

State of Oregon
Department of Environmental Quality

Memorandum

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To: FILE

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Northwest Region Cleanup Section

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Subject: East Multnomah County, Troutdale Sandstone Aquifer (TSA) Remedy. Staff Memorandum in support of a Conditional No Further Action Determination for Zone A of the TSA and a No Further Action Determination for the site Sand and Gravel Aquifer (SGA). ECSI # 1479

This document presents the basis for the Oregon Department of Environmental Quality's (DEQ's) recommended Conditional No Further Action (CNFA) determination for a portion of the Boeing Company and Cascade Corporation, collectively known as the East Multnomah County Troutdale Sandstone Aquifer Remedy (EMC Site), in Portland, Oregon. As discussed in this report, groundwater contaminant concentrations in the Troutdale Sandstone Aquifer and the Sand and Gravel Aquifer have been successfully remediated and are protective of human health and the environment, per stipulations set forth in the 1996 Record of Decision (ROD) for the project.

This proposed CNFA is partial as it applies to only Zone A of the Troutdale Sandstone Aquifer and also proposes an unencumbered NFA for the deeper Sand and Gravel Aquifer for the entire EMC project area. It is conditional as TSA groundwater monitoring from Portland Water Bureau monitoring wells (located at the downgradient margin of Zone A) will be sampled and analyzed for five years to confirm that contaminant concentrations remain below action levels specified in the ROD.

This proposed CNFA and NFA determination meets the requirements of Oregon Administrative Rules Chapter 340 Division 122, Sections 010 to 0140 for Cleanup Sites, and ORS 465.200 through 465.455.

This proposal is based on information documented in the administrative record for this site. A copy of the administrative record index is presented at the end of this report.

1. PURPOSE

This Memorandum presents the technical basis for DEQ's recommendation for a CNFA determination for Zone A of the TSA at the EMC Site, and a NFA determination for the SGA beneath the entire project site.

The EMC Site includes groundwater in portions of the TSA and the underlying SGA that were historically impacted by the past use of trichloroethene (TCE) and to a lesser extent, other volatile organic

compounds (VOCs) including: tetrachloroethene [PCE], cis-1,2-dichloroethene [cis-1,2, DCE], 1,1-dichloroethene [1,1-DCE], and vinyl chloride [VC]. The Cascade Corporation (Cascade) facility is located at 2201 NE 201st Ave in Gresham, Oregon, and The Boeing Company (Boeing) facility is located at 19000 NE Sandy Boulevard in Portland, Oregon (Figure 1). Cascade and Boeing are jointly responsible for the EMC remedy being implemented under DEQ's Consent Order No. WMCSR-NWR-96-08 (DEQ 1997).

Four groundwater restoration areas (Zones A, B, C, and D) were identified for operational efficiency and are shown on Figure 1. Further clarification on the concept of restoration zones was provided in the *Troutdale Sandstone Aquifer Remedial Action Annual Performance Evaluation for April 1, 1998 – March 31, 1999* (Landau Associates 1999). Contaminant concentrations of the dissolved VOC plume in groundwater in TSA Zone A, located north of Sandy Boulevard, and the SGA, located throughout the EMC Site, have met remedy performance criteria and are below cleanup levels specified in the ROD. At the present time, only three wells remain in TSA Zone A and one in the Zone A SGA, as wells were systematically decommissioned as the remedy progressed over time and analytical results indicated that groundwater quality met the Consent Order and ROD requirements. Analytical results from the last remaining three TSA wells and one SGA well have also met the Consent Order requirements and were approved by DEQ for decommissioning (DEQ, 2018b). Based on these criteria, a CNFA determination is recommended for TSA Zone A and an NFA for the SGA throughout the EMC Site.

The remedial actions undertaken at the EMC Site were completed under Oregon Administrative Rules, Chapter 340 Division 122, and the proposed CNFA/NFA determination described in this memorandum meets the requirements of Oregon Revised Statutes 465.230. Restoration and remediation actions taken at the EMC Site have attained cleanup in specific zones and have controlled environmental risk from further releases. These actions are now complete and are protective of public health and the environment. Institutional controls, such as groundwater use restrictions related to the EMC Site, as specified in the ROD, will be removed for Remedy Zone A SGA and the site TGA once this CNFA/NFA determination has been approved. However, this determination will not remove the EMC Site from the Confirmed Release List. Rather, this CNFA/NFA determination will recognize that the selected portions of the EMC Site (TSA Zone A and the SGA) meet restoration goals and meet cleanup levels set forth in the ROD. As an additional safeguard, groundwater from nested TGA wells at PWB-1 will be sampled and analyzed annually for five additional years to confirm that remediation goals have been met.

2. BACKGROUND

Site location.

- Address: (Boeing) 19730 NE Sandy Blvd., Portland, Multnomah County, Oregon.
- Latitude 45.5414° North; Longitude 122.4596° West (central remediation system position)
- Township 1 North, Range 3 East, Sections 19, 20, 28 and 29

The original study area for the EMC Site was an area of approximately 3.6 square miles (2300 acres) bounded by the Columbia River to the north, Fairview Avenue and NE 223 Avenue to the east, NE Halsey Street to the south, and NE 181 Avenue to the West (Figure 1). Topography at the EMC Site is highest to the south and descends in elevation in a series of river/flood-cut alluvial terraces northward to the Columbia River.

Four TSA restoration areas are assigned letters as follows and are shown in Figure 1:

TSA Restoration Zone	Zone Location
Zone A	Area north of Sandy Boulevard
Zone B	Area south of Sandy Boulevard in the western portion of the Boeing facility
Zone C	Area south of Sandy Boulevard directly east of Zone B and west of N.E. 205th Avenue
Zone D	Area south of Sandy Boulevard, directly east of Zone C and area east of N.E. 205th Avenue

Site setting

The EMC Site is located approximately 7 miles east of the Portland International Airport and is located within the Columbia South Shore Wellfield (CSSWF), Wellhead Protection Area. The CSSWF is operated by the Portland Water Bureau (PWB) as a backup/alternative drinking water source for the City of Portland and environs. The City of Portland's main drinking water source is the Bull Run watershed west of Mount Hood. The Bull Run Reservoir #2 headworks is approximately 16 miles southeast of the EMC site. Both the Boeing and Cascade manufacturing facilities are located within the EMC Site boundary, along with a mix of residential, manufacturing, agricultural, and vacant properties, as shown in Figure 2.

The original extent of the EMC TSA Remedy Site dissolved groundwater plume was approximately 400 acres (0.63 square miles). The dissolved VOC plume, based on 2019 data, as defined by groundwater concentrations with Compounds of Potential Concern (COPC) still above the Consent Order cleanup levels, is currently approximately 28 acres (0.044 square miles). Groundwater remediation has resulted in an estimated 93% reduction of the original remedy area, that now meets Consent Order cleanup levels. The remaining 7% of the remedy area is active and receives continued remediation and monitoring.

The 2018 and historic monitoring well network, extraction well and treatment system locations, and zone designations are shown in Figures 3, 4, and 5.

