SVE SYSTEM PILOT SHUTDOWN WORK PLAN

Former Astoria Warehousing Site
70 West Marine Drive
Astoria, Oregon
DEQ LUST File No. 04-18-0818
DEQ ECSI File No. 6381

For
Oregon Department of Environmental Quality
September 8, 2022

Project: BigBeams-1-04-05

September 8, 2022

Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232

Attention: Sarah Greenfield

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On behalf of Blue Jump Suit LLC and AHI Cannery LLC, NV5 (formerly GeoDesign, Inc.) is pleased to submit this work plan for the Former Astoria Warehousing Site located at 70 West Marine Drive in Astoria, Oregon. This work plan summarizes proposed measures to evaluate permanent cessation of SVE system operation within the context of PPA requirements for the subject property.

Sincerely,

NV5

Mike F. Coenen, P.E.
Principal Engineer

cc: Al Jaques, CM Services Co.
Chris Nemlowill, Blue Jump Suit LLC and AHI Cannery LLC
Jeff Schatz, Oregon Department of Environmental Quality
Rebecca Digiustino, Oregon Department of Environmental Quality

EAH:MFC:sn
Attachments
One copy submitted
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ACRONYMS AND ABBREVIATIONS

cfm	cubic feet per minute
CMMP	Contaminated Media Management Plan
COC	chemical of concern
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
eV	electronvolt
I.D.	identification
inHg	inches of mercury
iow	inches of water
IRM	Interim Remedial Measure
LUST	Leaking Underground Storage Tank
m^2	square meters
m^3	cubic meters
MEK	methyl ethyl ketone
mg/kg	milligrams per kilogram
MTBE	methyl tertiary-butyl ether
PCE	tetrachloroethene
PFA	perfluoroalkoxy
PID	photoionization detector
PPA	Prospective Purchaser Agreement
RAO	remedial action objective
RBC	risk-based concentration
RBDM	*Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites*
SOW	scope of work
SSD	sub-slab depressurization
SVE	soil vapor extraction
TCE	trichloroethene
TMB	trimethylbenzene
µg	microgram
µg/L	micrograms per liter
$µg/m^3$	micrograms per cubic meter
VOC	volatile organic compound

1.0 INTRODUCTION

This work plan (Plan) presents a scope of work to formally implement a pilot shutdown study associated with SVE system operation at the Former Astoria Warehousing site located at 70 West Marine Drive in Astoria, Oregon (subject property). This Plan was prepared in general accordance with the items discussed with DEQ on April 27, 2022.

1.1 PURPOSE

This Plan specifically presents a scope of work to (1) evaluate if permanent cessation of the active SVE remediation system is feasible and (2) monitor the effects and potential rebound conditions associated with proposed permanent cessation of the SVE system that was designed and installed at the subject property in general accordance with PPA requirements. A detailed description of the SVE system design, installation, and operations is presented in the following reports:

- GeoDesign, Inc., 2020. *Revised Interim Remedial Measure Work Plan; Former Astoria Warehousing Site; 70 West Marine Drive; Astoria, Oregon,* dated October 29, 2020.
- GeoDesign, Inc. dba NV5, 2021. *Annual Report – 2020; Former Astoria Warehousing Site; 70 West Marine Drive; Astoria, Oregon,* dated March 22, 2021.
- NV5, 2022. *Annual Report – 2021; Former Astoria Warehousing Site; 70 West Marine Drive; Astoria, Oregon,* dated March 18, 2022.

This Plan also presents a schedule for data collection and reporting of relevant data, and a contingency plan to address unacceptable rebound conditions, if encountered.

The subject property is shown relative to surrounding physical features on Figure 1. The subject property layout and surrounding properties are shown on Figures 2 and 3. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 BACKGROUND

This section presents a brief summary of the remedial objectives established in developing the PPA SOW, and also presents a summary of SVE system operations and efficacy as described in more detail in the aforementioned reports.

2.1 PPA REQUIREMENTS

Blue Jump Suit LLC and AHI Cannery LLC, on behalf of Fort George Brewery, entered into a PPA with DEQ in October 2019. The Covid-19 pandemic and subsequent emergency declarations resulted in severe adverse impacts to personnel, project schedule, and budget for the project. As a result, the scope of work presented in the original PPA was amended by DEQ to allow greater flexibility in the work performed and timeframe for its completion. The PPA amendment was transacted on May 28, 2020, and included the following general elements:

- Short-Term Measures
  - Sealing of the concrete slab of the north and east portions of the former can manufacturing warehouse and the former shop building.
  - Quarterly gauging of monitoring wells and removal of free product (greater than 0.02 foot thick).
  - Annual indoor air sampling using a passive diffusion-type air sampler.
  - Semi-annual groundwater monitoring of the eight monitoring wells for one year following approval of the original scope of work (October 2019). Annual groundwater monitoring of the eight monitoring wells after the first year.
- Long-Term Measures
  - Implementation of an active remedy within five years of the PPA amendment. Continuing operation of the SVE system until performance metrics are achieved.
  - If necessary, prepare a Remedial Action Plan presenting a final design for long-term active remediation technologies.
  - If necessary, enter into an Easement and Equitable Servitude.
  - Implement the DEQ-approved CMMP during earthwork conducted at the subject property.

To support the short-term and long-term measures described above, the IRM (GeoDesign, Inc., 2020) established a detailed scope of work to implement an active remedy (SVE) and to monitor groundwater, sub-slab vapor, and indoor air conditions at the subject property. The IRM established a schedule for data collection efforts following the first year of SVE system operation as follows:

- Annual groundwater monitoring
- Annual indoor air sampling
- Annual sub-slab vapor monitoring and sampling
- Semi-annual SVE effluent sampling and sub-slab vacuum pressure measurements
- Routine SVE system performance monitoring and observation/documentation of riverbank conditions

Descriptions of the concrete floor slab sealing activities and the installation, startup, and initial operation of the SVE system, as well as other monitoring activities conducted to date are presented in our 2020 Annual Report (GeoDesign, Inc. dba NV5, 2021) and Annual Report – 2021 (NV5, 2022).

2.2 REMEDIAL ACTION OBJECTIVES

The DEQ-approved IRM work plan presented the following RAOs specific to the design and operation of the SVE system installed at the subject property in December 2020:

- Sub-Slab Vapor: Beneath the floor slab, reduce and maintain sub-slab vapor concentrations to levels below the DEQ *Vapor Intrusion into Building*s RBCs for an occupational receptor.
- Indoor Air: Maintain indoor air concentrations to levels below the DEQ *Inhalation* RBCs for an occupational receptor.

- Contaminant Mass:[1] Remove approximately 50 percent of the estimated mass of gasoline and benzene in the vadose zone. Remove contaminant mass until asymptotic recovery is achieved and sustained for one year and/or sub-slab vapor concentrations exhibit decreasing trends for a minimum of three consecutive events.

2.3 SVE SYSTEM OPERATIONAL SUMMARY

2.3.1 General

We designed an SVE system based on a pilot study conducted at the subject property in December 2019. The SVE system was designed to (1) remediate impacted vadose-zone soil identified beneath the former shop building, the east portion of the former can manufacturing warehouse, and the east parking lot; (2) remediate vapors identified beneath the east portion of the subject property at concentrations greater than applicable DEQ RBCs; and (3) allow active and/or passive removal of accumulated sub-slab vapors in the future, if necessary. A description of the SVE system components, installation, and startup is summarized in the revised IRM work plan (GeoDesign, 2020) and the 2020 Annual Report (GeoDesign, Inc. dba NV5, 2021).

2.3.2 SVE System Operation and Monitoring

During calendar year 2021, NV5 conducted routine SVE system monitoring activities in general accordance with the quarterly schedule established in the IRM work plan. SVE system monitoring events included the following:

- Conducted a visual inspection of the system and its components for damage and wear in accordance with equipment manufacturer's recommendations.
- Checked condensate levels in the moisture knockout vessel and removed accumulated condensate as necessary.
- Recorded operating pressures/vacuums, temperatures, and flow rates to evaluate if the system is operating within the design criteria.
- Performed necessary system adjustments.
- Collected field meter readings (PID,[2] flow rate, vacuums, etc.).
- Recorded operational parameters for vapor effluent treatment equipment.
- Recorded vacuum response measurements from selected observation points.
- Collected pre-treatment effluent samples.
- Evaluated groundwater elevation data for potential mounding associated with SVE system operation.
- Recorded other pertinent information concerning the system operations and maintenance.

2.3.2.1 System Parameters and Induced Vacuum

During each SVE system monitoring event, we collected system measurements for the overall system and each SVE well, exhaust temperature, stack temperature, fresh air dilution, and pre-treatment PID readings.

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[1] Estimated contaminant mass of gasoline and benzene in the vadose zone was calculated by dividing the impacted portion of the subject property into four zones based on severity of detected impacts, as shown on Figure 13 of the IRM work plan. NV5 calculated the total estimated mass of gasoline and benzene in the vadose zone beneath the impacted portions of the subject property to be approximately 440 pounds and 2.2 pounds, respectively.

[2] PID readings could not be collected from the SVE wells because the PID pump cannot overcome the applied vacuum.

In 2021, the SVE system vacuum ranged from approximately -2.5 to -6.0 inHg. The applied vacuum measured at each SVE well ranged from approximately -49 to -67 iow. The measured flow rate from each SVE well ranged from approximately 92 to 332 cfm, with the highest flow rates originating from SVE-1. The average flow rate of the overall system since initial stabilization is 585 cfm.

Induced vacuum measurements were recorded during monitoring events at each of the SVE observation points (OSVE-1 through OSVE-4) and Vapor Pins® VP-1 through VP-4. In 2021, the vacuum measurements from the SVE observations points in the former shop building (OSVE-1 through OSVE-4) ranged from -6.0 to -14.4 iow. The induced vacuum measurements collected from the sub-slab Vapor Pins® ranged as follows:

- Induced vacuum at Vapor Pin® VP-1 ranged from 0.00 to -0.004 iow
- Induced vacuum at Vapor Pin® VP-2 ranged from 0.00 to -0.11 iow
- Induced vacuum at Vapor Pin® VP-3 ranged from -5.84 to -7.37 iow
- Induced vacuum at Vapor Pin® VP-4 ranged from -0.093 to -0.9 iow

Based on EPA guidance, induced negative pressures of -0.1 iow or greater are considered to be actively remediating soil (U.S. Environmental Protection Agency, 2017). In 2021, an average negative pressure of -0.10 iow or greater was measured in each SVE observation well (OSVE-1 through OSVE-4) and in Vapor Pins® VP-3 and VP-4, but not at Vapor Pins® VP-1 and VP-2. Based on these observations, the radius of remedial influence of the system experienced in 2021 was estimated to be approximately 100 feet.

Locations of the SVE wells, SVE observation points, and Vapor Pins® are presented on Figures 2 and 3.

2.3.2.2 Effluent Sampling and Mass Removal

In the course of SVE system monitoring in 2021, five pre-treatment effluent samples were collected to further evaluate concentration trends and associated remedial efficacy of the SVE system. The results of sample testing included the following:

- Gasoline-range hydrocarbons were detected during the January, March, April, May, and August 2021 effluent sampling events at concentrations of 351,000 $\mu g/m^3$, 1,200,000 $\mu g/m^3$, 781,000 $\mu g/m^3$, 189,000 $\mu g/m^3$, and 512,000 $\mu g/m^3$, respectively.
- Twenty-one VOCs were also detected in the pre-treatment effluent samples collected in 2021 and, in general, appear to follow the same trend as preceding sampling events. Notably, benzene concentrations in the 2021 pre-treated effluent sampling results reflected a sharp reduction since SVE system activation.

Estimated contaminant mass of gasoline and benzene removed by the SVE system was calculated using the (pre-treated) effluent analytical results and the average total flow rate calculated for the SVE system (581 cfm). Through August 10, 2021, approximately 7,262 pounds of gasoline and approximately 29.9 pounds of benzene had been removed by the

SVE system (see Appendix A). In comparison to the preceding effluent sampling results, the 2021 effluent sampling data reflected a substantial decrease in contaminant mass removal rates since system activation in December 2020.

In evaluating the RAO associated with 50-percent contaminant mass removal, the estimated total contaminant mass of gasoline and benzene in the vadose zone was calculated by dividing the impacted portion of the subject property into four zones based on severity of detected impacts, as shown on Figure 13 of the revised IRM work plan. NV5 has updated the calculated total estimated mass of gasoline and benzene in vadose zone vapor (vapor phase), vadose zone soil (solid phase) and groundwater (aqueous phase) beneath the impacted portions of the subject property.[3] Our updated total estimates of gasoline and benzene contaminant mass are approximately 2,639 pounds and 44 pounds, respectively. The contaminant mass calculations (updated from the version in the IRM work plan) are presented in Appendix A.

The calculated mass removal as of August 2021 (see Appendix A) exceeds the total estimated mass of gasoline and is approximately 68 percent of the total estimated mass of benzene. Given the operational issues described herein, it has not been possible to fully evaluate the contaminant mass removal RAO in terms of sustained asymptotic recovery rates and/or reduced sub-slab vapor concentrations measured over several consecutive monitoring events. However, an evaluation of available contaminant mass removal data indicates that more than 50 percent of the total contaminant mass has been removed, and asymptotic-like conditions were achieved relatively quickly following SVE system startup. In conjunction with the overall mass removed by the SVE system, we viewed this as sufficient evidence to support the pursuit of SVE system cessation. Appendix A includes depictions of the aforementioned mass removal rate trends supporting this approach. This RAO was considered to be achieved.

2.3.2.3 Groundwater Measurements

Pressure transducer dataloggers are installed in monitoring wells MW-1 through MW-7 to monitor groundwater levels at 10- to 15-minute intervals. Charts depicting water levels measured by the transducers (before and after SVE system startup) are presented in Appendix B. Based on our review of the transducer data presented in Appendix B, it does not appear that SVE system operation results in any significant groundwater mounding.

2.3.3 SVE Operational Issues

In early December 2021, the SVE system encountered a significant operational issue associated with the gas solenoid valve. The gas solenoid valve provides the only mechanism to supply natural gas to the oxidizer unit in order to sustain requisite temperatures for system operation. NV5 attempted to operate the system without the natural gas makeup component; however, the influent contaminant vapor concentrations have diminished (since system startup) to the point that the oxidizer unit cannot operate solely on the extracted contaminant mass. In consultation with Stratus Corporation, it was determined that a replacement valve would take up to six months to replace due to supply chain constraints. As a result, the 2021 fourth quarter monitoring event did not include the collection of SVE system operational parameters or induced vacuum measurements.

