seasonal and longer-term temporal evaluation. No contaminants of concern were detected in Mill Creek or the Auburn Environmental Park wetlands. TCE and VC were detected in some stormwater collection and control features in Algona and southwest Auburn and in the wetland west of these control features. However, the extent of TCE and VC concentrations detected in surface water is limited and all concentrations are less than health-based screening levels. . The detected concentrations of TCE and VC in surface water will need to be evaluated based on final surface water cleanup levels. These cleanup levels will be defined in the FS and a determination will be made regarding surface water remediation strategies, if needed. AOC A-15 is recommended to be carried forward to the FS.

Air quality was investigated throughout the Site to determine if VOC-contaminated groundwater was impacting indoor air, ambient air, or other air spaces through vapor intrusion. Investigations were completed on Boeing property and also in commercial and residential areas off Boeing property. Based on the investigations completed to date, exposure to VOCs as a result of vapor intrusion does not appear to be a concern in any area of the Site. No further indoor air evaluation is recommended at the Site and indoor air remediation will not be carried forward to the FS.

11.1 Summary of Contaminant Impacts for Areas of Concern Carried Forward to the Feasibility Study

Contaminant impacts at AOCs being carried forward to the FS include VOCs, TPH, and metals. The following sections summarize contaminant impacts related to these constituents.

11.1.1 Site-Wide Volatile Organic Compounds

The degreaser-related chlorinated solvent TCE has been detected above screening levels at a number of SWMUs and AOCs at the Facility and is a main component of the Site-wide groundwater plumes. While detections of TCE are widespread, concentrations are typically below 5 µg/L. The current concentrations of TCE detected indicate that source areas either have been remediated (IRA at the Area 1 source) or currently have the characteristics of a Stage 5 DNAPL release (western plume source) where DNAPL has been completely depleted and concentration trends are dominated by back-diffusion from lower permeability portions of the aquifer (Kueper et al. 2014).

VC is the only breakdown product of TCE that has concentrations in groundwater above screening levels. VC has also been detected at a number of SWMUs and AOCs at the Facility and is a main component of the Site-wide groundwater plumes. TCE degrades to VC under highly reducing aquifer

conditions. The presence of VC throughout the Site is influenced by aquifer redox conditions and advective transport in groundwater.

11.1.1.1 Facility Investigation

In general, the widespread, concentrations of TCE and VC mainly occur in the central and north portions of the Facility and throughout the groundwater plumes. Concentrations of TCE, and/or VC were detected above screening levels at all SWMUs and AOCs where VOCs were sampled in the northern and western portions of the Facility (i.e., at the Prologis warehouse and Buildings 17-07, 17-10, and 17-35). In contrast, SWMUs and AOCs located in the southern and eastern portions of the Facility (i.e., at Buildings 17-08, 17-29, 17-45, 17-64, 17-66, and 17-68) typically did not contain TCE or VC above screening levels.

The source of the Area 1 plume is relatively well understood based on historical data. The source of the Area 1 plume has been identified as SWMU S-12b (former TCE degreaser) and AOC A-08 (former tank line adjacent to the degreaser) in former Building 17-05 (currently the Prologis warehouse). Starting in 2004, Boeing conducted an IRA to clean up the Area 1 source area. Concentrations of TCE in the source of the Area 1 plume are currently below the laboratory reporting limits. Concentrations of VC are at or below 0.1 µg/L. Groundwater near the IRA continues to exhibit reducing conditions (elevated TOC, low sulfate, and elevated methane) more than 10 years following the last injection. Rebound of TCE and VC concentrations has not occurred.

The source history for the western plume appears to be more complex, but data support operations in and adjacent to Building 17-07 as the source of TCE in groundwater. Based on spatial TCE concentration trends, the western plume originates near Building 17-07 and extends to the northwest. Concentrations of TCE within the source area of the plume appears to have declined, and the highest concentrations now occur downgradient of the source area. Because concentrations in the source area have declined, the source is difficult to identify based on concentration data alone. The probable source areas of the western plume were determined based on a combination of Facility history and collected data. Sources at and around Building 17-07 include the original vapor degreaser (SWMU S-13a), the chrome waste holding tank (SWMU S-34) and piping, and the north lagoon (SWMU S-26). All of these SWMUs may have contributed in some way to the western plume and collectively are considered the source of the plume. The occurrence of VC is typically assumed to be the result of reductive dechlorination of TCE.

