Memorandum

Date:	16 February 2021
To:	Ken Thiessen, RG, DEQ
From:	Cindy Bartlett, RG, Geosyntec Consultants Christine Kimmel, LHG, Evelyn Ives, P.E., Landau Associates
Cc:	Jason Hegdahl, Cascade Corporation Debbie Taege, The Boeing Company
Subject:	East Multnomah County TSA Groundwater Remedy (ECSI 1479) Response to DEQ and PWB Comments received 08.20.20 on EMC TSA Remedy Documents

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Geosyntec Consultants (Geosyntec) and Landau Associates (LAI) have prepared this memorandum to provide clarification to the Oregon State Department of Environmental Quality (DEQ) in response to their comments and questions received via email on 20 August 2020 regarding the following document s:

- 2019 Annual Performance Report, 1 January 2019 – 31 December 2019, East Multnomah County, Troutdale Sandstone Aquifer Remedy dated 4 May 2020 (2019 Annual Report) (Geosyntec, LAI, SS Papadopulos, 2020). Partial No Further Action Request, East Multnomah County Troutdale Sandstone Aquifer Remedy, Zone A and SGA, dated 23 April 2020 (Geosyntec and LAI, 2020).

- 2019 Annual Progress & Performance Report, Troutdale Gravel Aquifer, Boeing Portland Facility, dated 12 March 2020 (Landau Associates 2020).

- Peer Review of Boeing Company and Cascade Corporation Request for a Partial No Further Action Determination at the East Multnomah County Site (GSI 2020).

The 2019 Annual Report and Partial No Further Action Request (Partial NFA) were submitted to the DEQ as part of the East Multnomah County Troutdale Sandstone Aquifer (EMC TSA) remedy being conducted jointly by Cascade Corporation (Cascade) and The Boeing Company (Boeing). The EMC TSA remedy is being implemented under the DEQ Consent Order No. WMCSR-NWR-96-08 (DEQ, 1997). PWB reviewed the document as part of the interagency agreement.

The EMC 2019 TSA Annual Report provided a comprehensive evaluation of groundwater, water level, soil vapor data; groundwater remedy and soil vapor extraction (SVE) performance data; overall remedy performance; and provided recommendations for changes in the monitoring network, including well decommissionings.

The 2019 Annual Progress and Performance Report was submitted to the DEQ as part of the Boeing remediation of the Troutdale Gravel Aquifer (TGA) which is being conducted under DEQ Order on Consent No. NWR-04-12(h) (DEQ 2008).

The Partial NFA was submitted to DEQ to request administrative closure for the Zone A and SGA portions of the EMC Remedy. The Partial NFA request was based on achievement of Remedial Action Objectives (RAOs) outlined in the 1996 Record of Decision (ROD; DEQ, 1996), including but not limited to: successful groundwater remediation of both Zone A and SGA groundwater and compliance with EMC Remedy cleanup criteria, which is the maximum contaminant limit (MCL) of 5 micrograms per liter (mg/L) for trichloroethene (TCE). Results of long-term monitoring indicate TCE concentrations have been consistently below the MCL and at or near the laboratory detection limits in Zone A and SGA wells.

Our response and clarifications are summarized below and have been grouped by DEQ's and PWB's comments, which are provided in bold and italic font.

DEQ Comments

1. ***GSI on behalf of the PWB, brings up several important points in its review (attached) of the proposed TSA Remedy Zone A Closure Proposal which generally have to do with the increasing TCE concentrations at PWB-1(lts) and PWB-1(uts). The TCE concentrations remain below the MCL but have been detectible/increasing since about 2010 and the increasing trend appears to be significant. DEQ needs to consider if a remedy is protective going forward. As well, the proposal seeks to remove the restriction for groundwater use from the TSA in Zone A, and from the SGA within the Locality of Facility. Future unrestricted TSA and SGA groundwater use would need to meet DEQ's Risk-Based Concentrations for TCE of 0.49 ug/L (residential, ingestion), and other contaminants as applicable. The DEQ RBC requirements are more stringent than the MCLs prescribed in the project ROD.***

The EMC TSA Remedy team collected data at PWB-1lts and PWB-1uts in 2019, which were not presented in GSI's statistical evaluation. Data were provided to ODEQ in the EMC 2019 Annual Report and are summarized in Table 1 of this memorandum. Between 2018 and 2019, TCE concentrations at PWB-1uts and PWB-1lts show a decrease from approximately 2 ug/L in 2018 to

approximately 1.5 ug/l for three 2019 monitoring events (Table 1 and Figure 1). TCE data from at this well between 1992 and 2019 are also summarized in Table 1 and Figure 1.

PWB prepared a Mann-Kendall evaluation using their data for PWB-1lts and noted a *statistically significant* increasing trend in TCE concentrations. The EMC data set for PWB-1lts includes the 2019 data, and we utilized these data to complete an independent Mann-Kendall statistical test for the results from 2009-2019. The results of the Mann-Kendall with the larger data set do not indicate a *statistically significant increasing* trend. This data set indicates a stable trend based on a Coefficient of Variation (COV) less than one (COV = 0.2 in both the EMC and GSI Mann-Kendall evaluations). We request that GSI rerun the statistics using the additional data from 2019, because the significant trend is the basis for future concern or use the Mann-Kendall results presented herein. Results of the EMC Mann-Kendall test are provided in Attachment 1.

While some increasing concentrations at PWB-1lts 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 the Partial NFA request; attached here in Attachment 2). 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.

Monitoring well PWB-1lts is a sentinel well that provides sentinel groundwater monitoring for 25 well Columbia South Shore Well Field (CSSWF) that, when used, are pumped to the Powell Butte Underground Reservoirs before distributed for public consumption. The Powell Butte Underground Reservoirs store about 10 billion gallons of water, of which the majority is sourced from Bull Run Watershed. Given that the water from the CSSWF is mixed together to provide a drinking water source before used at the tap, the residential RBC for ingestion should not be applied at PWB-1lts itself. An RBC represents potential human health risk based on exposure pathways including ingestion, inhalation, and dermal exposure to tap water. Evaluating individual well groundwater results to tap water utilization would require the application of many factors to evaluate potential risk/exposure, such as groundwater transport, TCE retardation, aquifer water blending, and volatilization in conveyance piping. For these reasons, the residential RBC of 0.49 ug/L is not appropriate for groundwater at PWB-1lts. The TCE cleanup level specified in the ROD for the EMC Remedy is the MCL of 5 ug/L and should be used in consideration of Site Closure.

2. ***As well, I have reviewed the 2019 Boeing Troutdale Gravel Aquifer Annual Report. Extraction well, E-13, maintains drawdown and provides hydraulic capture of an area of the unconfined TGA aquifer north of the Boeing property. Extraction well, E-13 is located approximately 2300 feet southwest of the PWB-1 well set. Quarterly groundwater quality data from E-13 in 2019 ranged from 8.1 to 10.0 ug/L for TCE (the ROD project cleanup goal is the MCL = 5 ug/L). The stratigraphic model for the Portland basin indicates a confining unit separates the TGA from the TSA aquifers. In the eastern portion of the Portland Basin, this confining unit may be thin, transmissive, or***

inconsistent and may represent a pathway for vertical transmission of contaminants from the TGA to the TSA, especially in areas of TSA pumping wells. Has TCE from the TGA been considered as a source to the TSA well set at PWB-1?

We would like to correct a few items in this comment. The Boeing TGA is not a current source of TCE to the TSA. The confining unit between the overlying TGA and the underlying TSA is present underneath Boeing's property and near extraction well E-13. The erosional truncation of the TGA and the confining unit occurs further to the east, near wells BOP-44(ds, dg, usg), as shown in geologic cross section in Figure 2 (see also Figure 3 of Partial NFA request, where the approximate extent of the truncation is depicted). TGA groundwater under Boeing's property flows towards the west- northwest and therefore, the well cluster PWB-1, which is located approximately 2,300 feet northeast of E-13, is cross-gradient rather than downgradient of the Boeing TGA. Extraction well E-13, located near the northern extent of the Boeing TGA dissolved plume, has consistently operated between 35 and 150 gallons per minute (gpm) to provide hydraulic capture since the well was installed in 1994.

Furthermore, TCE concentrations between TGA extraction well E-13 and TSA well PWB-1lts at TGA well BOP-10i, along with Upper TSA wells BOP-44ds and PWB-1uts, are below the laboratory reporting limits.

The potential for TCE impacted groundwater near E-13 to be a potential source of low-level TCE concentrations observed at PWB-1 is considered extremely low.

3. ***In general, I am supportive of the recommendations for well abandonments and monitoring/scheduling modifications presented in Section 6.0 of the attached EMC TSA 2019 Annual Report. However, the TCE trend at PWB-1(lts) and PWB-1(uts) must continue to be tracked until a steady-state condition is reached. Most of the TSA well abandonments proposed are approximately 3600 feet from the PWB-1 well set and appear to fit the project criteria for abandonment.***

Based on 2009 to 2019 data from PWB-1lts, a stable trend has been reached around 1.5 ug/L. Based on PWB's 2021 sampling schedule, they will continue to monitor PWB-1lts (and PWB-1uts/usg wells) on an annual basis (DEQ 2019).

Regarding well decommissioning, we agree that the remaining 4 wells in Zone A requested for decommissioning meet the EMC TSA remedy criteria for well abandonment, because TCE has not been detected since 2003 (EMC-2dg), 2008 (BOP-44ds), 2011 (BOP-44dg), and not at all at since 1997 at BOP-44usg (see Table 3 of Partial NFA request).

4. ***If monitoring/sampling of PWB-1(lts) and PWB-1(uts) is omitted from the East Multnomah County TSA remedy project as requested, will the PWB continue to perform this work?***

We understand PWB will continue to monitor the PWB well cluster on an annual basis as part of their Columbia Southshore Monitoring Program, based on the schedule from PWB forwarded to us by DEQ on 12/18/19 (DEQ 2019). The EMC TSA remedy PWB Contingency Monitoring sentinel wells in will continue to be monitored during PWB pumping events and the regular monitoring schedule laid out in the 2019 Annual Report.

PWB/GSI Comments

1. ***2.1 RAO(a): Meet Cleanup Levels. Page 2, middle of 2nd paragraph. "While the 1x10-6 excess cancer risk cleanup levels do not impact the partial NFA decision for the SGA and Zone A of the TSA, we mention the omission here because 1x10-6 cancer risk cleanup levels may impact future NFA decisions for other parts of the Site."***

We agree that the excess cancer risk level of $1x10^{-6}$ has been met for the SGA and Zone A, in addition to the MCLs. This was not included in the Partial NFA for simplification, and we agree it is an important consideration for future NFA decisions, in particular where TCE is still detected (i.e. Zones B and C). This risk level will be fully considered for these other portions of the EMC Site.

2. ***2.1.1: Evaluation of Whether TCE Currently Meets RAO(a). Page 4, first paragraph: "It is important to note that the partial NFA request prepared by Geosyntec and Landau (2020) does not include data from the PWB-1 well cluster because the wells were removed from the EMC Site sampling network in 2013."***

The Partial NFA does discuss data from the PWB well cluster on page 17 and provides data in Table 3 for these wells through 2015 at which time PWB_1lts was changed from annual to biennial monitoring. However, DEQ requested additional sampling in their 2017 Annual Report approval/response due to the detections at PWB-1lts (DEQ, 2018), and sampling was completed in 2017, 2018, and 2019 due to as part of PWB Contingency Monitoring, and these data were provided in respective EMC TSA annual reports. The data are also included in Table 1 and Figure 1 of this letter.

3. ***2.1.2: Evaluation of Whether TCE Will Meet RAO(a) in the Future. Page 4, First paragraph. "It is important to note that there is uncertainty as to whether VOC concentrations in Zone A of the TSA will continue to meet RAO(a) due to increasing trends in TCE concentrations at monitoring well cluster PWB-1."***

As mentioned previously, additional data collected in 2019 indicate that TCE concentrations at PWB-1lts declined to around 1.5 ug/L from 2.04 ug/L in 2018. All other EMC wells located in Remedy Zone A were below the TCE laboratory reporting limit. The use of one well to represent an entire zone (Remedy Zone A) is misleading and not representative of the aquifer. Furthermore,

TCE is detected at well PWB-1lts at less than half of the cleanup leave (MCL), which was determined in the ROD as a protective cleanup level for the EMC project.

The comment over the remedy uncertainty to meet RAO goals in the future is not merited, as remedy and groundwater monitoring will continue in areas of the EMC where TCE concentrations remain above the MCL. The partial zone closure was requested for Zone A after years of monitoring with concentrations below the MCL and the reporting limits. Based on groundwater flux and lack of TCE detections in Zone A and surrounding TSA groundwater monitoring wells, TCE concentrations at PWB-1lts are anticipated to continue to remain below the cleanup level under natural attenuation processes.

Clarification for data presented in PWB's Figure 1 is needed (or a title change), since it includes only two wells from Zone A, and select extraction well and treatment system shutdown information from Zone A, Zone B, and Zone C. A table summarizing the extraction well shutdown and decommission dates is provided as Table 2, since some of the dates in PWB's Figure 1 are incorrect (e.g. EW-17 was pilot shutdown in November 2003). In addition, the PWB-provided data table is incomplete and does not report data from 2019 data for PBW-1lts (three sets of data) or PWB-1uts (2 sets of data), as stated earlier and provided in Table 1.

4. ***Page 5, first bullet. "We evaluated TCE concentration increases since 2009, which is when EW-15 was shut-down. As such, the evaluation was based on 11 TCE concentrations from PWB-1(lts). EPA (2014) requires that at least 8 data points are used when evaluating attainment. A nonparametric Mann-Kendall trend test was performed at the 95% confidence interval to evaluate whether there was statistically significant evidence of an increasing trend in TCE concentrations at PWB-1(lts)."***

There are 14 measurements of TCE concentrations from PWB-1lts, which includes the 2019 data. These data are provided in Table 1 and Figure 1, attached.

The EMC Remedy team performed a Mann-Kendall statistical test on the full set of data collected since 2009, which includes 14 measurements rather than 8. These data are provided in Table 1 and Figure 1, attached. The results of the Mann-Kendall test show no *statistically significant* trend at 95% confidence and the COV was less than one, indicating a stable trend (results are provided in Attachment 1). Since the PWB dataset includes PWB's samples collected from approximately the same timeframe as those collected for the EMC Remedy, we request that GSI rerun the Mann-Kendall statistics using their own data along with EMC Remedy data from 2019 to confirm these results, or use the Mann-Kendall results provided herein.

It is important to note that one well should not be used to represent statistics for an entire zone where many wells are present. If PWB is to use Mann-Kendall statistical trends for Remedy Zone A, it would be more appropriate to complete the analysis on all Remedy Zone A wells to fully evaluate aquifer conditions. However, the other Zone A wells do not have detectable TCE concentrations over the same time period (2009-2019; Figures C-1 and C-2 of Partial NFA;

Attachment 2), so this statistical test may be of limited use unless data prior to 2009 are used (i.e. detections). A more qualitative analysis was provided in the Partial NFA request because of the absence of other wells with TCE detections.