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[3] Previous estimates of contaminant mass did not incorporate the solid and aqueous phase calculations.

Since that time, the SVE system is frequently cycled (which results in the blower running for several minutes until auto-shutdown) to periodically purge the subsurface. The ongoing cycling events result in approximately three minutes of blower run-time before auto-shutdown, and this occurs once to twice per week. Based on our knowledge of blower operational characteristics, we estimate that approximately 1,800 to 3,500 cubic feet of (pore-space) air are purged from the subsurface each week. The goal of this cycling is not focused on additional and/or sustained remedial progress but is to maintain a purged subsurface condition for the time being.

In regard to the unanticipated solenoid valve issue described above, NV5 considered alternative measures to re-initiate the SVE system operation, including modification of the SVE system for use of granular activated carbon as an effluent treatment alternative (which was cost prohibitive), and removal of effluent treatment altogether. In early August 2022, NV5 requested updated information from Stratus Corporation regarding the solenoid valve replacement. However, it should be noted that the cost of natural gas (which has more than doubled in the past year) will cause an economic hardship if DEQ requires re-initiation of the SVE system using the oxidizer effluent treatment. Ultimately, in the context of remedial objectives and based on our assessment of remedial progress achieved to date (see Section 2.3.2.2), we consulted with DEQ in developing this Plan to implement a pilot shutdown study rather than replace the solenoid valve at this time.

3.0 PILOT SHUTDOWN SCOPE

The objective of this Plan is to outline an SOW to assess the following:

- Identify compliance point locations for various media at the subject property.
- Establish a baseline condition for various media at the beginning of the pilot shutdown.
- Establish metrics to assess potential rebound conditions (relative to remedial objectives) in various media representing the remedial focus area.
- Assess the response to SVE system cessation by collecting sub-slab vapor, groundwater, and indoor air data in accordance with the proposed schedule outlined in this Plan.

Table 1 presents a summary of proposed pilot shutdown data collection activities, which are described in detail in the following sections.

The term “rebound” in the context of remedial systems evaluation is not precisely defined due to the site-specific complexities and RAOs for individual sites. In general, we define rebound as an equilibrium condition reflecting elevated constituent concentrations relative to equilibrium conditions during active remediation. In light of the RAOs established for the subject property, equilibrium (or consistently increasing) concentrations of constituents in sub-slab vapor and/or indoor air that exceed respective DEQ RBCs for occupational workers will be considered a condition warranting additional or contingency measures. For the purposes of this Plan, media-specific definitions of “rebound” are presented in the subsections that follow. Proposed contingency measures are summarized in Section 5 of this Plan.

3.1 SUB-SLAB VAPOR MONITORING

3.1.1 Compliance Points

We propose to utilize each of the existing monitoring sub-slab sampling points (Vapor Pins® VP-1 through VP-4) as compliance sampling points for the purposes of this study, as shown on Figure 2. Additional non-compliance points SVE observation wells OSVE-1 through OSVE-4 may also be utilized for data collection and evaluation purposes.

3.1.2 Baseline Condition

The most recent sub-slab vapor sampling activities were completed on August 11, 2021. At that time, the SVE system had been in continuous operation since December 18, 2020 (approximately eight months). With the exception of VP-1, the results of the August 2021 sub-slab sampling event represented the lowest sub-slab vapor concentrations measured at the subject property and were substantially less than applicable DEQ RBCs. We propose to utilize the August 2021 sub-slab vapor sampling results as the baseline condition for the purposes of this study. A summary of sub-slab vapor concentrations measured at the subject property are presented in Table 2.

For sub-slab vapor, rebound will be defined as those concentrations exceeding the August 2021 baseline sub-slab vapor concentrations for two consecutive quarterly monitoring events or increasing concentrations, as demonstrated by a trend evaluation, over three consecutive monitoring events. Contingency measures (see Section 5) will be triggered if rebound conditions are met, or if sub-slab concentrations exceed the applicable DEQ RBC for occupational workers in two consecutive quarterly monitoring events.

3.1.3 Data Collection and Analysis

Consistent with the procedures previously outlined in the IRM work plan, sub-slab vapor sampling will consist of quarterly collection of samples from the four sampling locations previously installed in the former can manufacturing warehouse and shop (VP-1 through VP-4). Specifically, each Vapor Pin® will be sampled as follows:

- Access the Vapor Pins™ and connect to a micromanometer. Record ambient sub-slab pressure/vacuum at each monitoring point.
- Connect each Vapor Pin™ to laboratory-provided 1-liter Summa canisters and sampling trains using new, disposable PFA tubing.
- Install a leak-check system at each location following DEQ-established protocol. The leak-check system will consist of placing rags saturated with isopropanol around the fittings and the ground penetration. Each sub-slab vapor sample will be analyzed for isopropanol to evaluate if the sampling system was sufficiently sealed.
- Each sample will be purged of approximately 2 to 3 volumes of dead air space (tubing and sampling train) using a calibrated 10.6-eV PID. Record the PID reading before sample collection.
- Collect the sample using a 1-liter Summa sample canister with an in-line filter (0.7 micron) and flow controller (less than 200 milliliters per minute). The initial and final vacuum pressures of the Summa canister will be measured and recorded on the laboratory chain-of-custody form. The sub-slab vapor samples will be analyzed for gasoline-range hydrocarbons and VOCs by EPA Method TO-15.

Forthcoming sub-slab vapor chemical analytical data will be evaluated with respect to the baseline condition and applicable RBCs for occupational worker exposure scenarios.

3.2 GROUNDWATER MONITORING

3.2.1 Compliance Points

The requirement for annual groundwater monitoring of all on-site monitoring wells as prescribed in the PPA SOW will continue (planned for late summer 2022). However, for the purposes of this study we propose to monitor a specific subset of monitoring wells in direct proximity to the SVE influence area on a quarterly basis. We propose to use monitoring wells MW-1, MW-2, MW-6, MW-7, and MW-8 for this purpose, as well as OAS-3. The wells comprise the closest array of wells to the SVE influence area, and wells OAS-3 and MW-8 are included due to the historic and sporadic observation of free product. Table 1 summarizes the proposed monitoring activities. The collection of depth-to-water and depth-to-product measurements, as well as groundwater sampling procedures, will be completed in a consistent fashion to prior monitoring events.

3.2.2 Baseline Condition

The most recent groundwater monitoring activities were completed in January 2022. As summarized in the draft 2021 Annual Report, this monitoring event generally reflects the lowest concentrations of petroleum compounds and constituents measured in the selected array of compliance monitoring wells to date. We propose to utilize the January 2022 groundwater results as the baseline condition for the purposes of this study. A summary of groundwater chemical analytical results for on-site monitoring wells at the subject property is presented in Table 3.

For groundwater, rebound will be defined as those concentrations exceeding the January 2022 baseline groundwater concentrations for two consecutive quarterly monitoring events or increasing concentrations, as demonstrated by a trend evaluation, over three consecutive monitoring events. Contingency measures (see Section 5) will be triggered if rebound conditions are met, or if sub-slab concentrations exceed the applicable DEQ RBC for occupational workers in two consecutive quarterly monitoring events. Given the provisions in the CMMP for construction/excavation workers, the triggering of contingency measures will be limited to those concentrations exceeding the volatilization and vapor intrusion pathways for occupational workers.

3.2.3 Data Collection and Analysis

The purpose of monitoring the specific array of wells is to evaluate potential rebound of petroleum hydrocarbons and/or constituents and to evaluate for the recurrence of measurable free product in the selected array of wells. Within the selected array of compliance groundwater sampling points, only wells OAS-3 and MW-8 have exhibited measurable free product, which is the basis for their inclusion (for gauging) in the compliance point array.

3.3 INDOOR AIR MONITORING

3.3.1 Compliance Points

The requirement for indoor monitoring as prescribed in the PPA SOW will continue, with the next event planned for late summer/early fall 2022. During the pilot shutdown study, indoor air sampling frequency will be conducted semi-annually. Forthcoming indoor air sampling locations will be consistent with those locations previously monitored, which include seven indoor air sample locations (Indoor-1 through Indoor-7) and one outdoor/background sampling location.

3.3.2 Baseline Condition

The most recent indoor air monitoring activities were completed in August 2021. To date, petroleum constituents have not been detected at concentrations exceeding applicable DEQ RBCs (including the monitored interval before SVE operation). For the purposes of evaluating the potential rebound conditions associated with SVE system cessation, the August 2021 sample results will be used to represent baseline conditions. A summary of indoor air chemical analytical results at the subject property is presented in Table 4.

For indoor air, data will be used to confirm that indoor air concentrations are protective of occupational workers. Contingency measures (see Section 5) will be triggered if indoor air concentrations for site COCs exceed the applicable DEQ RBC for occupational workers in any single monitoring event and implemented in consultation with DEQ.

3.3.3 Data Collection and Analysis

The methods of data collection and analysis of forthcoming indoor air samples will be consistent with those previously used at the subject property, as discussed in prior reports.

4.0 SCHEDULE

A tentative schedule for implementation of the scope items described herein is summarized in Table 1. For the purposes of this pilot shutdown evaluation, four consecutive quarters of data collection and evaluation will be used and shall include a "wet season" event and a "dry season" event. If rebound conditions (as defined herein) are not observed over this period and concentrations of contaminant constituents in sub-slab vapor, groundwater, and indoor air remain less than applicable RBCs and do not exhibit significant increasing trends, we will seek concurrence with DEQ for SVE system decommissioning and termination of the monitoring activities associated with the PPA requirements.

Forthcoming data will be evaluated in consultation with DEQ. If the established monitoring schedule requires modification based on forthcoming data, the schedule may be modified accordingly.

5.0 CONTINGENCY PLAN

If forthcoming data indicate that rebound is occurring and/or petroleum constituents in sub-slab vapor, groundwater, and/or indoor air begin to exceed applicable DEQ RBCs, the condition(s) will trigger contingency measures as described in the sections below. Contingency measures will be identified and implemented in consultation with DEQ.

5.1 SUB-SLAB VAPOR EXCEEDANCES

5.1.1 Approach

If forthcoming sub-slab vapor data reflect rebound conditions, we propose to address the response by ventilating/depressurizing the vadose zone in relevant areas of the subject property. An increased frequency of indoor air monitoring and active building ventilation measures may also be concurrently employed in consultation with DEQ.

The process of ventilating/depressurizing the vadose zone (that is, SSD) can be achieved using existing elements of the SVE system (e.g., extraction wells SVE-1, SVE-2, and/or SVE-3). If contingency measures are warranted, we propose to use the SVE extraction well(s) by installing one or more relatively low-energy fans (similar to radon mitigation fans, which are readily available) on the SVE extraction well risers where they currently stub-up at the SVE equipment enclosure. A riser section (exhaust stack) extending to the roofline would be installed at the discharge end of the fan(s).

Based on our experience with similar applications, these low-energy SSD systems can operate at vacuums ranging from approximately 20 to 50 iow and can achieve flow rates ranging from approximately 20 to 100 cfm depending on subsurface conditions.[4] Given the permeable conditions at the subject property, we anticipate that extraction rates would be on the higher end of this range at relatively low applied vacuum. For SSD system applications intended to address vapor intrusion concerns, the EPA recommends that SSD systems achieve an induced vacuum of 0.02 iow or greater (EPA, 2008) in target influence areas. Given our experience at the subject property and similar sites with highly permeable subgrade materials, we anticipate that the subject property is well suited for this application.

Extraction well SVE-1 is situated within the shop structure and would likely represent the first choice for installation of a ventilation fan, if sub-slab/indoor air conditions warrant. If implemented, ventilation of the subgrade would occur in progressive steps. Specifically, if multiple fans/extraction wells are warranted, they would be installed and initiated individually in order to establish performance metrics on an individual fan/ventilation point basis.

Specifics associated with the contingency plan (an SSD system) will be discussed with and approved by DEQ before implementation, including decommissioning and removal of the aboveground components of the SVE system.

5.1.2 Contingency Measure Monitoring

If the installation of one or more ventilation fans is warranted, performance metrics will be obtained to assess SSD system efficacy. Specifically, the following information will be recorded at relevant observation points (e.g., vapor pins and other available vadose/sub-slab zone observation points in relevant areas):

- Applied vacuums and extraction flow rates for each fan.
- Induced vacuum at available observation points[5] (see Figure 2):

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4 Subsurface conditions dictate the vacuum/flow operational characteristics of extraction fans, which are suitable for "stacked" configurations to achieve the desired effect at relevant compliance points.

5 A target-induced vacuum level of 0.02 iow is recommended by EPA for these applications.

- VP-1 through VP-4
- OSVE-1 through OSVE-4

- PID readings at available observation points and within extracted vapor streams upstream of the ventilation fan(s).
- Sub-slab sampling for petroleum constituents in accordance with the quarterly sampling program previously described.
- Effluent sampling to characterize theoretical emissions associated with the contingency measure.

If implemented, these performance metrics will be monitored on the following proposed schedule:[6]

- Daily for the first five days of fan operation
- Weekly for the first month of fan operation
- Quarterly after the first month of fan operation

Performance monitoring data collected over the course of the first quarter of operation will be evaluated in conjunction with sub-slab vapor concentration data to make recommendations for longer-term operation, monitoring, and possible modification of the SSD system based on performance data. If determined to be an appropriate contingency response, additional details regarding the performance criteria and monitoring requirements for the SSD system will be provided in a separate document for DEQ review and approval.

If the initial operational data for the proposed contingency measure indicate insufficient response to rebound conditions, we will engage DEQ in making a recommendation to re-start the SVE system as warranted based on forthcoming performance data.

5.2 GROUNDWATER EXCEEDANCES

If forthcoming groundwater monitoring data reflect a rebound condition, the following contingency measures may be employed:

- The frequency of sub-slab vapor monitoring may be increased.
- The frequency of monitoring well gauging may be increased.
- The frequency of indoor air monitoring may be increased.
- Riverbank observations may revert to a monthly or other schedule approved by DEQ.

If executed, contingency measures associated with rebounding groundwater concentrations will be discussed with and approved by DEQ before implementation.