Geology

The principal geologic units beneath the EMC Site, from shallowest to deepest, include alluvial floodplain deposits (referred to as the Troutdale Gravel, Blue Lake Gravel, and Floodplain sand and silt), siltstone unit 1, a sandstone unit, a conglomerate unit, siltstone unit 2, and a deeper conglomerate unit. These hydrogeologic units include three primary aquifers which include, from shallowest to deepest, The Troutdale Gravel Aquifer (TGA), the TSA (also referred as the Upper TSA) and the Troutdale Conglomerate Aquifer (also referred to as the Lower TSA), and the SGA. The TGA is separated from the TSA by Confining Unit 1 (CU1), while the TSA is separated from the SGA by a second confining layer identified as Confining Unit 2 (CU2) (Swanson, et al., 1993). Both confining layers have distinct subunits of siltstone interbedded with sandstone (Landau Associates, 1995). A comprehensive discussion of the geology and hydrogeology, including cross sections and a stratigraphic column, are included in the ROD

(DEQ 1996). A cross section illustrating stratigraphy of the northern EMC Site, including Zone A and the SGA, is provided as Figure 6.

Near the northeast portion of the EMC Site, between Blue Lake and the south shore of the Columbia River, erosion and suspected faulting of the Troutdale Formation has occurred and resulted in a deep channel of the Columbia River that has incised the Troutdale Formation. The channel was subsequently filled with gravel and comprises the Blue Lake Aquifer (BLA).

Hydrogeology

In natural conditions, shallow TGA groundwater flow is to the north and discharges in a series of springs in the southern/central portion of the EMC Site (in Zones C and D) and along the truncation where CU1 and the TGA have been eroded. The approximate extent of the erosional truncation is shown in Figure 3. This truncation does not extend to the southwest into Zone B, where the TGA is encountered at 7 to 20 feet below ground surface (ft bgs) and dips to the northwest with TGA thickness ranging from 10 to 100 ft bgs. CU1 and CU2 are generally unsaturated siltstone/claystone units, although sandstone interbeds are occasionally water-bearing. TGA groundwater in Zone A, where present, is often encountered within a few feet of ground surface, and artesian conditions have been described historically in portions of the remedy area.

Regional groundwater flow in the TSA and the SGA is generally northward towards the Columbia River. However, the Upper TSA in the central to northeastern portion of the EMC Site is unsaturated, likely due to a geologic structural high and possibly due to a higher degree of cementation. The approximate extent of this TSA unsaturated area is shown in Figure 3. Groundwater flow directions near this feature appear to be mixed due to increased recharge from the TGA and other areas of the Upper TSA to the TSA north of the TGA/CU1 erosional truncation, resulting in radial flow to the southeast/south/southwest, as described in the ROD. The pre-pumping flow gradient in the Upper TSA and Lower TSA is shown in Figures 7 and 8, respectively. The portion of the EMC Site with the radial groundwater flows is referred to as the “mound area”. Groundwater flow in the mound area and resultant contaminant distribution in the Upper and Lower TSA is complex; this area is the focus of groundwater pumping for capture of the dissolved VOC plume as well as vadose soil vapor extraction (Figures 9 and 10).

Depths to groundwater in the Upper TSA vary significantly across the EMC Site and range from:

- Zone A: 5 to 36 ft bgs (12 to 8 feet relative to mean sea level) under non-pumping conditions;
- Zone B: 70 to 125 ft bgs (9 to -6 feet relative to mean sea level) under non-pumping conditions;
- Zone C: 50 to 155 ft bgs (60 to -30 feet relative to mean sea level) in areas of active remedy groundwater pumping; and
- Zone D: 55 to 95 ft bgs (60 to 15 feet relative to mean sea level) under non-pumping conditions.

It should be noted that a companion remediation project is on-going in this area. Remediation of the unconfined, Troutdale Gravel Aquifer (TGA), is continuing over much of the same area as is described here as Zone A. This project, ECSI #13, is treating the upper TGA aquifer also for chlorinated VOCs as well as petroleum hydrocarbons. The TGA is isolated from the deeper TSA and SGA aquifers by aquitards. These projects are separated stratigraphically even though they generally occupy the same areal extent. DEQ has not found downward aquifer cross

contamination in the project area following the removal of certain historical wells which did not hydraulically isolate the area aquifers.

3. BENEFICIAL LAND AND WATER USE DETERMINATIONS

Land use

The EMC Site includes a mixture of industrial, commercial, residential, agricultural, and recreational land uses. Historically, area zoning was primarily agricultural; however, conversion of these properties to mixed uses has increased over the past few years and is ongoing. Below are examples of some of the land use in the EMC Site and within Remedy Zone A. The current property zoning within the EMC Site is summarized in Figure 2.

EMC Site land uses:

- Various industrial land uses, including Boeing and Cascade manufacturing facilities, grocery distribution facilities, Phelan and Dermody property warehouses. Other industrial land use properties are located south of Interstate 84.
- Residential areas are located north and south of Interstate 84 and north and east of NE 201st Avenue.
- Current and former agricultural land north of NE Sandy Boulevard is being developed as light industrial and commercial warehousing and distribution facilities.

Zone A:

- A Union Pacific Railroad corridor bisects Remedy Zone A running east to west, and NE Sandy Boulevard is directly south of the zone.
- Recreational use of water bodies (Blue Lake, Fairview Lake, and the Columbia Slough), along with Blue Lake Park and the Columbia River marina (directly north of Zone A).
- Residential areas are located near the above-mentioned water bodies. Other areas include additional residential housing and a mobile home development.
- Agricultural areas are located throughout Zone A, although most are undergoing development as light industrial and commercial warehouse facilities.
- A large warehouse and support facility were recently developed along the north side of NE Sandy Boulevard in Zone A and are served by municipal water.

Groundwater

The EMC Site is located within the CSSWF – Wellhead Protection Area, managed by the Portland Water Bureau. City of Portland municipal water is provided to users within the Locality of Facility (LOF, the original area of actionable contamination extent, or about 400 acres). The primary source of City of Portland drinking water is the Bull Run Reservoir, located 16 miles to the southeast of the EMC site. The wellfield is activated periodically to supplement the City of Portland water supply. Seven PWB-operated wells (three in the SGA and four in the BLA) are located north of the EMC Site (north of Zone A), within the original EMC Study Area and are generally near the Columbia River (Figure 1). An EMC contingency plan includes monitoring requirements for use during PWB groundwater pumping events (Landau Associates 2019).

The Rockwood Public Utility District and the City of Gresham utilize wells in the SGA and are developing new wells in the SGA. These wells are collectively known as the Cascade Well Field. These municipal wells tap groundwater from the deep SGA aquifer in eastern Multnomah County. The managers of the Rockwood Public Utility District and the City of Gresham wellfield were contacted specifically for comment on this proposed conditional No Further Action Staff Memorandum.

Comments received on the draft *East Multnomah County Groundwater, ECSI #1479; Staff Memorandum in support of a Conditional No Further Action Determination for the Zone A TSA/SGA* are included in the Appendix to this report.

A review of Oregon Water Resources Department well logs was completed for the vicinity of the EMC Site (Township 1N, Range 3E, Sections 19-22 and 27-34). No domestic or supply wells have been installed in the EMC Site since the Remedial Investigation project phase in 1995. Domestic and supply wells installed prior to 1995 have been removed from service. No wells with site-related impacts are currently in use.

Groundwater Use

Historic wells in the EMC Site area produced groundwater for a mix of domestic, irrigation, and industrial purposes. Many of these earlier wells were repurposed in the 1990s for use as groundwater monitoring wells and extraction wells. Some wells were decommissioned in the early phase of the project, as summarized in the *Remedial Investigation/Feasibility Study* (Emcon and Landau Associates, 1995). During the early phase of site investigations, groundwater quality samples and groundwater elevation data were collected from multiple sources, such as local private water wells, municipal production wells, industrial water supply wells, and remedy extraction and monitoring wells. Due to the complex network of wells, each early phase well was also identified with unique Portland Monitoring Reference (PMX) well nomenclature. If analytical results indicated that any existing wells had no impacts from the EMC Site, then the use of these wells for data collection was discontinued and access agreements were terminated. Domestic use of groundwater around the EMC Site, including Zone A, has been restricted, Per the ROD when receptors could be exposed to site contaminants. At this time, with contaminants removed from groundwater to at least MCLs, these institutional controls may be lifted. New well installations around the EMC Site, including Zone A, must be approved by DEQ per the Institutional Controls Plan (ICP; Landau Associates, Prowell Environmental 1999).

