Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

FINAL

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.1
Site-Specific Health and Safety Plan Requirements

FINAL

Table of Contents

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
EDR	Zone A Removal Action Engineering Design Report
GC	General Contractor
HASP	Health and Safety Plan
JSA	Job Safety Analysis
NPL	National Priorities List
PPE	Personal protective equipment
Site	Pasco Sanitary Landfill National Priorities List Site
SOW	Scope of Work and Schedule
SVE	Soil vapor extraction
Zone A	Industrial Waste Area Zone A

1.0 Introduction

This appendix specifies the health and safety procedures and emergency response guidelines that must be included and expanded upon in the General Contractor's (GC's) Health and Safety Plan (HASP) for the Industrial Waste Area Zone A (Zone A) Removal Action at the Pasco Sanitary Landfill National Priorities List (NPL) Site (Site). The requirement for a HASP is included in Task A.2 of the Site's Scope of Work and Schedule (SOW), Exhibit C of the Cleanup Action Plan – Pasco Landfill NPL Site, prepared by Ecology and dated August 2019.

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2.0 Health and Safety Plan Requirements

The HASP shall comply with the requirements of the Occupational Safety and Health Act of 1970 (29 U.S.C. Sec. 651 et seq.) administered by the Occupational Safety and Health Administration and the Washington Industrial Safety and Health Act (WISHA; chapter 49.17 RCW) administered by the Washington Department of Labor and Industries and regulations promulgated pursuant thereto.

The HASP is described in Task A.2 of the SOW:

> *"The HASP shall meet the requirements of WAC 173-340-810 and include emergency information, characteristics of the waste, levels of protection, hazard evaluation, procedures for protecting workers from the hazards of excavation and drum removal, operating construction equipment, and safety procedures required in the event of systems failure, and any other applicable Site information. The HASP shall identify the requirements for performance of the cleanup action to attain compliance with that plan. The HASP shall include a job hazard and job safety analysis, and address emergency response actions and procedures. The HASP also will address site security, site communications, and access control. Air monitoring to ensure the health and safety of onsite workers, visitors, and support personnel also will be specified for all aspects of the work: excavation, drum and debris handling and staging, material segregation, and waste/debris loading operations. The air monitoring will satisfy, in part, WAC 173-340-410 protection monitoring requirements."*

WAC 173-340-410 protection monitoring requirements include, in part, confirmation that human health and the environment are adequately protected during construction of a cleanup action.

The GC will be responsible for implementing the HASP and ensuring that it is strictly adhered to during all activities and by all persons accessing the Zone A Removal Action work areas. The health and safety of the public and Site personnel and the protection of the environment will take precedence over cost and scheduling considerations for all project work.

2.1 ACTIVITIES COVERED UNDER THE HEALTH AND SAFETY PLAN

The major tasks listed in the SOW to be conducted under the GC's HASP include the following:

- Drum waste/mixed debris/soil excavation, waste segregation, and excavation area backfilling
- Waste characterization, handling, staging, and disposal

Other tasks that are not part of the GC's SOW but that will be conducted as part of the existing, separate HASP for the Site include modifying and operating the existing soil vapor extraction (SVE) system; operating the existing regenerative thermal oxidizer; decommissioning of groundwater monitoring wells, SVE wells, gas probes, temperature thermocouples, and other monitoring infrastructure; installation of new monitoring wells and SVE wells; and characterization sampling. If necessary, amendments to the existing PBS Site HASP will be completed prior to conducting the above tasks.

In the event that activities that are subject to separate HASPs occur at the same time as the GC's activities and within the areas controlled by the GC, then the GC's HASP will be followed. The GC's HASP will have primacy for the Zone A Removal Action at the Site. All subcontractors and vendors will be subject to the GC's HASP and must abide by the GC's HASP.

The anticipated activities to be conducted under the GC's HASP are presented in part in the SOW under Task A.1 Preparation of a Zone A Removal Action Engineering Design Report (EDR) and Task A.3 Execution of the Work Detailed in the Approved Final Zone A Removal Action EDR and Associated Compliance Monitoring Plan and are generalized as follows:

- Equipment mobilization, setup, and staging
- Preliminary Site preparation
- Zone A existing cover removal
- Establishing the air monitoring program and installing required air quality engineering controls
- Drum/waste excavation, overpacking, testing, segregation, and temporary staging
- Mixed debris excavation, segregation, testing, consolidation, and handling
- Interim backfilling and temporary interim surface grading
- Waste designation, offsite transport, and disposal
- Documenting construction limits and characterizing residual contamination at and below the limits of excavation
- Documenting certificates of disposal/return copy of manifests
- Site grading and covering (geomembrane or alternative low permeability cover) to prepare for in situ thermal treatment system installation
- Excavation backfilling and compaction
- Equipment decommissioning and demobilization

If Site operations are altered or if additional tasks are assigned, then an addendum or addenda to the GC's HASP shall be developed to address the specific hazards associated with those changes.

During a portion of these activities, personnel may come in contact with waste materials, chemicals, debris, soils, vapors, gases, particulates, contaminated liquid, non-aqueous-phase liquid, wash water, and other waste-related factors, which may contain hazardous substances.

The GC's HASP shall be developed to minimize direct contact by project personnel with materials potentially having chemical presence by ensuring:

- That project personnel are not adversely exposed to the contaminants, including establishing proper personal protective equipment (PPE) protocols and action levels;
- That public health and the environment are not adversely impacted by the work;
- Compliance with applicable governmental and nongovernmental regulations and guidelines; and
- Initiation of proper emergency response procedures to minimize the potential for any adverse impact to project personnel, the general public, or the environment.

The GC's HASP requires the following measures:

- The communication of the contents of the HASP to project personnel.
- The elimination of unsafe conditions. Efforts shall be initiated to identify conditions that can contribute to an accident and to remove exposure to those conditions.
- The review of all activities before beginning the task/job, after an incident, and/or in the event of any unusual circumstances. Stop activities to think about the task, analyze the task hazards, determine methods to reduce risk, and review the results with affected personnel.
- The review of existing and the development of new Job Safety Analysis (JSA) forms for each project work activity. Supervisors and affected personnel are responsible for the development and any ongoing revisions of project JSAs. JSAs templates for all known work activities shall be presented in an attachment to the HASP.
- The reduction of unsafe acts. Project personnel shall make a conscious effort to work safely. A high degree of safety awareness must be maintained so those safety factors involved in a task become an integral part of the task. Supervisory personnel shall ensure that project personnel committing unsafe acts are held accountable via counseling, mentoring, and, if necessary, reprimand.
- The frequent inspection of project activities. Regular safety inspections of the work site, materials, and equipment by qualified persons ensure early detection of unsafe conditions. Safety and health deficiencies shall be corrected as soon as possible, and project activities shall be temporarily suspended until the appropriate corrective actions are taken. Documentation of the daily inspections and corrective actions taken should be kept with the project files.
- Daily safety briefing. Review tasks to be performed and applicable JSAs and any near misses or safety incidents from the previous day.

A detailed description of the required PPE shall be presented in the GC's HASP and identified on each JSA form.

A copy of the HASP and employer specific Standard Operating Procedures will be maintained on Site whenever activities are in progress.

The GC's HASP must include, at a minimum, all the requirements described above and as set forth in Section 2.2.