5.3 INDOOR AIR EXCEEDANCES

Indoor air quality data are used to confirm that indoor air concentrations are protective of occupational workers. Contingency measures will be triggered if indoor air concentrations for site COCs exceed the applicable DEQ RBC for occupational workers in any single monitoring event and implemented in consultation with DEQ. A “rebound” condition would presumably

[6] With the exception of sub-slab vapor sampling for chemical analysis, which will continue on a quarterly basis.

reflect the rebound condition in subsurface media, which is addressed in relevant sections of this document. In conjunction with the implementation of contingency measures for subsurface media, active building ventilation using fans may be employed in consultation with DEQ.

6.0 REPORTING

NV5 will prepare and furnish quarterly reports to DEQ upon initiation of this plan. In addition to other elements of reporting associated with the overall PPA scope, each quarterly report will include (1) a brief discussion of activities associated with execution of this Plan, (2) a presentation of relevant site data and a discussion of data trends for various media, and (3) recommendations associated with contingency measures, as appropriate.

The fourth quarter monitoring report will present the results of all trend evaluations, including discussion and recommendations regarding whether the data support permanent shutdown of the SVE system.

♦ ♦ ♦

We appreciate the opportunity to be of service. Please call if you have questions regarding this Plan.

Sincerely,

NV5

Erik A. Hedberg, P.E., C.W.R.E.
Associate Engineer

Mike F. Coenen, P.E.
Principal Engineer

REFERENCES

GeoDesign, Inc., 2020. *Revised Interim Remedial Measure Work Plan; Former Astoria Warehousing Site; 70 West Marine Drive; Astoria, Oregon,* dated October 29, 2020. GeoDesign Project: BigBeams-1-04-03

GeoDesign, Inc. dba NV5, 2021. *Annual Report – 2020; Former Astoria Warehousing Site; 70 West Marine Drive; Astoria, Oregon,* dated March 22, 2021. BigBeams-1-04-05

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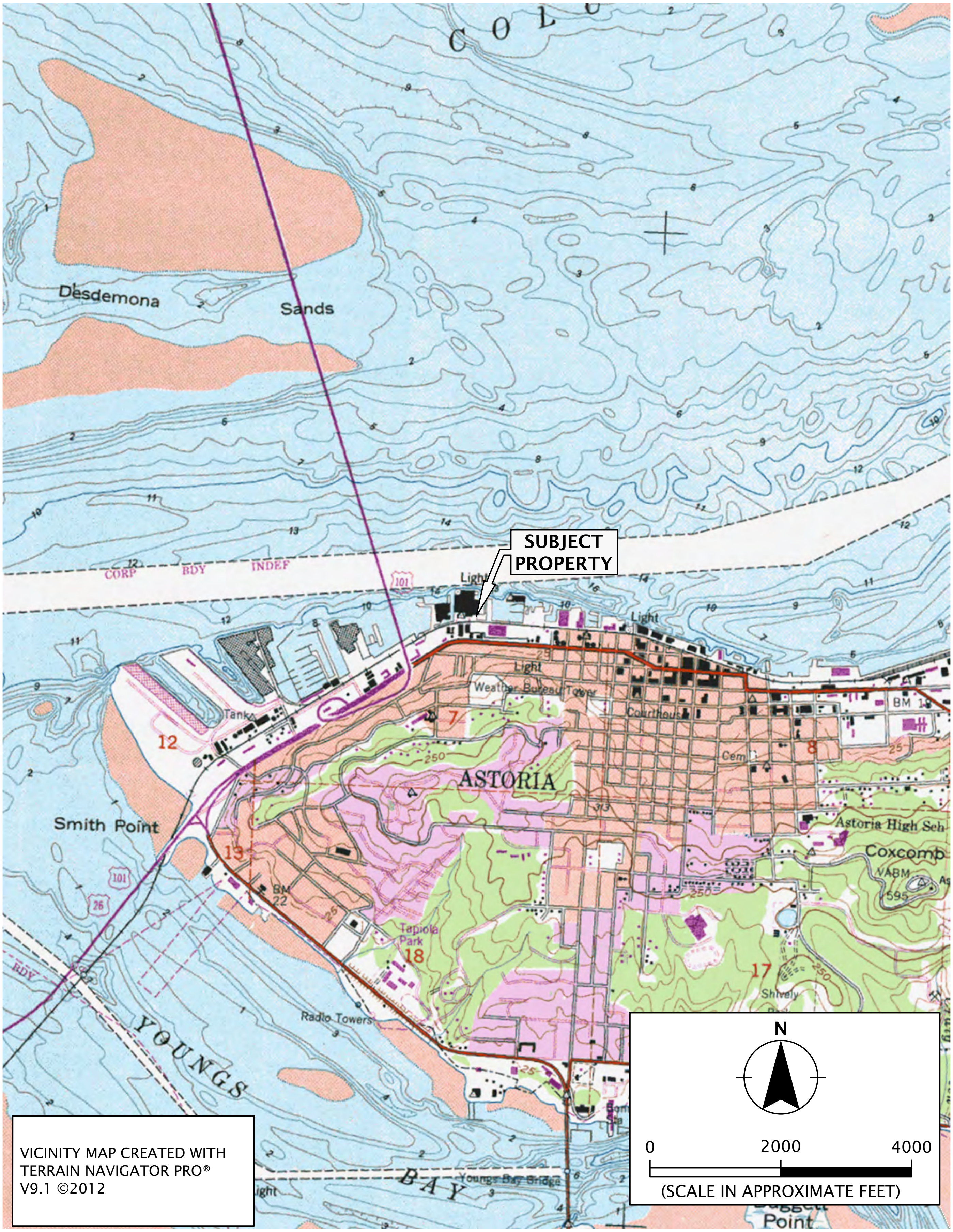
U.S. Environmental Protection Agency, 2017. *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, A Guide for Corrective Action Plan Reviewers*, Land and Emergency Management, EPA 510-B-17-003, dated October 2017.

FIGURES



VICINITY MAP CREATED WITH
TERRAIN NAVIGATOR PRO®
V9.1 ©2012

NV5	BIGBEAMS-1-04-05	**VICINITY MAP**	
	SEPTEMBER 2022	FORMER ASTORIA WAREHOUSING SITE ASTORIA, OR	**FIGURE 1**

Printed By: mmiller | Print Date: 9/8/2022 1:58:34 PM
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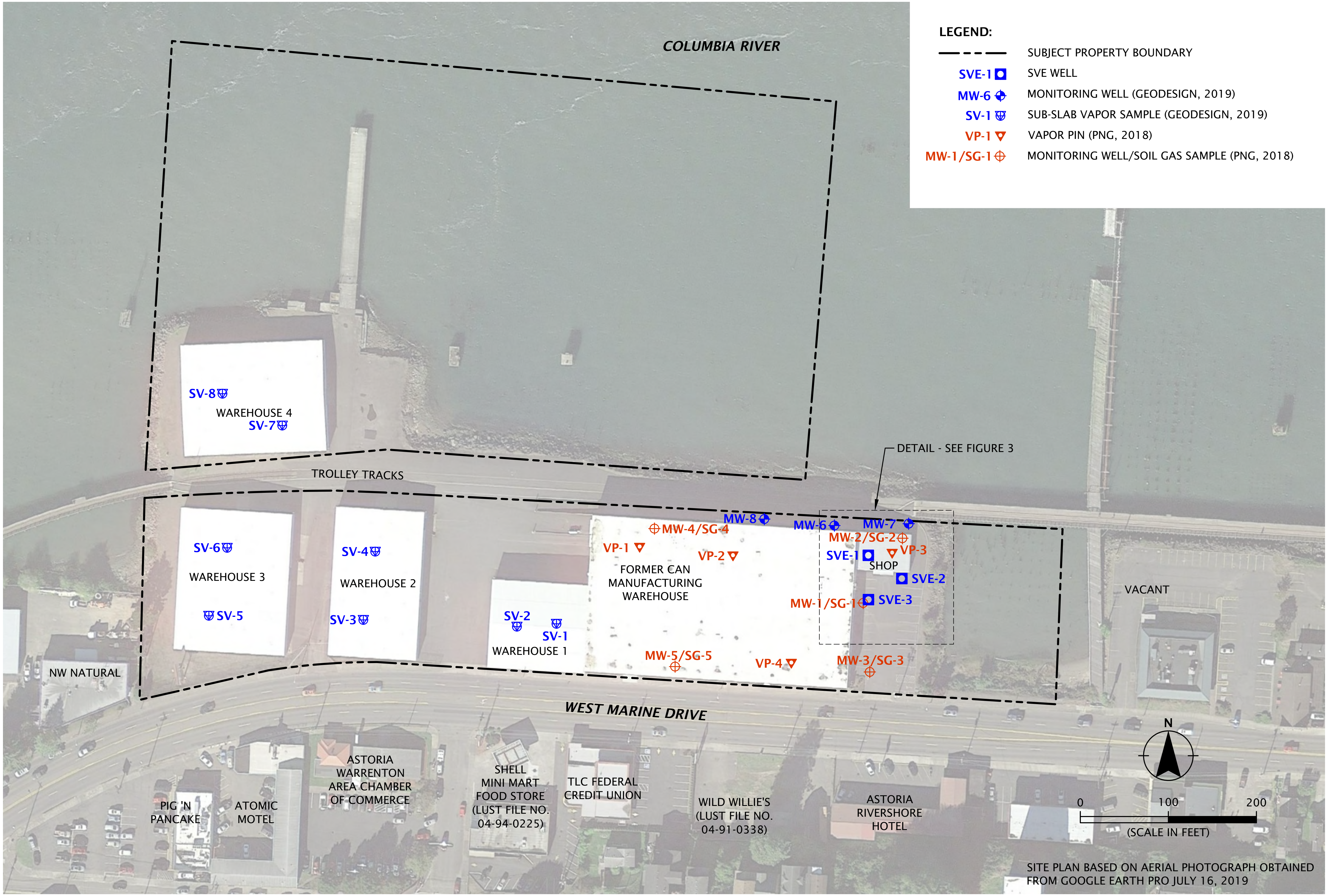

FIGURE 2

SITE PLAN

FORMER ASTORIA WAREHOUSING SITE
ASTORIA, OR

BIGBEAMS-1-04-05

SEPTEMBER 2022

NV5

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LEGEND:

— - —	SUBJECT PROPERTY BOUNDARY
- - - -	PIPING TRENCH
(hatched)	SYSTEM ENCLOSURE
SVE-1	SOIL VAPOR EXTRACTION WELL
MW-6	MONITORING WELL (GEODESIGN, 2019)
VP-3	VAPOR PIN (PNG, 2018)
MW-1/SG-1	MONITORING WELL/SOIL GAS SAMPLE (PNG, 2018)
OAS-1	AIR SPARGING OBSERVATION WELL (GEODESIGN, 2019)
PAS-1	AIR SPARGING PILOT WELL (GEODESIGN, 2019)
OSVE-1	SOIL VAPOR EXTRACTION OBSERVATION WELL (GEODESIGN, 2019)

NOTE:
1. SVE-1 WAS PREVIOUSLY LABELED PSVE-1.

N

0 15 30

(SCALE IN FEET)

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO JULY 16, 2019

FIGURE 3

SITE PLAN - DETAIL

FORMER ASTORIA WAREHOUSING SITE
ASTORIA, OR

BIGBEAMS-1-04-05

SEPTEMBER 2022

NV5

Printed By: mmiller | Print Date: 9/8/2022 1:59:05 PM
File Name: J:\A-D\BigBeams\BigBeams-1\BigBeams-1-04\BigBeams-1-04-05- Monitoring\Figures\CAD\Pilot Shutdn Wrk Pln\BigBeams-1-04-05-SP01.dwg | Layout: FIGURE 3

TABLES

TABLE 1
Summary of Proposed Pilot Shutdown Monitoring
Former Astoria Warehousing Site
Astoria, Oregon

Scope	Data Collection Points		Quarterly Monitoring				Semi-Annual Monitoring	Annual Monitoring
			Sample Collection	PID Reading	Vacuum/ Pressure Reading	Piezometric and Free Product Gauging	Sample Collection	Sample Collection
Sub-Slab Vapor Monitoring	Compliance Points	VP-1	X	X	X	--	--	X
		VP-2	X	X	X	--	--	X
		VP-3	X	X	X	--	--	X
		VP-4	X	X	X	--	--	X
	Additional Data Points	OSVE-1	--	X	X	--	--	--
		OSVE-2	--	X	X	--	--	--
		OSVE-3	--	X	X	--	--	--
		OSVE-4	--	X	X	--	--	--
Groundwater Monitoring	Compliance Points	MW-1	X	--	--	X	--	X
		MW-2	X	--	--	X	--	X
		MW-6	X	--	--	X	--	X
		MW-7	X	--	--	X	--	X
		OAS-3[1]	--	--	--	X	--	--
	Additional Data Points	MW-3	--	--	--	X	--	X
		MW-4	--	--	--	X	--	X
		MW-5	--	--	--	X	--	X
		MW-8	X	--	--	X	--	X
Indoor Air Monitoring	Compliance Points	Indoor-1	--	--	--	--	X	--
		Indoor-2	--	--	--	--	X	--
		Indoor-3	--	--	--	--	X	--
		Indoor-4	--	--	--	--	X	--
		Indoor-5	--	--	--	--	X	--
		Indoor-6	--	--	--	--	X	--
		Indoor-7	--	--	--	--	X	--

Notes:
Anticipated date for the first quarterly pilot shutdown monitoring event is July 2022, which is approximately one year after the prior monitoring event for sub-slab vapor and indoor air completed in August 2021.
Anticipated date for the second quarterly pilot shutdown monitoring event is October 2022.
Anticipated date for the third quarterly pilot shutdown monitoring event is January 2023.
Anticipated date for the fourth quarterly pilot shutdown monitoring event is April 2023.
1. Observation well OAS-3 is not proposed for groundwater sample collection because required baseline data does not exist and monitoring well MW-2 is positioned near this location.
--: not analyzed
X: item designated for sample or data collection

TABLE 2
Summary of Sub-Slab Vapor Sample Chemical Analytical Results
Gasoline-Range Hydrocarbons and VOCs
Former Astoria Warehousing Site
Astoria, Oregon