Within the larger 27-well CSSWF, groundwater is used for augmentation of the public water supply by the City of Portland Water Bureau. The wellfield can produce 102 million gallons of groundwater per day. In the 2/3 mile of the CSSWF between the Columbia River and the northern extent of EMC Zone A, there are three SGA, and four BLA municipal production wells.

Surface water

A reach of the Columbia Slough is located north of the EMC Site. The Columbia Slough extends 31-miles from Fairview Lake (northeast of the EMC Site) to the confluence of the Willamette and Columbia Rivers. The Columbia Slough is identified by DEQ as an Area of Concern. DEQ issued a ROD in 2005 for cleanup of contaminated slough sediment within the Columbia Slough.

DEQ has been authorized to enter into Prospective Purchaser Agreements to encourage beneficial use and redevelopment of commercial and industrial properties within the Columbia Slough vicinity.

Treated groundwater from the EMC Site's Central Treatment System (CTS) is discharged under an NPDES permit (included with the 1996 ROD) to the Gresham Sandy Boulevard WWTP. EMC treated water is tested quarterly at the CTS, and TCE concentrations have been below detection limits. The WWTP in turn, releases treated water to Columbia River.

Surface Water Use

Surface water bodies nearest the EMC Site provide for scenic and recreational uses, irrigation, and include the following:

- The Columbia Slough is located north of NE Sandy Blvd (Zone A). Routine analytical testing of the slough was not included as a requirement of the EMC Consent Order, since initial testing indicated that VOCs were less than cleanup goals and testing of treated groundwater is conducted at the EMC groundwater treatment system discharge locations. Currently, testing of treated groundwater is conducted only at the Central Treatment System as this is the only remaining location with system water discharge.
- Storm Drain Creek discharges into the Columbia Slough north of NE Sandy Blvd (Zone A). Historically, this creek received treated water from the West Treatment System (TSA groundwater treatment ceased in 2009) and drained to the Columbia Slough. Analytical testing of the former West Treatment System discharge was conducted as part of the EMC National Pollutant Discharge Elimination (NPDES) permit.
- Fairview Lake and Blue Lake are located to the north-northeast of Zone A. During the early phase of the EMC remedial investigation (RI), groundwater elevation data from the two lakes were included in the groundwater modeling program.
- Two springs (Shepard and Taggart Springs) are located on the Cascade and Dermody (former Boyd's) properties, respectively, north of Interstate 84 (Zone C). These springs discharge TGA groundwater along the erosional truncation. Shepard Springs was contained and piped to the City of Gresham wastewater treatment plant (WWTP) as part of the Cascade TGA Remedy. TCE concentrations at Taggart Springs were below ROD cleanup levels and did not require further sampling or remediation. Taggart Springs currently is free flowing (natural conditions).
- Osborn Creek is located east of Zone D. Surface water samples were collected upstream of Osborn Creek at the East Ditch, with VOCs below laboratory reporting limits. As a result, Osborn Creek and East Ditch did not require additional sampling or remedial action and were removed from Consent Order requirements.
- The East and West Salish Ponds are located southeast of the EMC Site and beyond the EMC Site boundaries. These ponds are upgradient with respect to both surface and groundwater flow and are not of concern with respect to the EMC project.

EMC site stormwater that does not infiltrate into unpaved areas is diverted to catch basins which drain to the Columbia Slough, with some of that flowing through the Columbia Slough Regional Stormwater Facility.

4. INVESTIGATION AND CLEANUP ACTIVITIES

EMC Site Discovery and Investigations

A summary of EMC Site environmental discovery and investigation work is presented in Table B-1 and is discussed below.

EMC Site discovery and groundwater investigation of the TSA and the SGA began in 1986. Site discovery activities in the project area included DEQ and EPA evaluation of 11 facilities to identify those that were likely to use the chlorinated VOCs found in groundwater. DEQ completed federal preliminary assessments on these 11 facilities.

Results of early EMC study area investigations indicated VOC concentrations in groundwater were above EPA drinking water Maximum Contaminant Levels (MCLs) for the following chlorinated solvents: TCE (trichloroethene), PCE (tetrachloroethene), cis-1,2-DCE (cis-1,2-dichloroethene), 1,1-DCE (1,1-dichloroethene), and VC (vinyl chloride). The maximum concentrations of these VOCs detected in the TSA in a sampling round conducted in August 1994 were: 160 µg/L for TCE, 8 µg/L for PCE, 29 µg/L for cis-1,2- DCE, and 2 µg/L for 1, 1-DCE. TCE is the most widespread of the VOCs detected in the TSA

and is detected at the highest concentrations. Of these solvents, TCE was determined to be the predominant contaminant and it continues to be used to evaluate the progress of the EMC remedy.

Cis-1,2-DCE, 1,1-DCE, and VC are degradation (daughter) products associated with the breakdown of “source” solvents such as TCE and PCE. This degradation or breakdown is commonly attributable to anaerobic bacteria, resulting in reductive dechlorination. Under natural oxidative aquifer conditions, common to the EMC site, anaerobic bacteria tend to be limited, thus limiting natural anaerobic breakdown of TCE.

Following releases of TCE to near-surface groundwater from both Cascade Corporation and Boeing, the primary source of contamination to the deeper TSA was the discharge of contaminated groundwater from near-surface groundwater and the TGA. Contaminant migration pathways from the TGA downward to the TSA include infiltration from springs, seeps, and vertical leakage downward through the CU1 aquitard near the TGA/CU1 truncation north of Cascade (Figure 3), and leakage along well casings of former water supply wells at the Boeing and Cascade facilities. The areas of highest TCE concentrations in the TSA, correlate to locations of these preferential pathways from the TGA to the TSA and subsequent migration from these areas both laterally and vertically. Initial TGA source control measures implemented by Boeing and Cascade, include intercepting the contaminated groundwater flow that formerly discharged at springs and seeps and abandonment of wells with leaking casings.

The source of VOC contamination from the TSA to the deeper SGA was most likely leakage along well casings completed through the CU2 aquitard. Four private water supply wells tapping the SGA in the EMC study area had confirmed detections of VOCs. These four wells were all constructed without a seal through CU2. All four wells have been abandoned to prevent further cross-aquifer contamination.

The VOCs that were historically detected in the SGA occurred beneath the area where the TSA was contaminated. The VOCs detected in the SGA include TCE, cis-1,2-DCE and PCE, but concentrations are significantly lower than those in the TSA. TCE is the only contaminant historically detected above the MCL. The maximum TCE concentration detected in the SGA in January 1997 was 59 µg/L at well DEQ-3. No VOC detections have been recorded in the SGA since 2007.

In 1990, DEQ implemented a groundwater use management plan (ROD, Section 4.2.2) that included decommissioning of some domestic and supply wells for the EMC Site, as well as coordination with the PWB regarding pumping at the CSSWF. Groundwater use at the EMC Site has been restricted during investigation and remediation work, as documented in a DEQ-approved Institutional Control Plan (Landau Associates, Prowell Environmental 1999). With approval of this CNFA/NFA, these institutional controls restricting groundwater use (ROD Section 9.1.4) will be removed.