2.2 HEALTH AND SAFETY PLAN ELEMENTS

The GC's HASP shall include the following elements at a minimum:

- A list of applicable safety and health regulations, standards, and guidelines must be presented that form the basis for design of the HASP
- Stop Work Authority
  - All employees are empowered and expected to stop the work of coworkers, contractors, client employees, or other subcontractors if any person's safety or the environment are at risk. No repercussions for the employee will result from this action.
- HASP Amendments
  - Any change to the scope of work must be evaluated for its impact on the overall health and safety of the project and associated personnel, and necessary changes to the HASP must be documented.
- Project Management and Safety Organization
  - A list of key project personnel and descriptions of safety responsibilities must be presented, such as the following:
    - Company Safety and Health Manager
    - Project Manager
    - Site Supervisor
    - Site Safety and Health Officer
    - Emergency Coordinator
- Descriptions of safety responsibilities for the following general categories must be presented:
  - Equipment Operators
  - General Project Personnel
  - Subcontractors
  - Authorized Visitors
- A general description of the Site, Site characterization, and potentially hazardous materials including figures and tables, as well as a table or tables with potential contaminants of concern, along with potential exposure routes and regulatory time-weighted average exposure levels that are set to protect the health of the workers

- Requirements for medical surveillance for those who may come in contact with potentially contaminated materials and how records of such surveillance are maintained including reference to applicable regulations
- Personnel Training Requirements
  - Hazardous waste operations and emergency response (HAZWOPER) training including basic 40-hour training and supervisor training
  - First aid and CPR
  - Daily safety meetings
  - Site-specific training
- A description of how changes to the management of the project will be documented and communicated including, at a minimum, change to key project personnel, equipment, safety procedures, and field procedures
- Requirements for PPE to perform the activities safely including the following:
  - Descriptions of levels of protection, how and why the levels of protection required will be selected, and when levels of protection may be upgraded or downgraded
  - A description of the respiratory protection program and how air quality will be monitored to assess the level of respiratory protection required
  - Donning and doffing procedures
  - How the allowable duration of work tasks and rest breaks will be established and adjusted based on the usage of PPE and work conditions
  - A description of the limitations of protective clothing, how to use and inspect PPE to ensure optimal protection, and requirements for discarding non-reusable and damaged reusable PPE
- Requirements for site control measures including the following:
  - Communication for planned field activities and changes
  - Maintaining a list of personnel authorized to enter the various support and work areas
  - Signage and site security during working and non-working time
  - Review and record keeping of required training and medical certifications
  - Site orientation and hazard briefing procedures
  - Daily safety briefings
  - Entry requirements
  - Emergency entry and exit procedures
  - Description of contamination control zones (i.e., Exclusion Zone, Contamination Reduction Zone, and Support Zone)
  - Designated safe work zone for mechanics or others to complete maintenance on equipment outside of the Exclusion Zone

- A description of activity hazard/risk analysis and general safety practices including the following:
  - Evaluation of potential chemical, physical, and biological hazards that may be encountered while conducting work activities
  - General safety practices including the following:
    - Review of applicable JSAs prior to commencing a task
    - Staging of emergency equipment in readily accessible locations
    - Containment and proper labeling of potentially contaminated waste, debris, and clothing
    - Safe procedures for moving of containers and heavy objects using proper equipment
    - Use of the buddy system
    - Communication systems
    - Sanitation systems
    - Break area locations and rules
    - Potable water supply and management
    - Washing facilities management
    - Lavatory management
    - Trash collection and management
  - Chemical exposure prevention including discussion of potential exposure pathways (e.g., inhalation, direct contact, ingestion, and injection) and exposure levels, chemical hazard controls, and hazard communication (e.g., Safety Data Sheets, container labels, handling)
  - Heat stress information, safety precautions, and prevention
  - Sun exposure information, safety precautions, and overexposure prevention
  - Cold stress information, safety precautions, and prevention
  - Fatigue management
  - Utility locating and protection for intrusive work
  - Vehicle operation
  - Heavy equipment operation
  - Noise management and protection
  - Electrical safety requirements
  - Material handling procedures (e.g., hoisting and rigging, storage procedures, grounding protocols, hand protection)
  - Manual lifting procedures
  - Hand and power tool safety requirements
  - Evaluation of adverse weather conditions including work restrictions
  - Slip/trip/hit/fall hazards avoidance

  - Management of site-specific social conditions unique to the area, if required
  - Management of potential trespassers including aggressive or menacing behavior
  - Management of potential biological hazards such as vegetation overgrowth, tick borne diseases, poisonous plants, insects, threatening dogs, and rodents
- Air Monitoring Program
  - A description and details of an air monitoring program to protect workers and the surrounding community, including the following at a minimum:
    - Person(s) responsible for implementation
    - Types of field equipment to be used, parameters to be monitored, and frequency of monitoring
    - Action levels to determine appropriate levels of protection
    - Action levels to initiate modification of work practices
    - Sample collection and laboratory analysis
- Radiological waste monitoring
- Decontamination procedures (equipment and personnel)
- Personal hygiene requirements
- Description of designated areas for food consumption and any prohibitions
- Emergency response and contingency procedures, including the following:
  - Emergency information sheet, including posting requirements, with the nearest hospital address, phone number(s), and directions; emergency services/responders phone numbers; government agency phone numbers; and project staff and client contacts and phone numbers
  - Additional emergency numbers not included on the emergency information sheet
  - Pre-startup safety meeting with local emergency responders to inform of the work and potential risks to ensure preparedness in case of an emergency and to determine rally points and evacuation routes
  - Emergency communication
  - Accident, injury, and illness reporting
  - Documentation of HASP revisions/assessments due to incidents or near misses
  - Emergency and first aid equipment
  - Project personnel responsibilities during emergencies
  - Medical emergencies
  - Fire or explosion
  - Spill control and countermeasures
  - Site evacuation
- Environmental control program outlining procedures and precautions to avoid hazards associated with adverse and severe weather

- Required forms for documenting management of the HASP
- Record keeping, including the following at a minimum:
  - A copy of the HASP and amendments
  - Names of all personnel working on the Site (i.e., daily log of all persons on site, including visitors; personnel on site must be signed in and out to ensure an accurate account of all personnel on site)
  - Training records
  - Training acknowledgment
  - Medical surveillance
  - Fit testing
  - Safety inspections and audits
  - Daily safety meetings
  - Emergency reports
  - Air monitoring equipment calibration records
  - Air monitoring data
  - Emergency equipment inventory

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.2
Contingency Plan

FINAL

Emergency Contact Information

SITE ADDRESS: Pasco Sanitary Landfill
1820 or 1901 Dietrich Road
Pasco, Washington 99301

EMERGENCY CONTACTS:

Fire Department	911
Ambulance	911
Police Department	911

FIELD/SITE CONTACTS:

_________________ (GC Emergency Coordinator)	( ) ___-____
_________________/GRAM Northwest (Resident Engineer)	( ) ___-____
_________________/PBS (Resident Engineer)	( ) ___-____
Mary McElheron/PBS (Operations and Oversight)	(509) 492-6593

IWAG PROJECT COORDINATOR:

Jessi Massingale/Floyd|Snider (Owner's Representative)	(206) 683-4307

IWAG GROUP III CONTACTS:

Nick Garson/Boeing	(425) 269-7866
Carol Wiseman/Weyerhaeuser	(360) 562-7733

Additional Contacts

FRANKLIN COUNTY FIRE DISTRICT #3 (primary responder)
Chief Mike Harris (509) 547-9306

PASCO FIRE DEPARTMENT (backs up County Fire District)
Bob Gear, Fire Chief (509) 545-3426

LOCAL EMERGENCY PLANNING COMMITTEE (LEPC); FRANKLIN COUNTY EMERGENCY MANAGEMENT
Sean T. Davis, Director (509) 546-5846
sdavis@co.franklin.wa.us, www.fanklinem.org

STATE EMERGENCY RESPONSE COMMISSION (SERC)/
WASHINGTON EMERGENCY MANAGEMENT DIVISION (WEMD) (800) 258-5990

ECOLOGY EASTERN REGION OFFICE
Chuck Gruenenfelder, Site Manager (509) 496-7021

NATIONAL RESPONSE CENTER (800) 424-8802

HAZARDOUS MATERIAL RESPONSE TEAM
Team will be selected based on the type of incident, if local responders cannot contain the incident.