5. ***2.1.3: Implications of Future TCE Concentration Increases, Page 4, middle of first paragraph. "Figure 1 shows dates that extraction wells in the TSA were shut down. Only TSA extraction wells located in Zone A and zones located upgradient of Zone A (i.e., Zone B and Zone C) are shown because the shutdown of engineering controls in these zones is most likely to affect TCE concentrations in Zone A, either due to rebound of groundwater elevations or loss of hydraulic capture."***

Phased shutdown of extraction wells has been conducted over the years with DEQ approval once data indicates groundwater quality goals and RAOs have been achieved. Indications of long-term, sustained TCE rebound above the MCL have not been observed at EMC wells located near these phased shutdown extraction wells. This comment appears to regard potential rebound caused by shutdown of additional extraction wells in the future.

PWB's Figure 1 does not include all of the upgradient extraction wells located in Zones B and C, since EW-4, EW-5, and EW-12 are missing. We have attached a summary of the 23 EMC remedy extraction well operational and shutdown dates in Table 2.

TCE concentrations in wells effected by, or downgradient of, extraction wells are used to evaluate rebound following extraction well shutdown. Increases in TCE concentrations have been observed following shutdown of some extraction wells; however, sustained and large-scale rebound has not been observed. We offer here some additional discussion and figures showing TCE concentrations at monitoring wells surrounding extraction wells in each of the Zones to demonstrate how rebound has been observed at some wells following shutdown of extraction wells.

After initial rebound, TCE concentrations decline and stabilize below the MCL in each of the Zones, in particular, at downgradient monitoring wells along the northern portions of Zones B and C (Figures 3 and 4). Water level and TCE concentration rebound following extraction well shutdown continues to be monitored at extraction wells and sentinel, downgradient monitoring wells. Sampling frequency at wells and removal of wells from remedy monitoring occurs in a phased approach over two years, once remedy criteria are met (i.e. TCE concentrations below the MCL for two subsequent years, TCE below the detection limits for two years) (Table 2-1 of EMC TSA Annual Report; Geosyntec et al., 2020).

Zone A

Six extraction wells operated in Zone A, including EW- 6, EW-7, EW-9, EW-17, EW-19, and EW-20(usg). Figures C-1 and C-2 from the Partial NFA show TCE concentrations at remaining Zone A monitoring wells along with the extraction well shutdown dates (Attachment 2).

- Zone A extraction wells were shut down in 2003 and 2006.
- Rebound was not observed in monitoring wells following shutdown, except at well BOP-44ds, where TCE increased above the detection limit for 4 monitoring events in 2007-2008 (Figure C-1).
- TCE increases were not observed in SGA wells (Figure C-2).

Zone B

Four groundwater extraction wells have operated in Zone B, including EW-3, EW-13, EW-22, and EW-23.

- Rebound was not observed following shutdown of extraction wells EW-3 and EW-22 (Figures 3 and 4).
- EW-23 is shown in Figure 5, and it began pumping in January 2007 following shutdown of the North Treatment System (NTS) extraction wells EW-6, EW-7, EW-9, and EW-19, in 2006. EW-23 was installed to focus groundwater remediation in the northeast portion of Zone B at the Zone B/C boundary and to increase flushing at SGA well BOP-69usg, located in Zone A.
- Following shutdown of the NTS pumping wells,
    - increases in TCE concentrations were not observed in Zone A wells or BOP-69usg (Figures C-1 and C-2, Attachment 2), or
    - in two monitoring wells, BOP-21ds/dg, located northwest of EW-23 (Figure 5).
- Increases in TCE concentrations were observed in the eastern portion of Zone B after shutdown of two extractions wells in Zone C, EW-8 and EW-12, in 2007, and EW-13 in 2009 (Figure 6).
    - TCE concentrations varied between 5 and 10 ug/L at two Lower TSA wells, BOP-61ds and BOP-61dg, located northeast of EW-13. By February 2019, TCE concentrations at both of these monitoring wells declined and remained below the MCL.
    - TCE increases of a lesser magnitude (~5 ug/L) were observed at two other wells near EW-13, BOP-65ds and BOP-66ds, but not BOP-42ds/dg (Figure 6).

Zone C

Nine extraction wells have operated in Zone C, EW-1, EW-2, EW-4, EW-5, EW-8, EW-12, EW-14, EW-15, and EW-18, and two (EW-2 and EW-14) continue to pump groundwater.

- In the western portion of Zone C, TCE increases were observed at two extraction wells, EW-8 and EW-12, following shutdown in August and December 2007, respectively, and pulse pumping of EW-1 in 2009 (Figure 7).
    - TCE concentrations at EW-12 increased from 1.4 ug/L in 2009 up to 11 ug/L in 2011, then declined and remained below the MCL by 2013.
    - TCE increases at EW-8, located farther north than EW-12, were less pronounced, and TCE concentrations increased up to 7.8 ug/L in November 2007, then bounced above and below the MCL until TCE declined below the MCL by May 2010.

- EW-1 was pulse pumped in 2009 for 6 months and pilot shutdown in September 2018 and remains in pilot shutdown mode.
    - TCE increases were observed at BOP-13ds, which is within 150 ft of EW-1, following a 6-month pulse pumping of EW-1 in 2009.
    - By February 2013, concentrations at BOP-13ds declined and still remain below the MCL (Figure 7).
    - TCE concentrations at EW-1 have fluctuated since pilot shutdown of pumping, but increases in TCE concentrations have not been observed in nearby monitoring wells BOP-13dg, BOP-31ds/dg, nor BOP-23dg (Figure 7), which are located west/northwest, and north of EW-1 (locations shown in Figures 3 and 4 of Partial NFA, included here in Attachment 2).
- In the central portion of Zone C, north of the mound area,
    - TCE increases were observed at MW-25dg following shutdown of EW-4 and EW-5 in November 2003. TCE concentrations at MW-25dg increased from 0.51 ug/L in August 2005 up to 7.3 ug/L in February 2006, remained above the MCL for 3 sampling events in 2006, then decreased to at/below the MCL through August 2008 when TCE concentrations decreased and remain below the MCL (Figure 8).
    - TCE increases were not observed at downgradient wells CMW-14ds/dg following shutdown of EW-18 in 2009 (Figure 8).

Zone D

Zone D extractions wells included EW-11, EW-16, and EW-21; one other single well extraction system, EW-10 was much farther east and not discussed further herein. A summary of shutdown of Zone D extraction wells and TCE concentrations at downgradient wells in Zone D was provided in the June 2020 CMW-26dg Decommissioning letter (Geosyntec, 2020).

- TCE increases were observed at EW-16 and CMW-26dg following shutdown of EW-16 in 2011, EW-16 was turned back on and operated from 2010 to 2012, and shut off again in 2014 when TCE concentrations again went below remedy criteria.
- TCE increases at EW-16 and CMW-26dg did increase to concentrations at, and slightly over, the MCL (6 µg/L), but TCE concentrations at EW-16 and the 4 other wells in Zone D have remained below the cleanup level (see Figure 4 of CMW-26dg Decommissioning letter in Attachment 2).
- These 4 other extraction and monitoring wells located down- and cross-gradient of CMW-26dg did not show TCE increases or significant TCE detections above the MCL (Figure 4, Attachment 2).
- TCE concentrations in the vicinity of CMW-26dg are anticipated to decline through natural attenuation processes as observed at other Zone D wells. DEQ concurred with decommissioning of this well in 2020 (DEQ, 2020).

In summary, although increases in concentrations after extraction well shutdowns have occurred at some monitoring wells that are in the vicinity of an extraction well or the extraction well itself,

sustained rebound has not been observed. As DEQ indicated, almost 3,600 feet separates PWB-1lts from the leading edge of the EMC TSA dissolved-TCE plume. The EMC TSA Site will continue to monitor wells located between PWB-1lts and the dissolved-TCE plume. Furthermore, engineering controls and hydraulic capture have been in place to contain the dissolved-TCE plume. The EMC team is currently focusing a large effort on and have implemented additional remedy components to treat and accelerate cleanup the remaining areas of the plume above the MCL (i.e. the mound area).

6. ***2.2 "RAO(b): Prevent Ingestion of Groundwater with VOCs above MCLs, last paragraph: On Page 1 of the partial NFA request, Landau and Geosyntec (2020) state that ". . . groundwater use restrictions related to the EMC Site will not remain active for the SGA and Remedy Zone A (of the TSA) once the Partial NFA is determined." Note that TCE concentrations in Zone A of the TSA exceed the DEQ Risk Based Concentration (RBC) for ingestion of tap water under the residential scenario (0.49 micrograms per liter) and urban residential scenario (2.0 micrograms per liter) (DEQ, 2018). Therefore, removal of institutional controls prohibiting groundwater use in Zone A of the TSA may pose a <u>significant</u> threat to human health."*** *(underline added for emphasis)*

The TCE cleanup level specified in the ROD for the EMC Remedy is the MCL of 5 ug/L. The TCE concentrations at PWB-1lts (and PWB-1uts) are below the urban residential RBC of 2.0 ug/L, with one exception (August 2018 at 2.04 ug/L). These RBCs represent potential human health risk to ingestion, inhalation, and dermal exposure to tap water, and the concentrations at the well are unlikely to represent the concentration that would be in tap water due to processes that occur during groundwater transport and mechanical transport of water to the tap.

TCE concentrations at well PWB-1 are below the urban residential tap water RBC and are less than half of the MCL and do not pose a *significant* threat to human health based on these screening levels.

Regarding EMC institutional controls, the SGA and Remedy Zone A TSA are located within the Columbia River South Shore Well Field Protection Area, which has separate and more stringent institutional controls that will remain in-place. In addition, Multnomah County restricts groundwater use and limits installation of any new wells (i.e. private water supply/irrigation). These multiple layers of institutional controls are in effect and will remain in place. Finally, the EMC TSA site will not be removed from the NPL until the entire site meets the RAOs. Removal of the EMC TSA-related institutional controls would only apply to the SGA and Zone A of the TSA Remedy.

7. ***2.3 RAO(c): Protection of Aquatic Receptors.***

Although GSI/PWB did not evaluate this RAO, it is important to note that RAO(c) was met by the time the ROD was issued (DEQ, 1996).

8. ***2.4 RAO(d): Prevent Further Spread of Contamination in the TSA. "While it would be premature to conclude that the statistically significant increases in TCE concentrations indicate the plume is spreading, it is clear that the plume has not yet reached a steady-state condition. In other words, there is uncertainty as to whether Boeing and Cascade have met RAO(d) for the TSA in Zone A. Future groundwater sampling and evaluation of TCE concentration trends from the PWB-1 monitoring well cluster will resolve whether the plume is approaching a new steady-state condition (e.g., due to rebounding water levels as engineering controls are shut off) or whether the plume is spreading (e.g., due to loss of hydraulic capture as engineering controls are shut off)."***

The revised Mann-Kendall evaluation for the EMC data at well PWB-1 indicates the TCE trend is not statistically significant, and a COV less than one indicates a stable trend. Recent data from PWB-1 indicates that steady state has been achieved at almost half the MCL. As stated earlier in this document, results from one well do not indicate a plume is spreading, aquifer rebound, nor that engineering controls or hydraulic capture have failed, in particular where TCE concentrations at other well are below detection limits. TCE concentrations at the four other Zone A Wells have been below detection limits since 2008 (Partial NFA Figure C-1, Attachment 2), during the progressive shutdowns of extraction wells EW-6, EW-7, EW-9, and EW-17 and the North and Far North Treatment Systems. Continued monitoring of these other Zone A wells is not a cost effective way to use EMC Remedy resources.

9. ***2.5 RAO(e): Protect Groundwater Quality. Last sentence: "Therefore, Boeing and Cascade appear to have met RAO(e)."***

Agreed, the EMC Site has achieved RAO(e).

10. ***2.6 RAO(f): Existing Uses of Groundwater Resources, RAO(f) requires that Boeing and Cascade (DEQ, pg. 6-2, 1996): "Allow existing uses of groundwater resources in eastern Multnomah County, or if not feasible, minimize the type and length of groundwater use restrictions."***

RAO(f) does not require groundwater use restrictions, rather the minimization of them. This requirement is currently fulfilled in Zone A since groundwater use near the monitoring well (PWB-1lts) where TCE is detected (below the MCL) could occur with treatment (if required) and thus groundwater use restrictions are minimized. The scenario for use of PWB-1lts as a residential supply well is highly unlikely given the well was designed for monitoring purposes only and the availability of municipal water in the CSSWF. Since TCE is not detected in the other Zone A monitoring wells, groundwater treatment is not needed for TCE in these areas. Removal of the TSA related institutional controls in Zone A as part of the Partial NFA would continue to allow use of groundwater as specified in RAO(f) and eliminate potential deed restrictions/notices. Institutional controls will remain in-place for the remaining remediation zones associated with the EMC remediation project (Zone B, C, and D).

And, first bullet: "While Boeing and Cascade currently meet RAO(f), the statistically significant increases in TCE concentrations in Area A of the TSA may represent early-warning of plume migration and future impairment of groundwater at a City well. Therefore, there is uncertainty as to whether Boeing and Cascade meet RAO(f) in Zone A of the TSA."

As previously stated herein, use of data from 2019 indicate that TCE concentrations are not statistically significantly increasing but rather are stable. Furthermore, use of one well to represent an entire zone is not appropriate. Recent data from PWB-1lts indicates a steady state has been achieved at almost half the MCL. The other Remedy Zone A wells are below the laboratory reporting limits.

11. ***3.2 Recommendations. "It would be more appropriate, in light of the statistically significant increases in TCE concentrations in Zone A of the TSA, to issue a type of partial NFA that is specifically designed to ensure that engineering controls are maintained at an adequate level to ensure RAOs are met in the future."***

The slight increases of TCE concentrations at PWB-1lts are not *statistically significant* when including the data from 2019. Rather, use of these data indicate the TCE concentrations are steady between 1 and 2 ug/L, and this well does not represent Zone A aquifer conditions. A Partial NFA is appropriate for Zone A, as well as the SGA.

And, "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."

Based on PWB's monitoring schedule provided 12/19/19, PWB will be monitoring these wells annually. The EMC TSA Remedy monitoring at sentinel wells in Zones B and C will continue.

Thank you for the detailed review of the 2019 Annual Report and for allowing the opportunity to provide these responses to PWB. We are looking forward to continuing collaboration with DEQ and PWB.

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Attachments:

Table 1: Select VOC Results for PWB-1 Well Cluster, EMC Remedy
Table 2: Summary of EMC Extraction Wells

Figure 1: TCE Concentrations in wells PWB-1lts and PWB-1uts
Figure 2: Cross Section A-A'
Figure 3: TCE Concentrations in Zone B Wells near EW-3
Figure 4: TCE Concentrations in Zone B Wells near EW-22
Figure 5: TCE Concentrations in Zone B and C Wells near EW-23
Figure 6: TCE Concentrations in Zone B and C Wells near EW-13
Figure 7: TCE Concentrations in Zone C Wells near EW-1, EW-8, and EW-12
Figure 8: TCE Concentrations in Zone C Wells near EW-4, EW-5, and EW-18

Attachment 1: Mann-Kendall Results
Attachment 2: Other Figures: Figures 3, 4, C-1 and C-2 from Partial NFA Request. Figure 4 from CMW-26dg Decommissioning Letter.

References:

Geosyntec Consultants, 2020. CMW-26dg Monitoring Well Rehabilitation and Decommissioning Request, East Multnomah County Troutdale Sandstone Aquifer Remediation (ECSI #1479), Fairview, Oregon. 26 June 2020.