Sample I.D.	Sample Date	Gasoline-Range Hydrocarbons EPA Method TO-03/15 (µg/m³)	VOCs[1] EPA Method TO-15 (µg/m³)										
			Benzene	Ethylbenzene	iso-Propylbenzene	Naphthalene	2-Propanol	Styrene	Toluene	1,2,4-TMB	1,3,5-TMB	m,p-Xylene	o-Xylene
VP-1	09/24/18	18,000	79	360	30	43	17 U	6.4 U	6.4	690	150	640	
	06/28/19	32,000 U	2.3 U	2.3 U	2.3 U	2.3 U	9.4 U	2.4 U	4.9	2.4 U	2.4 U	4.9 U	2.4 U
	12/17/20	500 U	3.9 U	5.3 U	6.0 U	--	56	5.2 U	4.6 U	6.0 U	6.0 U	5.3 U	5.3 U
	08/11/21	2,610	0.639 U	0.867 U	0.983 U	3.30 U	6.59	0.851 U	1.88 U	4.06	1.12	1.78	0.867 U
VP-2	09/24/18	27,000	100	510	43	130	17 U	6.0 U	6.4	1,300	260	893	
	06/28/19	33,000 U	2.4 U	2.4 U	2.4 U	2.3 U	14	2.4 U	3.9	2.4 U	2.4 U	5.0 U	2.4 U
	12/17/20	480 U	3.7 U	5.0 U	5.7 U	--	11 U	5.0 U	4.4 U	5.7 U	5.7 U	5.0 U	5.0 U
	08/11/21	826 U	0.639 U	0.867 U	0.983 U	3.30 U	5.97	0.851 U	1.88 U	2.80	1.01	1.73 U	0.867 U
VP-3	09/24/18	61,000,000	650,000	210,000	7,500 U	32,000 U	3.9 U	1.3 U	5,800 CN, J	20,000	11,000	267,000	
	06/28/19	58,000,000	530,000	67,000	9,500 U	9,100 U	38,000 U	9,500 U	9,500 U	13,000	9,500 U	120,000	9,500 U
	12/17/20	57,000,000	470,000	210,000	5,900	--	6,400 U	2,800 U	2,700	62,000	25,000	240,000	4,400
	08/11/21	24,400	130	67.6	10.2	3.30 U	3.07 U	0.851 U	3.44	395	154	156	6.46
VP-4	09/24/18	4,900,000	1,800	1,600	380 U	1,600 U	750 U	320 U	290 U	920	470	1,400	
	06/28/19	1,200,000	130 U	130 U	130	130 U	520 U	130 U	130 U	130 U	130 U	270 U	130 U
	12/17/20	6,100,000	830 U	1,100 U	1,300 U	--	2,600 U	1,100 U	980 U	1,300 U	1,300 U	1,100 U	1,100 U
	08/11/21	6,570	1.70	0.867 U	0.983 U	3.3 U	6.00	0.851 U	1.88 U	6.48	1.84	1.73 U	0.867 U
DEQ Generic RBCs[2]													
Vapor Intrusion into Buildings													
Occupational		1,700,000	1,600	4,900	1,800,000	360	NE	4,400,000	21,900,000	260,000	260,000	440,000	

Notes:
1. Only VOCs detected with regulatory screening values are listed. For a complete listing of VOCs, refer to the laboratory report in Appendix C.
2. DEQ Generic RBCs dated May 2018.
CN: High concentration of VOCs required an off-line dilution using a Tedlar bag. Toluene is a common contaminant in Tedlar bags and a CN-flag was applied to indicate a high bias.
J: The result is an estimated quantity.
NE: not established
U: Not detected. Reporting or detection limit shown.
Bolding indicates analyte detection.
Shading indicates analyte detection at a concentration greater than DEQ RBCs.
--: not analyzed

TABLE 3
Summary of Monitoring Well Groundwater Sample Chemical Analytical Results
Gasoline-Range Hydrocarbons and RBDM VOCs
Former Astoria Warehousing Site
Astoria, Oregon

Monitoring Well	Sample Date	Gasoline-Range Hydrocarbons Method NWTPH-Gx (µg/L)	RBDM VOCs EPA Methods 8260B/8260D (µg/L)																	
			Benzene	n-Butylbenzene	sec-Butylbenzene	tert-Butylbenzene	1,2-Dibromoethane	1,2-Dichloroethane	cis-1,2-Dichloroethene	Ethylbenzene	Isopropylbenzene	P-Isopropyltoluene	MTBE	Naphthalene	n-Propylbenzene	Toluene	1,2,3-TMB	1,2,4-TMB	1,3,5-TMB	Total Xylenes
MW-1	10/03/18	19,900	1,000	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	--	1,090	98.4	7.60	11.5	397	83.1	25.1	--	54.5	40.6	196
	11/15/19	6,280	292	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	--	529	25.3	5.00 U	5.06	174	73.9	6.36	--	5.82	5.00 U	29.1
	06/25/20	12,100	854	--	--	--	1.26 U	0.819 U	--	1,720	83.8	--	9.69 J	546	203	20.1	--	6.97 J	8.90 J	64.7
	08/11/21	12,700	663	--	--	--	10.0 U	10.0 U	--	1,780	74.1	--	7.40 J	505	247	15.3	--	10.0 U	6.37 J	37.5
	01/04/22	2,710	37.4	4.39	3.49	0.567 J	1.00 U	1.00 U	1.00 U	116	20.4	1.17	3.37 C3	51.0	60.8	2.15	40.4	0.396 J	0.914 J	7.19
MW-2	10/03/18	34,500	2,320	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	--	1,690	89.6	21.7	26.0	465	277	52.3	--	1,650	370	3,180
	11/15/19	7,000	416	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	--	290	36.3	10.0 U	14.1	80.7	72.0	11.1	--	207	49.6	335
	06/25/20	6,160	625	--	--	--	0.126 U	0.0819 U	--	375	61.5	--	13.4	70.8	103	9.56	--	72.4	51.2	347
	08/11/21	2,580	119	--	--	--	10.0 U	10.0 U	--	12.0	37.1	--	12.0	33.1 J	68.3	4.81 J	--	10 U	10.9	15.1 J
	01/04/22	2,720	134	4.36	3.92	1.00 U	1.00 U	1.00 U	1.00 U	53.5	32.8	0.640 J	7.53 C3	17.5	76.6	7.58	16.8	14.6	15.8	40.9
MW-3	10/03/18	148 B, J	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	--	0.500 U	0.500 U	0.500 U	1.30	2.50 U	0.500 U	0.500 U		0.500 U	0.500 U	1.50 U
	11/15/19	370	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	--	1.00 U	4.19	1.00 U	6.68	5.00 U	1.23	1.00 U		1.00 U	1.00 U	3.00 U
	06/25/20	634 B	0.09 U	--	--	--	0.126 U	0.0930 J	--	13.9	21.3	--	2.47	3.10 J	25.9	0.643 J		0.742 J	1.67	2.99 J
	08/11/21	603	1.00 U	--	--	--	1.00 U	1.00 U	--	1.00 U	11.4	--	9.01	5.00 U	17.6	0.716 U		1.00 U	0.256 J	1.60 J
	01/04/22	224	0.218 J	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.364 J	0.311 J	0.308 J	1.00 U	1.15 C3	1.77 J, B	0.550 J	1.00 U	0.360 J	1.00 U	0.212 J	0.662 J
MW-4	10/03/18	6,080	133	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	--	168	18.7	3.99	6.45	33.0	65.0	82.1	--	167	56.1	757
	11/15/19	10,600	561	25.0 U	25.0 U	25.0 U	25.0 U	25.0 U	--	493	30.5	25.0 U	25.0 U	133	80.3	90.0	--	456	113	1,660
	06/25/20	17,000	1,060	--	--	--	2.52 U	1.64 U	--	1,190	44.3	--	2.66 J	247	102	138	--	660	179	3,420
	08/11/21	10,500	634	--	--	--	20.0 U	20.0 U	--	991	51.2	--	2.82 J	306	150	40.1	--	569	90.8	1,220
	01/04/22	21,200	289	4.09 J	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	206	27.1	11.2	3.70 C3, J	179	74.5	43.8	381	805	238	3,880
MW-5	10/03/18	6,010	167	0.500 U	14.3	0.500 U	0.500 U	0.500 U	--	88.2	49.0	2.25	0.500 U	14.9	184	9.37	--	16.0	5.84	16.0
	11/15/19	3,420	83.5	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	--	48.2	23.8	10.0 U	10.0 U	50.0 U	79.8	10.0	--	10.4	10.0 U	30.0 U
	06/25/20	3,150	38.3	--	--	--	0.126 U	0.0819 U	--	90.6	31.6	--	0.101 U	29.2	76.4	7.79	--	5.86	3.37	13.0
	08/11/21	4,870	55.8	--	--	--	1.00 U	1.00 U	--	170	53.0	--	1.00 U	51.5	197	9.94	--	1.15	2.13	16.5
	01/04/22	1,800	3.52	11.8	12.8	0.308 J	1.00 U	1.00 U	1.00 U	2.40	12.1	1.16	9.40 C3	1.19 J, B	52.6	0.685 J	0.873 J	1.00 U	0.615 J	2.07 J
MW-6	12/07/19	23,700	796	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	--	1,980	129	18.0	12.8	268	345	71.7	--	926	273	2,390
	06/25/20	72,200	681	--	--	--	0.6 U	0.4 U	--	459	78.8	--	16.8	102	171	37.5	--	258	94.5	582
	08/11/21	4,340	380	--	--	--	5.00 U	5.00 U	--	71.4	26.7	--	16.0	30.2	72.6	32.0	--	38.6	20.7	55.6
	01/04/22	1,670	169	1.65	1.51	1.00 U	1.00 U	1.00 U	1.00 U	26.0	11.1	0.466 J	7.85 C3	8.96 B	31.5	8.31	23.8	12.2	9.66	21.4
MW-7	12/07/19	5,920	151	1.00 U	7.96	1.00 U	1.00 U	1.00 U	--	216	59.7	5.34	9.97	113	168	12.6	--	67.7	63.4	185
	06/25/20	7,610	556	--	--	--	0.630 U	0.409 U	--	586	102	--	15.2	355	217	15.4	--	11.6	96.8	207
	08/11/21	5,180	170	--	--	--	5.00 U	5.00 U	--	102	95.9	--	13.2	47.8	227	16.8	--	5.00 U	16.1	24.5
	01/04/22	3,060	178	5.43	5.71	0.552 J	1.00 U	1.00 U	1.00 U	70.3	42.8	0.755 J	2.75 C3	9.7 B	202	6.26	23.0	0.437 J	3.00	12.8
MW-8	12/07/19	8,290	1,520	1.00 U	8.68	1.00 U	1.00 U	1.00 U	--	263	80.6	6.17	8.35	95.5	199	35.1	--	249	86.8	530
	06/25/20	2,840	2,330	--	--	--	3.15 U	2.05 U	--	1,900	131	--	6.24 J	381	297	91.4	--	1,310	441	5,020
	08/11/21	15,700	1,560	--	--	--	25.0 U	25.0 U	--	408	77.5	--	6.73 J	214	225	42.2	--	1,000	313	1,560
	01/04/22	17,200	2,750	10.5	7.92	1.00 U	1.00 U	1.00 U	1.00 U	408	64.0	15.5	7.41 C3	163	326	30.0	444	1,320	196	1,620
PAS-2	12/07/19	8,160	102	124	7.07	1.22	1.00 U	1.00 U	--	122	109	1.00 U	10.4	13.9	163	16.0	--	10.0 U	28.8	49.0
DEQ Generic RBCs[1]																				
Volatilization to Outdoor Air																				
Occupational		>S	14,000	NE	NE	NE	790	9,000	>S	43,000	>S	NE	1,500,000	16,000	NE	>S	NE	>S	>S	>S
Vapor Intrusion into Buildings																				
Occupational		>S	2,800	NE	NE	NE	590	3,900	>S	8,200	>S	NE	870,000	11,000	NE	>S	NE	>S	>S	>S
Groundwater in Excavation																				
Construction/Excavation Worker		14,000	1,800	NE	NE	NE	27	630	18,000	4,500	51,000	NE	63,000	500	NE	220,000	NE	6,300	7,500	23,000

Notes:
1. DEQ Generic RBCs dated May 2018
B: The same analyte is found in the associated blank.
C3: The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
J: The result is an estimated quantity.
NE: not established
>S: This groundwater RBC exceeds the solubility limit. Refer to Appendix D of DEQ's RBDM guidance document for the corresponding value of S. Groundwater concentrations in excess of S indicate that free product may be present.
U: Not detected. Reporting or detection limit shown.
Bolding indicates analyte detection.
Shading indicates analyte detection at a concentration greater than DEQ RBCs.
--: not analyzed

TABLE 4
Summary of Air Sample Chemical Analytical Results
VOCs
Former Astoria Warehousing Site
Astoria, Oregon