The SWMUs and AOCs identified as sources of TCE groundwater contamination at the Facility are not recommended to be carried forward to the FS. Instead, Facility TCE and VC concentrations will be evaluated as part of the Site-wide groundwater AOC (A-14).

11.1.1.2 Site-Wide Groundwater Investigation

The TCE and VC groundwater plumes extend to the northwest of the Facility to approximately 1-mile downgradient. TCE and VC concentrations (typically less than 5 µg/L) are detected throughout the Site. A Site-wide approach to remediating the TCE and VC groundwater plumes is recommended due to the widespread detections. The TCE and VC groundwater contamination at the Site has been designated as AOC A-14. A-14 is recommended to be carried forward to the FS.

11.1.1.3 Site-Wide Surface Water Investigation

Detections of TCE and VC in surface water were identified at the Chicago Avenue ditch and the Auburn 400 ponds. Concentrations detected were below health-based screening levels; however, concentrations in surface water will need to be evaluated against surface water cleanup levels. Surface water features with detections of TCE and VC and the area of Mill Creek directly downgradient of the groundwater plumes has been designated as AOC A-15. A-15 is recommended to be carried forward to the FS.

11.1.2 Facility Petroleum Hydrocarbons

Petroleum hydrocarbons were detected in soil and groundwater above screening levels during the investigation of SWMU S-15a/S-16 (Building 17-06 Sump SAU06-12 and Aluminum Briquetter, and Chip Conveyance System) and AOC A-01 (Building 17-06 Former USTs TAU-01 and TAU-02).

11.1.2.1 Building 17-06 Investigation

Petroleum hydrocarbon contamination was detected along the eastern side of Building 17-06. The petroleum hydrocarbon contamination was originally believed to be associated with SWMU S-15a/S-16. However, more recent forensic investigations provide evidence that the structures associated with the aluminum chip conveyance system and briquetter are not likely the source of the release. Petroleum hydrocarbon concentrations in groundwater persist and minor amounts of residual non-aqueous phase product are present in groundwater. The source of these petroleum hydrocarbon detections is unclear; as a result, this area been designated as a separate AOC (A-13) to address contamination in the area that is not necessarily associated with a particular SWMU. AOC A-13 is recommended to be carried forward to the FS to address petroleum hydrocarbon residual soil and groundwater impacts. TCE and VC concentrations in the area will continue to be monitored as part of the Site-wide groundwater AOC (AOC A-14).

11.1.2.2 AOC A-01 Investigation

Petroleum hydrocarbon contamination at AOC A-01 originated from two former 10,000-gallon fuel USTs; one of the USTs (TAU-01) was a diesel tank used to power emergency generators and the other UST (TAU-02) was a gasoline tank. Petroleum hydrocarbon concentrations in groundwater persist and minor amounts of residual non-aqueous phase product or soil impacts at AOC A-01 may be causing

concentrations to persist. AOC A-01 is recommended to be carried forward to the FS to address petroleum hydrocarbon groundwater impacts.

11.1.3 Facility Metals and Cyanide

Residual metals contamination at the Facility is limited to the area around AOC A-09 (Acid Scrubber Drain Line Leak). Releases of metals and cyanide were associated with a leak from the acid scrubbers at AOC A-09. A partial remediation of the area was conducted prior to the RI; however, compliance soil samples indicated that cadmium, copper, lead, and cyanide were left in place above screening levels. Groundwater continued to be monitored in the area for cadmium and nickel. Groundwater in one monitoring well (AGW050) at this AOC continues to exceed the screening level for cadmium. Nickel concentrations have dropped below screening levels at all wells. Groundwater sampling for copper and cyanide was discontinued in 2004 and 2000, respectively, because concentrations were below screening levels. However, screening levels for both compounds have changed and in reviewing the most recent data (2004 and 2000), the concentration of copper exceeded the current screening level at AGW049 and the concentration of cyanide exceeded the current screening level at AGW047 and AGW049. Collection of additional groundwater data at AGW047 and AGW049 is recommended in order to verify current concentrations of copper and cyanide. AOC A-09 is recommended to be carried forward to the FS to address metals and cyanide impacts to soil and groundwater.

11.2 Groundwater and Surface Water Monitoring Programs

Groundwater and surface water monitoring programs are currently being implemented at the Site. Groundwater is being monitored as part of the Phase VII interim Site-wide groundwater monitoring program (LAI 2016j). In addition to the Phase VII monitoring, additional groundwater natural attenuation sampling is being conducted as part of the Algona pilot test. Surface water is being monitored as detailed in the surface water monitoring work plan (LAI 2015e). Boeing plans to continue monitoring groundwater and surface water at the Site under the current programs with appropriate updates as approved by Ecology.