Cascade and Boeing conducted multi-phase Remedial Investigation and Feasibility Studies (RI/FS) (Century West Engineering, 1991; Century West Engineering, 1991a; EMCON 1995) under multiple Consent Orders with DEQ. Prior to initiating the joint RI/FS, Cascade and Boeing implemented groundwater pumping and treatment while maintaining a groundwater capture zone as an interim removal action measure (IRAM). This work was performed to control the further spread of groundwater contamination to the north of their facilities. The groundwater IRAM is a component of DEQ’s final selected remedial action in the 1996 ROD.

A well inventory was conducted as part of the EMC Site RI (Emcon and Landau Associates 1995). The ROD identified 53 private water supply (irrigation and domestic) wells within the EMC Project Area (ROD Section 3.1.2); of these, 27 were utilized to augment RI findings, and six SGA and two TSA wells were decommissioned, and the associated properties provided with public water supply. The remaining 18

private water supply wells that were no longer needed for EMC monitoring, were transferred back to private property owners. These 18 private water supply wells were determined to be unimpacted by the dissolved VOC plume.

A total of 27 of the private wells (typically denoted with the “PMX” prefix) were incorporated into the EMC Site network and converted to use for monitoring (23 wells) or remedy extraction pumping (4 wells). Site wide, a total of 80 wells have been decommissioned as remedy cleanup goals have been achieved and an additional 8 wells have been approved by DEQ for pending decommissioning. The monitoring and extraction well network, utilized for the EMC Site remedy after the 1997 Consent Order, are summarized in Table 1, and the current and historic groundwater monitoring well network is shown in Figures 3, 4, and 5. Zones for these wells are designated in these tables and figures.

All but two SGA wells, BOP-44(usg) and PWB-1(usg), in Zone A have been decommissioned with DEQ approval based on TCE concentrations below the MCL. EMC groundwater monitoring at these two remaining wells was discontinued in 2013, as approved by DEQ. Well PWB-1(usg) was installed by the City of Portland for monitoring groundwater quality in the CSSWF and was also utilized by the EMC for remedy monitoring. Once PWB-1(usg) was determined to be unneeded for monitoring the SGA remedy, DEQ approved the removal of the well from the EMC monitoring program. The City of Portland continues to monitor PWB-1(usg).

Currently, groundwater quality and water level monitoring continue throughout the EMC Site at 67 TSA wells (Table 1 and Figures 3 through 5). Eleven wells were installed in 2011-2019 for combined groundwater monitoring and vapor extraction in Zone C; two of these wells have been decommissioned. Groundwater monitoring is conducted at select sentinel wells during PWB CSSWF pumping (Landau Associates, 2015 and 2019). The current EMC Site groundwater monitoring wells are shown in Figures 9 and 10.

In 2021, six additional soil borings were installed in the mound area of Zone C (Geosyntec and Landau, 2021). These borings were completed as wells in the upper TSA and are designed to allow groundwater sampling and aquifer testing as well as soil vapor monitoring. These wells are under design consideration and testing to improve aquifer flushing and VOC recovery during groundwater extraction and treatment, as well as expansion of the vapor extraction system.

Extent of Contamination

At the time of ROD issuance in 1996, contamination in the TSA generally extended over an area of about 400 acres in the central part of the project area from south of Interstate 84 near the Cascade site, northward just beyond the Columbia Slough. The extent of contamination in the TSA Sandstone and Conglomerate subunits, was defined by the presence of TCE in groundwater. The highest TCE concentration in both the TSA Sandstone and Conglomerate, reported in August 1994, occurred in and west of the Zone C groundwater mound area. The maximum TCE concentrations were 140 µg/L at MW-18(ds) in the TSA sandstone and 160 µg/L at well BOP-13(dg) in the lower TSA conglomerate. The historical source of contamination at these wells is interpreted to be discharge of contaminated groundwater from TGA near the TGA/CU1 truncation and TSA recharge in the groundwater mound area.

Outside of the mound area, the maximum observed TCE concentration was 90 µg/L in the TSA sandstone on the Boeing facility near the location of a former supply well. In 1996, approximately 3 billion gallons of water in the TSA contained concentrations of TCE in excess of the MCL (based on an aquifer porosity of 0.25). The total mass of TCE in this volume was estimated to be about 1900 pounds at that time.

The distributions of PCE and total 1,2-DCE in the TSA Sandstone and Conglomerate are less extensive than the TCE distribution, and concentrations are much lower. PCE concentrations exceed the MCL (5 µg/L) at a few wells within the groundwater mound area. 1,2-DCE concentrations did not exceed the MCL (70 µg/L) within the project area. In August 1994, detections of 1, 1-DCE were only reported at three wells; none of these detections exceed the MCL of 7 µg/L. Maximum concentrations of PCE and 1,2-DCE in the TSA Sandstone generally occur within and downgradient of the groundwater mound area. The maximum concentration of 1, 1-DCE occurred in the TSA Sandstone beneath the Boeing facility.

Contaminant Fate and Transport

The VOCs in the TSA result from migration of dissolved VOCs from the TGA to the TSA via discharge of contaminated groundwater from the TGA to the TSA, and leakage along unsealed water supply well casings. Within the TSA, the primary VOC transport process is advective transport with groundwater movement. VOCs have migrated radially from the TSA mound to the east and west and eventually farther downgradient in the direction of regional TSA groundwater flow-to the north/northeast. Contaminants have been transported a shorter distance to the northeast of the groundwater mound, because of the decreased sandstone saturated thickness in that direction, the lower transmissivity of the conglomerate, and because most of the TGA recharge to the TSA occurs on the south side of the mound where groundwater flows to the south.

Pumping from the City of Portland's South Shore well field has the potential to affect the direction and rate of groundwater flow in the TSA. A numerical groundwater transport model (June 1993) was used to investigate potential plume migration under four different wellfield use scenarios and the absence of remediation:

- Reasonable Current Average (RCA) Scenario. Pumping of the existing BLA production wells at estimated maximum capacity of 50 mgd, for 90 days per year, for 20 years.
- Reasonable Current Maximum (RCM) Scenario. Pumping of existing TSA, BLA, SGA and TGA production wells at estimated maximum capacity of 99 mgd, for 151 days per year, for 20 years.
- Reasonable Future Maximum (RFM) Scenario. Pumping of existing and proposed production wells at estimated total maximum capacity of 150 mgd, for 151 days per year, for 20 years.
- Emergency-Use Scenario. Continuous pumping of existing production wells at estimated maximum capacity of 99 mgd, for 3 years.

The results of the modeling analyses indicated that, in the absence of remediation, the TCE plume would expand significantly beyond its current configuration. Under the RCA scenario, most of the plume eventually discharges to the surface water bodies, but the plume also expands to encompass the BLA production wells. Under the RCM and RFM scenarios the VOC plume expands to the west and is not substantially captured by the surface water bodies. The TCE plume in the TSA is calculated to extend to the BLA and TSA production wells under these scenarios. Under the emergency use scenario, the TCE plume is primarily northwesterly and is less extensive than predicted under the RCM or RFM scenarios. The plume front is not predicted to extend to either the BLA or TSA production wells within the simulated 3-year period. This analysis led to the requirement that a Record of Decision be prepared to specify remediation expectations.

Endangerment Assessment

An endangerment assessment was performed as part of the 1996 Remedial Investigation, in accordance with OAR 340-122-080 and USEPA guidance to evaluate the potential risks to human health and the environment and the need for remedial action, or no action, at the site. The endangerment assessment included a human health evaluation and an ecological evaluation. Each evaluation included an evaluation

of the chemicals of concern, a toxicity assessment, an exposure assessment, risk characterization, and an uncertainty assessment.