Sample I.D.	Sample Exposure Dates	VOCs[1] EPA Method TO-17 (µg/m³)																
		Benzene	Bromomethane	Carbon Tetrachloride	Chloroform	1,4-Dichlorobenzene	1,2-Dichloroethane	Ethylbenzene	Freon 113	Methylene Chloride (Dichloromethane)	Styrene	PCE	Toluene	TCE	1,2,4-TMB	1,3,5-TMB	m,p-xylene	o-xylene
Indoor-1	06/29/19 – 07/13/19	0.72	0.36*	ND	ND	0.069	ND	0.91	0.3*	4.8*	0.69	0.073	0.63	0.046 U	1.5	0.38*	2.8	0.67
	11/06/19 – 11/15/19	0.90	–	0.23	0.19	0.15 U	0.10 U	1.7	–	–	0.13 U	0.13 U	2.5	0.11 U	–	–	5.7	1.6
	11/18/20 – 12/02/20	0.69	–	0.47	0.28	0.10 U	0.082	2.0	–	–	0.17	0.087 U	26	0.074 U	–	–	8.1	2.5
	08/12/21 – 08/26/21	0.37	–	0.34	0.86	0.098 U	0.065 U	0.60	–	–	0.20	0.084 U	1.2	0.072 U	–	–	2.3	0.86
Indoor-2	06/29/19 – 07/13/19	0.72	ND	ND	ND	ND	ND	0.97	ND	ND	0.65	0.074	0.61	0.046 U	1.1	ND	2.4	0.64
	11/06/19 – 11/15/19	1.0	–	0.24	0.24	0.15 U	0.10 U	1.9	–	–	0.13 U	0.13 U	2.7	0.11 U	–	–	6.2	1.7
	11/18/20 – 12/02/20	0.73	–	0.51	0.27	0.10 U	0.082	1.7	–	–	0.15	0.087 U	24	0.074 U	–	–	6.8	2.1
	08/12/21 – 08/26/21	0.33 J	–	0.29 J	0.73 J	0.098 U	0.065 U	0.47 J	–	–	0.17 J	0.084 U	1.2 J	0.072 U	–	–	1.7 J	0.64 J
Indoor-3	06/29/19 – 07/13/19	0.23	ND	0.4*	ND	ND	ND	0.23	ND	ND	0.17	0.063	1.2	0.046 U	0.58	ND	1.5	0.35
	11/06/19 – 11/15/19	0.42	–	0.24	0.10 U	0.15 U	0.10 U	0.80	–	–	0.13 U	0.13 U	1.3	0.11 U	–	–	2.8	0.84
	11/18/20 – 12/02/20	0.50	–	0.24	0.071 U	0.10 U	0.069 U	2.3	–	–	0.087 U	0.092	56	0.096	–	–	8.8	2.6
	08/12/21 – 08/26/21	0.32	–	0.22	0.65	0.098 U	0.064 U	0.57	–	–	0.20	0.084 U	1.2	0.072 U	–	–	2.2	0.77
Indoor-4	06/29/19 – 07/13/19	0.21	ND	0.49*	ND	ND	ND	0.18	ND	ND	0.14	0.054	1.1	0.046 U	0.45	ND	1.3	0.28
	11/06/19 – 11/15/19	0.42	–	0.25	0.10 U	0.15 U	0.10 U	0.63	–	–	0.13 U	0.13 U	1.2	0.11 U	–	–	2.2	0.67
	11/18/20 – 12/02/20	0.52	–	0.26	0.071 U	0.10 U	0.069 U	2.1	–	–	0.087 U	0.091	67	0.11	–	–	7.6	2.3
	08/12/21 – 08/26/21	0.31	–	0.17	0.44	0.098 U	0.065 U	0.56	–	–	0.20	0.084 U	1.3	0.072 U	–	–	2.2	0.76
Indoor-5	06/29/19 – 07/13/19	0.79	ND	0.43*	ND	ND	ND	1.3	0.29*	ND	0.23	0.098	2.5	0.046 U	1.4	ND	3.8	1.8
	11/06/19 – 11/15/19	0.46	–	0.20	0.10 U	0.15 U	0.10 U	0.65	–	–	0.13 U	0.13 U	1.4	0.11 U	–	–	2.3	0.69
	11/18/20 – 12/02/20	0.57	–	0.27	0.071 U	0.10 U	0.069 U	0.84	–	–	0.087 U	0.090 U	26	0.077 U	–	–	3.1	0.94
	08/12/21 – 08/26/21	0.32	–	0.27	0.61	0.097 U	0.064 U	0.64	–	–	0.22	0.084 U	1.5	0.072 U	–	–	2.6	0.88
Indoor-6	06/29/19 – 07/13/19	0.35	ND	0.38*	ND	ND	ND	0.44	ND	ND	0.23	0.11	1.6	0.046 U	1.1	ND	2.2	0.69
	11/06/19 – 11/15/19	0.47	–	0.23	0.10 U	0.15 U	0.10 U	0.82	–	–	0.13 U	0.13 U	1.5	0.11 U	–	–	2.9	0.88
	11/18/20 – 12/02/20	0.49	–	0.25	0.071 U	0.10 U	0.069 U	1.2	–	–	0.087 U	0.090 U	35	0.077 U	–	–	4.5	1.4
	08/12/21 – 08/26/21	0.33	–	0.21	0.63	0.098 U	0.065 U	0.69	–	–	0.22	0.084 U	1.3	0.072 U	–	–	2.8	1.0
Indoor-7	06/29/19 – 07/13/19	0.24	ND	0.48*	ND	ND	ND	0.22	0.27*	ND	0.14	0.058	0.96	0.046 U	0.44	1*	1.2	0.32
	11/06/19 – 11/15/19	0.46	–	0.26	0.10 U	0.15 U	0.10 U	0.87	–	–	0.13 U	0.13 U	1.5	0.11 U	–	–	3.1	0.92
	11/18/20 – 12/02/20	0.50	–	0.24	0.071 U	0.10 U	0.069 U	2.6	–	–	0.089	0.12	60	0.077 U	–	–	10	3.0
	08/12/21 – 08/26/21	0.30	–	0.22	0.62	0.098 U	0.065 U	0.52	–	–	0.16	ND	1.1	0.072 U	–	–	2.0	0.68
Background	11/06/19 – 11/15/19	0.40	–	0.26	0.10 U	0.15 U	0.10 U	0.11 U	–	–	0.13 U	0.13 U	0.49	0.11 U	–	–	0.27	0.12 U
	11/18/20 – 12/02/20	0.50	–	0.32	0.071 U	0.10 U	0.069 U	0.14	–	–	0.087 U	0.090 U	1.5	0.077 U	–	–	0.41	0.14
	08/12/21 – 08/26/21	0.27	–	0.20	0.066 U	0.097 U	0.064 U	0.12	–	–	0.081 U	0.084 U	0.45	0.072 U	–	–	0.45	0.15

TABLE 4
Summary of Air Sample Chemical Analytical Results
VOCs
Former Astoria Warehousing Site
Astoria, Oregon

Sample I.D.	Sample Exposure Dates	VOCs[1] EPA Method TO-17 (μg/m³)																
		Benzene	Bromomethane	Carbon Tetrachloride	Chloroform	1,4-Dichlorobenzene	1,2-Dichloroethane	Ethylbenzene	Freon 113	Methylene Chloride (Dichloromethane)	Styrene	PCE	Toluene	TCE	1,2,4-TMB	1,3,5-TMB	m,p-xylene	o-xylene
DEQ Generic RBCs[2]																		
Inhalation																		
Occupational		1.6	22	2.0	0.53	1.1	0.47	4.9	130,000	1,200	4,400	47	22,000	2.9	260	260	440	

Notes:
1. Only VOCs detected with regulatory screening values are listed. For a complete listing of VOCs, refer to the laboratory report in Appendix C.
2. DEQ Generic RBCs dated May 2018
J: The identification of the analyte is acceptable; the reported value is an estimate.
ND: not detected
U: Not detected. Reporting or detection limit shown.
Bolding indicates analyte detection.
Shading indicates analyte detection at a concentration greater than DEQ RBCs.
--: not analyzed
*: Laboratory reported concentration as ng/sample because they do not have an uptake rate. Values shown were calculated by assuming an uptake rate of 1 percent.

APPENDIX A

TABLE A-1
Estimation of Mass of Gasoline
Former Astoria Warehousing Site
Astoria, Oregon

Zone	Zone Area (m^2)	Zone Unit Thickness (meters)	Zone Unit Volume (m^3)	Zone Unit Volume Assuming 30 Percent Porosity (m^3)	Average Concentration	Concentration Unit	Total Contaminant Mass (µg)	Total Contaminant Mass (pounds)
Vapor Phase Calculation[1]								
1	1,028	3.56	3,660	1,098	96,750,000	$\mu g/m^3$	106,222,212,000	234.0
2	2,137	3.65	7,800	2,340	30,022,000	$\mu g/m^3$	70,251,930,330	154.7
3	2,273	2.93	6,660	1,998	11,700,000	$\mu g/m^3$	23,376,213,900	51.5
4	575	2.56	1,472	442	8,200	$\mu g/m^3$	3,621,120	0.01
							Estimated Total Gasoline Mass – Vapor Phase	440.2
Aqueous Phase Calculation[2]								
1	1,028	3.00	3,084	925	20,678	µg/L	19,131,285,600	42.1
2	2,137	3.00	6,411	1,923	12,314	µg/L	23,683,516,200	52.2
3	2,273	3.33	7,569	2,271	16,595	µg/L	37,682,714,565	83.0
4	575	3.33	1,915	574	3,004	µg/L	1,725,572,700	3.8
							Estimated Total Gasoline Mass – Aqueous Phase	181.1
Solid Phase Calculation[3]								
1	1,028	3.56	3,660	2,562	186.6	mg/kg	812,737,896,000	1790.2
2	2,137	3.65	7,800	5,460	1.37	mg/kg	12,685,481,000	27.9
3	2,273	2.93	6,660	4,662	11.1	mg/kg	87,864,817,000	193.5
4	575	2.56	1,472	1,030	2.83	mg/kg	2,918,608,000	6.4
							Estimated Total Gasoline Mass – Solid Phase	2,018.1
							CUMULATIVE MASS ESTIMATE	**2,639.4**

Notes:
1. Average concentration calculated for zone 1 using highest concentrations from SG-1, SG-2, and VP-3; zone 2 using highest concentrations from SG-4, VP-1, and VP-2; zone 3 using highest concentrations from SG-5 and VP-4; and zone 4 using the most recent data from SG-3.
2. Average concentration calculated for zone 1 using highest concentrations from MW-1, MW-2, MW-6, MW-7, DP-3, DP-4, DP-7, DP-8, and B-2; zone 2 using highest concentrations from MW-4, MW-8, DP-9, DP-14, and DP-15; zone 3 using highest concentrations from MW-5, DP-11, DP-12, DP-13, B-1, and B-3; and zone 4 using highest concentrations from MW-3, DP-5, DP-6, and DP-16.
3. Average concentration calculated for zone 1 using vadoze zone soil data from MW-1, MW-2, MW-6, MW-7, DP-1, DP-2, DP-3, DP-4, DP-7, DP-8, PAS-1, PAS-2, OAS-1, OAS-2, OAS-3, OAS-4, PSVE-1, OSVE-1, OSVE-2, OSVE-3, and OSVE-4; zone 2 using vadoze zone soil data from MW-4, MW-8, DP-9, DP-14, and DP-15; zone 3 using vadoze zone soil concentrations from MW-5, DP-11, DP-12, DP-13, B-1, and B-4; and zone 4 using vadoze zone soil data from MW-3, DP-5, DP-6, and DP-16.

TABLE A-2
Estimation of Mass of Benzene
Former Astoria Warehousing Site
Astoria, Oregon

Zone	Zone Area (m^2)	Zone Unit Thickness (meters)	Zone Unit Volume (m^3)	Zone Unit Volume Assuming 30 Percent Porosity (m^3)	Average Concentration	Concentration Unit	Total Contaminant Mass (µg)	Total Contaminant Mass (pounds)
Vapor Phase Calculation[1]								
1	1,028	3.56	3,660	1,098	752,500	µg/m^3	826,172,760	1.8
2	2,137	3.65	7,800	2,340	74,037	µg/m^3	173,247,691	0.4
3	2,273	2.93	6,660	1,998	8,643	µg/m^3	17,268,429	0.04
4	575	2.56	1,472	442	58	µg/m^3	25,613	0.00
							Estimated Total Gasoline Mass – Vapor Phase	2.2
Aqueous Phase Calculation[2]								
1	1,028	3.00	3,084	925	860	µg/L	795,672,000	1.8
2	2,137	3.00	6,411	1,923	1,546	µg/L	2,973,421,800	6.5
3	2,273	3.33	7,569	2,271	1,241	µg/L	2,817,972,207	6.2
4	575	3.33	1,915	574	27	µg/L	15,509,475	0.03
							Estimated Total Gasoline Mass – Aqueous Phase	14.5
Solid Phase Calculation[3]								
1	1,028	3.56	3,660	2,562	2.74	mg/kg	11,942,898,000	26.3
2	2,137	3.65	7,800	5,460	0.01	mg/kg	102,845,000	0.2
3	2,273	2.93	6,660	4,662	0.04	mg/kg	292,601,000	0.6
4	575	2.56	1,472	1,030	0.01	mg/kg	10,167,000	0.0
							Estimated Total Gasoline Mass – Solid Phase	27.2
							CUMULATIVE MASS ESTIMATE	**44.0**

Notes:
1. Average concentration calculated for zone 1 using highest concentrations from SG-1, SG-2, and VP-3; zone 2 using highest concentrations from SG-4, VP-1, and VP-2; zone 3 using highest concentrations from SG-5 and VP-4; and zone 4 using the most recent data from SG-3.
2. Average concentration calculated for zone 1 using highest concentrations from MW-1, MW-2, MW-6, MW-7, DP-3, DP-4, DP-7, DP-8, and B-2; zone 2 using highest concentrations from MW-4, MW-8, DP-9, DP-14, and DP-15; zone 3 using highest concentrations from MW-5, DP-11, DP-12, DP-13, B-1, and B-3; and zone 4 using highest concentrations from MW-3, DP-5, DP-6, and DP-16.
3. Average concentration calculated for zone 1 using vadoze zone soil data from MW-1, MW-2, MW-6, MW-7, DP-1, DP-2, DP-3, DP-4, DP-7, DP-8, PAS-1, PAS-2, OAS-1, OAS-2, OAS-3, OAS-4, PSVE-1, OSVE-1, OSVE-2, OSVE-3, and OSVE-4; zone 2 using vadoze zone soil data from MW-4, MW-8, DP-9, DP-14, and DP-15; zone 3 using vadoze zone soil concentrations from MW-5, DP-11, DP-12, DP-13, B-1, and B-4; and zone 4 using vadoze zone soil data from MW-3, DP-5, DP-6, and DP-16.