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ATTACHMENTS

Table 1
Select VOC Results for PWB-1 Well Cluster
EMC Remedy

Monitoring Well ID	Date Sampled	Trichloroethene (TCE) MCL: 5.0 µg/L	Tetrachloroethene (PCE) MCL: 5.0 µg/L	cis-1,2-Dichloroethene MCL: 70 µg/L	1,1-Dichloroethene MCL: 7.0 µg/L	Vinyl Chloride MCL: 2.0 µg/L	Remedy Zone	Aquifer Zone
PWB-1(lts)	8/14/1992	**5.4**	< 0.50	**0.10**	--	--	Zone A	Lower TSA
PWB-1(lts)	8/20/1992	**5.7**	< 0.50	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	8/27/1992	**5.9**	--	--	--	--	Zone A	Lower TSA
PWB-1(lts)	9/3/1992	**6.5**	< 0.50	< 0.50	--	--	Zone A	Lower TSA
PWB-1(lts)	9/10/1992	**7.9**	< 0.50	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	9/17/1992	**6.8**	< 0.50	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	9/23/1992	**6.4**	**0.10**	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	10/1/1992	**3.7**	< 0.50	**0.20**	--	--	Zone A	Lower TSA
PWB-1(lts)	10/8/1992	**8.4**	< 0.50	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	10/14/1992	**7.8**	< 0.50	**0.30**	--	--	Zone A	Lower TSA
PWB-1(lts)	11/15/1992	**5.9**	--	--	--	--	Zone A	Lower TSA
PWB-1(lts)	11/18/1992	**7.6**	< 0.50	**0.20**	--	--	Zone A	Lower TSA
PWB-1(lts)	3/18/1993	**11**	**0.70**	< 0.50	--	--	Zone A	Lower TSA
PWB-1(lts)	3/18/1993	**8.8**	< 0.50	< 0.50	--	--	Zone A	Lower TSA
PWB-1(lts)	5/11/1993	**8.1**	< 1.0	< 1.0	< 1.0	< 2.0	Zone A	Lower TSA
PWB-1(lts)	12/1/1993	**23**	< 1.0	< 1.0	< 1.0	< 2.0	Zone A	Lower TSA
PWB-1(lts)	3/4/1994	**24**	< 1.0	**1.0**	< 1.0	< 2.0	Zone A	Lower TSA
PWB-1(lts)	7/28/1994	**26 J**	**0.28 J**	**1.1 J**	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	11/28/1995	**26**	**0.20**	**1.0**	--	--	Zone A	Lower TSA
PWB-1(lts)	12/6/1995	**29**	**0.30**	**1.0**	--	--	Zone A	Lower TSA
PWB-1(lts)	12/13/1995	**25**	**0.60**	**1.1**	--	--	Zone A	Lower TSA
PWB-1(lts)	12/22/1995	**35**	**0.50**	< 0.50	--	--	Zone A	Lower TSA
PWB-1(lts)	2/8/1996	**29**	**0.20**	**1.2**	--	--	Zone A	Lower TSA
PWB-1(lts)	2/12/1996	**30**	**0.20**	**1.0**	--	--	Zone A	Lower TSA
PWB-1(lts)	8/29/1996	**31**	**0.40**	**1.0**	--	--	Zone A	Lower TSA
PWB-1(lts)	9/12/1996	**34**	**0.50**	**1.5**	--	--	Zone A	Lower TSA
PWB-1(lts)	9/19/1996	**37**	**0.30**	**1.0**	--	--	Zone A	Lower TSA
PWB-1(lts)	9/26/1996	**41**	**0.80**	**1.3**	--	--	Zone A	Lower TSA
PWB-1(lts)	8/19/1997	**42**	< 1.0	**2.4**	< 1.0	< 2.0	Zone A	Lower TSA
PWB-1(lts)	2/16/1998	**34**	**0.40**	**2.0**	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	8/14/1998	**0.4**	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	2/10/1999	**0.5**	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	8/16/1999	**0.3**	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	2/10/2000	**0.2**	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	8/18/2000	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	2/15/2001	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	8/22/2001	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	Zone A	Lower TSA
PWB-1(lts)	3/13/2002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/12/2002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/13/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/19/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	9/24/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/11/2004	**0.61**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/19/2004	**1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/14/2005	**1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	5/23/2005	**1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/7/2005	**0.97**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/7/2005	**0.97**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	11/8/2005	**0.96**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/9/2006	**1.2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	5/11/2006	**0.94**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/9/2006	**1.1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/9/2006	**1.2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	11/8/2006	**0.95**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/13/2007	**1.2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/8/2007	**0.86**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/11/2008	**0.89**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/17/2009	**0.92**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/11/2010	**1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/11/2011	**1.2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/11/2011	**1.4**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	7/31/2012	**1.7**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	7/31/2012	**1.6**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/21/2013	**1.4**	< 1.0	< 1.0	< 1.0	< 1.0	Zone A	Lower TSA
PWB-1(lts)	8/5/2014	**1.5**	< 1.0	< 1.0	< 1.0	< 1.0	Zone A	Lower TSA
PWB-1(lts)	8/5/2015	**1.6**	< 1.0	< 1.0	< 1.0	< 1.0	Zone A	Lower TSA
PWB-1(lts)	7/2/2018	**1.9**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/24/2018	**2.04**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA

Table 1
Select VOC Results for PWB-1 Well Cluster
EMC Remedy

Monitoring Well ID	Date Sampled	Trichloroethene (TCE) MCL: 5.0 µg/L	Tetrachloroethene (PCE) MCL: 5.0 µg/L	cis-1,2-Dichloroethene MCL: 70 µg/L	1,1-Dichloroethene MCL: 7.0 µg/L	Vinyl Chloride MCL: 2.0 µg/L	Remedy Zone	Aquifer Zone
PWB-1(lts)	9/20/2018	**1.59**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	11/1/2018	**1.82**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	2/6/2019	**1.39**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	8/6/2019	**1.42**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Lower TSA
PWB-1(lts)	9/17/2019	**1.45**	< 0.500	< 0.500	< 0.500	< 0.500	Zone A	Lower TSA
PWB-1(uts)	8/20/1992	**29**	**1.1**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	8/27/1992	**36**	**1.3**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	9/3/1992	**31**	**1.1**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	9/10/1992	**40**	**1.6**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	9/10/1992	**43**	**1.7**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	9/17/1992	**36**	**1.4**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	9/23/1992	**47**	**1.6**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	10/1/1992	**49**	**1.6**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	10/1/1992	**55**	**1.8**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	11/15/1992	**42.3**	**2.3**	--	--	--	Zone A	Upper TSA
PWB-1(uts)	5/11/1993	**49**	**1.5**	**4.7**	< 1.0	< 2.0	Zone A	Upper TSA
PWB-1(uts)	5/11/1993	**55**	**1.9**	**5.2**	< 1.0	< 2.0	Zone A	Upper TSA
PWB-1(uts)	12/1/1993	**56**	**2.4**	**7.5**	< 1.0	< 2.0	Zone A	Upper TSA
PWB-1(uts)	3/4/1994	**49**	**1.6**	**7.0**	< 1.0	< 2.0	Zone A	Upper TSA
PWB-1(uts)	7/28/1994	**49**	**2.0**	**6.6**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	8/19/1997	**48**	**1.2**	**4.6**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	2/16/1998	**11**	**0.60**	**2.9**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	8/14/1998	**38**	**1.3**	**4.6**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	2/10/1999	**14**	**0.60**	**3.0**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	8/16/1999	**14**	**0.60**	**3.2**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	2/10/2000	**4.8**	**0.20**	**0.80**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	8/17/2000	**1.8**	< 0.20	**0.30**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	2/16/2001	**2**	< 0.20	**0.40**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	8/22/2001	**1.6**	< 0.20	**0.30**	< 0.20	< 0.20	Zone A	Upper TSA
PWB-1(uts)	3/13/2002	**2.2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/12/2002	**2.1**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	2/13/2003	**2**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/19/2003	**1.4**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	2/11/2004	**0.63**	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/19/2004	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	2/14/2005	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/7/2005	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	2/9/2006	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/9/2006	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/8/2007	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/11/2008	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/13/2009	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/10/2010	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/10/2011	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/20/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	Zone A	Upper TSA
PWB-1(uts)	8/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	Zone A	Upper TSA
PWB-1(uts)	9/20/2018	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	11/2/2018	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	8/6/2019	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	Zone A	Upper TSA
PWB-1(uts)	9/17/2019	**0.703**	< 0.500	< 0.500	< 0.500	< 0.500	Zone A	Upper TSA
PWB-1(usg)	9/23/1992	**0.60**	--	--	--	--	--	SGA
PWB-1(usg)	5/11/1993	**4.7**	< 1.0	< 1.0	< 1.0	< 2.0	--	SGA
PWB-1(usg)	12/1/1993	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	--	SGA
PWB-1(usg)	3/4/1994	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	--	SGA
PWB-1(usg)	7/28/1994	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	11/3/1994	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	11/23/1994	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	1/11/1995	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	2/6/1995	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/19/1997	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	2/16/1998	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	8/14/1998	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	2/10/1999	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	8/16/1999	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	2/10/2000	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	8/17/2000	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	2/16/2001	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA
PWB-1(usg)	8/22/2001	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	SGA

Table 1
Select VOC Results for PWB-1 Well Cluster
EMC Remedy

Monitoring Well ID	Date Sampled	Trichloroethene (TCE) MCL: 5.0 µg/L	Tetrachloroethene (PCE) MCL: 5.0 µg/L	cis-1,2-Dichloroethene MCL: 70 µg/L	1,1-Dichloroethene MCL: 7.0 µg/L	Vinyl Chloride MCL: 2.0 µg/L	Remedy Zone	Aquifer Zone
PWB-1(usg)	3/13/2002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/12/2002	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	2/13/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/18/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	9/29/2003	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	2/11/2004	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/19/2004	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	2/14/2005	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/7/2005	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	2/9/2006	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/9/2006	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	11/8/2006	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/8/2007	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/11/2008	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/17/2009	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/11/2011	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	--	SGA
PWB-1(usg)	8/21/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	--	SGA

Notes:
Results are shown in micrograms per liter (µg/L)
< 0.2 = not detected above the method reporting limit shown
J = estimated
MCL = maximum contaminant limit
TSA = Troutdale Sandstone Aquifer
SGA = Sand and Gravel Aquifer
Bold = detection
Bold and shaded = result is greater than MCL

Table 2
Summary of EMC Extraction Wells
EMC TSA Remedy

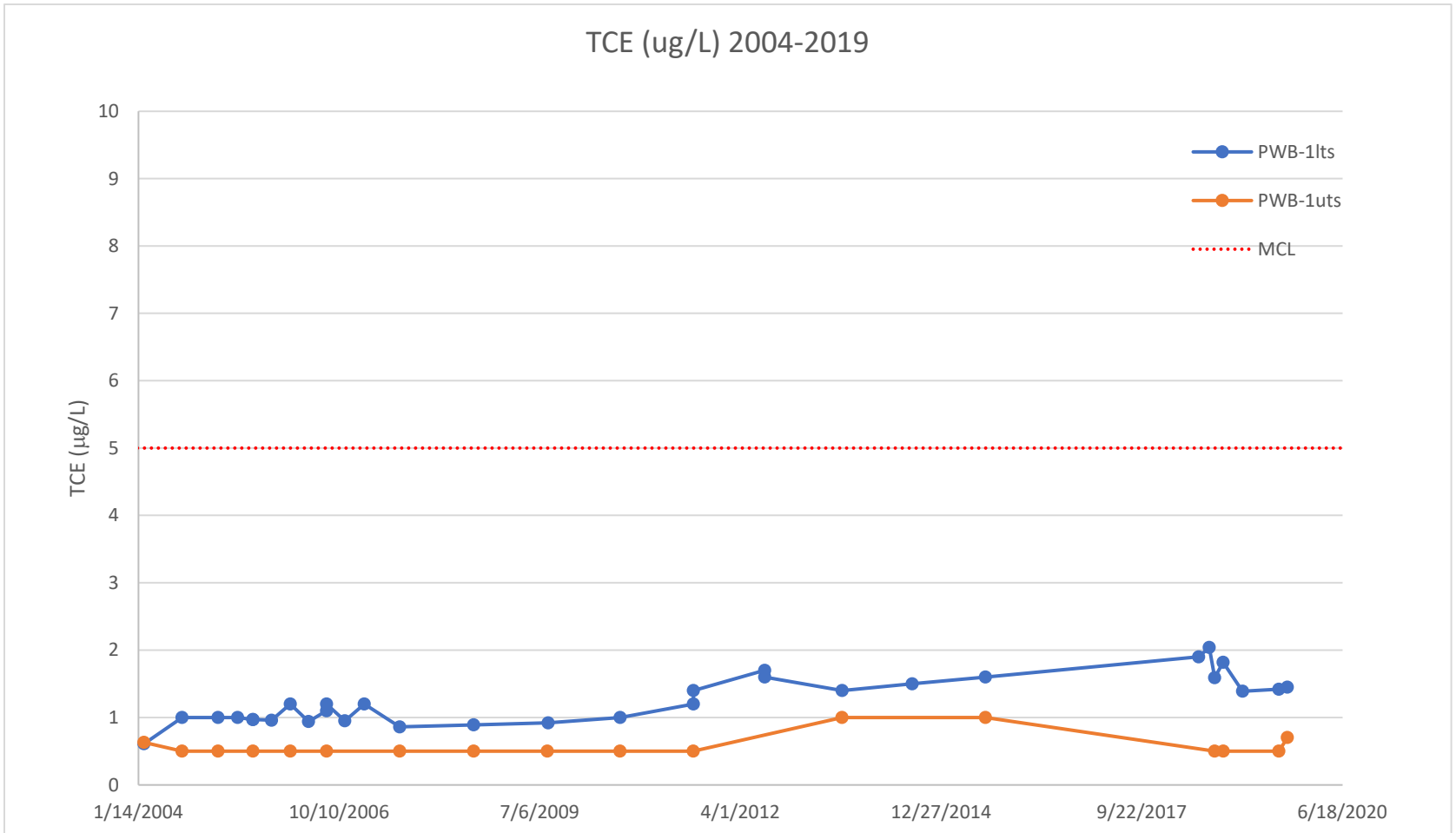
Well Name	Completed Date	Pumping Start Date	Shutdown DEQ Approval	Shutdown Date	Conversion to Monitoring DEQ Approval	Decommission Date	Decommission DEQ Approval	Decommision Method	Zone	Treatment System
EW-1	12/07/1996	06/12/1997	08/02/2018	**08/31/2018**	Pilot Shutdown / Monitoring				C	CTS
EW-2	09/23/1996	06/12/1997	Operational Well						C	CTS
EW-3	10/28/1996	06/19/1997	12/10/2009	**12/12/2009**	04/15/2013	Monitoring			B	WTS
MW-16(dg) [EW-4]	06/02/1992	06/12/1997	10/30/2003	**11/11/2003**	03/21/2007	11/12/2015	11/18/2009	overdrill and in situ grout	C	CTS
MW-24(dg) [EW-5]	10/07/1992	06/12/1997	10/30/2003	**11/11/2003**	10/28/2008	Monitoring			C	CTS
EW-6	05/12/1997	09/13/1997	10/30/2003	**11/11/2003**	10/30/2003	10/18/2006	08/30/2006	grout injection	A	NTS
EW-7	05/07/1997	09/13/1997	06/05/2006	**06/06/2006**	06/05/2006	10/23/2008	06/24/2008	grout injection	A	NTS
EW-8	06/10/1997	09/15/1997	08/13/2007	**08/14/2007**	06/17/2009	Monitoring			C	CTS
EW-9	05/20/1997	09/13/1997	06/05/2006	**06/06/2006**	06/05/2006	10/23/2008	06/24/2008	grout injection	A	NTS
EW-10 [PMX-189]	08/25/1950	07/15/1998	08/30/2007	**removed from remedy**	-	05/2005	-	-	D EAST	ETS
EW-11	01/23/1998	06/25/1998	12/18/2007	**12/19/2007**	11/03/2009	Monitoring			D	CTS
EW-12	06/26/1997	09/15/1997	12/18/2007	**12/19/2007**	03/11/2009	Monitoring			C	CTS
EW-13	11/25/1997	12/16/1997	11/24/2009	**11/25/2009**	08/01/2012	Monitoring			B	WTS
EW-14	11/13/1997	05/04/1998	Operational Well						C	CTS
EW-15	07/16/1998	08/13/1998	04/06/2010	**04/12/2010**	08/01/2012	Monitoring			C	CTS
EW-16	10/21/1997	6/25/1998 Resumed	4/6/2010 10/04/17	**4/12/2010 12/1/2014**	4/6/2010 10/4/2017	Monitoring			D	CTS
EW-17	02/11/1998	05/04/1998	10/30/2003	**11/11/2003**	10/30/2003	10/23/2008	05/21/2007	abandon/bentonite	A	FNTS
EW-18	05/08/1998	06/25/1998	11/03/2009	**11/03/2009**	11/03/2009	11/20/2015	01/30/2014	overdrill and in situ grout	C	CTS
EW-19	11/24/1997	01/06/1998	06/05/2006	**06/06/2006**	06/05/2006	10/23/2008	06/24/2008	abandon/bentonite	A	NTS
EW-20(usg)	05/27/1998	06/29/1998	06/05/2006	**06/06/2006**	06/05/2006	10/18/2006	08/30/2006	grout injection	A	NTS
EW-21 [PMX-417]	02/02/1983	10/30/2000	05/21/2007	**removed from remedy**	08/19/2004	-	-	-	D	EW21TS