Human Health Evaluation

TCE, PCE, cis-1,2-DCE, and 1,1-DCE were identified as COPCs based on chemical toxicity, and detection frequency in groundwater and surface water. TCE and cis-1,2, -DCE were identified as COPCs in TSA and SGA groundwater and in surface water of the Columbia Slough. PCE was identified as a COPC in both TSA and SGA groundwater, and 1,1-DCE was identified as a COPC in TSA groundwater.

Residential, occupational, and recreational exposure scenarios were evaluated based on land use and zoning information. For each of these scenarios, the following potential current exposure pathways were quantitatively evaluated for potential impacts from the TSA VOC plume:

- Residential ingestion, dermal contact, and inhalation of chemicals volatilizing from TSA water during household use;
- Residential ingestion, dermal contact, and inhalation of chemicals volatilizing from SGA water during household use;
- Residential ingestion of food crops that have been irrigated with water from the TSA, the SGA, or the Columbia Slough;
- Residential and occupational inhalation of chemicals volatilizing from TSA water through soil into a residence and workplace environment, respectively;
- Recreational dermal contact with surface water in the Columbia Slough.

For each of these exposure pathways, Central Tendency Exposure (CTE) and reasonable maximum exposure (RME) conditions were used to evaluate potential impacts to human health. CTE and RME intake assumptions from EPA guidance, professional judgment, and data collected from the TSA, the SGA, and the Columbia Slough were used to estimate Chronic Daily Intakes (CDIs) and Lifetime Daily Intakes (LDIs). The results of this Human Health Evaluation are detailed in the 1996 Remedial Investigation.

Ecological Evaluation

Potential impacts to ecological receptors from discharge of TSA groundwater into surface water bodies were also evaluated in the 1996 Remedial Investigation. Cis-1,2-DCE and TCE in Columbia Slough water were identified as the COPCs for ecological receptors. No COPCs were identified for the other surface water bodies evaluated at that time. No TSA-related chemicals were detected in sediments of the Columbia Slough. The COPCs were used to estimate potential adverse ecological effects associated with ingesting water from the slough.

The marsh wren and the common muskrat were selected as the indicator species for assessing ecological impacts based on their size and higher food and water intake rates relative to body weight. The muskrat was also selected because it can ingest bottom-dwelling plants in the slough while foraging. Two sensitive-critical species (i.e., the painted turtle and western pond turtle) were identified in the project area, but were observed only at Fairview Lake, a surface water body that had no detectable levels of VOCs. Details of the Ecological Risk Evaluation can be found in the 1996 Remedial Investigation.

Feasibility Study and DEQ Record of Decision

Pursuant to DEQ Consent Order No. ECSR-NWR-93-7, issued on July 23, 1993, and amended on July 18, 1994, and again on February 9, 1996, Boeing and Cascade completed interim removal measures and

a Remedial Investigation and Feasibility Study regarding the TSA contaminant plume. On September 1, 1996, DEQ provide public notice and opportunity to comment on a proposed remedial action for the TSA contaminant plume. The comment period ended on October 30, 1996.

After consideration of public comments received, DEQ's Director selected the remedial action described in the ROD in a published document dated December 31, 1996.

Remedial Action Objectives

Remedial Action Objectives (RAOs) established in the 1996 ROD and Consent Order, were to facilitate restoration of the TSA to MCL levels within specific timeframes. These RAOs were based on analyses performed for the *Feasibility Study* (Landau Associates and Emcon 1996) and subsequent analyses performed for DEQ (S.S. Papadopoulos Assoc., 1996a and 1996b). The RAOs defined in the ROD include:

- Restore TSA groundwater to protective concentrations (MCLs) within a reasonable time (i.e., 20 years), if feasible. If not feasible, minimize the extent of TSA groundwater with concentrations above the MCL and provide long-term hydraulic containment.
- Prevent ingestion of TSA groundwater that contains COPCs above MCLs.
- Prevent surface water discharge of TSA groundwater with VOC concentrations in excess of surface water cleanup levels.
- Prevent further spread of contamination in the TSA to the extent practicable.
- Protect groundwater quality in the SGA and the BLA; and
- Allow existing uses of groundwater in eastern Multnomah County or minimize type and length of groundwater use restrictions.

Cleanup Levels

Groundwater cleanup goals for the project, or cleanup levels, were set forth in the ROD as the federal (US EPA) drinking water Maximum Contaminant Levels (MCLs), as are as follows:

- TCE: 5 micrograms per liter ($\mu\text{g/L}$);
- PCE: 5 $\mu\text{g/L}$;
- Cis-1,2-DCE: 70 $\mu\text{g/L}$;
- 1,1-DCE: 7 $\mu\text{g/L}$; and
- VC: 2 $\mu\text{g/L}$.

The cleanup goals prescribed in the ROD for the four COPCs in groundwater (TCE, PCE, cis-1,2-DCE and 1,1-DCE) and vinyl chloride (VC), are the National Primary Drinking Water Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act. MCLs are the maximum concentrations of contaminants allowed in water used for drinking. Oregon has adopted these federal standards as our state drinking water regulations (OAR Chapter 333 Division 61). The current MCLs for the COPCs are listed above and their corresponding risk levels are listed on Table 6-1 of the ROD (Table 5, this document). The risk levels presented in ROD Table 6-1, were estimated using EPA residential exposure assumptions for ingestion of and dermal contact with drinking water. Cleanup of the TSA to the TCE MCL, has reduced the concentration of the other COPC chemicals to well below their respective MCLs. Cleanup levels for surface water were set at the Ambient Water Quality Criteria for individual contaminants, which are higher than concentrations detected in groundwater. Therefore, the ROD concluded that future groundwater discharges to surface water would not cause an exceedance of surface water criteria provided that MCLs are met. TCE was determined to be the predominant contaminant of concern and continues to be utilized as the key COPC to evaluate the effectiveness of the remedy. Given that the impacted aquifers are oxygen-rich (aerobic), there are limited breakdown products found in groundwater of surface water attributable to reductive dechlorination.

Remedial Actions

The remedial action timeline for TSA Zone A and the SGA is presented in Table B-1 of this memo and is discussed below.

Installation of groundwater monitoring wells and Interim Remedial Action Measures (IRAMs) were completed in the TGA and the TSA at both the Boeing and Cascade properties following initial discovery of TCE in groundwater. Groundwater cleanup began in the TGA in 1989 at both Boeing and Cascade under separate Consent Orders. Cleanup of TGA groundwater is ongoing at the Boeing facility (ECSI #13) and was completed at the Cascade facility (ECSI #635) where a Certificate of Completion was issued in January 2015 (DEQ, 2015). IRAMs included source control measures in the TGA and closure of industrial water supply wells in the TSA. In 1993, TSA groundwater extraction using pump and treat methods was commenced as an IRAM in the northern-most portion of the EMC Site plume (remedial pumping “RPW” wells). In 1997, installation of extraction wells and the Central Treatment System were completed in the TSA mound area (Emcon 1997). The EMC Site Remedial Investigation and Feasibility Study reports were published in 1995 and 1996 (Emcon and Landau 1995; Landau and Emcon, 1996), followed by selection of the remedial action (groundwater containment, pump and treat) described in the ROD (DEQ 1996) and Consent Order (DEQ 1997).