Contingency Plan Revision Table

Review or Revision Date	Plan Updated (Y/N)	Description of Revision

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List of Figures

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
BDI	Basin Disposal, Inc.
CAP	*Cleanup Action Plan – Pasco Landfill NPL Site*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
Ecology	Washington State Department of Ecology
EDR	Zone A Removal Action Engineering Design Report
EO	Enforcement Order
GC	General Contractor
HASP	Health and Safety Plan
HMTA	Hazardous Materials Transportation Act
HSO	Health and Safety Officer
IWAG	Industrial Waste Area Generators Group III
LEPC	Local Emergency Planning Committee
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PAMP	Perimeter Air Monitoring Plan
PBS	PBS Engineering and Environmental, Inc.
RE	Resident Engineer
RQ	Reportable Quantity
RTO	Regenerative thermal oxidizer
SERC	State Emergency Response Commission
Site	Pasco Sanitary Landfill National Priorities List Site
SOW	Scope of Work and Schedule
SVE	Soil vapor extraction
USEPA	U.S. Environmental Protection Agency
Zone A	Industrial Waste Area Zone A

1.0 Introduction

This Contingency Plan is part of the Zone A Removal Action Engineering Design Report (EDR) as a resource for emergency preparedness and response during the removal action activities in Industrial Waste Area Zone A (Zone A) at the Pasco Sanitary Landfill National Priorities List (NPL) Site (Site). This appendix has been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) as part of fulfilling the requirements of an Enforcement Order (EO) dated November 8, 2019, and the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), prepared by Ecology and dated August 2019.

The Scope of Work and Schedule (SOW) is provided in Exhibit C of the CAP. This Contingency Plan has been prepared to meet the requirements of SOW Task A.2 Preparation of a Zone A Removal Action Compliance Monitoring Plan Subtask B Contingency Plan.

The General Contractor (GC) shall be responsible for implementing the Contingency Plan in the event of an accident or emergency at the Site and ensuring that the Contingency Plan is strictly adhered to during all activities and by all persons accessing the Zone A Removal Action work areas. The health and safety of the public and Site personnel and the protection of the environment will take precedence over cost and scheduling considerations for all project work.

A copy of the Contingency Plan shall be maintained on site whenever activities are in progress and distributed to any potential first responders. All workers entering the Site should be familiar with the onsite location and contents of the Contingency Plan, and any visitors (e.g., vendors, Ecology, IWAG members) should be briefed on the plan before entering the Site. A copy of the Contingency Plan shall be kept at the following locations, as a minimum:

- GC's field/site office trailer
- Resident Engineer (RE) team's field/site office trailer

Emergency contact numbers (inside the cover page of this document, to be reviewed, checked, and revised by the GC and IWAG as needed) shall be posted on the inside of the door of any work trailers and buildings located within Zone A Removal Action construction areas.

Additional Site resources for emergency preparedness and response include the following:

- Perimeter Air Monitoring Plan (PAMP): This is Appendix B.3 of the EDR and presents perimeter air monitoring requirements and action levels for emissions of odor and airborne contaminants from the Zone A Removal Action. The action levels have been developed to be protective of potential risks to the surrounding community and are meant to be conservative. The PAMP presents control measures that will be implemented should these action levels be exceeded. Excursions above these action levels for short duration are acceptable. If emissions at the perimeter persist above action levels, work may be modified or stopped. The PAMP also identifies threshold conditions for emissions of odor or airborne contaminants at the perimeter that would warrant Contingency Plan implementation.

- Zone A Removal Action—Temporary Structure Air Treatment Summary to Support Compliance with Air Permitting Substantial Equivalency: This memorandum describes the use of a temporary structure air handling and treatment system to maintain negative pressure over areas subject to the drum excavation activities. The memorandum includes an anticipated air treatment operating schedule and proposed monitoring with air handling and treatment system operation and maintenance considerations, as well as monitoring requirements for breakthrough of carbon beds.
- Incidental Spill Response Plan: This is Attachment D.1.1 of the Stormwater Runoff Management Plan, which is Appendix D.1 of the EDR. It presents preventative measures and response actions for spills.
- Health and Safety Plan (HASP): Prepared by the GC, the HASP will contain similar emergency information and have specific response actions and procedures. Appendix B.1 of the EDR provides the HASP requirements.
- Integrated Contingency Plan for the Industrial Waste Areas, Including the Zone A Landfill Soil Vapor Extraction (SVE) and Regenerative Thermal Oxidizer (RTO) Systems and Waste Management: Prepared by PBS Engineering and Environmental, Inc. (PBS) in September 2019, the Integrated Contingency Plan contains additional information for the continued operation of the SVE and RTO systems.
- Traffic Control Plan: Prepared by the GC, the Traffic Control Plan will identify requirements for transportation of waste from Zone A to the ultimate disposal facility along with transporter requirements in the event of an emergency. Appendix D.2 of the EDR provides the Traffic Control Plan requirements.

2.0 Objective

The objective of the Contingency Plan is to protect onsite personnel and minimize the impact to neighbors and the environment in the event of an accident or emergency at the Site associated with the Zone A Removal Action. It is essential that Site personnel and local authorities be prepared in the event that an emergency arises during completion of the work.

The Contingency Plan identifies the emergency preparedness and response measures to be used by personnel performing remedial activities associated with Zone A and the procedures for notification of offsite emergency response personnel.

If a fire, explosion, or release of hazardous materials that potentially threaten human health or the environment is encountered, the Contingency Plan shall be implemented by Site personnel and first responders, as appropriate. It is noted that any major event will involve the appropriate outside emergency responder (e.g., Franklin County Fire Department); Site personnel are to keep personal safety at the forefront and not attempt to perform services beyond their skills and training.

If any of these agencies respond to an emergency, they will follow their own individual response management procedures.

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3.0 Coordination with Local Emergency Response Organizations

Copies of this plan, following Ecology approval of the final EDR, will be distributed to the following local agencies:

- Franklin County Fire District #3
- Pasco Fire Department
- Local Emergency Planning Committee (LEPC): Franklin County Emergency Management
- Benton Franklin Health District
- City of Pasco School District
- Basin Disposal Inc.

In the event that the content of the plan changes significantly, modified portions of the plan will be provided to the appropriate agencies. The agencies will be invited to comment and recommend modifications to this plan.

Prior to the start of the Zone A Removal Action, a contingency planning meeting will be held with the community, local responders, hazardous materials response teams, and other municipal or local/county government agencies. Participants will be informed of the work and potential risks to ensure preparedness in case of an emergency, determine appropriate response coordination and activities, and confirm rally points and evacuation routes. During site mobilization, the LEPC hospital and police department will be notified and briefed about the potential hazards at the Site. A Site visit will also be planned for their inspection. The ENTACT Health and Safety Officer/Emergency Coordinator will be responsible for this notification in coordination with the IWAG and Ecology.