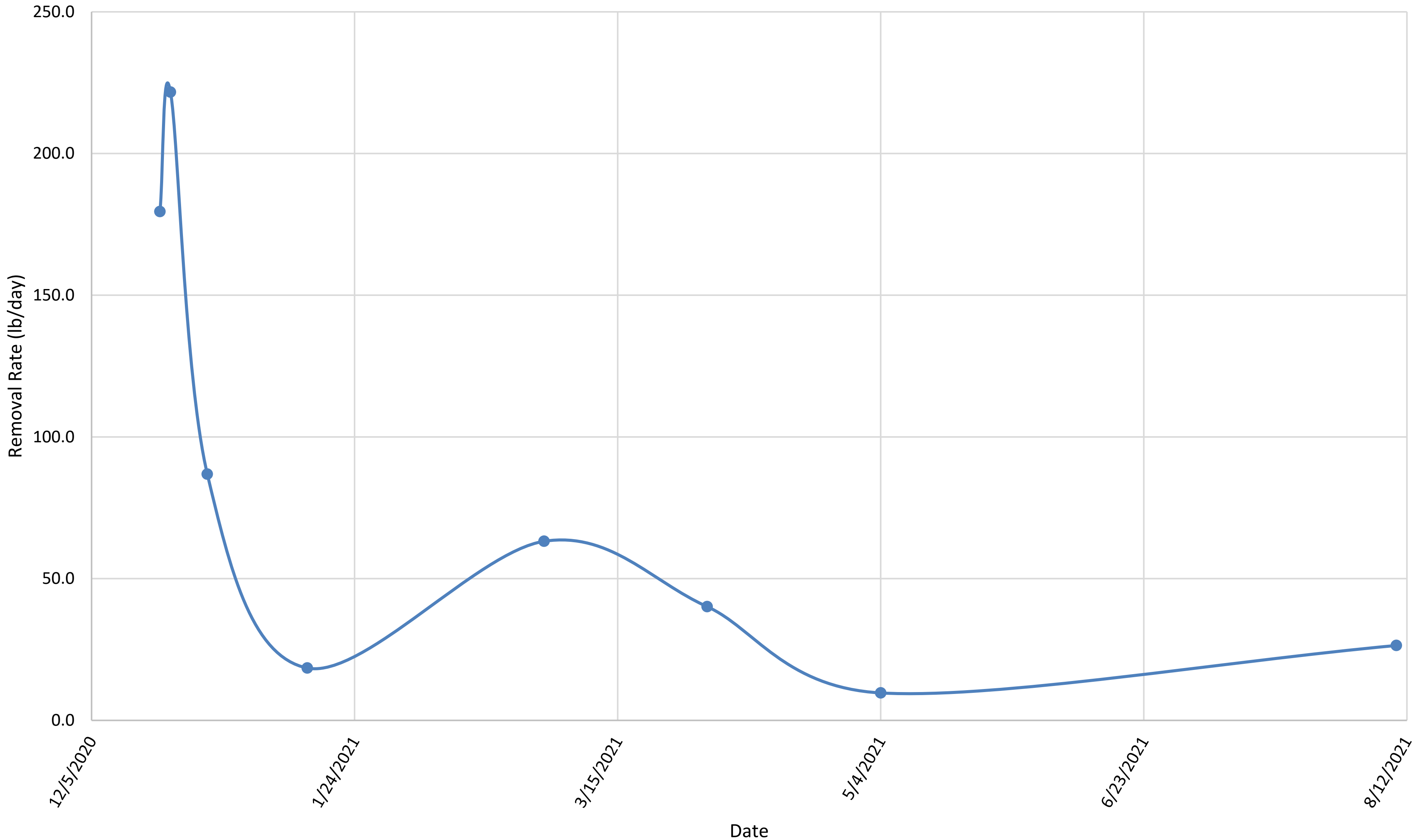
TABLE A-3
Summary of Effluent Vapor Sample Chemical Analytical Results
Gasoline-Range Hydrocarbons and VOCs
Former Astoria Warehousing Site
Astoria, Oregon

Sample I.D.	Sample Date	Gasoline-Range Hydrocarbons EPA Method TO-15 (µg/m³)	VOCs[1] EPA Method TO-15 (µg/m³)																									
			Acetone	Benzene	2-Butanone (MEK)	Carbon Disulfide	Chloromethane	Cyclohexane	Dichlorodifluoromethane	Trichlorofluoromethane	1,4-Dioxane	Ethanol	Ethylbenzene	4-Ethyltoluene	Heptane	n-Hexane	iso-Propylbenzene	Methylene Chloride (Dichloromethane)	Naphthalene	2-Propanol	Propene	Toluene	TCE	1,2,4-TMB	1,3,5-TMB	2,2,4-Trimethylpentane	m,p-Xylene	o-Xylene
Pre-Treatment Samples																												
PRE(121820)	12/18/20	**3,410,000**	**585**	**52,400**	295 U	49.8 U	33.0	**95,000**	79.1 U	89.9 U	57.7 U	**1,960**	**34,500**	**5,550**	**131,000**	**338,000**	**1,650**	55.6 U	264 U	**1,740**	**72.7**	**866**	85.7 U	**11,300**	**3,570**	**182,000**	**38,600**	**2,040**
PRE(122020)	12/20/20	**4,210,000**	**554**	**42,800**	295 U	49.8 U	33.0	**66,100**	79.1 U	89.9 U	63.4 U	**871**	**70,200**	**15,600**	**126,000**	**184,000**	**4,250**	55.6 U	264 U	**1,210**	**90.2** B	**1,440**	85.7 U	**30,200**	**7,850**	**144,000**	**78,500**	**4,510**
PRE(122720)	12/27/20	**1,650,000**	**366**	**13,400**	295 U	49.8 U	33.0	**17,900**	79.1 U	89.9 U	57.7 U	**338**	**30,300**	**10,500**	**60,500**	**77,900**	**2,600**	55.6 U	264 U	**1,050**	**55.8** B	**738**	85.7 U	**18,700**	**5,600**	**71,900**	**33,900**	**2,870**
PRE(011521)	01/15/21	**351,000**	**30.9**	**2,640**	3.69 U	0.622 U	0.413 U	**6,890**	**2.54**	**1.42**	0.721 U	**36.6**	**7,020**	**1,920**	**13,100**	**14,700**	**484** J4	0.694 U	**161**	**17.9**	**7.30**	**321**	1.07 U	**3,690**	**1,220**	**16,800**	**11,100**	**1,020**
PRE(030121)	03/01/21	**1,200,000**	**70.8**	**6,800**	73.7 U	12.4 U	8.26 U	**17,200**	34.0 U	22.5 U	14.4 U	**132**	**24,700**	**6,920**	**40,000**	**30,400**	**1610**	13.9 U	**165**	61.5 U	**14.8** B	**561**	21.4 U	**11,600**	**5,060**	**53,700**	**33,400**	**2,940**
PRE(040121)	04/01/21	**781,000**	**35.9**	**2,230**	36.9 U	6.22 U	4.13 U	**9,090**	9.89 U	11.2 U	14.4 U	**315**	**19,400**	**5,740**	**22,500**	**18,700**	**1880**	6.94 U	**505**	30.7 U	6.89 U	**273**	21.4 U	**13,800**	**4,380**	9.34 U	**26,000**	**2,700**
PRE(050421)	05/04/21	**189,000**	59.4 U	**645**	73.7 U	12.4 U	8.26 U	**3,110**	19.8 U	22.5 U	14.4 U	**180**	**3,920**	**1,020**	**5,560**	**6,200**	**273**	13.9 U	66.0 U	61.5 U	43.0 U	**65.2**	21.4 U	**1,950**	**692**	**8,880**	**5,590**	**398**
PRE(081021)	08/10/21	**512,000**	**20.7**	**629**	3.69 U	0.622 U	**0.651**	**4,920**	**2.12**	**1.19**	0.721 U	**677**	**9,060**	**134**	**5,930**	**8,710**	**1,070**	0.694 U	3.30 U	**27.8**	**6.72**	**123**	1.07 U	**30.9**	**153**	**14,200**	**16,200**	**1,460**
Post-Treatment Sample																												
POST(011521)	01/15/21	**851**	**11.5**	0.639 U	3.69 U	**1.62**	0.413 U	0.689 U	0.989 U	1.12 U	0.721 U	1.190 U	0.867 U	**1.65**	0.818 U	2.22 U	0.983 U	**7.15**	3.30 U	3.07 U	0.689 U	**3.35**	1.07 U	**1.90**	0.982 U	0.934 U	**2.86**	**1.39**
POST(030121)	03/01/21	826 U	**67.0**	**1.09**	**10.4**	0.622 U	**0.789**	0.689 U	**1.62**	1.12 U	14.4 U	**192** E	**2.74**	**1.65**	0.818 U	2.22 U	0.983 U	**0.924**	3.30 U	**248** E	0.689 U	**7.68**	21.4 U	**14.5**	**5.10**	**4.18**	**20.0**	**5.25**
POST(040121)	04/01/21	826 U	**17.5**	**9.97**	3.69 U	0.622 U	0.528 U	**2.69**	**1.17**	1.12 U	0.721 U	**439** E, J3	**1.43**	0.982 U	**1.54**	**7.62**	0.983 U	**3.23**	3.30 U	**21.6**	0.689 U	**11.6**	1.07 U	**1.10**	0.982 U	**2.60**	**2.72**	0.867 U
POST(050421)	05/04/21	**901**	**26.9**	**0.872**	**5.16**	0.622 U	**1.48**	**2.21**	**1.47**	1.12 U	**0.912**	**46.4**	**4.09**	**2.35**	**4.21**	**5.82**	0.983 U	**5.73**	3.30 U	**17.5**	2.15 U	**2.11**	**1.36**	**3.93**	**1.30**	**68.2**	**7.07**	**1.52**
POST(081021)	08/10/21	**2,900**	**22.7**	0.639 U	3.69 U	0.622 U	0.413 U	0.689 U	0.989 U	1.12 U	0.721 U	**17.2**	**49.0**	**21.3**	**30.7**	**36.0**	0.983 U	0.694 U	3.30 U	**12.3**	2.15 U	1.88 U	1.07 U	**49.6**	**15.0**	**67.3**	**96.2**	**10.1**

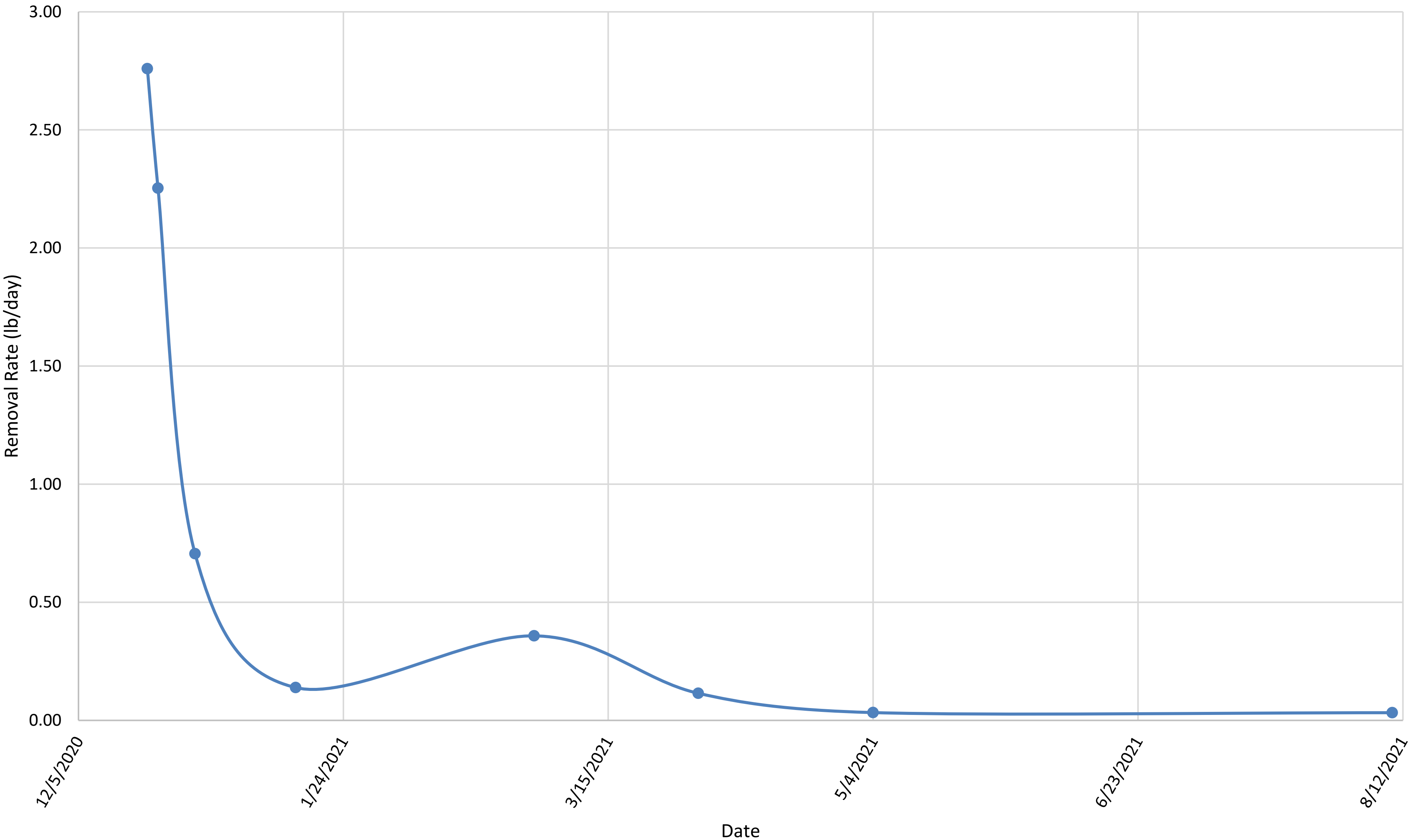
Notes:
1. Only VOCs detected are listed. For a complete listing of VOCs, refer to the laboratory reports
B: The same analyte is found in the associated blank.
E: The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J3: The associated batch QC was outside the established QC range for precision.
J4: The associated batch QC was outside the established quality control range for accuracy.
U: Not detected. Reporting or detection limit shown.
Bolding indicates analyte detection.