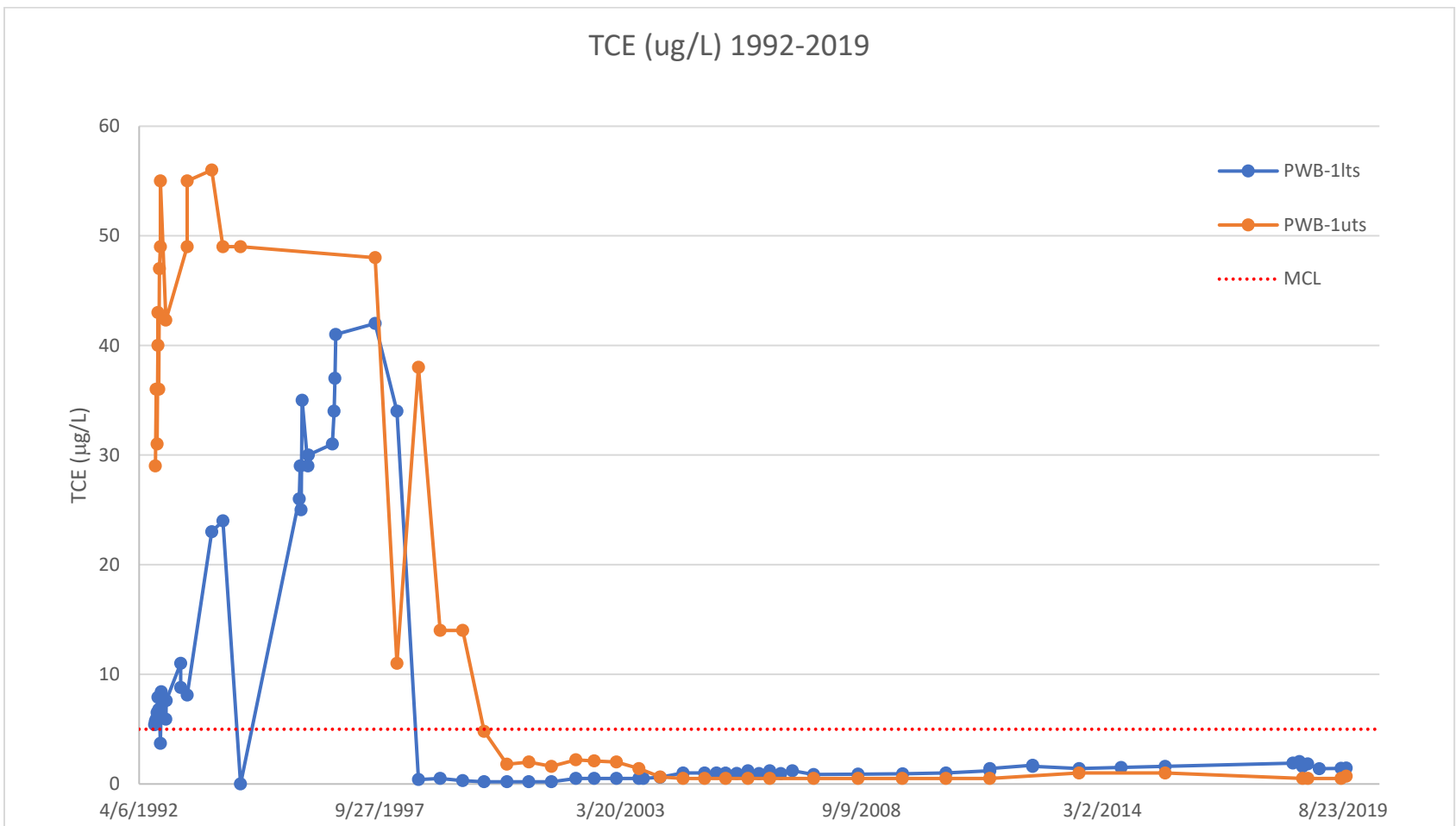
Table 2
Summary of EMC Extraction Wells
EMC TSA Remedy

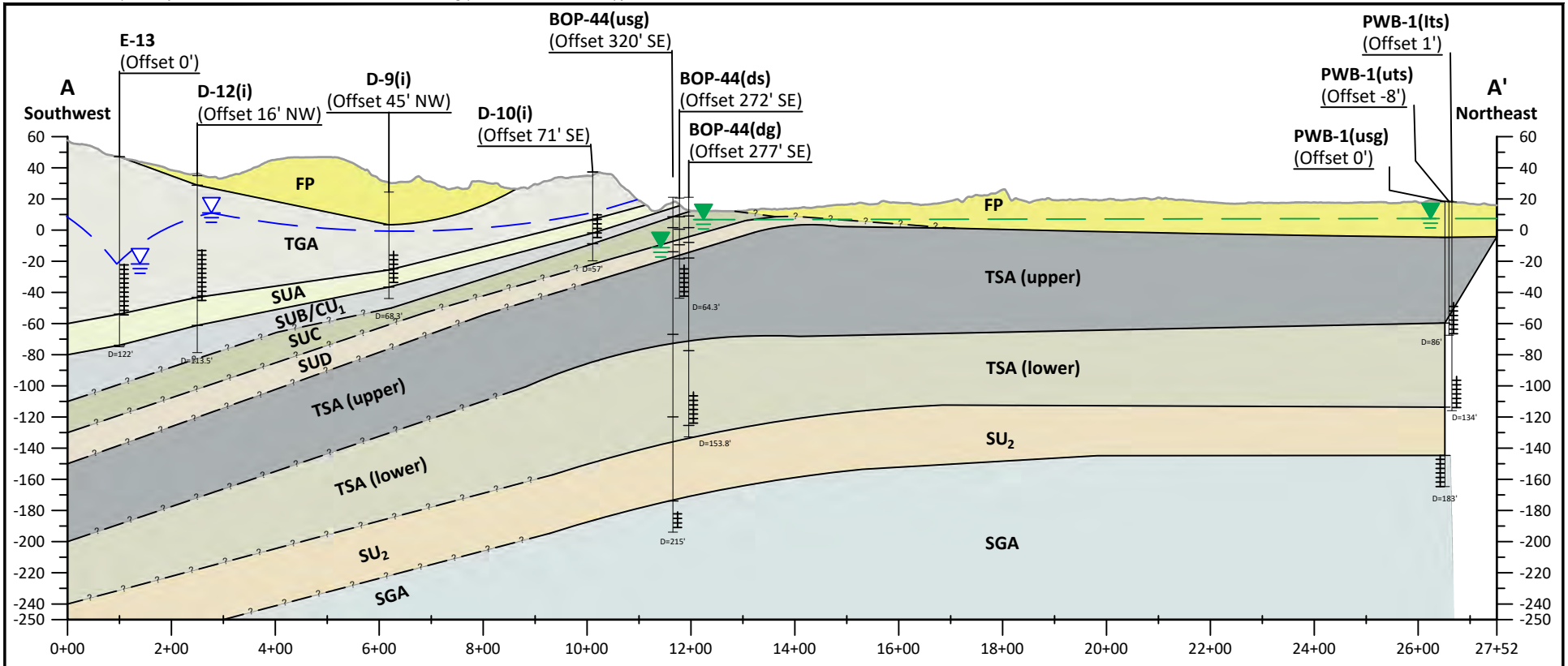
Well Name	Completed Date	Pumping Start Date	Shutdown DEQ Approval	Shutdown Date	Conversion to Monitoring DEQ Approval	Decommission Date	Decommission DEQ Approval	Decommision Method	Zone	Treatment System
EW-22	06/12/2003	07/10/2003	10/28/2008	**10/29/2008**	05/04/2009	03/26/2010	05/04/2009	grout injection	B	WTS
EW-23	01/23/2007	04/30/2007	Operational Well						B	CTS

Notes:
CTS = Central Treatment System
ETS = East Treatment System
EW21TS = EW-21 Treatment System
FNTS = Far North Treatment System
NTS = North Treatment System
WTS = West Treatment System

Figure 1: TCE Concentrations in wells PWB-1lts and PWB-uts







FP: Flood Plain Deposits: Silty, sandy GRAVEL

TGA: Troutdale Gravel: Sandy, silty GRAVEL

SUA | SUB | SUC | SUD: SU_1: Siltstone Unit 1 consisting of four distinct low permeable layers (SUA, SUB/CU_1, SUC, & SUD) with the second layer being a blueish/gray Clayey Siltstone

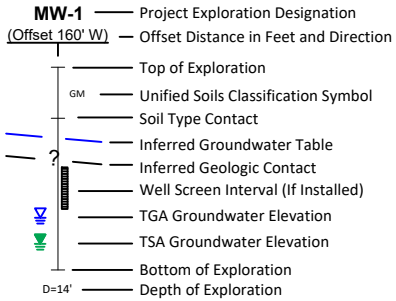
TSA (Upper): Upper portion of the Troutdale Sandstone Unit: Sandstone

TSA (Lower): Lower portion of the Troutdale Sandstone Unit: Conglomerate

SU_2: Siltsone Unit 2

SGA: Sand and Gravel Aquifer

Legend

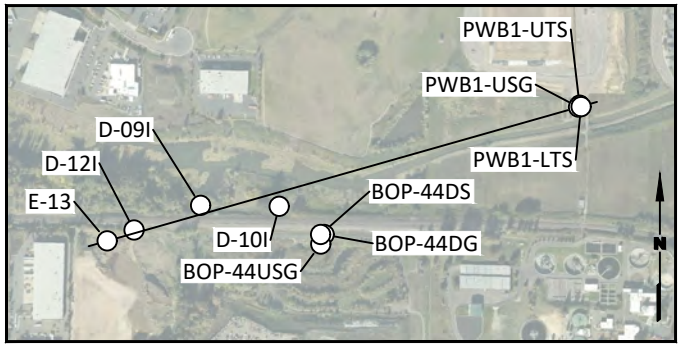


Geologic Profile Alignment -A-A

Horizontal Scale in Feet: 1"=300'
Vertical Scale in Feet: 1"=100'
3x Vertical Exaggeration

Notes

1. All well elevations derived from DOGAMI LIDAR, except BOP series which is derived from boring logs.
2. Soil descriptions are generalized, based on interpretation of field and laboratory data. Stratigraphic contacts are interpolated between borings and based on topographic features; actual conditions may vary.
3. See report text for descriptions of geologic units.
4. For Cross Section location, see the Site and Exploration Plan, Figure _.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.



Source: Bing Aerial Imagery, 2020

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East Multnomah County Cleanup
Portland, Oregon

Cross Section A-A'