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4.0 Site Description

The landfill property is located approximately 2 miles from downtown Pasco and approximately 0.75 miles north of the intersection of US Route 12 and Pasco Kahlotus Road (Figure B.2.1). In February 1990, the Site was added to the NPL by the U.S. Environmental Protection Agency (USEPA). The CAP for Zone A is being implemented under EO No. DE 16899.

Site Name:
Pasco Sanitary Landfill NPL Site – Industrial Waste Area Zone A landfill

Responsible Parties/Property Owner:

Responsible Parties:
Industrial Waste Area Generators Group III; 3M Company; Akzo Nobel Canada Inc.; Basin Disposal Inc.; Blount International, Inc.; BNSF Railway Company; The Boeing Company; Carr Aviation, LLC; Crown Beverage Packaging LLC; Daimler Trucks North America LLC; Leonard Dietrich; E.I. du Pont de Nemours & Co., Inc.; Franklin County; Georgia Pacific LLC; Goodrich Corporation on behalf of Kalama Specialty Chemicals, Inc.; Intalco Aluminum; PACCAR Inc.; Pasco Sanitary Landfill, Inc.; PCC Structurals, Inc.; Pharmacia Corporation; PPG Architectural Finishes, Inc.; PPG Industries, Inc.; Puget Sound Naval Shipyards; Sandvik Special Metals LLC; Simpson Timber Company; Union Oil of California, on behalf of Collier Carbon and Chemical; United States Air Force; United States Department of Agriculture, Forest Service; United States Department of the Interior, Bureau of Reclamation; Weyerhaeuser NR Company; and Zep Inc.

Property Owners:
Leonard and Glenda Dietrich, approximate southern third of Zone A (Franklin County Assessor parcel number 113-580-037).

Pasco Sanitary Landfill, Inc., approximate northern two-thirds of Zone A and all other landfill areas (Franklin County Assessor parcel numbers 113-580-082, 113-580-091, 113-580-117, 113-580-135, 113-580-126, 113-200-072, 113-510-059, and 113-580-064).

Physical Address of the Site:
1820 and 1901 Dietrich Road
Pasco, Washington 99301

Landmarks:
The Basin Disposal, Inc. (BDI) Transfer Station and Basin Recycling are located immediately south of the Zone A landfill.

Nearest Cross Street:
N Commercial Avenue (south of transfer station)

Google Maps:
46.249861, -119.054962

Township/Range:
SW quarter of Section 15, NW quarter of Section 22, Township 9 North, Range 30 East, Willamette Meridian, in Franklin County, Washington

Mailing Address of the Site
Mail is not deliverable to this Site.

Phone inquiries should be directed to one of the field/site Contacts, who will identify if package deliveries should be sent to a temporary field trailer/office or to a permanent offsite address.

Other Identifying Information

- Property owner's USEPA Hazardous Waste Generator ID # WAD991281874
- Ecology Facility Site ID: 575
- Ecology Cleanup Site ID: 1910
- Agreed Order (AO) No. DE 9240
- EO No. DE 16899
- Approval Order 16AQ E031 (RTO air permit)

Emergency Contacts and Information

FIRE:	911
AMBULANCE:	911
POLICE:	911

A list of emergency contacts is provided at the front of this report.

Nearest Emergency Medical Facility:
Lourdes Medical Center
520 N 4th Avenue
Pasco, Washington 99301
(509) 547-7704

Figure B.2.2 provides the route to the hospital from the Site.

The closest fire hydrant is located approximately 500 feet south of Zone A's southern gate (on Dietrich Road). The hydrant is located to the south of the BDI Transfer Station.

5.0 Contingency Plan Activities

The required action at Zone A includes the excavation and sorting of all material to the agreed-upon vertical and lateral extent of waste. Zone A contains an estimated 35,000 55-gallon drums, which originally contained solvent and paint sludges, cleaners, and a broad variety of other hazardous industrial waste. During the Zone A excavation, drums, drummed waste, pooled free liquids, and readily separable (by mechanical means) potentially combustible material will be managed for offsite treatment and/or disposal.

To control air emissions, the drum removal is taking place within a temporary structure, with workers inside the structure to be in Level B protective equipment. The structure will be moved into six locations over the course of the removal action, as depicted in Figure B.2.3 (Sheet 7 in Appendix E).

Work at Zone A involves use of heavy equipment and activities where injury to personnel is possible. The GC's HASP and Job Safety Analysis will describe the various hazards present at Zone A.

The anticipated activities to be conducted under the Contingency Plan are presented in part in the SOW under Tasks A.1 and A.3 and are generalized as follows:

- Equipment mobilization, setup, and staging
- Preliminary preparation for work associated with the Zone A excavation
- Establishing the air monitoring program, including monitoring locations and baseline monitoring
- Zone A existing cover removal
- Installing required air quality engineering controls
- Drum/waste excavation, overpacking, testing, segregation, and temporary staging
- Mixed debris excavation, segregation, testing, consolidation, and handling
- Interim backfilling and temporary interim surface grading
- Waste designation, profiling, manifesting, offsite transport, and disposal
- Documenting construction limits and characterizing of remaining material in Zone A at the limits of excavation
- Documenting certificates of disposal/return copy of manifests
- Site grading and covering to prepare for in situ treatment system installation
- Excavation backfilling and compaction, possibly including an engineered fill barrier installed to help isolate or separate some or all of the BT-2 Burn Trench wastes from possible in situ treatment impacts, if supported by waste characterization activities described in the SOW Task A.1 Subtask C
- Equipment decommissioning and demobilization

The existing Site Integrated Contingency Plan (PBS 2019) will be used for other Zone A activities that are part of the EDR but will be conducted before or after the excavation work or outside the Zone A excavation work zone (e.g., operations and maintenance activities at the Site). These include the following:

- Modifying and operating the existing SVE system
- Operating the existing RTO
- Decommissioning groundwater monitoring wells, SVE wells, gas probes, temperature thermocouples, and other monitoring infrastructure
- Installing new monitoring wells and SVE wells
- Sampling monitoring wells for groundwater characterization purposes

In the event that activities under separate contingency plans occur at the same time as the GC's activities and within the areas controlled by the GC, then the GC's HASP will be followed.

6.0 Emergency Control Procedures

The Contingency Plan outlines emergency control procedures with procedural flow diagrams for air quality exceedances, spills and releases, and fire and explosions. Section 6.3 provides more detailed information for handling fire emergencies. Modification of these procedures can occur during the emergency if the GC or emergency responder Incident Command determines a different procedure will result in a better response to the emergency.

6.1 DISCOVERY

During the Zone A Removal Action, the GC will designate an Emergency Coordinator. If the Emergency Coordinator discovers an emergency, he or she will call 911 and then determine the proper response in accordance with the control procedures. The Emergency Coordinator will also notify the RE. When the emergency responder arrives, or if emergency responders are the first to respond to the emergency, the lead onsite responder for that agency (i.e., fire department captain/chief, hazardous material spill contractor leader) will become the Emergency Coordinator.

During active construction, the Site will be staffed at all times by either the GC or an off-hours security team. If someone other than the Emergency Coordinator discovers a spill, fire, or other emergency:

1. Call 911 if professional emergency response is needed
2. Call the Emergency Coordinator: NAME, PHONE
3. Call the RE: NAME, PHONE

The phone numbers of the Emergency Coordinator, alternate contact, and RE will be posted on the inside of the door of each temporary facility associated with the project.