Six original groundwater extraction pump and treatments systems were installed within the Locality of Facility between 1993 to 2000 as shown in Figures 3, 4, and 5. Two of these original groundwater extraction pump and treatments systems were installed in Zone A and were served by seven Zone A extraction wells. A summary of the Zone A systems is provided below. Generally, the extraction wells were shut down in accordance with the project Remedy Performance Criteria. Only the Central Groundwater Treatment System in Remedy Zone C remains in operation today.

- Zone A. North Treatment System (Figures 3, 4, and 5): Began pilot testing in 1993 with full-scale operation starting in 1997 with one Upper TSA extraction well (EW-9), 5 Lower TSA extraction wells (EW-6, -7, -9, -19, and RPW-2), and one SGA extraction well (EW-20). Extraction wells were shut down and decommissioned in phases, and the treatment system was shut down in 2006 with DEQ approval (DEQ 2006) based on TCE concentrations below the cleanup level. In Zone A, the historical maximum TCE concentrations were 64 µg/L (EW-10) in the TSA (Upper and Lower TSA) and 29 µg/L in the SGA (EW-20). All other COPC results were below the respective MCLs for the North Treatment System extraction wells.
- Zone A. Far North Treatment System (Figures 3 and 4): Installed as a stand-alone system with one Lower TSA extraction well EW-17. The system operated from 1998 to 2003 and was decommissioned with DEQ approval in 2007 because TCE concentrations were consistently below the cleanup level for the prior 2 years. All other COPC results were below the respective MCLs for the Far North Treatment System extraction well. Extraction well EW-17 was located adjacent to the PWB-1 nested well set.

Currently, only the Central Treatment System (Fig. 4) remains operational with four operating groundwater extraction wells in Remedy Zone C, including EW-1 (in temporary shutdown mode), EW-2, EW-14, and EW-23. These four extraction wells are screened within and pump groundwater from the Lower TSA. In 2018, the Central Treatment System removed approximately 1.3 pounds of VOCs from groundwater. However, the total lifespan VOCs removed from groundwater between 1997 to 2018 is 494 pounds. The pumped extraction wells also provide hydraulic containment of the dissolved VOC plume, which is a requirement of the ROD.

In 2015, a soil vapor extraction (SVE) system was added to the Central Treatment System mound area to enhance removal of VOCs in the vadose zone. The system was expanded in 2016, in 2019, and again in 2021, with additional expansion being considered where TCE concentrations in groundwater remain above the cleanup level. By the end of 2018, approximately 60 pounds of VOCs had been removed as soil vapor. The current SVE wells are shown in Figure 3.

Restoration Progress

Cleanup goals have been met in the Zone A TSA aquifer, and in the SGA throughout the EMC Site.

Monitoring Network Criteria

The ROD establishes criteria for the remedy well network, including extraction and monitoring wells. In broad terms, the remedy well network provides hydraulic control of the plume and provides information on restoration progress and hydraulic control. The specific criteria established in the 2005 Annual Report (Landau Associates, Prowell Environmental, Pegasus Geoscience 2006), and used thereafter for evaluating changes to the remedy well network is provided in Table 2 and include criteria for shutting down extraction wells, modifying the monitoring well network, and criteria for well decommissioning. Extraction and monitoring wells are removed where: 1) contaminant concentrations have repeatedly been shown to be below the cleanup levels (MCLs); and 2) well locations no longer provide useful information for evaluating restoration progress or hydraulic control (i.e., well locations are redundant).

Remedial Zone A Status

The 2020 Annual Performance Report (Geosyntec, Landau Associates, and SSPA, 2021) describes remedy progress and summarizes the status of each restoration zone. Restoration goals for the Zone A TSA and the whole site SGA have been attained.

SGA – Whole Site

- Cleanup goals were met, and restoration of the SGA was achieved by 2007. As SGA groundwater quality met the MCL and the established well network criteria (Table 2), DEQ approved the decommissioning of all wells in the SGA. Out of the 24 SGA wells incorporated into the EMC Site, only one SGA well, BOP-44(usg), remains. This well has been used as part of the PWB Contingency Monitoring Plan, and DEQ approved decommissioning of BOP-44(usg) in 2018 (DEQ 2018a) since concentrations of TCE were below the cleanup level from 1997 through 2013. All COPCs were uniformly below detection limits in BOP-44(usg) during this 16-year period.

Zone A – Troutdale Sandstone Aquifer

- Four TSA wells remain in the EMC Site well network in Zone A for use during PWB contingency monitoring, but these wells are no longer monitored as part of the EMC Remedy performance evaluation, since TCE concentrations were consistently below the MCL in Remedy Zone A and met the remedy performance and monitoring criteria. PWB Contingency monitoring wells in Zone A were monitored during the 2018 and 2019 PWB CSSWF pumping events, and TCE was not detected. Groundwater flow directions did not change significantly in the TSA wells monitored during the 2018 and 2019 PWB CSSWF pumping events.
- PWB monitors several groundwater monitoring wells in Zone A as part of the CSSWF monitoring program. Four PWB wells were also utilized for EMC Site monitoring purposes during the early phases of the investigation; however only two wells, PWB-1 (well cluster with wells screened in the Upper TSA, Lower TSA, and SGA) and PWB-2 (two wells screened in the Lower TSA and SGA) were monitored for the EMC Site during full-scale remediation operation. At Upper TSA well PWB-1(uts), TCE concentrations decreased from the maximum concentration of 49 µg/L

(1994) to below the MCL in 2000, and then consistently to non-detect at the laboratory reporting limit from 2004 to 2015 when the well was removed from the EMC monitoring program with DEQ's approval. In the past few years, TCE has been detected in well PWB-1(uts), with the most recent detection of 1.49 µg/L in November 2021.

- PWB well PWB-1(lts), screened in the Lower TSA, had a maximum TCE concentration of 42 µg/L in 1997. The TCE concentration in this well decreased to below the MCL in 1998. In the past few years, low-level TCE concentrations, ranging from 1 µg/L to 2.45 µg/L (May 2021), have been detected. The most recent TCE concentration data available for this well is 2.33 µg/L (Nov. 2021). The low-level concentrations are less than half of the MCL (5 µg/L) and appear to be generally isolated to PWB-1(lts). TCE concentrations in EMC Site wells located closer to the dissolved plume are non-detect at the laboratory reporting limit (0.2 to 1.0 µg/L). To evaluate potential reasons for the low-level concentrations, PWB-1(lts) well construction was compared to other, similar Lower TSA EMC Site wells [i.e., BOP-44(dg)]. Both wells are constructed similarly with schedule 80 polyvinyl chloride well casing and 0.020-ft slot sized screens installed toward the base of the Lower TSA and the top of CU2. However, the bottom of PWB-1(lts) screen interval is directly on top of the contact between the Lower TSA and the underlying CU2, while BOP-44(dg) is approximately 2 feet above the contact. In addition, a step-down in drilling casing was utilized during drilling of BOP-44(dg) to minimize the potential of downward migration of impacted material during drilling from the upper CU1 to the underlying Upper TSA but does not appear to have been conducted at PWB-1(lts). The PWB continues to monitor PWB-1(lts) and other vicinity wells as part of their groundwater monitoring network.
- Groundwater restoration has been achieved in Zone A for the Upper TSA, Lower TSA, and for the underlying SGA throughout the entire site. EMC Site wells that currently remain in Zone A include one Upper TSA well, BOP-44(ds), two Lower TSA wells BOP-44(dg) and EMC-2(dg), and one SGA well BOP-44(usg). PWB continues to monitor several of their wells located in Zone A, including PWB-1lts, PWB-1uts, PWB-1usg, and PWB-2lts.