Figure 2

ZONE B WELLS

Figure 3: TCE Concentrations in Zone B Wells near EW-3

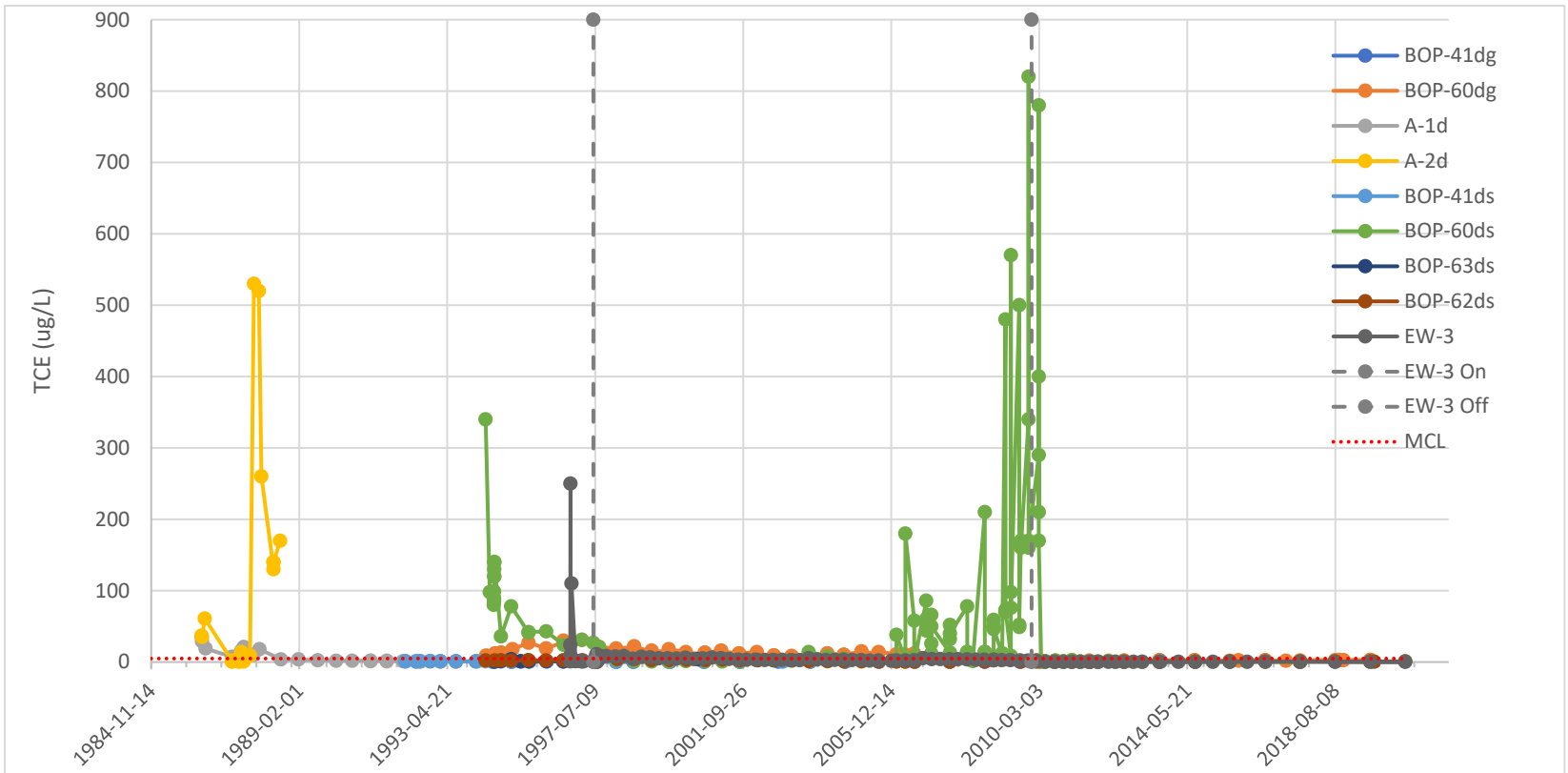


Figure 4: TCE Concentrations in Zone B Wells near EW-22

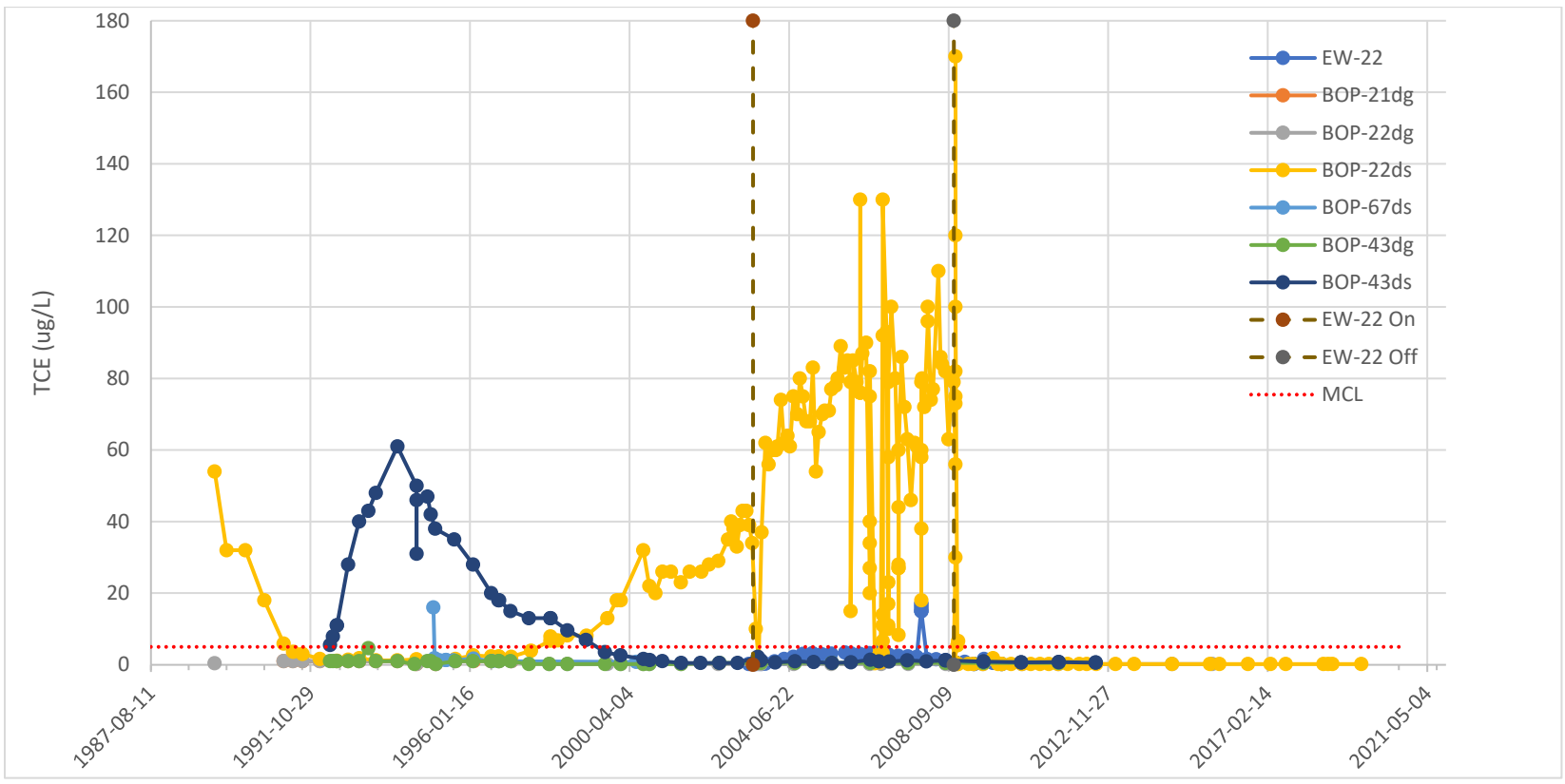


Figure 5: TCE Concentrations in Zone B and C Wells near EW-23

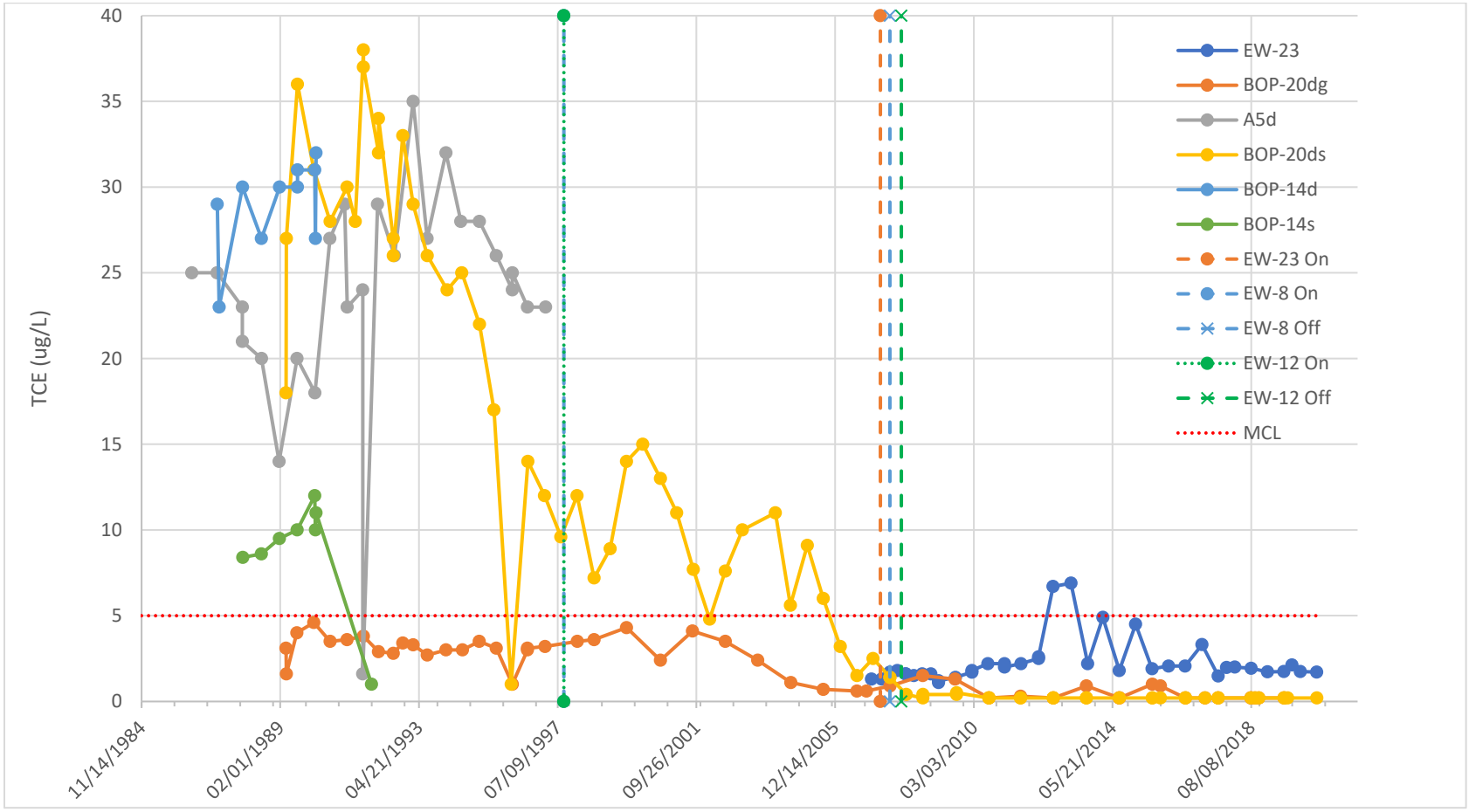
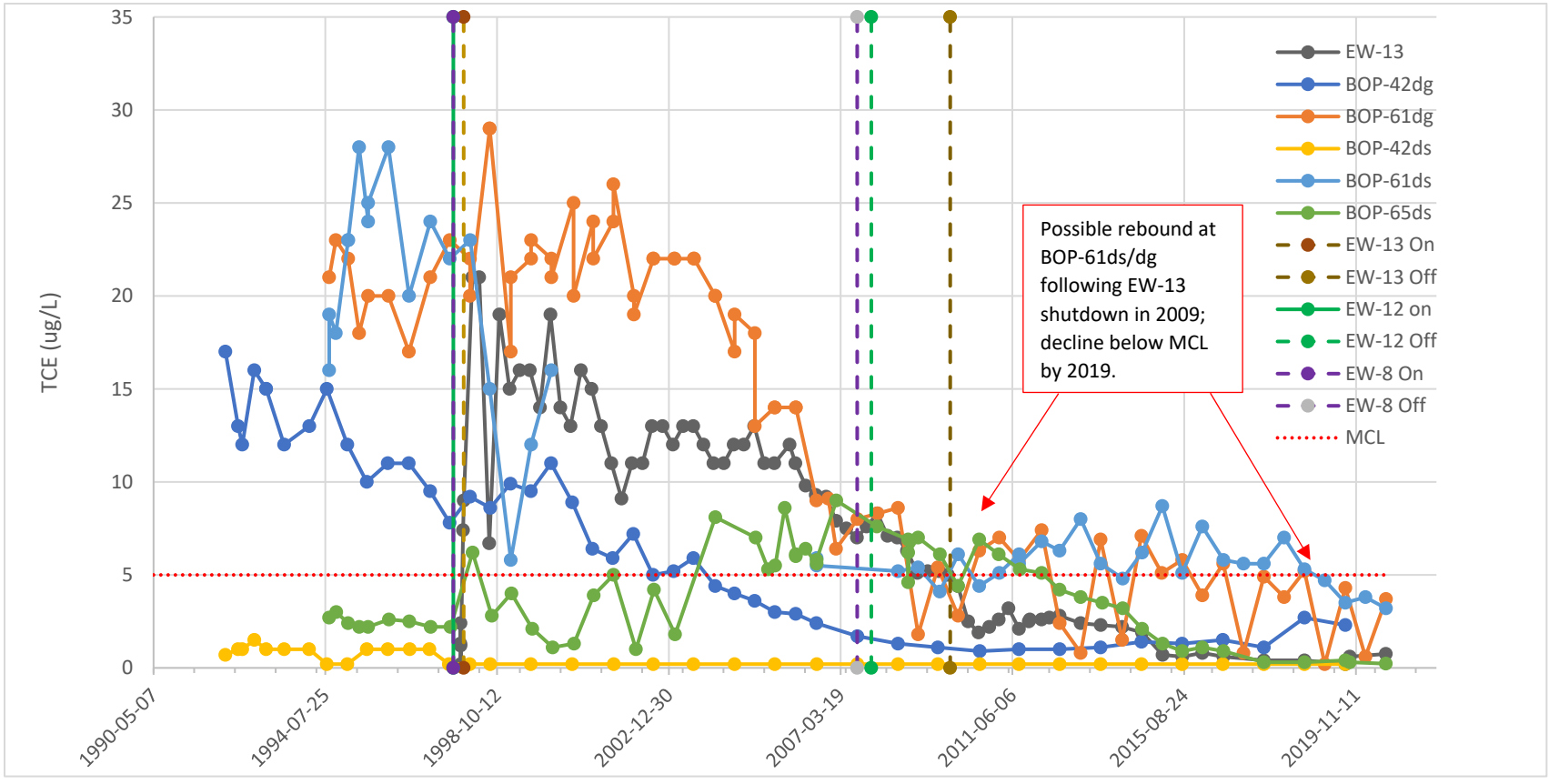
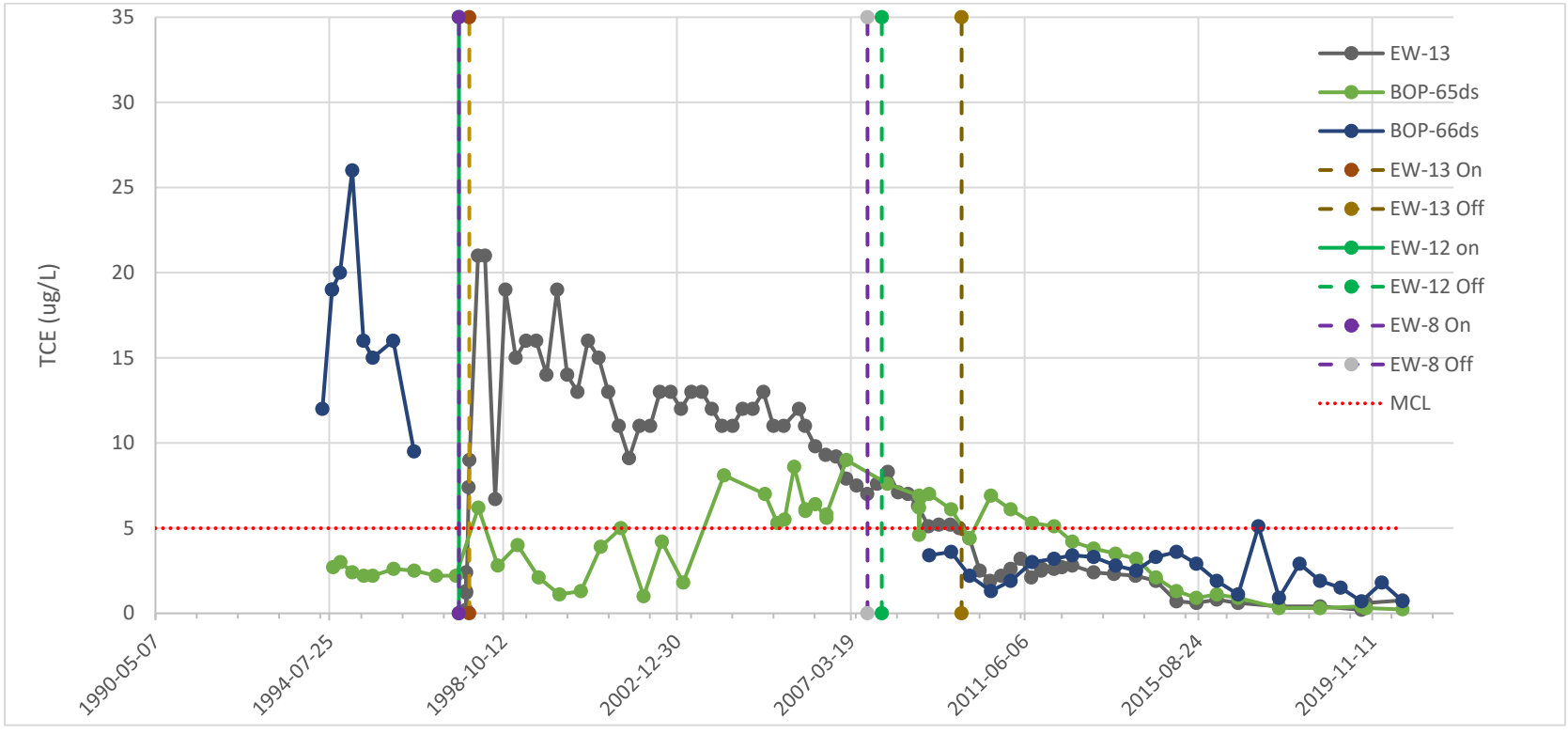