6.2 INITIAL RESPONSE

Upon discovery, the emergency will be assessed to determine the following:

1. Type of emergency (i.e., leak, spill, fire, explosion, injury)
2. Hazards involved
3. Magnitude of the problem
4. If the source is under control
5. Resources threatened
6. If an exclusion zone is needed or evacuation of personnel required

Figure B.2.4 includes evacuation routes for the Site that may be slightly adjusted following construction of the temporary structure in coordination with the GC.

The discoverer or Zone A Emergency Coordinator will determine if any immediate action needs to be taken using the procedural flow diagrams in Figure B.2.5 for worker safety air quality exceedances and Figure B.2.6 for fire or explosion. If the emergency involves the release of a hazardous material, fire, explosion, or serious injury, first call 911 and/or hazardous material emergency response personnel. Spill or fire containment activities shall then commence immediately, using all available trained personnel and materials on hand. For spills, refer to the Incidental Spill Response Plan (Appendix D.1, Attachment D.1.1). If the response needed is not within the training of Site personnel or there is imminent danger, evacuation should begin.

The location of available emergency equipment will be depicted in the GC's HASP, and this Contingency Plan will be updated to reflect those locations.

6.3 PRECAUTIONARY MEASURES FOR FIRE

The following precautionary measures are in place to minimize the spreading of fire:

- Fire extinguishers are located in the temporary structure, the project trailer/office, fuel areas, and storage areas.
- Fire extinguishers will be fully charged, appropriate for the type of possible fire, inspected monthly, and tested annually.
- Personnel are trained annually on how to properly use fire extinguishers.
- Personnel are trained on fire response procedures including calling 911. The appropriate fire fighting methods will be determined by the fire department.

6.3.1 Fire Procedures

If the Emergency Coordinator or another person discovers a fire or explosion, they will determine if the fire can be safely controlled with a fire extinguisher. If it cannot, they will leave the immediate area, call 911, and provide the following information:

- Nature of the emergency
- Location of the emergency
- Size and extent of the emergency
- Hazardous materials involved (if any)
- Person(s) injured and seriousness of injury

The Emergency Coordinator will contact an ambulance and hospital if personnel are injured and then assess the situation to determine the following:

- Hazards involved
- Magnitude of the problem (specifically, whether the fire is significant)
- Resources threatened
- Exclusion Zone needed, or evacuation of facility required

If the fire is small and contained (just beginning) and does not involve hazardous materials:

- The Emergency Coordinator or other personnel with fire extinguisher training will extinguish the fire, if it is safe to do so.
- The Emergency Coordinator will determine whether any buildings or areas nearby should be evacuated due to smoke buildup.
- Upon coordination with the IWAG, the IWAG Project Coordinator or RE will notify the appropriate agency as identified in the beginning of this plan.

If the fire is significant:

- The person discovering the fire will alert all onsite personnel and those working in the vicinity.
- The Emergency Coordinator or person discovering the fire will notify the fire department by dialing 911.
- Upon arrival of the fire department, the Emergency Coordinator and/or personnel discovering the fire will report the location and type of fire and any injured or missing personnel.
- Emergency responders will take charge and perform appropriate actions for the incident.
- After the incident is complete, the Emergency Coordinator and/or person discovering the fire will document the incident.

6.4 SUSTAINED ACTIONS

Once the emergency response actions are under way, further assessment by the Emergency Coordinator (or an incident commander of a first responder's team) or their designee is required to ensure that the course of action selected is the best possible. An ongoing assessment should be performed to ensure the following:

- The initial assessment of the emergency was accurate.
- The emergency response procedure is working effectively.
- Hazards to personnel, the public, and the environment are being controlled.

The basic questions to be answered by the ongoing assessment address four key areas:

1. The Public and Project Personnel. Is a material being released or potentially being released in quantities likely to affect the public or project personnel? How soon might they be at risk? Should they be evacuated or sheltered? What areas of the Site or community are at risk (direction and distance)?
2. The Environment. Is material being released or potentially released in exceedance of reportable quantities? Can the release be contained, diverted, or reduced to minimize possible environmental impact?

3. The Property. Is the emergency likely to spread to other areas (if so, how soon)? Will the hazard affect project utilities or systems needed for safe operation? How soon can processes be shut down, and how must this be coordinated?
4. Emergency Response Actions. Is there anything now known about the current status of the emergency that conflicts with the magnitude or nature of a previous assessment? Are the current actions effectively mitigating the hazard? Is there any additional course of action, or any additional resource, that would significantly improve the effectiveness of the action plan? Ongoing assessment is a critical tool to evaluate the current status of the response and to keep the response actions focused on the best approaches to mitigate the emergency.

6.5 TERMINATION AND FOLLOW-UP ACTIONS

The Emergency Coordinator, in conjunction with the RE and PBS Site Manager, is responsible for determining when the emergency is over. If response agencies and/or emergency response contractor(s) were called on site, consulting with them to decide when to terminate the emergency will be required.

Termination of an incident response should consider the following, at a minimum:

- Is the situation stable and under control?
- Is there likely to be any release of materials or other hazard to project personnel, public, or the environment?
- Are any wastes that may be incompatible with the released material treated, accumulated, or disposed of prior to completion of cleanup procedures?
- Are the spill materials properly stored in accordance with the compatibility of the original material?
- Is there any need for the continued presence of response contractors?
- Is there any need for continued involvement of the onsite emergency response organization?

The Emergency Coordinator, in coordination with the RE, will make sure all notifications have been made within 24 hours and decontamination and disposal are addressed. They will document the incident within 1 to 2 days, begin an evaluation of the incident and effectiveness of emergency procedures, develop a corrective action plan, and review the plan for modifications.

7.0 Notification

Multiple federal, state, and local regulations require the notification of specified agencies in the event of a spill or release of hazardous materials, hazardous substances, hazardous wastes, and other emergencies. This section of the Contingency Plan describes the reporting requirements for the Zone A Removal Action following a potential emergency, including reporting responsibility, the criteria and deadlines for notification, the appropriate agencies to be notified, and the format for notification following an incident.

The reporting information and phone numbers that may be useful during notification (such as contact information for local agencies) are included in front cover of this Contingency Plan. The Emergency Coordinator and the RE, in coordination with the IWAG Project Coordinator, are responsible for ensuring that the necessary notifications are made to the appropriate agencies during or after a spill, release, or other emergency in accordance with all deadlines. Notification of a release should be made without delay and should not be held up pending collection of additional information. This is particularly true in cases of immediate notification requirements and/or those with a 2-hour notification deadline, as required by the National Response Center and the USEPA. The LEPC, Ecology, and/or the Occupational Safety and Health Administration (OSHA) also need to be promptly notified following certain releases or events. In addition, internal reporting is required. Missing information should be supplied during follow-up calls.

7.1 INTERNAL NOTIFICATIONS

In the event of an emergency, the personnel discovering the incident will immediately contact the Emergency Coordinator. Notification will be made to all other personnel or contractors who may be working at the Site. Because of the limited area of the Site, this can readily be achieved through vocal communications and/or cellular telephones. The GC will provide procedures for notifying personnel inside the temporary structure of an outside issue and for structure personnel to notify the Emergency Coordinator. Following notification of onsite personnel, the Emergency Coordinator, or discoverer, must notify the RE.