11.3 Feasibility Study

Data collected as part of the RI and associated investigations is generally sufficient to characterize the nature and extent of contamination and provides detailed information to develop and evaluate remedial alternatives in an FS. A draft FS work plan will be submitted following approval of the RI.

Table 11-1
Summary of Recommendations for SWMUs and AOCs to be Addressed in the Feasibility Study
Boeing Auburn Remedial Investigation
Auburn, Washington

SWMU/AOC	Building	Description	Primary Constituents of Concern	SWMU/AOC to be addressed in Feasibility Study?	Comments
SWMU					
S-06	17-15	Rinsewater Treatment Plant (Wastewater Pre-treatment Plant)	VOCs	No	Evidence of a number of small releases, but these do not appear to have caused significant soil or groundwater contamination. VOC concentrations in groundwater will be addressed as part of the Site-wide VOC impacts.
S-11	17-45	Aqueous Degreasers; Formerly Vapor Degreasers	VOCs	No	There is no evidence of a release associated with these degreasers.
S-12a	17-03	Former Vapor Degreaser; Former Metal Fabrication and Finishing	VOCs	No	Letter of determination for NFA received as part of the Area 1 RI.
S-12b	17-05	Former Vapor Degreaser (VD-01); Process Assembly, Metal Bonds, and Composite Parts	VOCs	No	IRA completed in 2004 to 2005; TCE concentrations are now non-detect. Remaining VOC concentrations in groundwater will be addressed as part of the Site-wide VOC impacts.
S-12c	17-05	Former Vapor Degreaser (VD-02); Process Assembly, Metal Bonds, and Composite Parts	VOCs	No	Letter of determination for NFA received as part of the Area 1 RI.
S-12d	17-12	Former Vapor Degreaser; Former Metal Fabrication and Finishing	VOCs	No	There is no evidence of a release from this former degreaser.
S-12f	17-68	Former Vapor Degreaser	TCE	No	There is no evidence of a release from this former degreaser.
S-13a/b	17-07	Fomer Vapor Degreasers; Machine Fabrication	VOCs	No	Threre is no evidence of a release from the TCA degreaser (S-13b). There was likely a release from the former TCE degreaser (S-13a); however, the release/releases were not extensive and groundwater flux has depleted much of the mass from the source area. VOC concentrations in groundwater will be addressed as part of the Site-wide VOC impacts.
S-15a/S-16	17-06	Machine Sump (SAU06-12)/ Active Aluminum Chip Briquetter and Chip Conveyance System	TPH	No	Petroleum hydrocarbon contamination (DRO and ORO) exceeds screening levels; however, the concentrations do not appear to be related to S-15a or S-16. The petroleum hydrocarbon contamination will be addressed as part of the general petroleum hydrocarbon contamination in Building 17-06 (A-13). Detections of VOCs in groundwater will be addressed as part of the Site-wide VOC impacts.
S-15b	17-07	Machine Sumps SAU07-024,-025,-028,-029	TPH	No	There is no evidence of a release from these machine sumps in Building 17-07.
S-15c	17-34	Chip Shed Sumps (SAU34-001 through -004)	TPH	No	There is no evidence of a release from these chip shed sumps.
S-15d	17-52	Machine Sump (SAU52-001)	TPH, Metals	No	Letter of determination for NFA received as part of transfer of the south Site to Safeway.
S-17	17-29	Titanium Chip Bailer (Shed and Sump)	TPH	No	There is no evidence of a TPH release at this SWMU. Detections of VOCs in groundwater in this area will be addressed as part of the Site-wide VOC impacts.
S-18	17-35	Miscellaneous Sumps at Chip Shed	TPH	No	There is no evidence of a release at this SWMU. Detections of VOCs will be addressed as part of the Site-wide VOC impacts.
S-19	17-05	Former Waste Oil Tank (TAU-22); Process Assembly, Metal Bonds, and Composite Parts	TPH	No	Letter of determination for NFA received as part of the Area 1 RI.
S-30	17-10	Former Debris Pile and Burn Pit	TPH, VOCs, Metals	No	Concentrations of TCE and VC north and downgradient of this SWMU do not indicate a significant release from this SWMU. Detections of VOCs in groundwater in this area will be addressed as part of the Site-wide VOC impacts.
AOC					
A-01	17-06	Former USTs (TAU-01 and TAU-02)	TPH, BTEX	Yes	Petroleum hydrocarbon related constituents (DRO, GRO, BTEX) are above screening levels. Concentrations of VOCs at this area will be addressed as part of the Site-wide VOC impacts.