TABLE A-4
Estimation of Contaminant Mass Removal
Former Astoria Warehousing Site
Astoria, Oregon

Sample I.D.	Sample Date	Sample Time	Interval Run Duration (minutes)	Total Run Duration (minutes)	Total Average Flow Rate (cfm)	Vapor Discharge Samples (µg/m³)		Contaminant Mass Removed for Interval (pounds)		Contaminant Mass Removal Rate for Interval (pounds per day)	
						Gasoline-Range Hydrocarbons	Benzene	Gasoline-Range Hydrocarbons	Benzene	Gasoline-Range Hydrocarbons	Benzene
PRE(121820)	12/18/20	15:09	189	189	586	3,410,000	52,400	23.6	0.36	179.5	2.76
PRE(122020)	12/20/20	13:32	2,783	2,972	586	4,210,000	42,800	428.4	4.36	221.7	2.25
PRE(122720)	12/27/20	17:22	10,310	13,282	586	1,650,000	13,400	622.0	5.05	86.9	0.71
PRE(011521)	01/15/21	12:44	27,082	40,364	586	351,000	2,640	347.6	2.61	18.5	0.14
PRE(030121)	03/01/21	16:24	39,100	79,464	586	1,200,000	6,800	1715.6	9.72	63.2	0.36
PRE(040121)	04/01/21	12:00	44,376	123,840	572	781,000	2,230	1237.0	3.53	40.1	0.11
PRE(050421)	05/04/21	14:29	47,639	171,509	571	189,000	645	320.8	1.09	9.7	0.03
PRE(0810421)	08/10/21	16:40	139,716	311,195	575	512,000	629	2566.6	3.15	26.5	0.03
Totals								7,262	29.89		

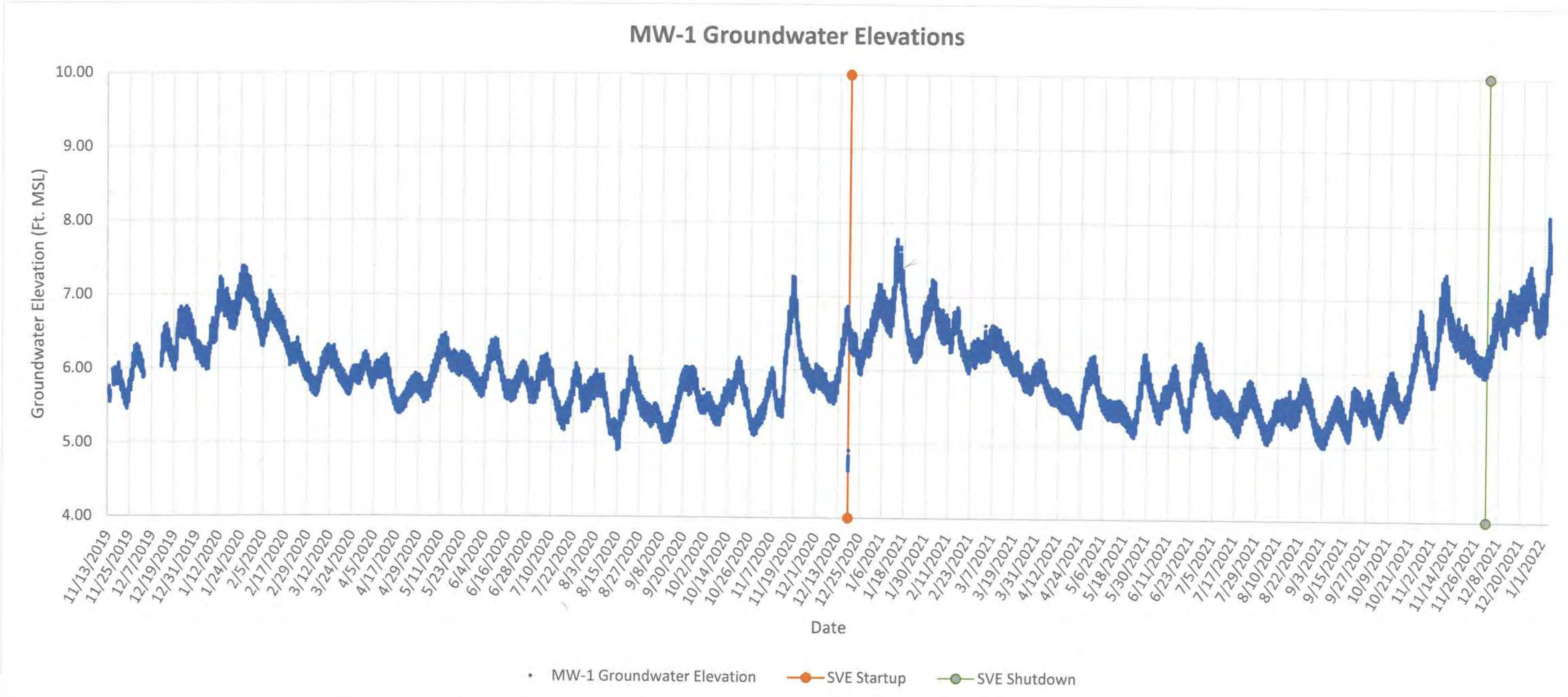


NV5	BIGBEAMS-1-04-05	**CALCULATED REMOVAL RATES – GASOLINE RANGE HYDROCARBONS**
	SEPTEMBER 2022	FORMER ASTORIA WAREHOUSING SITE ASTORIA, OR — **FIGURE A-1**



NV5	BIGBEAMS-1-04-05	**CALCULATED REMOVAL RATES – BENZENE**
	SEPTEMBER 2022	FORMER ASTORIA WAREHOUSING SITE ASTORIA, OR — **FIGURE A-2**

APPENDIX B


MW-1 Groundwater Elevations
Groundwater Elevation (Ft. MSL)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
11/13/2019
11/25/2019
12/7/2019
12/19/2019
12/31/2019
1/12/2020
1/24/2020
2/5/2020
2/17/2020
2/29/2020
3/12/2020
3/24/2020
4/5/2020
4/17/2020
4/29/2020
5/11/2020
5/23/2020
6/4/2020
6/16/2020
6/28/2020
7/10/2020
7/22/2020
8/3/2020
8/15/2020
8/27/2020
9/8/2020
9/20/2020
10/2/2020
10/14/2020
10/26/2020
11/7/2020
11/19/2020
12/1/2020
12/13/2020
12/25/2020
1/6/2021
1/18/2021
1/30/2021
2/11/2021
2/23/2021
3/7/2021
3/19/2021
3/31/2021
4/12/2021
4/24/2021
5/6/2021
5/18/2021
5/30/2021
6/11/2021
6/23/2021
7/5/2021
7/17/2021
7/29/2021
8/10/2021
8/22/2021
9/3/2021
9/15/2021
9/27/2021
10/9/2021
10/21/2021
11/2/2021
11/14/2021
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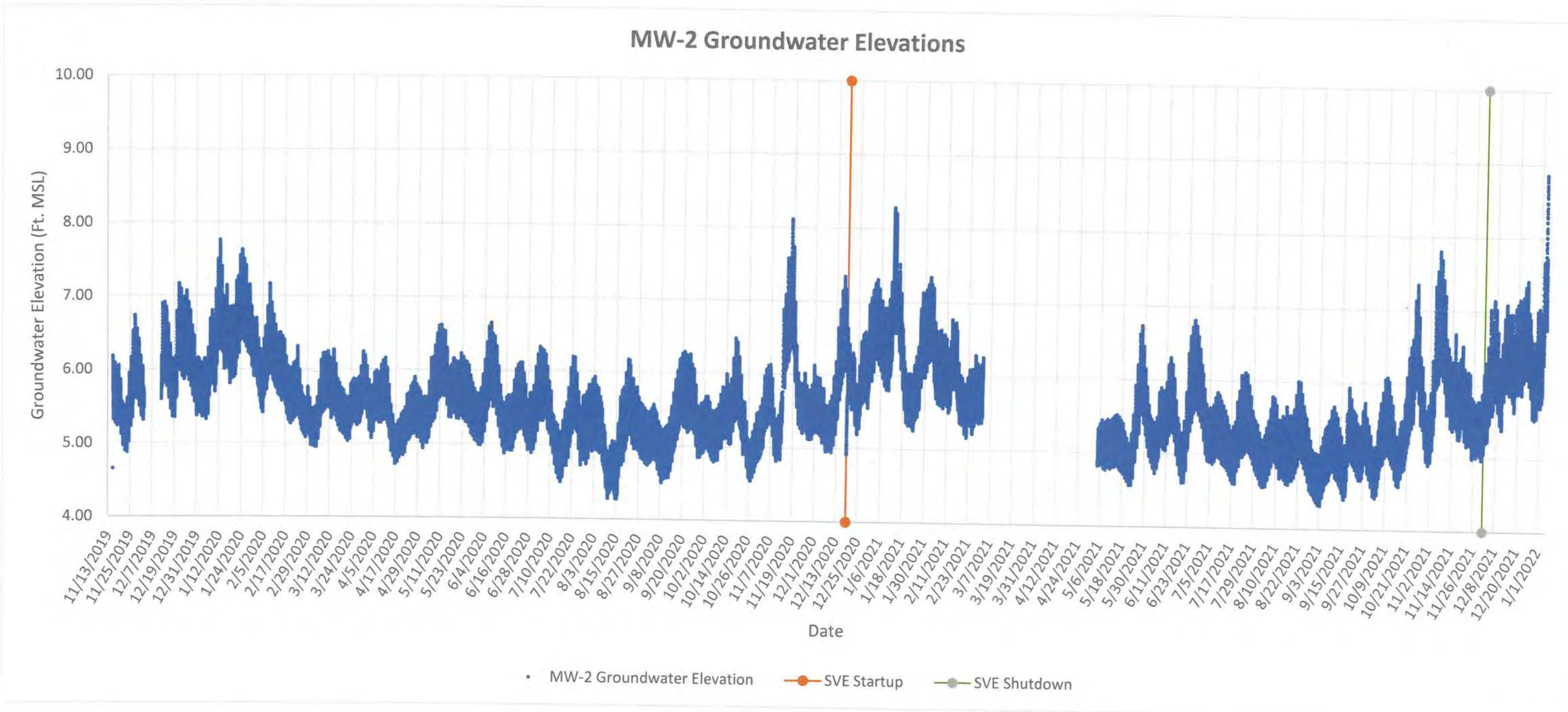
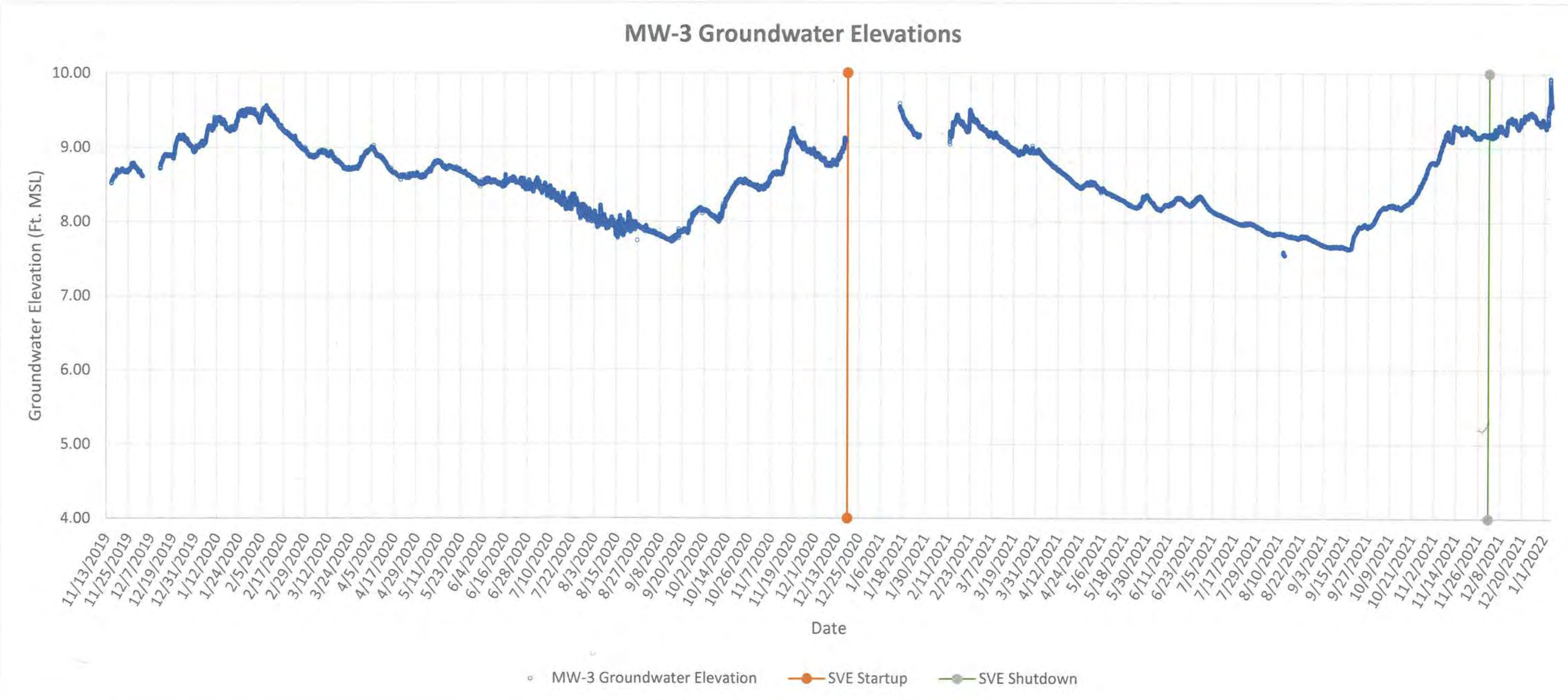
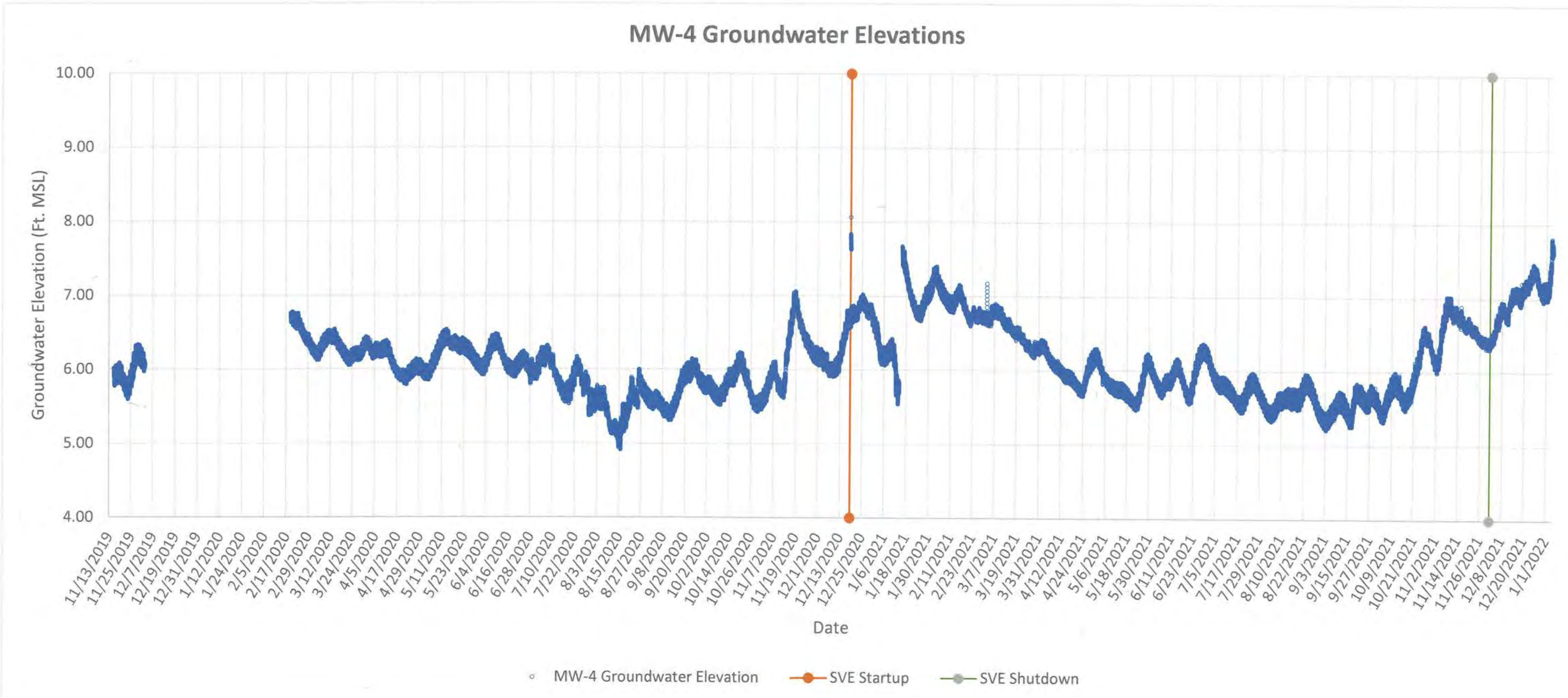
SVE Startup
SVE Shutdown