Following this internal notification, the Emergency Coordinator will be responsible for dealing with the emergency, and the RE will make the additional notifications. All releases and/or health and safety incidents will be reported to the RE. The RE will notify the IWAG Project Coordinator and IWAG contacts.

7.2 COMMUNITY NOTIFICATIONS

In the event of a fire, explosion, leak, or spill of flammable or combustible material, the Franklin County Fire District (with Pasco Fire Department as backup for the county), LEPC, and Ecology regional office will be notified immediately.

7.3 FEDERAL AND STATE AGENCY NOTIFICATION

All notification to federal, state, and local agencies (other than emergency responders) must be coordinated through the IWAG Project Coordinator, who will coordinate with the IWAG.

Clean Water Act (CWA) Notification Requirements

Section 311(b)(5) of the CWA, codified at 40 CFR 110, establishes reporting requirements for the release of oil into navigable waters, which include wetlands. A release of oil to navigable waters that (1) cause a sheen to appear on the surface, (2) violate applicable water quality standards, or (3) cause a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines is reportable to the National Response Center at (800) 424-8802.

The closest navigable waters are approximately 2.5 miles from the Site. There are no wetlands near the Site.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Notification Requirements

Releases of a hazardous substance (as defined in 40 CFR 302.4) exceeding CERCLA Reportable Quantities (RQs) must be immediately reported to the National Response Center at (800) 424-8802 as soon as knowledge of the release is obtained. Releases of hazardous substances exceeding CERCLA RQs, or extremely hazardous substances (as defined under federal Emergency Planning and Notification regulations 40 CFR 355) should also be reported immediately to the LEPC if any area outside the Site is affected. The State Emergency Response Commission (SERC) should be verbally notified at (800) 258-5990 if areas of concern, as determined in coordination with Ecology, are likely to be affected. Ecology's Eastern Regional Office will be notified.

In addition to the above, certain continuous releases of hazardous substances and/or air emission releases (from unpermitted minor sources and concentrations above permitted emissions limits due to accidents and malfunctions and/or during start-up and shut down) may also be reportable under CERCLA and the Emergency Planning and Notification regulations as defined in 40 CFR 355. Releases of hazardous substances that could expose anyone outside of the facility should be reported immediately to the SERC at (800) 258-5990, the LEPC Franklin County Emergency Management at (509) 545-3546, and the National Response Center at (800) 424-8802.

Occupational Health and Safety Act Notification Requirements

OSHA (29 CFR 1904.8) requires that the fatality of one or more people or the hospitalization of three or more personnel is to be verbally reported to OSHA within 8 hours after knowledge of this information. Additionally, regardless of whether the incident is immediately reportable, if the incident results in the death of a personnel or the hospitalization of three or more personnel within 30 days of the incident, the fatality or multiple hospitalization is to be reported within 8 hours of learning of it.

Washington State Department of Labor and Industries Requirements

Employers are required to contact the Division of Occupational Safety and Health within 8 hours of a workplace fatality or in-patient hospitalization of any employee and within 24 hours of a non-hospitalized amputation or loss of an eye of any employee. Call (800) 423-7233, select option 1.

When reporting an incident, make sure to provide the following:

- Name and phone number of the best person to contact
- The name of the establishment/business
- The location/address where it happened
- The date and time it happened
- The names and number of employees harmed
- A brief description of the incident

Department of Transportation Notification Requirements

The Hazardous Materials Transportation Act (HMTA; 49 CFR 171.15) requires that, if a release of hazardous materials occurs in transport (including loading or unloading) that causes injury or death, property damage over $50,000, public evacuation, a major road closure lasting more than 1 hour, aircraft re-routing, spillage or fire of a radioactive or etiologic material, or continuing danger of life at the scene of the incident exists, then the carrier must notify the Washington State Department of Transportation via the National Response Center at (800) 424-8802. Each notice must include the following information:

- Name of reporter
- Name and address of carrier
- Phone number where reporter can be reached
- Date, time, and location of incident
- The extent of injuries (if any)
- Type and quantity of materials involved
- Type of incident and whether a continuing danger to life exists at the scene

The carrier must also submit a written report regarding the incident within 30 days, and if any unintentional release of hazardous material occurs (under conditions not necessarily listed above), a written report must be submitted.

State Notifications: Spills and Discharges into the Environment (WAC 173-303-145)

Washington regulations establish the requirements for any person responsible for a spill or discharge of a dangerous waste or hazardous substance that is intentionally or accidentally spilled or discharged into the environment (unless otherwise permitted) such that human health or the environment is threatened, regardless of the quantity of dangerous waste or hazardous substance. Any person who is responsible for a spill or non-permitted discharge must immediately notify the individuals and authorities described for the following situations:

- For spills or discharges onto the ground or into groundwater or surface water, notify all local authorities. Check with the local emergency service coordinator and the Franklin County Fire District (with Pasco Fire Department as backup to the county) to determine all notification responsibilities under the local emergency plan. Also notify the Eastern Regional Office of Ecology.
- For spills or discharges that result in emissions to the air, notify the LEPC and the fire department to determine all notification responsibilities. Also notify the Eastern Regional Office of Ecology, because there is no local clean air agency for Franklin County. The Benton Clean Air Agency has jurisdiction over Benton County; in case of a large air emission release that could affect neighboring Benton County, the Benton Clean Air Agency should also be notified.

7.4 MEDIA INQUIRIES

Media inquiries should be directed to the IWAG's media relations representative, Barbara Smith, (206) 605-3392. In the event of an emergency, the RE and Owner's Representative will brief the media relations representative on the details of the situation, and she will be available to respond to public or media inquiries and provide notification to the Ecology Public Involvement point of contact. Under direction of the IWAG, Ms. Smith will issue any necessary statement or media release. Coordination with Ecology will occur prior to any statements or communications with the media are initiated by the IWAG's media relations coordinator, for non-emergency response communication with media or public news.

8.0 References

PBS Engineering and Environmental, Inc. (PBS). 2019. *Integrated Contingency Plan for the Industrial Waste Areas, Including the Zone A Landfill SVE and RTO Systems and Waste Management.* Prepared for Industrial Waste Area Generators Group III. September.