Figure 6: TCE Concentrations in Zone B and C Wells near EW-13

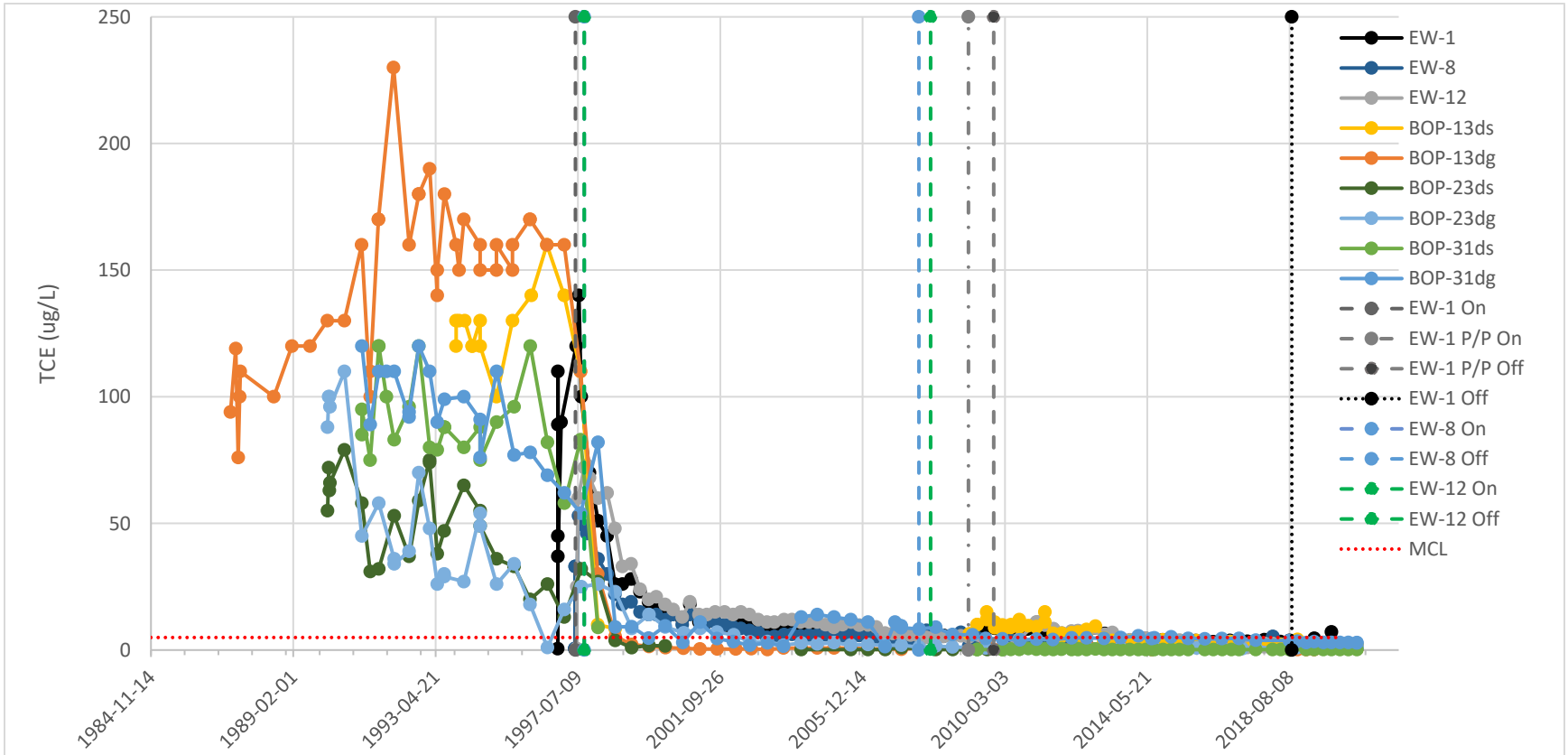


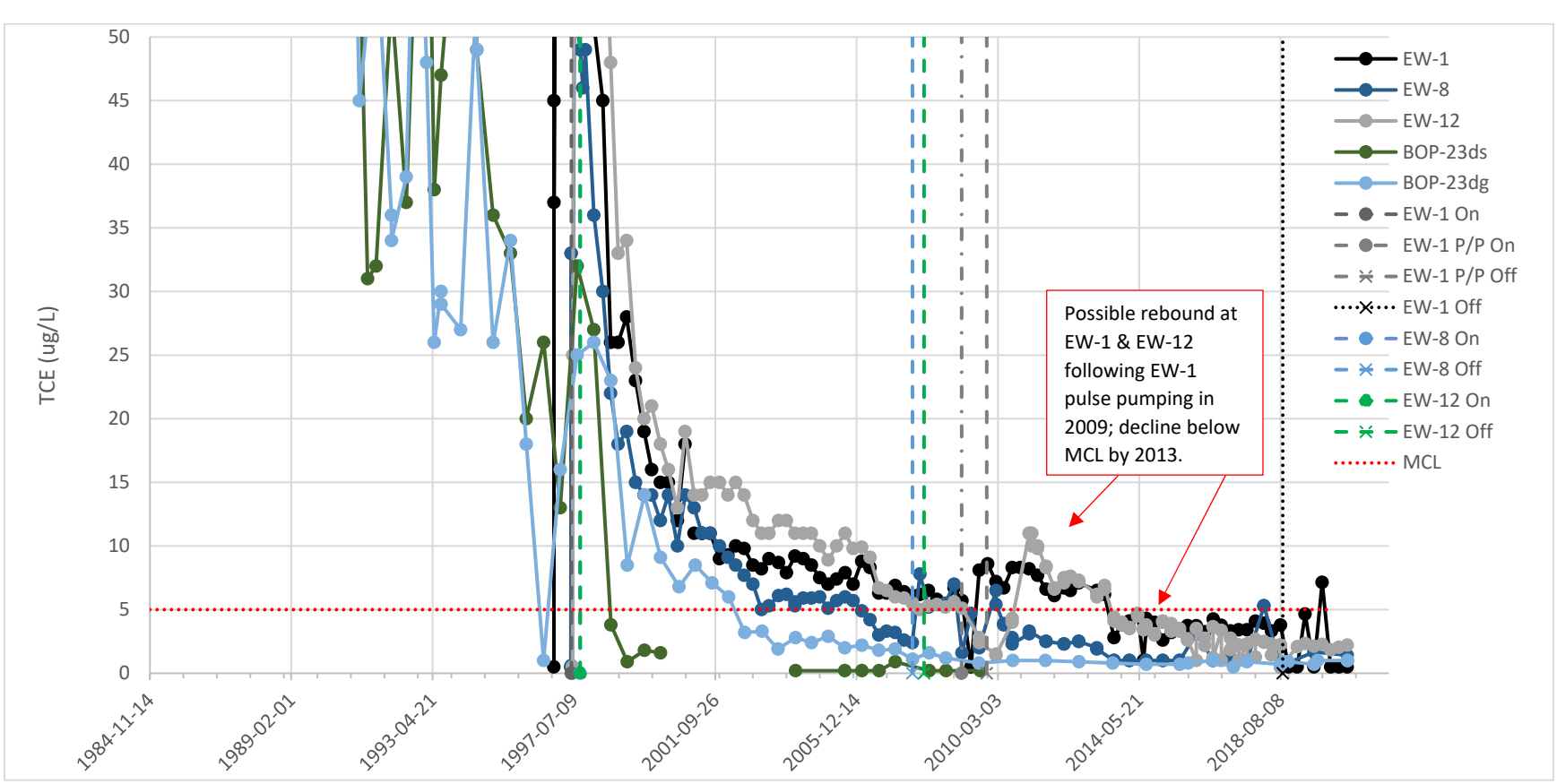


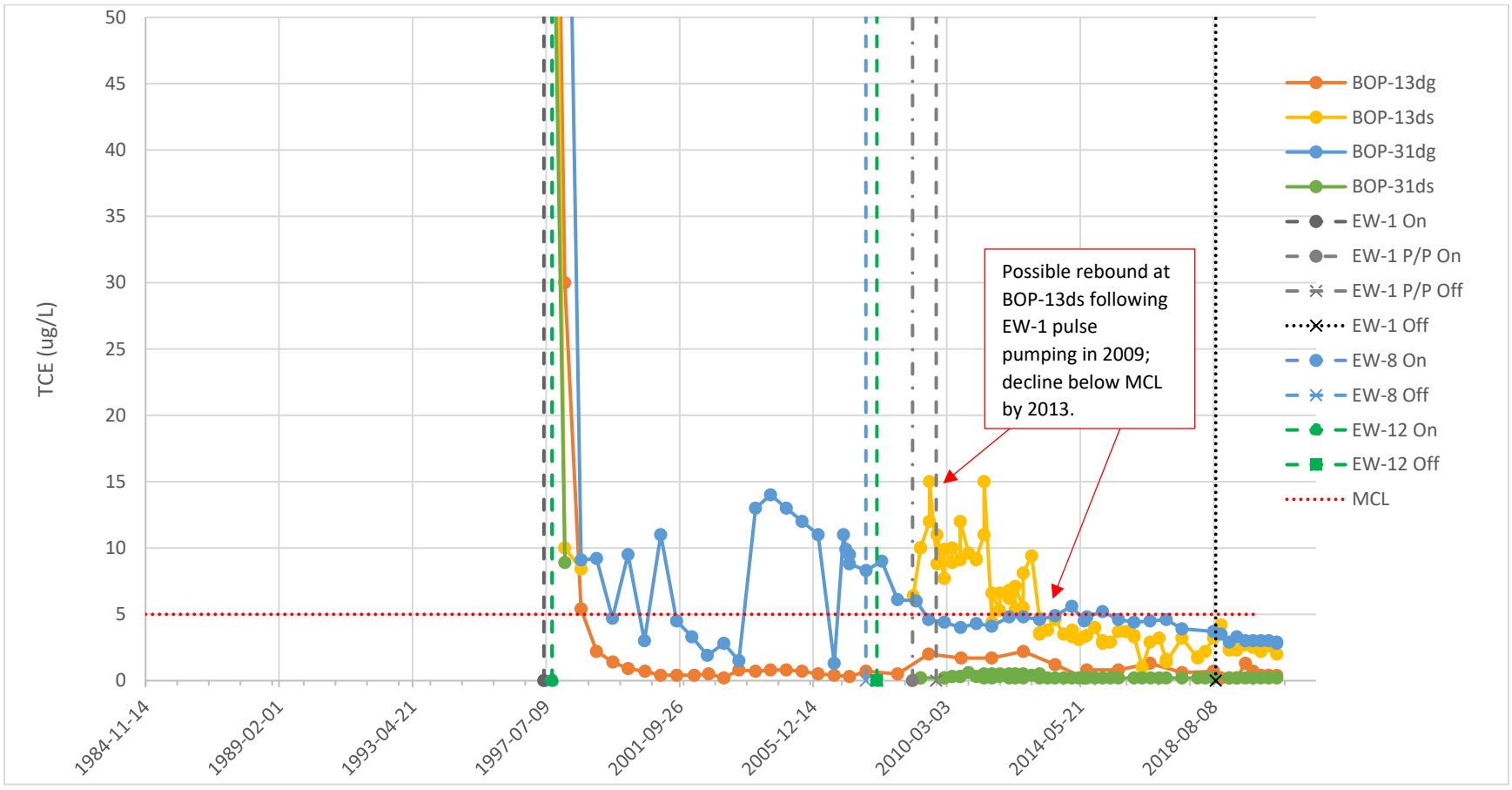
Note: The two charts show monitoring and extraction wells near EW-13, separated for clarity. The gap in the TCE data for BOP-61ds and BOP-66ds represents a time when these Upper TSA wells were unsaturated due to Lower TSA groundwater extraction.