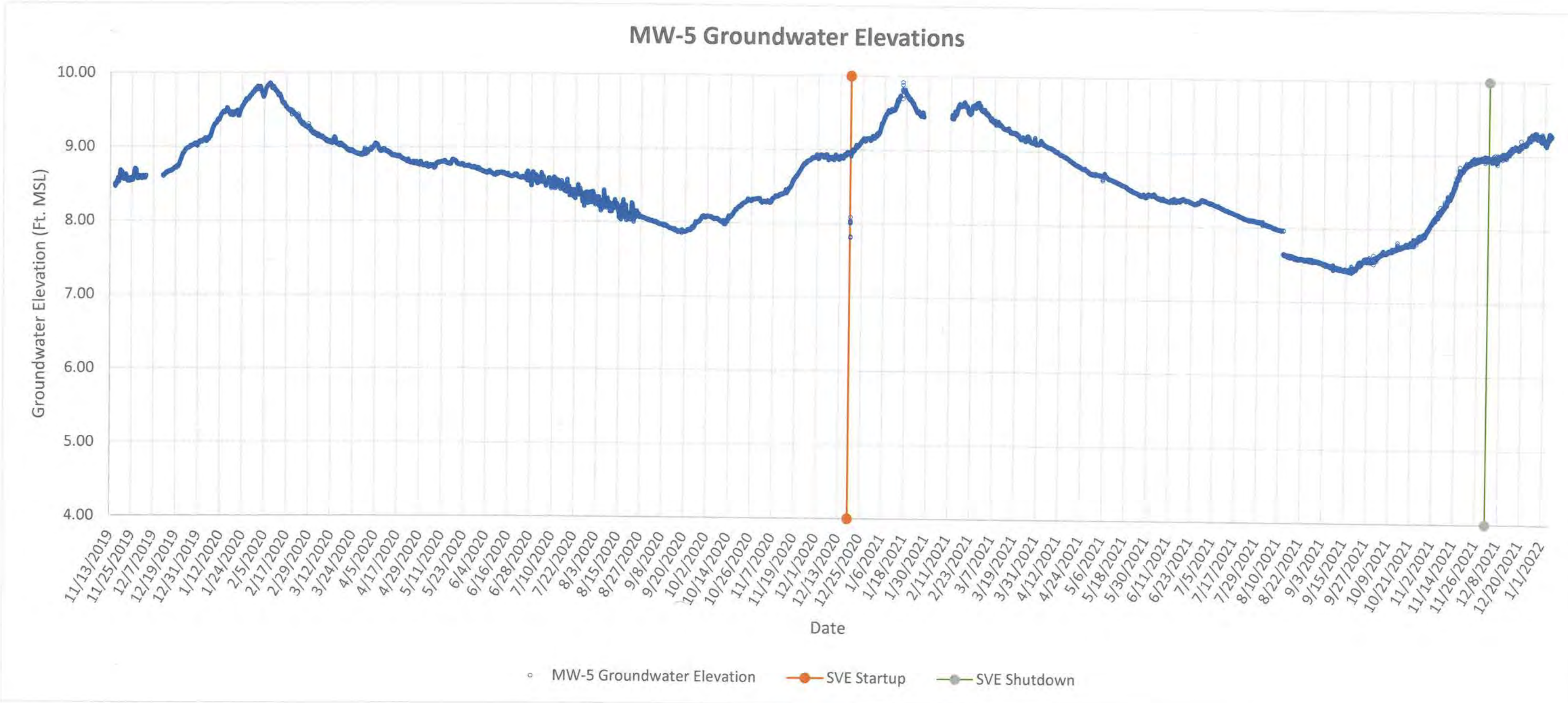

MW-2 Groundwater Elevations
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Groundwater Elevation (Ft. MSL)
11/13/2019
11/25/2019
12/7/2019
12/19/2019
12/31/2019
1/12/2020
1/24/2020
2/5/2020
2/17/2020
2/29/2020
3/12/2020
3/24/2020
4/5/2020
4/17/2020
4/29/2020
5/11/2020
5/23/2020
6/4/2020
6/16/2020
6/28/2020
7/10/2020
7/22/2020
8/3/2020
8/15/2020
8/27/2020
9/8/2020
9/20/2020
10/2/2020
10/14/2020
10/26/2020
11/7/2020
11/19/2020
12/1/2020
12/13/2020
12/25/2020
1/6/2021
1/18/2021
1/30/2021
2/11/2021
2/23/2021
3/7/2021
3/19/2021
3/31/2021
4/12/2021
4/24/2021
5/6/2021
5/18/2021
5/30/2021
6/11/2021
6/23/2021
7/5/2021
7/17/2021
7/29/2021
8/10/2021
8/22/2021
9/3/2021
9/15/2021
9/27/2021
10/9/2021
10/21/2021
11/2/2021
11/14/2021
11/26/2021
12/8/2021
12/20/2021
1/1/2022
Date
MW-2 Groundwater Elevation
SVE Startup
SVE Shutdown

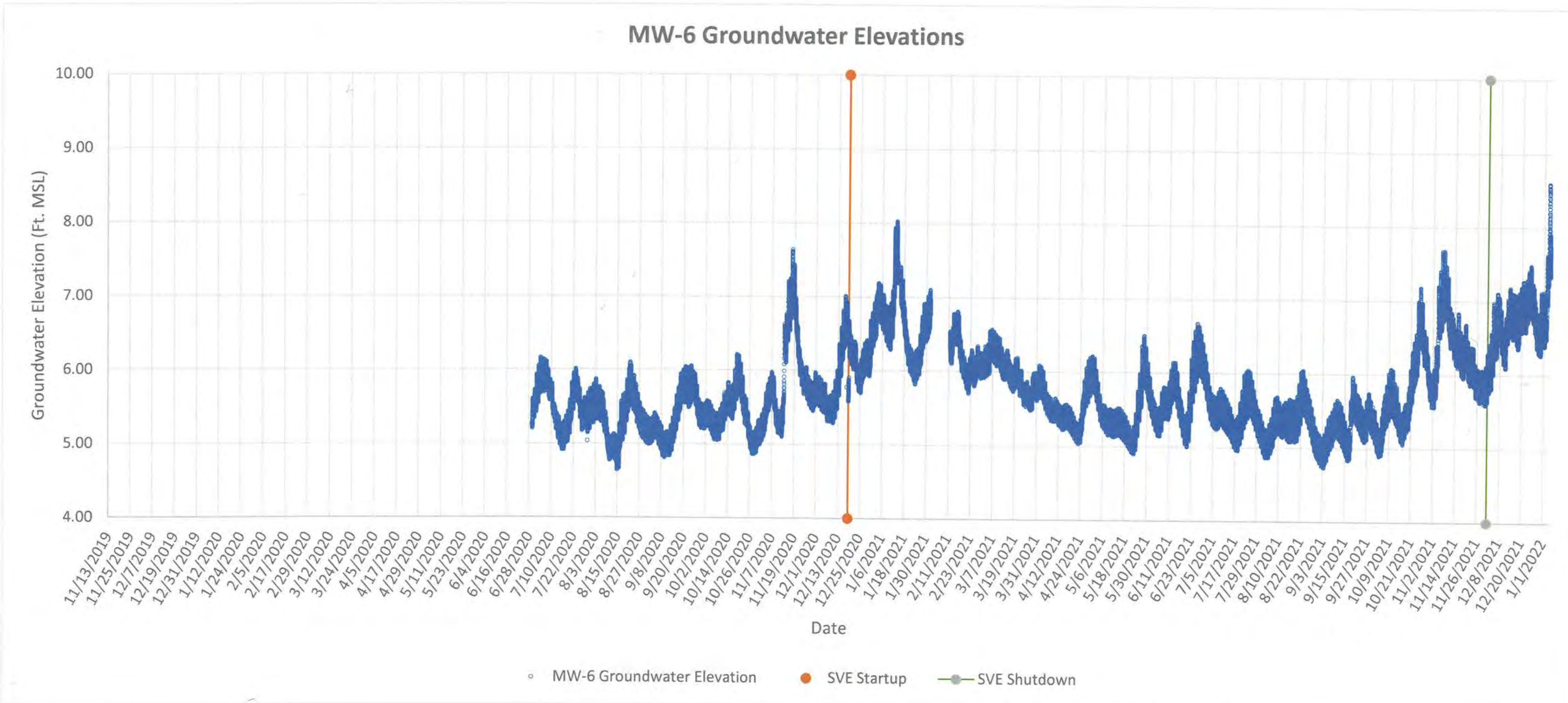


MW-3 Groundwater Elevations
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Groundwater Elevation (Ft. MSL)
Date
MW-3 Groundwater Elevation
SVE Startup
SVE Shutdown

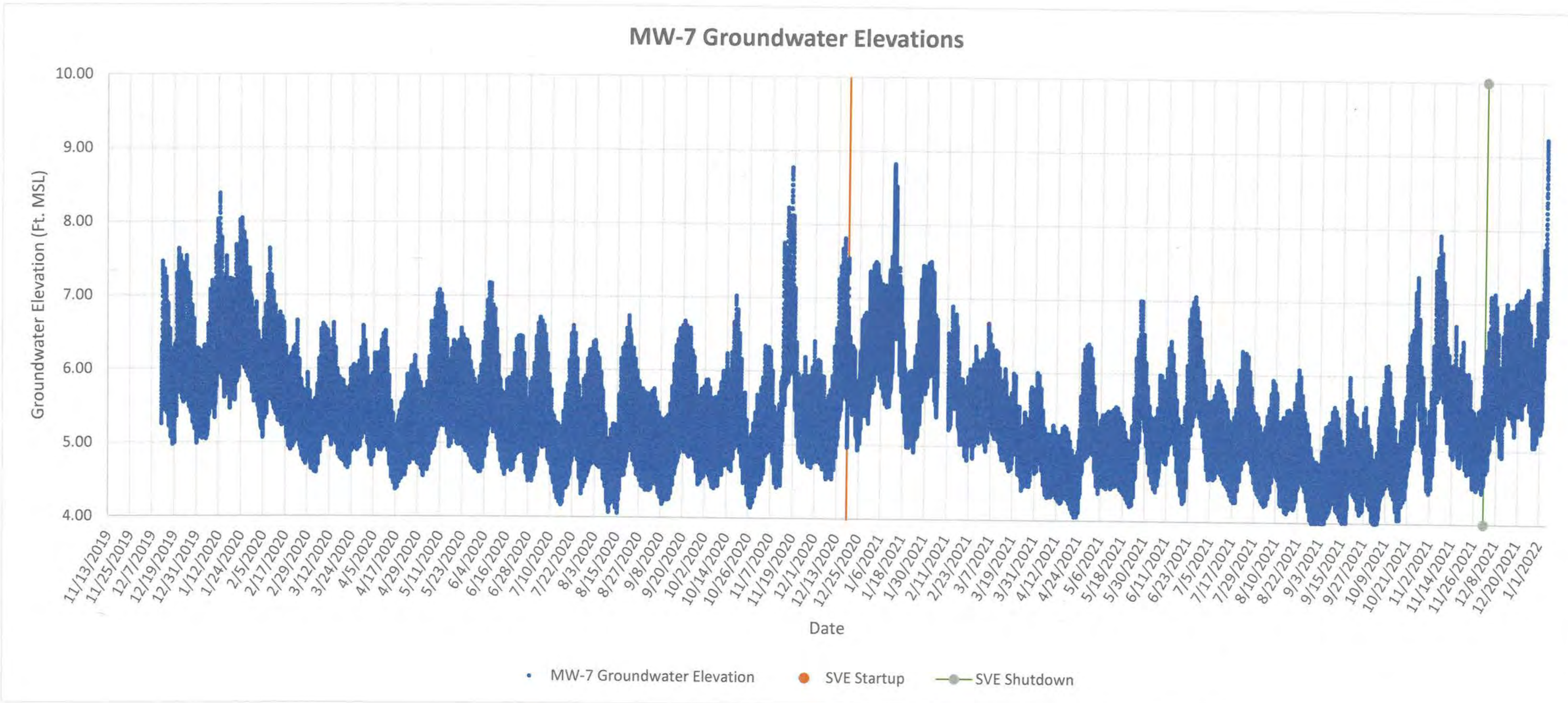


MW-4 Groundwater Elevations
Groundwater Elevation (Ft. MSL)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Date
MW-4 Groundwater Elevation
SVE Startup
SVE Shutdown


MW-5 Groundwater Elevations
Groundwater Elevation (Ft. MSL)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Date
MW-5 Groundwater Elevation
SVE Startup
SVE Shutdown



MW-6 Groundwater Elevations
Groundwater Elevation (Ft. MSL)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Date
MW-6 Groundwater Elevation
SVE Startup
SVE Shutdown


MW-7 Groundwater Elevations
Groundwater Elevation (Ft. MSL)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Date
MW-7 Groundwater Elevation
SVE Startup
SVE Shutdown

Delivering Solutions
Improving Lives