Pasco Sanitary Landfill NPL Site

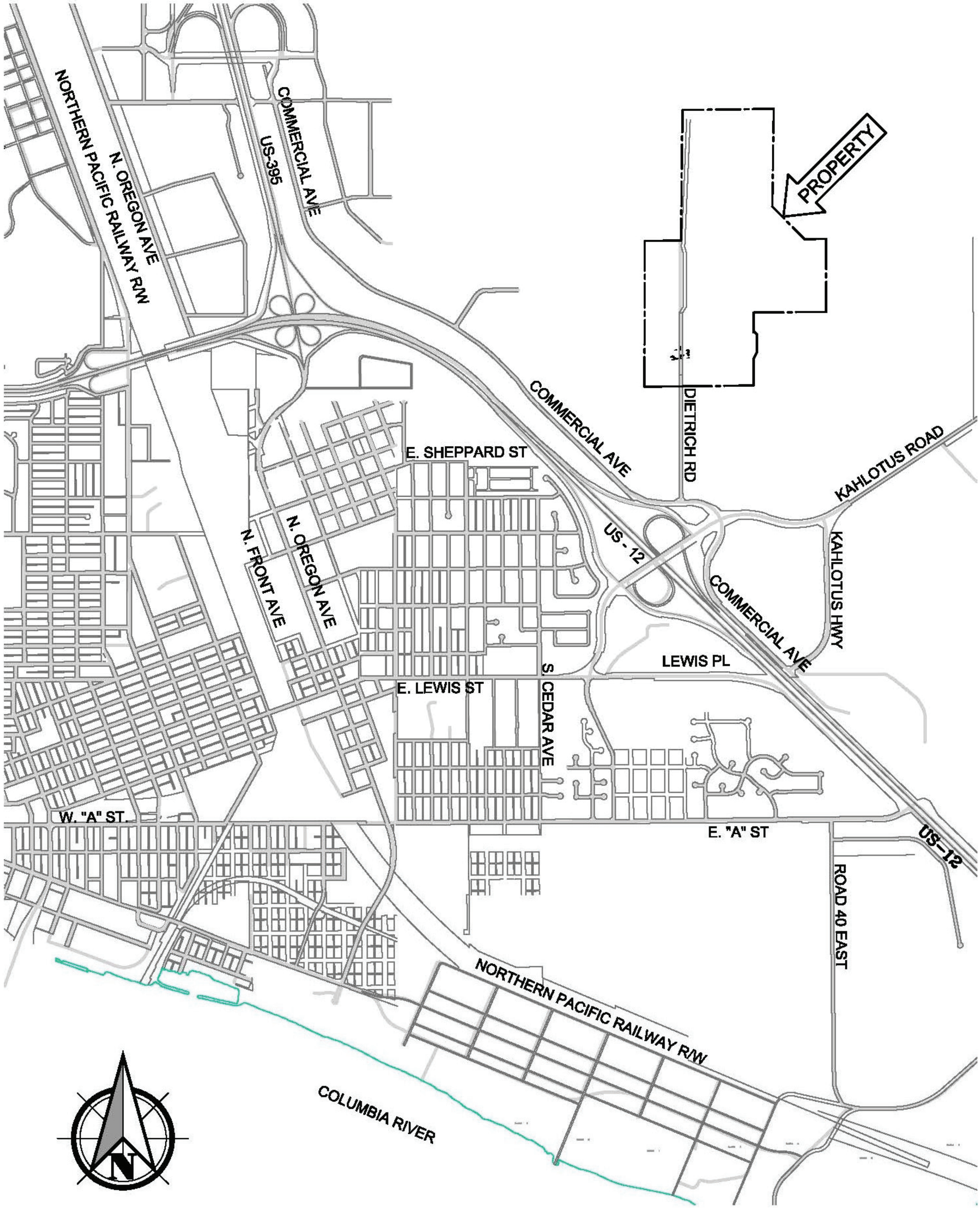
Zone A Removal Action Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.2
Contingency Plan

Figures

FINAL



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Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

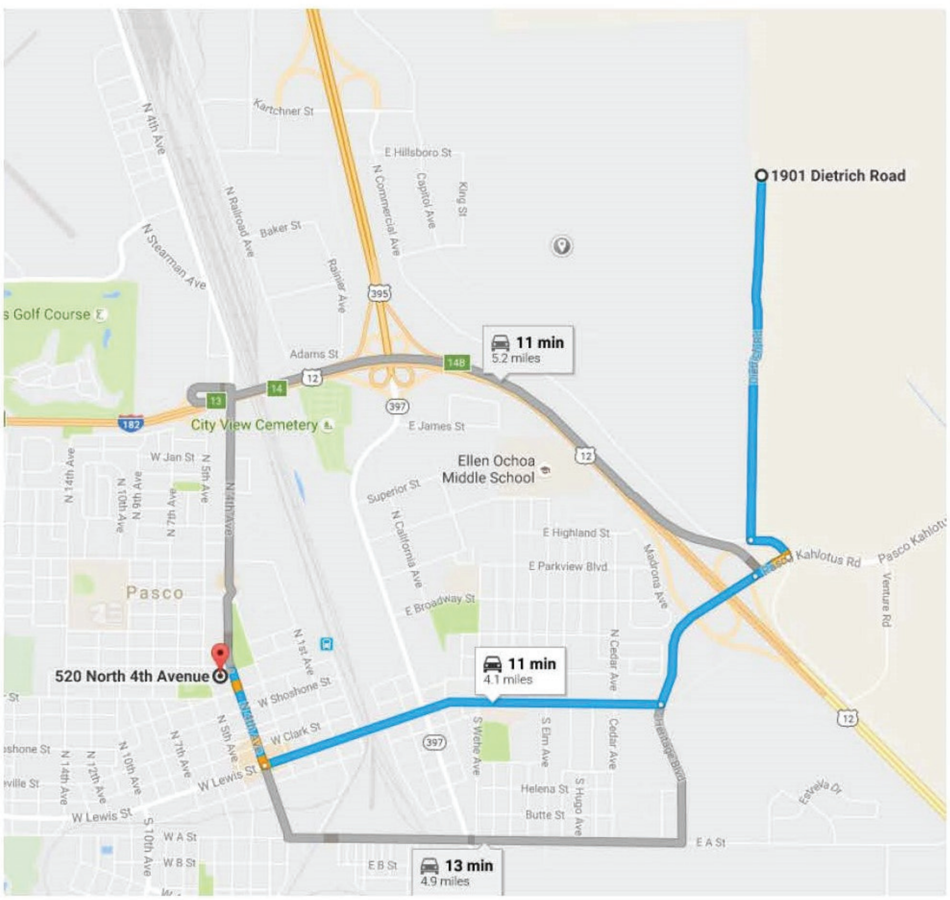
Figure B.2.1
Pasco Landfill General Vicinity Map