ZONE C WELLS

Figure 7: TCE Concentrations in Zone C Wells near EW-1, EW-8, and EW-12

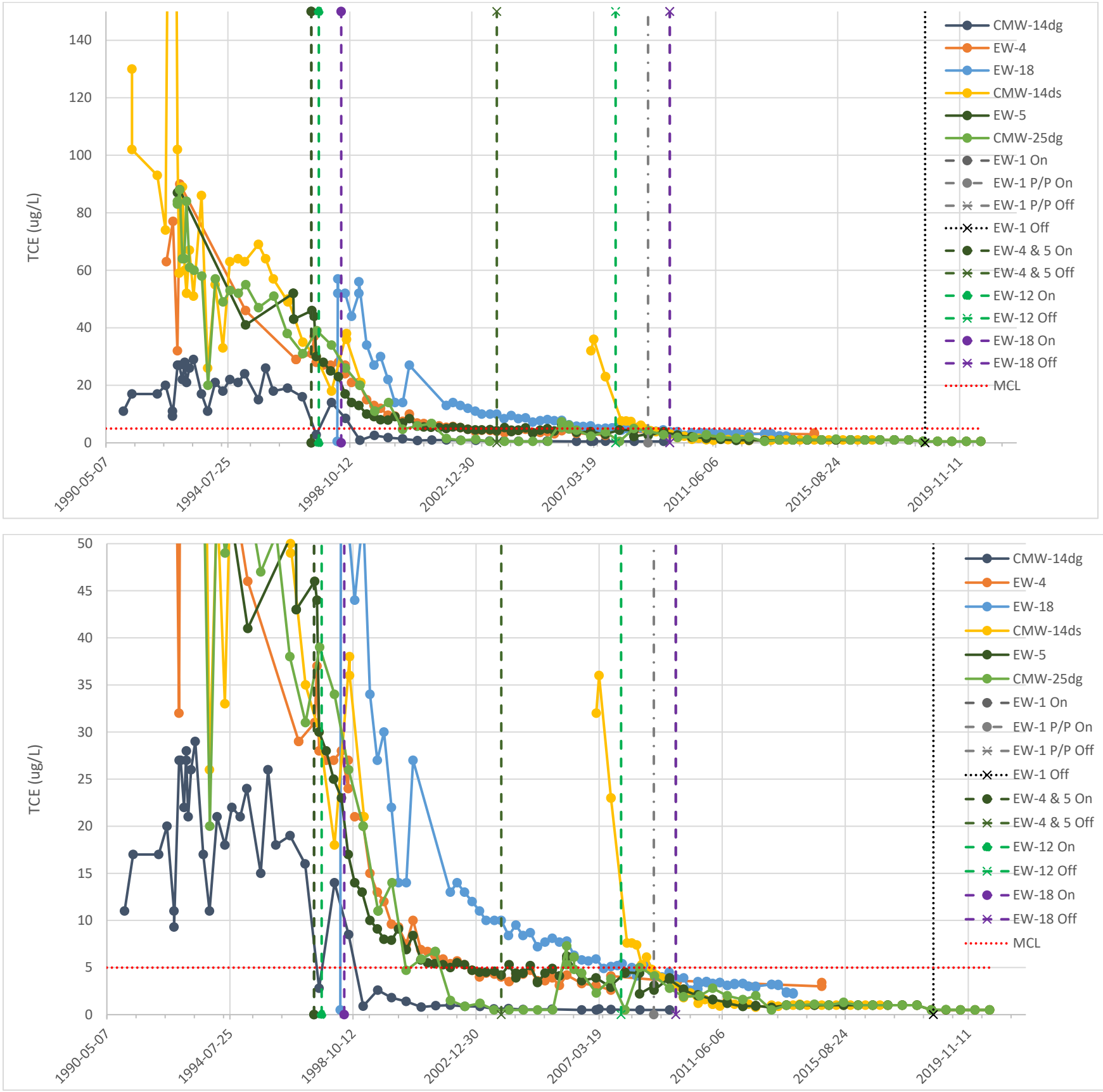


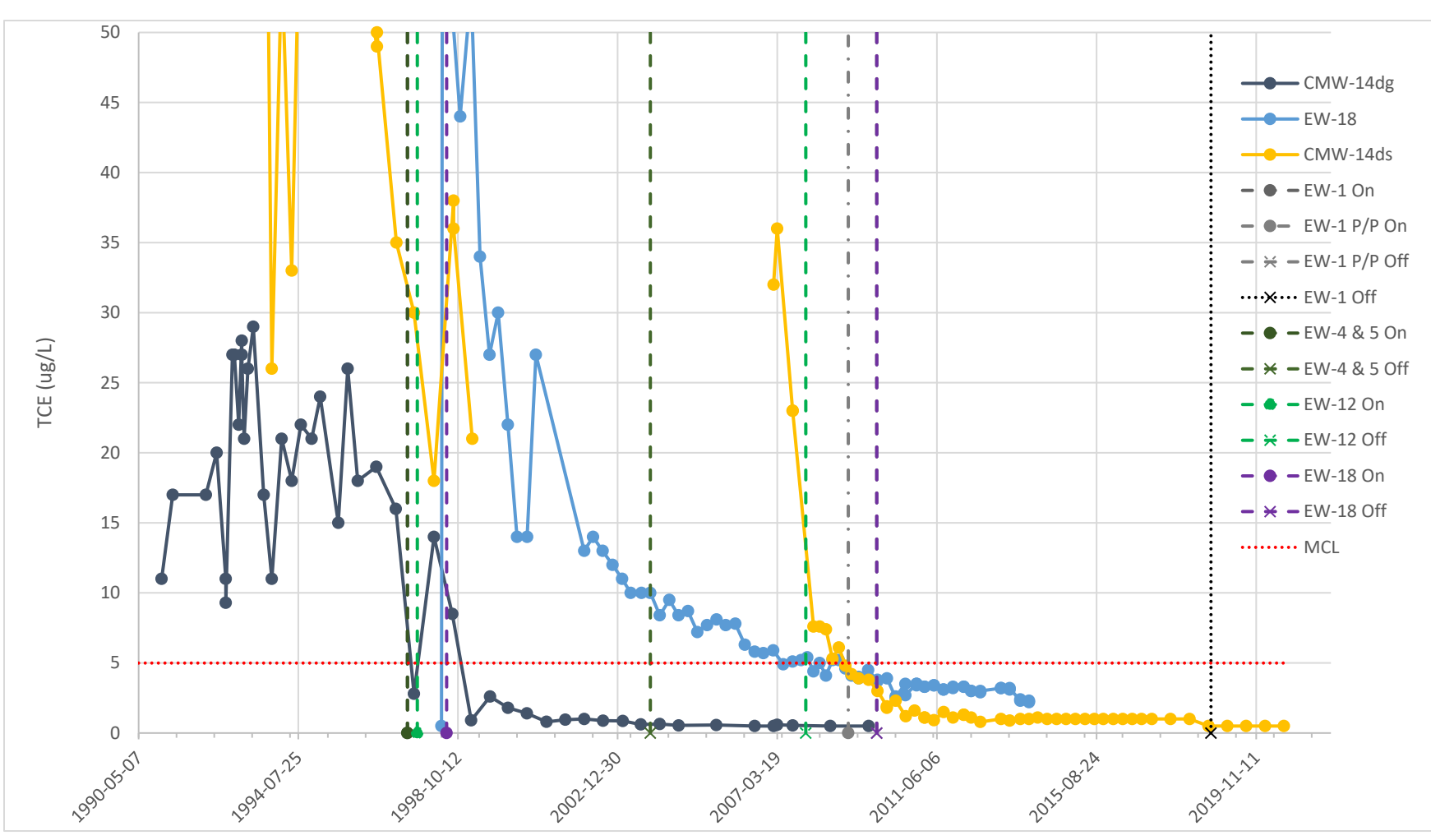




Note: The first chart includes monitoring and extraction wells near EW-1, EW-8, and EW-12, and the latter two charts include a smaller TCE range and fewer wells, separated for clarity. The gap in the TCE data for BOP-23ds represents a time when this Upper TSA well was unsaturated due to Lower TSA groundwater extraction.

Figure 8: TCE Concentrations in Zone C Wells near EW-4, EW-5, and EW-18





Note: The first chart includes monitoring and extraction wells near EW-4, EW-5, and EW-18, and the latter two charts include a smaller TCE range and fewer wells, separated for clarity. The gap in the TCE data for CMW-14ds represents a time when this Upper TSA well was unsaturated due to Lower TSA groundwater extraction. Data from replacement wells CMW-14Rds and CMW-14Rdg are combined with CMW-14ds and CMW-14dg, respectively.

ATTACHMENT 1

Mann Kendall Results

Mann-Kendall Trend Test Analysis		
User Selected Options		
Date/Time of Computation	ProUCL 5.18/24/2020 10:13:09 AM	
From File	TCE_PWB-1lts.xls	
Full Precision	OFF	
Confidence Coefficient	0.95	
Level of Significance	0.05	

TCE

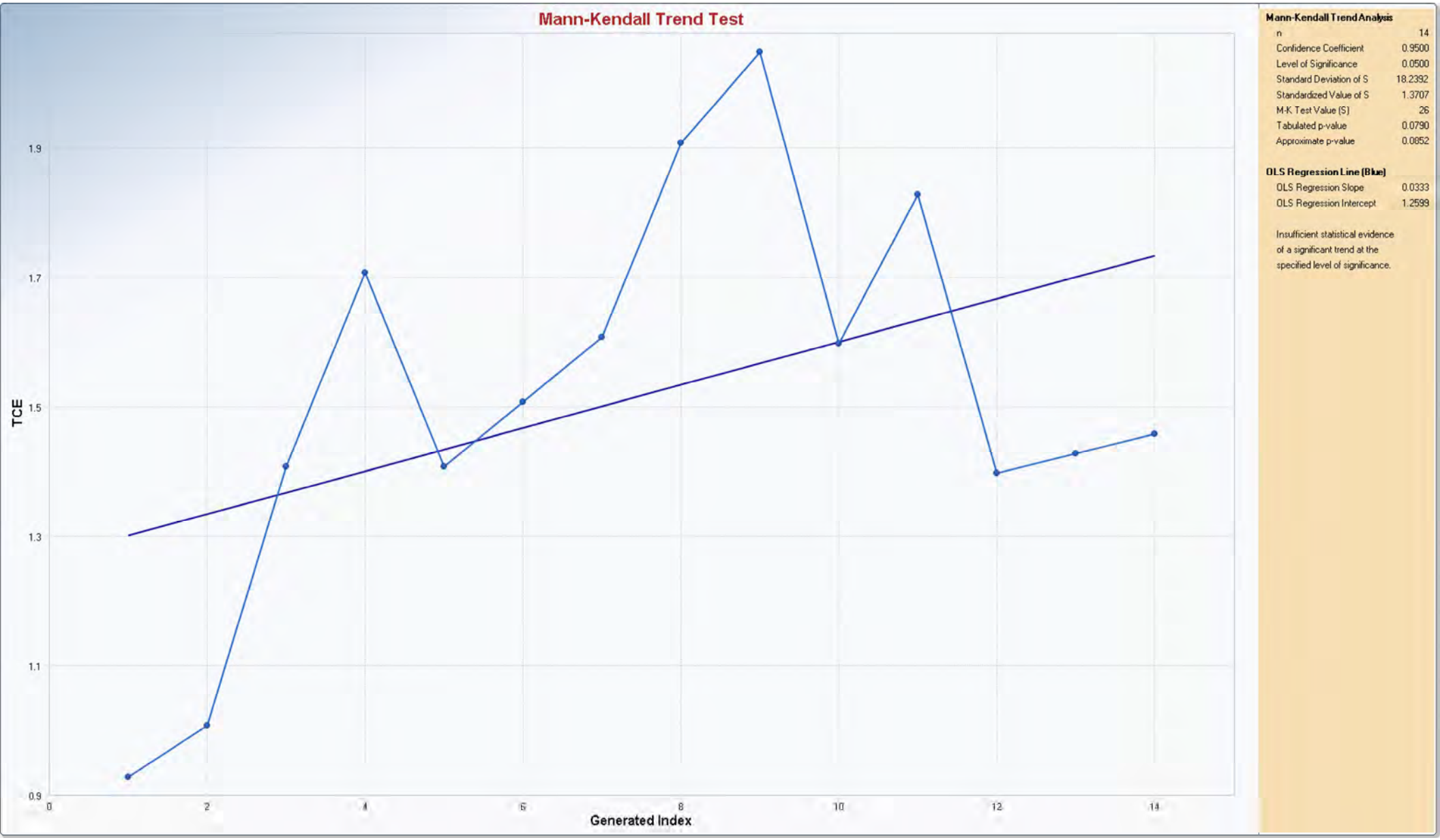
General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	0.92
Maximum	2.04
Mean	1.509
Geometric Mean	1.477
Median	1.475
Standard Deviation	0.309
Coefficient of Variation	0.204

Mann-Kendall Test

M-K Test Value (S)	26
Tabulated p-value	0.079
Standard Deviation of S	18.24
Standardized Value of S	1.371
Approximate p-value	0.0852

Insufficient evidence to identify a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis	
n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.2392
Standardized Value of S	1.3707
M-K Test Value (S)	26
Tabulated p-value	0.0790
Approximate p-value	0.0852

OLS Regression Line (Blue)	
OLS Regression Slope	0.0333
OLS Regression Intercept	1.2599

Insufficient statistical evidence of a significant trend at the specified level of significance.

ATTACHMENT 2

Other Figures:

Figures 3, 4, C-1 and C-2 from Partial NFA Request

Figure 4 from CMW-26dg Decommissioning Letter

COLUMBIA RIVER
NE Marine Dr
N
D-15(ds)
PMX-168
NE 223Rd Ave
A'
BLUE LAKE
PMX-167
PMX-138.18
EMC-1(ds)
PMX-141
RPW-1(ds)
D-16(ds)
FNTS
D-18(ds)
FAIRVIEW LAKE
Truncation
PWB-1(uts)
Remedy Zone A
North Groundwater
Treatment System
(Decommissioned 2008)
EMC-2(ds)
BOP-44(ds)
EW-9
DEQ-3(s)
BOP-43(ds)
BOP-70(ds)
PWB-4(s)
BOP-71(ds)
MW-41(ds)
A-7(i)
A
BOP-22(ds)
BOP-21(ds)
BOP-20(ds)
BOP-22R(ds)
BOP-67(ds)
A-5(d)
East Groundwater
Treatment System
(Decommissioned 2005)
A-3(s)
EW-22
Remedy Zone B
BOP-23(ds)
A-6(ia)
A-4(i)
EW-10 (PMX-189)
A-2(d)
BOP-60R(ds)
BOP-14(s)
BOP-60(ds)
BOP-63(ds)
EW-3
BOP-61(ds)
Remedy Zone C
West Groundwater
Treatment System
BOP-65(ds)
BOP-31(ds)
NE 201st Ave
NE 205th Ave
NE Sandy Blvd
A-1(d)
BOP-62(ds)
BOP-66(ds)
Remedy Zone D
MW-29(ds)
BOP-41(ds)
BOP-64(ds)
MW-17(ds)
VMW-A
VW-17d-95.5
BOP-42(ds)
D-17(ds)
VMW-H
VW-17d-75.0
BOP-13(ds)
VMW-C
VMW-G
MW-26(ds)
VMW-B
MW-18(ds)
VMW-D
VMW-F
MW-20(ds)
VMW-E
EW-21 (PMX-417)
MW-10(ds)
DEQ-5(ds)
MW-19(ds)
EW-21 Groundwater
Treatment System
(Decommissioned 2007)
MW-3
DEQ-1(ds)
84
84
Fairview Ave

Legend

- Supply Wells
- TSA Extraction Wells
- TSA Monitoring Wells
- TSA Monitoring Wells - Private
- Upper/Lower TSA Monitoring Wells - Private
- Decommissioned Wells
- Aquifer Restoration Zones
- Treatment Systems
- Original EMC Site Study Area
- Boeing Portland Property
- Cascade Corporation Property
- TSA TCE Plume 1998
- TSA TCE Plume 2019
- Unsaturated Areas
- Approximate Location of Truncation
- Cross Section Location

0 1,000 2,000
Scale in Feet

ta Source: Esri World Imagery.