5. RISK EVALUATION

This section describes the risk conceptual site model, sources of contamination, and pertinent receptors and pathways that were determined for the EMC Site. An Endangerment Assessment is summarized in Section 3 of this document.

Risk Conceptual Site Model

Potential human and ecological exposures were evaluated as part of the Endangerment Assessment completed in the RI (Emcon and Landau 1995) and summarized in the ROD. Potentially complete exposure pathways evaluated included occupational exposures to TSA groundwater, residential exposures to TSA and SGA groundwater, and residential and recreational exposures to groundwater discharges into the Columbia Slough. In 1996, risk estimates for cancer and non-cancer endpoints, with TCE as the primary COPC, ranged from 4.0×10^{-5} to 4.8×10^{-6} for the TSA and 3.4×10^{-6} to 4.6×10^{-7} for the SGA, as summarized in the ROD. For ecological receptors, discharge of groundwater to surface water in the Columbia Slough was evaluated, with the marsh wren and muskrat as key indicator species. Results of the ecological risk evaluation indicated that these receptors were not expected to be impacted by COPCs in the Columbia Slough.

Volatilization of contaminants from groundwater to residential receptors, including inhalation (along with ingestion and dermal contact), was evaluated as part of the Endangerment Assessment in the ROD. The cleanup levels established in the ROD were selected to be protective for groundwater exposures. For human health, these were selected as the federal drinking water MCLs and for ecological receptors as the Ambient Water Quality Criteria (as described in Section 4.3). These two potentially complete pathways were considered for the Remedy Zone A CNFA.

Sources of contamination

TCE was released into the environment at both the Cascade and Boeing facilities and adversely affected the near-surface TGA aquifer. The primary source of contamination to the deeper TSA aquifer is the downward migration of contaminated groundwater from the overlying TGA. Potential migration pathways from the TGA to the TSA included spring infiltration, seeps, and vertical leakage along well casings of former water supply wells, leakage through the confining layer (CU1), and lateral flow across the TGA and underlying CU1 erosional truncation.

The primary source of contamination to the underlying SGA was likely leakage along well casings completed through the confining layer (CU2) separating the TSA and the SGA.

In EMC TSA Remedy Zone A, the primary source of contamination in this area north (downgradient) of the source area is groundwater migration (advective transport) via lateral flow in the TSA and the SGA along regional flow paths and gradients.

Pertinent Pathways and Receptors in Zone A TSA and the SGA

Of the COPCs identified during early investigations in the EMC Site, TCE was the compound most detected by mass in the dissolved VOC plume. During the early phase of the remedy, the maximum TCE concentration reported in the SGA was 59 µg/L (DEQ-3(i)) and 68 µg/L (EW-10) in the TSA Zone A wells. The table below provides a summary of TCE concentrations in the SGA and the TSA in Zone A. Time versus concentration plots for select SGA and Zone A, TSA wells are included as Figures C-1 and C-2.

TCE concentrations in the SGA and the TSA in Zone A

Aquifer/ Zone	No of Wells	No. Samples	Maximum TCE Concentration (µg/L)	Minimum TCE Concentration (µg/L)	MCL for TCE (µg/L)	No. TCE Detects Above MCL (1986-2012)	No. TCE Detects Above MCL (2013-2018)
SGA	24	631	59	<0.2	5	59	0
TSA Zone A	38	1429	68	<0.2	5	661	4
BLA	9		0.3	<0.2	5	0	Not applicable

Columbia South Shore Wellfield

The SGA, the BLA, and the TSA provide groundwater for the PWB CSSWF. Most of the EMC Site is located within the CSSWF Wellhead Protection Area and is located upgradient of several CSSWF municipal wells. Based on the proximity of the EMC Site to the CSSWF, DEQ and PWB have an interagency agreement in which PWB can provide comments and recommendations on the EMC Site remedy progress to DEQ, while also keeping DEQ informed of wellfield operations. This interactive process has been used to develop and refine this Staff Memorandum.

Typically, the CSSWF is only operated for maintenance purposes or to augment municipal water normally sourced from the Bull Run Reservoir system, which is located 16 miles east of the CSSWF. The CSSWF can produce 110 million gallons a day (mgd) from aquifers to provide drinking water to the greater Portland area. During large volume pumping of the CSSWF, groundwater elevations in some EMC wells can decline from 10 to 40 feet, based on the duration of the PWB pumping event, the CSSWF wells that are selected to operate during the event, and the extraction rate and depth of the CSSWF individual production wells. During active operation of the CSSWF, hydraulic capture of the dissolved VOC plume is maintained in the mound area, although water levels can decrease temporarily in Zone A of the EMC Site.

Cascade Wellfield

The City of Gresham and the Rockwood Public Utility District utilize groundwater from an area known as the Cascade Wellfield. Both of these municipal water providers plan to utilize additional groundwater from the SGA aquifer in the future. The northern boundary of the Cascade Wellfield is about 1,900 feet south of Zone A. Groundwater wellfield managers from the City of Gresham and the Rockwood Public Utility District were contacted for review and comment on this Staff report. See public comments appended to this memo.

6. BOEING/CASCADE REQUEST FOR CONDITIONAL NFA, INPUT FROM PWB

In April 2020, Boeing and Cascade submitted a request to the Oregon Department of Environmental Quality (DEQ) for a Conditional NFA (CNFA) at the EMC Site. The CNFA would apply to groundwater contamination in Zone A of the Troutdale Sandstone Aquifer (TSA) and to the entire project area Sand and Gravel Aquifer (SGA) (Landau and Geosyntec, 2020). The technical basis for this request was provided in the following document: *Partial No Further Action Request, East Multnomah County Troutdale Sandstone Aquifer Remedy, Zone A and SGA, ECSI 1479*.

This document was shared with the City of Portland Water Bureau (PWB) consistent with the DEQ-PWB inter-governmental agreement for the CSSWF. On July 3, 2020, GSI Water Solutions provided a response on behalf of the PWB (*Peer Review of the Boeing Company and Cascade Corporation Request for a Partial No Further Action Determination at the East Multnomah County Site*). While taking issue with a number of technical elements of the Boeing/Cascade CNFA request, including TCE trend analysis for Zone A of the TSA, the City indicated the following in Section 3, Conclusions and Recommendations of the document:

“The EMC Site appears to meet the RAOs for the SGA; therefore, the SGA has met the conditions for a partial NFA determination from DEQ. Zone A of the TSA does not appear to be a candidate for a partial NFA because while Zone A of the TSA currently meets most RAOs, there is considerable uncertainty about whether Zone A of the TSA will continue to meet RAOs because of rising TCE concentrations in monitoring well cluster PWB-1.”

The PWB analysis concluded with the following: *“A CNFA, conditioned on continued groundwater quality monitoring in Zone A of the TSA, would be appropriate for the EMC Site because it would mitigate the uncertainty of about whether RAOs will continue to be met in Zone A of the TSA in the future. We further point out that, based on our application of the EPA (2014) guidance for evaluating whether restoration goals have been met, additional monitoring is recommended.”*

On August 20, 2020, DEQ provided comments via email to Boeing and Cascade on a number of documents related to the NFA request for Zone A of the TSA and the SGA, including the peer review comments from the PWB.

On behalf of Boeing and Cascade, a memorandum responding to DEQ and PWB comments was submitted to DEQ on February 16, 2021, entitled *Response to DEQ and PWB Comments received on 08.20.20 on EMC TSA Remedy Documents*; Geosyntec and Landau Associates. Their response included the following:

“While some increasing concentrations at PWB-1(lts) have been detected, they are anomalous, as no other wells, including those closer to the remaining EMC TCE plume, show TCE increases. TCE was not detected in the remaining three TSA wells in Zone A over the last decade (see Figures C-1 and C-2 of this Partial NFA request; provided in this memo as attachments). It is important to note that one well should not be used to evaluate trends for the entire aquifer zone where many wells are present and TCE is not detected.”