**Table 11-1
Summary of Recommendations for SWMUs and AOCs to be Addressed in the Feasibility Study
Boeing Auburn Remedial Investigation
Auburn, Washington**

SWMU/AOC	Building	Description	Primary Constituents of Concern	SWMU/AOC to be addressed in Feasibility Study?	Comments
A-02a	17-03	Former USTs (TAU-7 and TAU-8)	TPH	No	Letter of determination for NFA received as part of the Area 1 RI.
A-02b	17-06	Former UST (TAU-23) Jet Fuel Product Storage	TPH	No	There is no evidence of a release from this former UST.
A-02c	17-08	Former UST (TAU-16) Diesel Product Storage	TPH	No	There is no evidence of a release from this former UST.
A-02d	17-10	Former UST (TAU-6) Diesel Product Storage Tank	TPH	No	There is no evidence of a release from this former UST.
A-03	17-35	Former Unregistered Waste Oil Tanks	TPH	No	There is no evidence of a release from these former waste oil tanks. Detections of VC will be addressed as part of the Site-wide VOC impacts.
A-04	17-29	Former Underground Titanium Chip Bailer Tank; PS300, cutting oil, and solvents	TPH	No	There is no evidence of a release from this sump.
A-05	17-64	Unleaded Gasoline UST (TAU-32); Transportation Building Fuel Island	TPH	No	There is no evidence of a release from this former UST.
A-06	17-66	Excavations for the expansion of 17-66	TPH, VOCs, Metals	No	There is evidence of a minor release of TCE and related constituents to groundwater in this area. However, current concentrations are below screening levels. Impacts from releases were minor and have been largely addressed through soil removal and natural attenuation.
A-07	17-08	Former MEK UST (TAU-18)	MEK/2-butanone	No	There is no evidence of a release from this former UST. Detections of TCE will be addressed as part of the Site-wide VOC impacts.
A-08	17-05	Former Metalbond Tank Line; Process Assembly, Metal Bonds, and Composite Parts	VOCs	No	IRA completed in 2004 to 2005; TCE concentrations are now non-detect. Remaining VOC concentrations in groundwater will be addressed as part of the Site-wide VOC impacts.
A-09	17-07	Acid Scrubber Drain Line Leak; Machine Fabrication	Metals, Cyanide	Yes	Metals contamination was left in place in soil above screening levels and has resulted in metals contaminated groundwater.
A-10	17-10	G&L Post Mill; Tooling/Tool Fabrication	TPH, VOCs	No	Minor historical exceedence of petroleum hydrocarbon (ORO) screening levels occurred at well AGW038. Detections of VOCs will be addressed as part of the Site-wide VOC impacts.
A-12	17-09	Fuel Oil Spill; southwest of Building 17-09	TPH	No	There is no evidence of a significant release associated with this fuel oil spill.
A-13	17-06	Petroleum contamination in soils and groundwater	TPH	Yes	Soil and groundwater exceedences of screening levels for petroleum hydrocarbons (DRO and ORO).
A-14	Site-wide	Site-wide TCE and VC concentrations in groundwater	TCE, VC	Yes	Groundwater exceedences of screening levels for TCE and VC.
A-15	Site-wide	Site-wide TCE and VC concentrations in surface water	TCE, VC	Yes	Detections of TCE and VC in surface water.

Abbreviations/Acronyms:

AOC = area of concern
 BTEX = benzene, toluene, ethylbenzene, and xylenes
 DRO = diesel-range organics
 GRO = gasoline-range organics
 IRA = interim remedial action
 MEK = methyl ethyl ketone
 NFA = No Further Action
 ORO = oil-range organics

RI = remedial investigation
 SWMU = solid waste management unit
 TCA = trichloroethane
 TCE = trichloroethene
 TPH = total petroleum hydrocarbons
 UST = underground storage tank
 VC = vinyl chloride
 VOC = volatile organic compounds

Notes:

1. TPH stands for petroleum hydrocarbons (can include DRO, ORO, or GRO).
2. MEK is the same as 2-Butanone.
3. Green highlighting indicates SWMUs or AOCs that will be carried forward to the FS.