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

G:\Projects\025\116\619\622\F03TSAUpperWellLocations.mxd 1/13/2020

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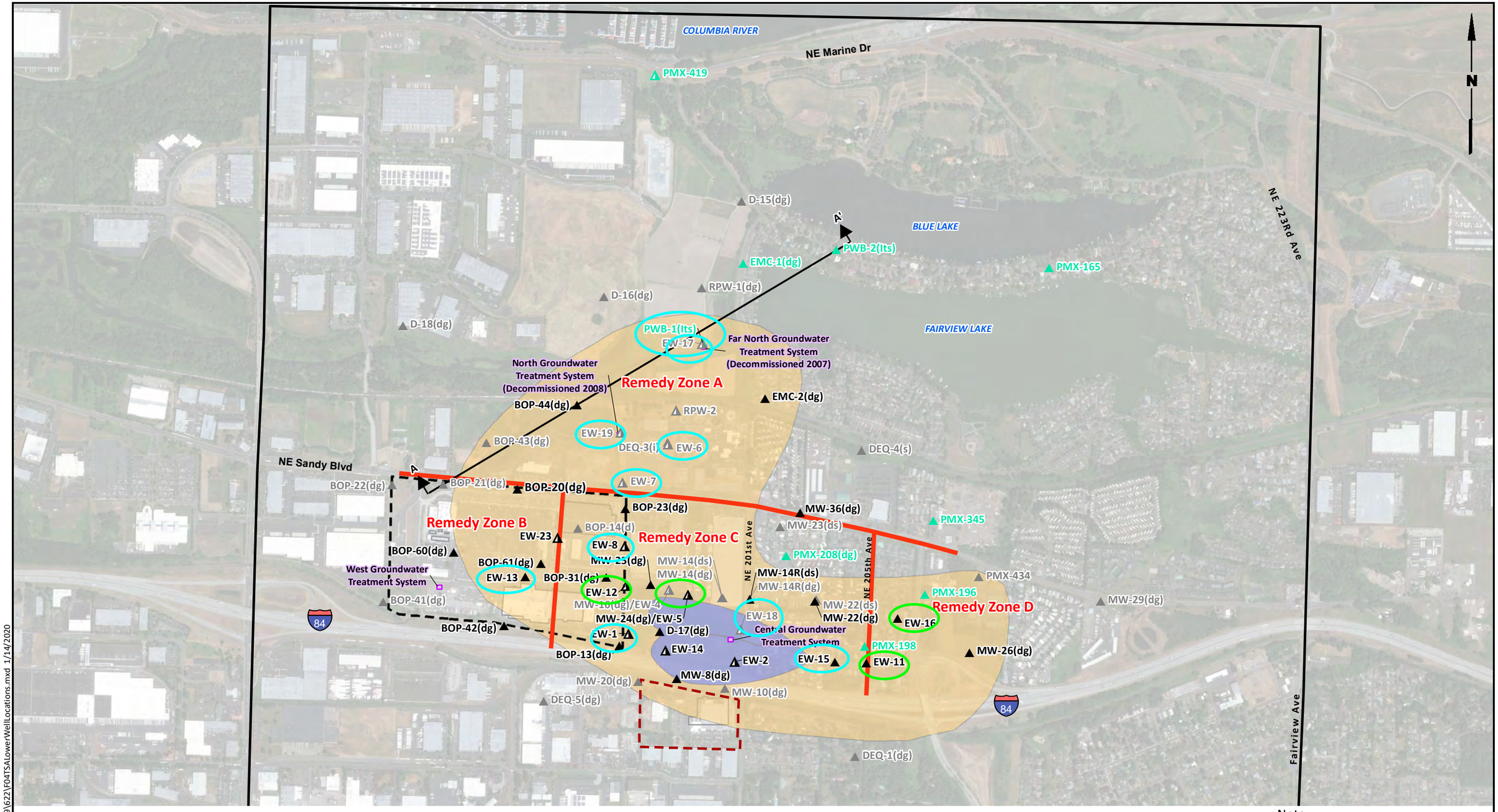
East Multnomah Site
Gresham, Oregon

Upper TSA Well Locations

Figure
3



G:\Projects\025\116\619\622\F04TSALowerWellLocations.mxd 1/14/2020

Legend

- TSA Extraction Wells
- TSA Extraction Wells - Private
- TSA Monitoring Wells
- TSA Monitoring Wells - Private
- Decommissioned Wells
- Aquifer Restoration Zones
- Treatment Systems
- Original EMC Site Study Area
- Boeing Portland Property
- Cascade Corporation Property
- TSA TCE Plume 1998
- TSA TCE Plume 2019
- Cross Section Location

0 1,000 2,000

Scale in Feet

Data Source: Esri World Imagery.

Note

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

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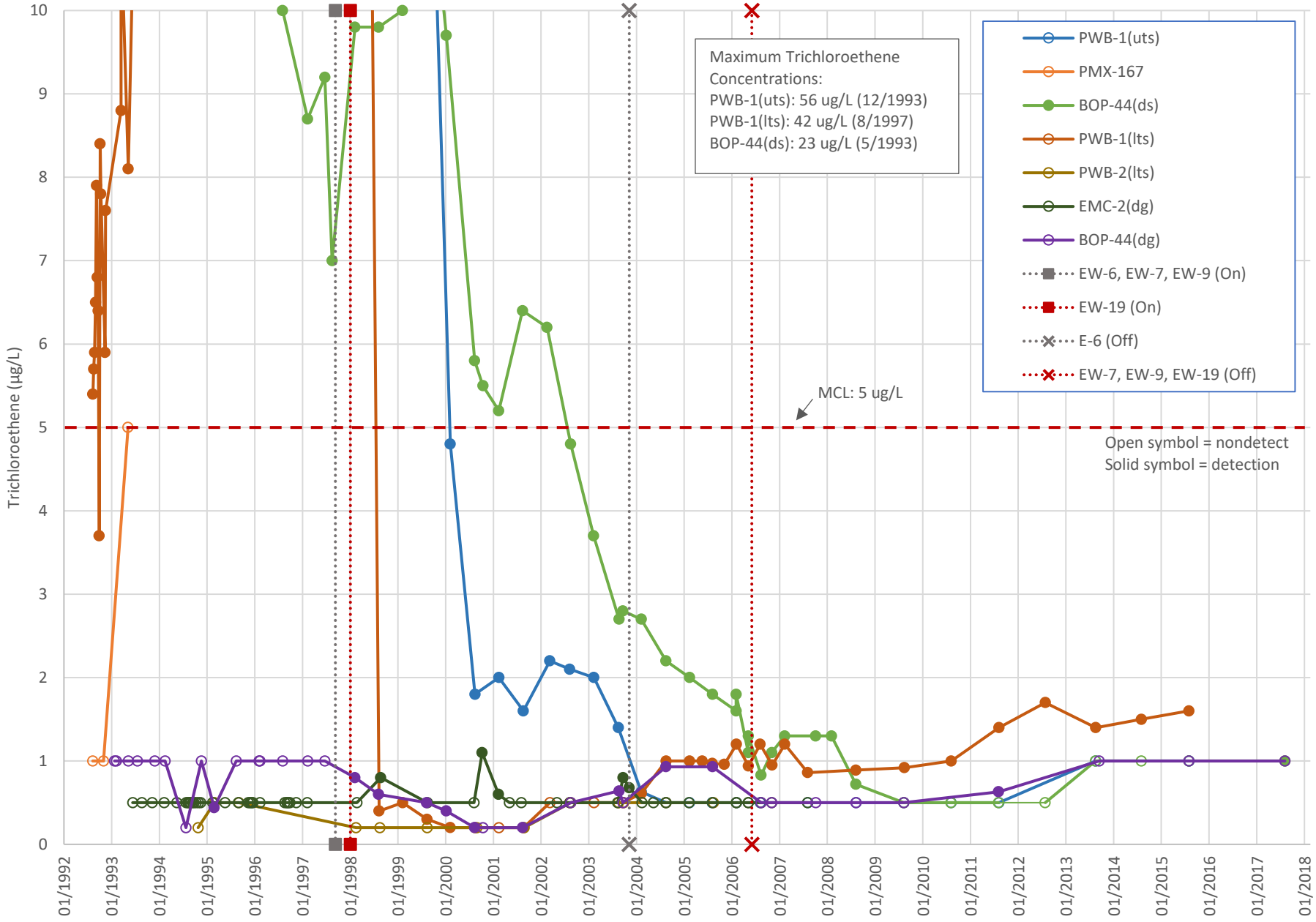
East Multnomah Site
Gresham, Oregon

Lower TSA Well Locations

Figure 4

Trichloroethene Profile

1/22/21 P:\025\116\WIP\T\EQuIS\Exports\TSA\C-10 Zone A TCE Profiles.docx



LANDAU ASSOCIATES

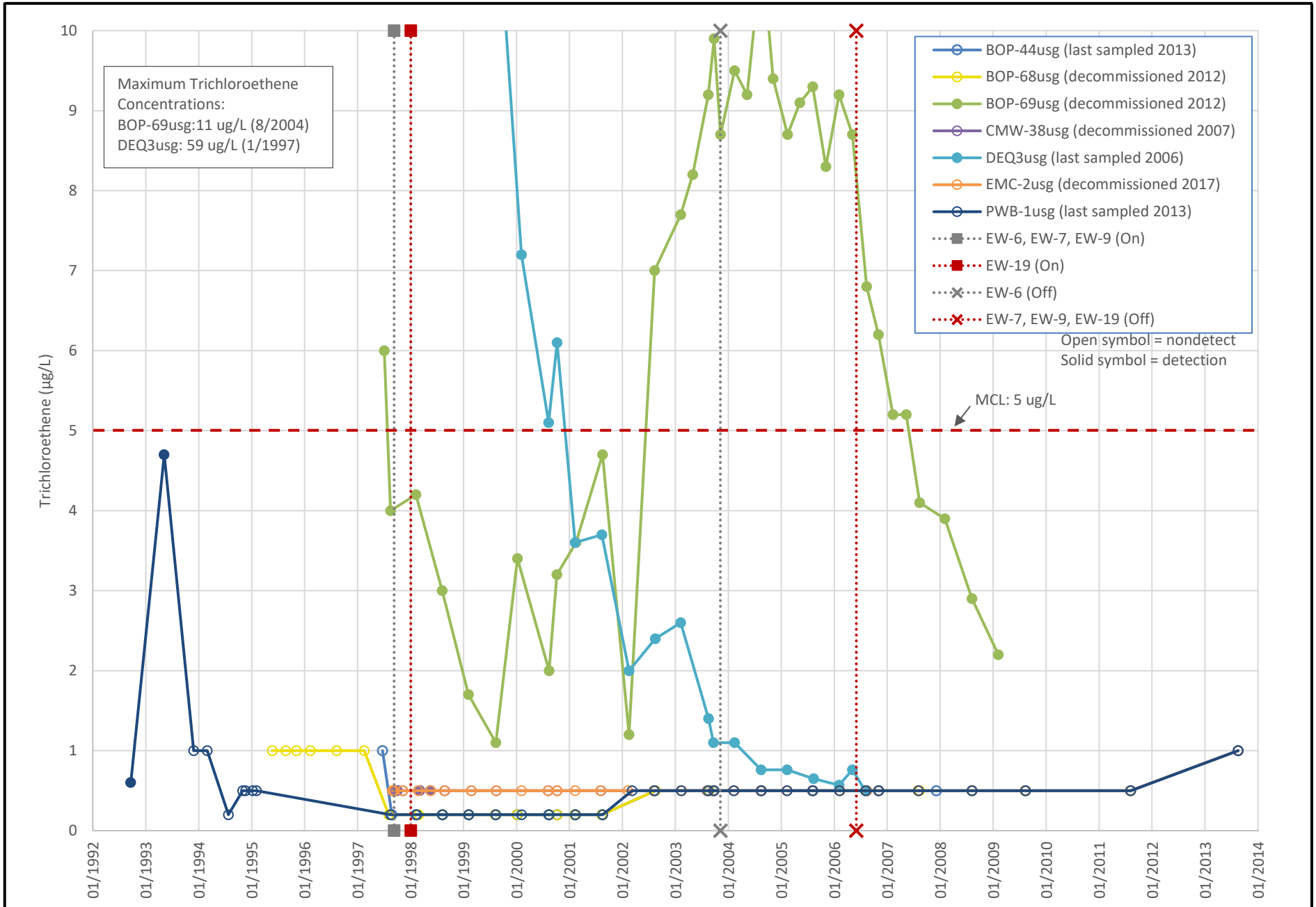
East Multnomah County Remedy

Zone A Select TSA Well- TCE Profiles

Figure
C-1

Trichloroethene Profile

1/22/21 P:\025\116\WIP\T\EQuIS\Exports\TSA\C-11 TCE Profiles for SGA Wells.docx

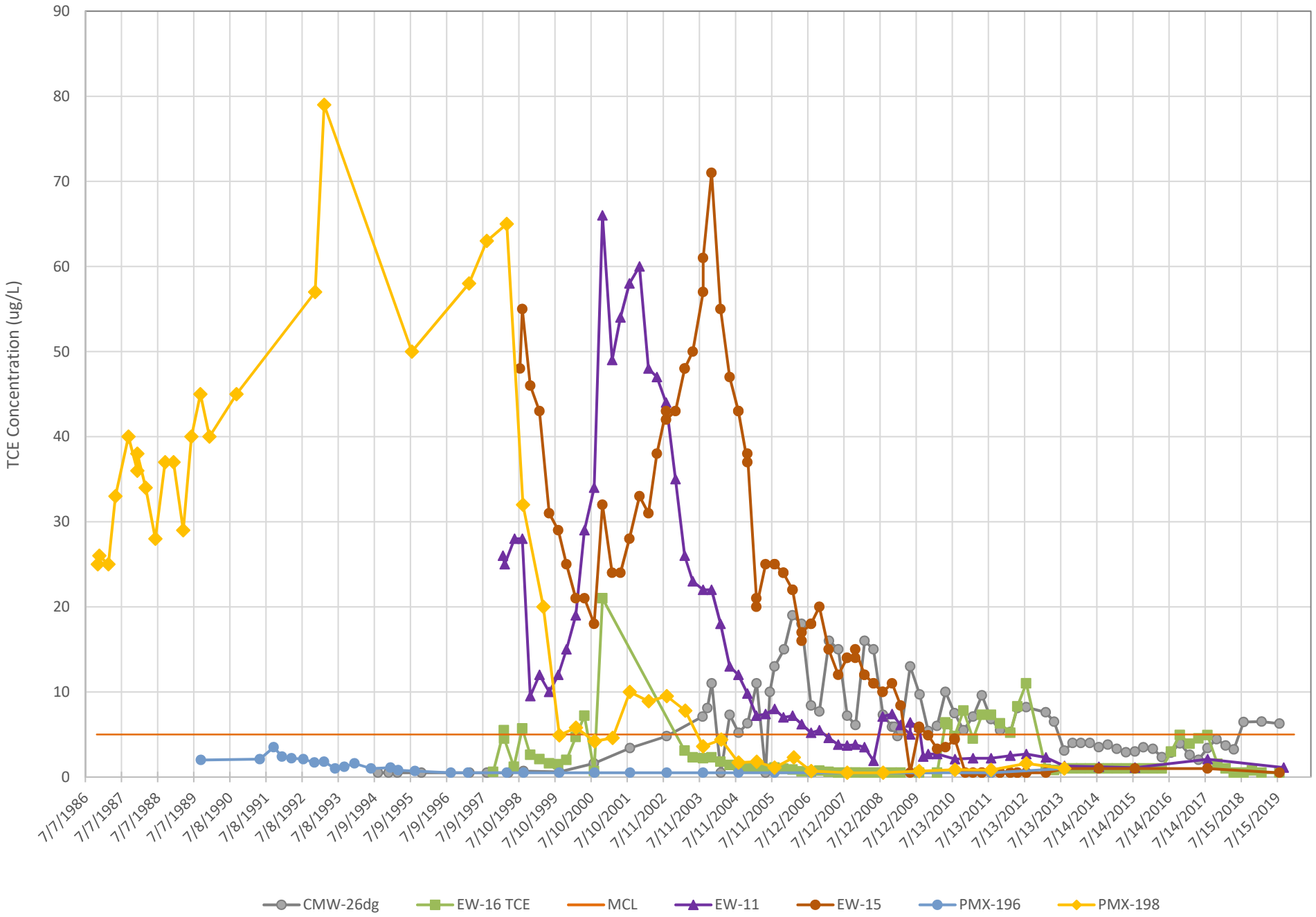


LANDAU ASSOCIATES

East Multnomah County Remedy

TCE Profiles for Select SGA Wells

Figure
C-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentrations at CMW-26dg, EW-11, EW-15, EW-16, PMX-196, & PMX-198 EMC TSA Remedy**	Figure 4