DEQ Analysis. The Portland Water Bureau has expressed comfort with the Boeing/Cascade request for a NFA determination for the SGA but continues to have concerns about DEQ’s issuance of a Conditional NFA for Zone A of the TSA, based on ongoing detections of TCE in nested monitoring wells PWB-1(uts) and PWB-1(lts) (see data Table 4 of this Memo). There is disagreement between Boeing/Cascade and the PWB as to whether changes in TCE concentrations in the well are statistically significant using the Mann-Kendall (M-K) statistical test and if they predict a future exceedance of the TCE MCL at the PWB-1 well set. The M-K test is a tool commonly used to analyze data collected over time to identify increasing or decreasing trends.

Each of the documents outlined above was reviewed by DEQ and considered in preparation of this revised CNFA Staff Memorandum. As discussed in the following section, DEQ has determined that there is an adequate technical basis for proceeding with a CNFA determination for Zone A of the TSA and the full SGA at the EMC Site, but that monitoring of the PWB-1 well cluster should continue annual sampling, for a minimum five additional years, to confirm that TCE concentrations do not exceed MCLs within the TSA. DEQ will consider an increase in TCE concentrations at the PWB-1 TSA wells exceeding 5 µg/L to be a change in site conditions, requiring a reevaluation of the CNFA determination.

7. CONCLUSIONS AND RECOMMENDATIONS

DEQ has determined that remedial action objectives specified in the 1996 ROD for the EMC project have been met, with groundwater contaminant concentrations within Zone A of the TSA and the entirety of the project-area SGA having achieved protective standards. Specifically, contaminant concentrations in groundwater as sampled via project monitoring wells within the subject area are either not detectable or are below EPA drinking water standards (MCLs), which are also the 1996 ROD Cleanup Goals.

As discussed in Section 4 of this memorandum, EMC-related contaminants have not been detected in deeper SGA wells and monitoring has generally been discontinued as approved by DEQ and the Portland Water Bureau. No additional monitoring is required by DEQ within this deeper aquifer, and we are comfortable with issuance of a NFA determination for the deeper SGA aquifer for the whole EMC Site. The Portland Water Bureau concurs with this decision.

Monitoring of groundwater within and downgradient of Zone A of the TSA has largely been discontinued based on an absence of contaminant detections exceeding cleanup requirements, over many years. Groundwater monitoring has continued at the Portland Water Bureau, PWB-1 well cluster located downgradient of the EMC release area in Zone A. See tabulated groundwater quality data from the PWB-1(uts) and (lts) well set in attached Table 4.

Monitoring well PWB-1(uts) is completed within the upper TSA aquifer. This well contained groundwater exceeding the TCE cleanup level of 5.0 ug/L from August 1992 until August 1999. Since February 2000, the TCE concentrations from groundwater collected from PWB-1(uts) has been below the TCE cleanup level of 5.0 ug/L, with 1.49 ug/L TCE most recently detected in November 2021.

Monitoring well PWB-1(lts) is completed within the lower TSA. Well PWB-1(lts) contained water exceeding the TCE MCL from August 1992 to February 1998 (with a maximum detection of 42 ug/L in August 1997). Since August 1998, TCE concentrations have been below the 5.0 ug/L MCL, with other HVOCs (including degradation products) not detected. No TCE concentrations exceeding lab reporting limits were generally found from August 1998 through October 2003. Since 2004, TCE was detected in PWB-1(lts), fluctuating over this period from 1.0 ug/L to 2.45 ug/L in May 2021. In November 2021, PWB-1(lts) contained 2.33 ug/L TCE. DEQ has determined that these data are reasonably stable and that the current TCE concentration less than half of the project remediation goal and meets DEQ's closure criteria.

The Institutional Controls, specified in the ROD, including groundwater use restrictions related to the Zone A TSA and the SGA for the whole EMC Site, will be lifted once this CNFA/NFA has been approved. DEQ will continue to coordinate with the Oregon Department of Water Resources however, to ensure that DEQ has a role in new well installation permits and water right applications in the project area SGA and the Zone A TSA aquifer.

Given Portland Water Bureau concerns about TCE trends at the PWB-1 well cluster, and the importance of the TSA and SGA as a supplemental drinking water resource for the Portland metropolitan area, DEQ will require that monitoring of PWB-1(lts) and PWB-1(uts) be continued for a period of five years after issuance of the CNFA decision to confirm that contaminant concentrations remain below MCLs, consistent with DEQ's ROD. Monitoring shall be completed on at least an annual basis. If monitoring is not completed by the Portland Water Bureau as part of ongoing activities within the CSSWF, it will be the responsibility of Boeing/Cascade to complete the work and report the results to DEQ. To be clear, groundwater monitoring at the PWB-1 well cluster will continue *after* DEQ issuance of the CNFA decision. After five years of monitoring and if contaminant concentrations remain below MCLs, DEQ will confirm cessation of monitoring requirements in letter form, after which any monitoring of PWB-1 wells will be the responsibility of the City of Portland. If significant changes in contaminant concentrations *are* observed by DEQ during the monitoring period, we will meet with Boeing/Cascade Corporation and the City to discuss whether any additional actions, including continued monitoring, are necessary. Exceedance of MCLs that are determined to be EMC Site-related could warrant additional action beyond monitoring.

DEQ will also maintain communications with the Portland Water Bureau to ensure timely reporting of groundwater quality data from PWB monitoring and production wells in the vicinity of the EMC project. Monitoring of other EMC Site sentinel wells will continue during times of Portland Water Bureau CSSWF pumping in accordance with the DEQ-approved 2019 Portland Water Bureau, Contingency Monitoring Plan, or DEQ-approved subsequent plans.

The existing remedy requirements shall continue in other areas of the EMC Site (Zones B, C, D) until Consent Order and Record of Decision criteria are met.

This Staff Memorandum proposing and supporting a Conditional NFA for the EMC Remedy Zone A and the SGA was submitted for public review and comment during the month of March 2022. Comments received were reviewed and considered by DEQ prior to a project decision being made.

Following DEQ management approval of the conditional NFA for Zone A TGA and the project area SGA, the remaining four (3 TSA and 1 SGA) wells within Zone A will be decommissioned, as approved by DEQ in 2018. The CNFA determination for Zone A and the SGA will be recorded in DEQ's ECSI database (ECSI # 1479).

8. ADMINISTRATIVE RECORD

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9. ATTACHMENTS

Tables

- Table 1. EMC TSA Remedy Well Inventory and Construction Details
 Table 2. Remedy Well Network Criteria EMC TSA Remedy

Table B-1. East Multnomah County-TSA and SGA Remedy Timeframe
Table 4. TCE groundwater data for PWB-1 (uts) and (lts), 2007 to 2021
Table 5. Groundwater Cleanup Levels for the TSA (1996 ROD)

Figures

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Figure 9. Upper TSA Aquifer Groundwater Levels Aug. 2018
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Figure C-1. Zone A Select TSA Well – TCE Profiles (Time vs. concentration graph)
Figure C-2. TCE Profiles for Select SGA Well (Time vs. concentration graph)

Appendix

Comments received on draft East Multnomah County Groundwater, ECSI # 1479; Staff Memorandum in support of a Conditional No Further Action Determination for the Zone A TSA/SGA