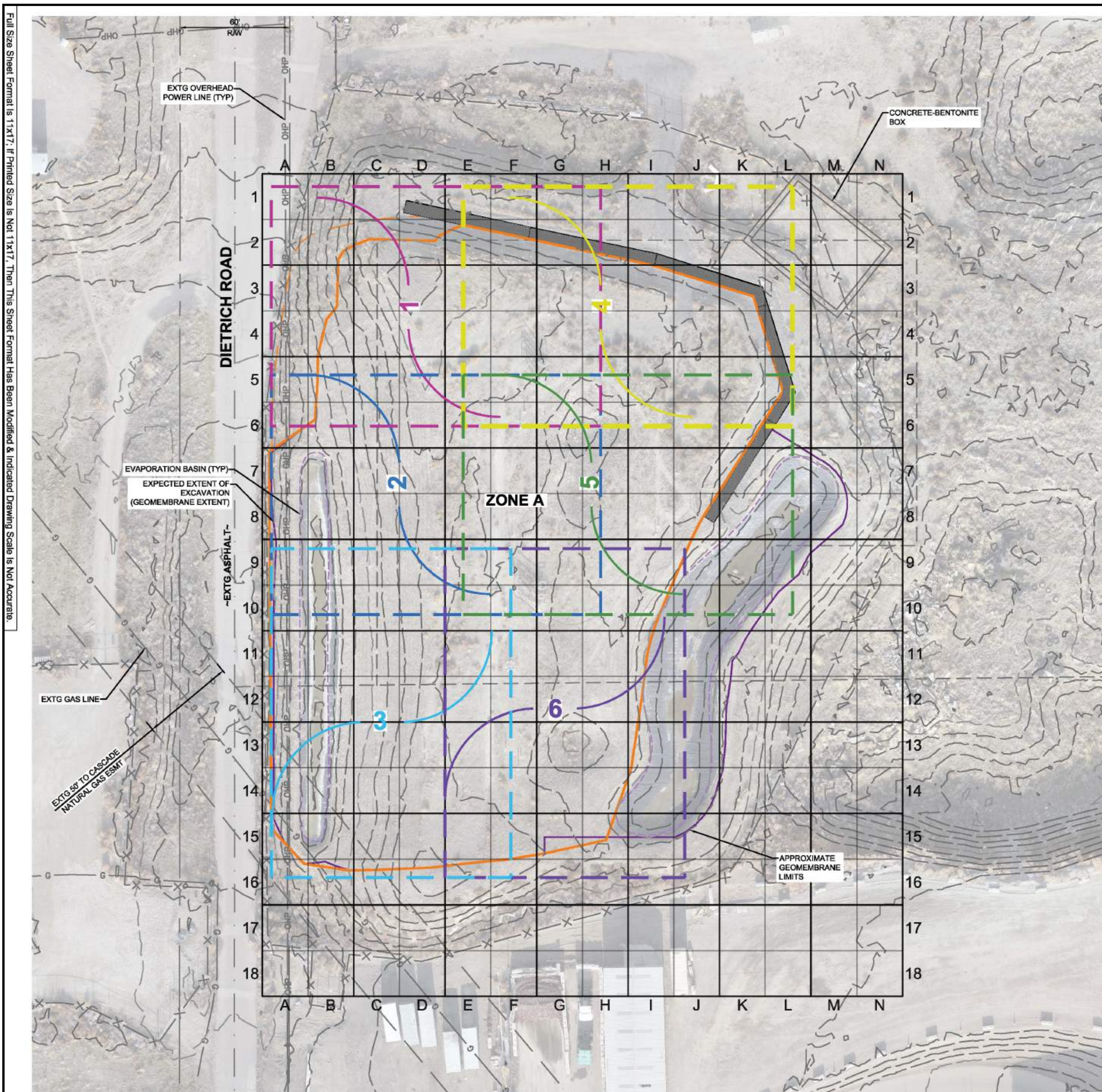
12/9/2019

Name: Lourdes Medical Center
Address: 520 N 4th Avenue, Pasco, Washington, 99301
Phone: 509.547.7704

Emergency Route to Hospital:

1. From the Pasco Landfill, head south on Dietrich Road.
2. Turn left onto Commercial Avenue.
3. Turn right onto Pasco Kahlotus Road.
4. Cross over the highway, and turn right onto E Lewis Street.
5. Drive west on E Lewis Street for 2.1 miles.
6. Drive under the railroad tracks through a short tunnel.
7. Turn right onto 4th Avenue and drive north four blocks.
8. After the intersection of 4th and Sylvester, take the first left and drive to the entrance of Lourdes Medical Center.





LINETYPE LEGEND
EXTENT OF EXCAVATION
GEOMEMBRANE LIMITS
EXISTING EVAPORATION PONDS
EXISTING EASEMENT
EXISTING GAS LINE
EXISTING RIGHT-OF-WAY
EXISTING PARCEL LINE
EXISTING FENCE
EXISTING SECTION LINE
EXISTING OVERHEAD POWER
TEMPORARY STRUCTURE POSITION
25' x 25' GRID

SOURCE: SHEET 7 OF ZONE A REMOVAL ACTION EDR DESIGN DRAWINGS (APPENDIX E).

NOTE:
1. STRUCTURE POSITIONS SUBJECT TO CHANGE BASED ON FIELD CONDITIONS.

Scale 1" = 60'
0 30 60 120

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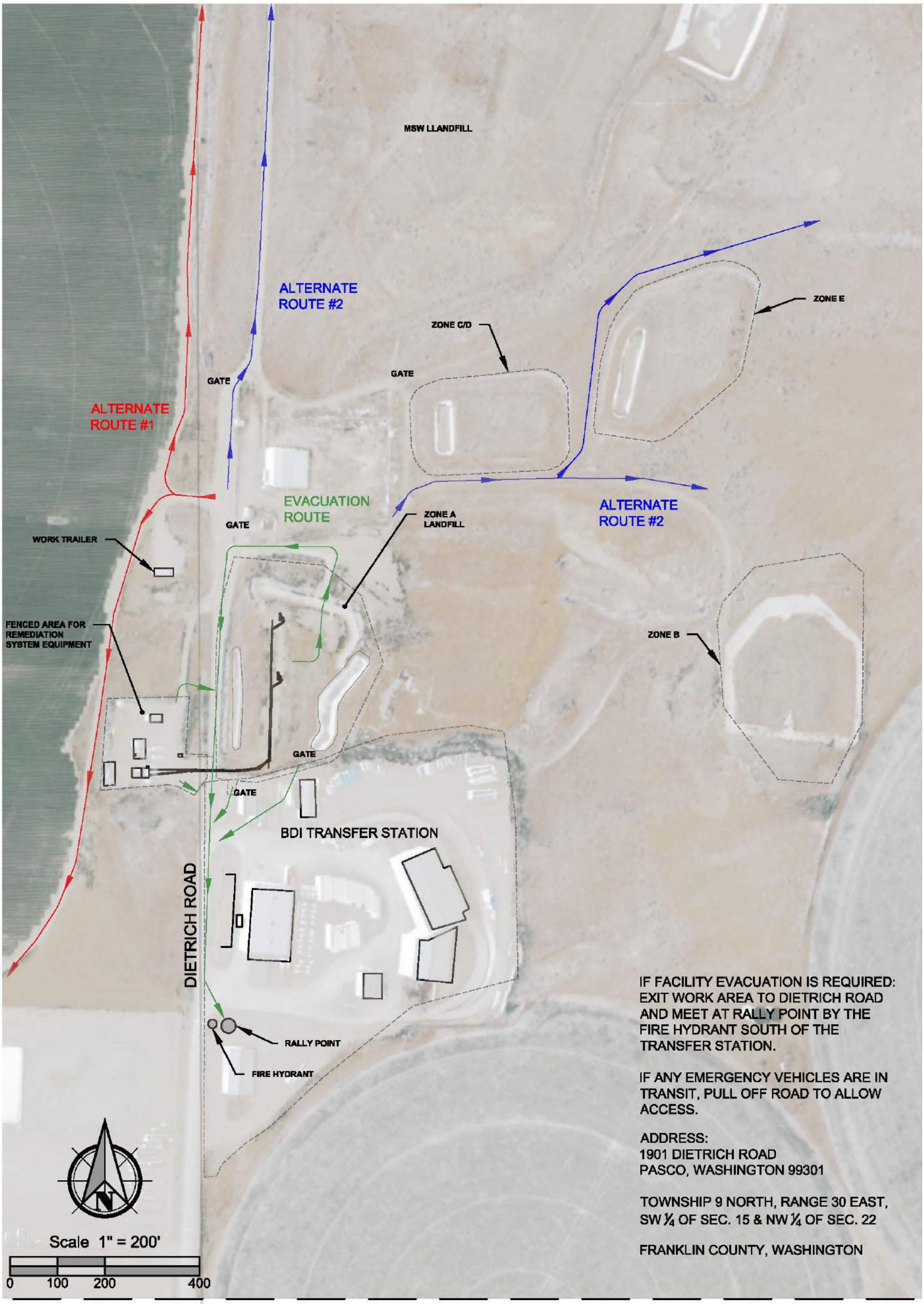
Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure B.2.3
Temporary Structure Positions and Excavation Grid

Full Size Sheet Format is 11x17; If Printed Size is Not 11x17, Then This Sheet Format Has Been Modified & Indicated Drawing Scale is Not Accurate.



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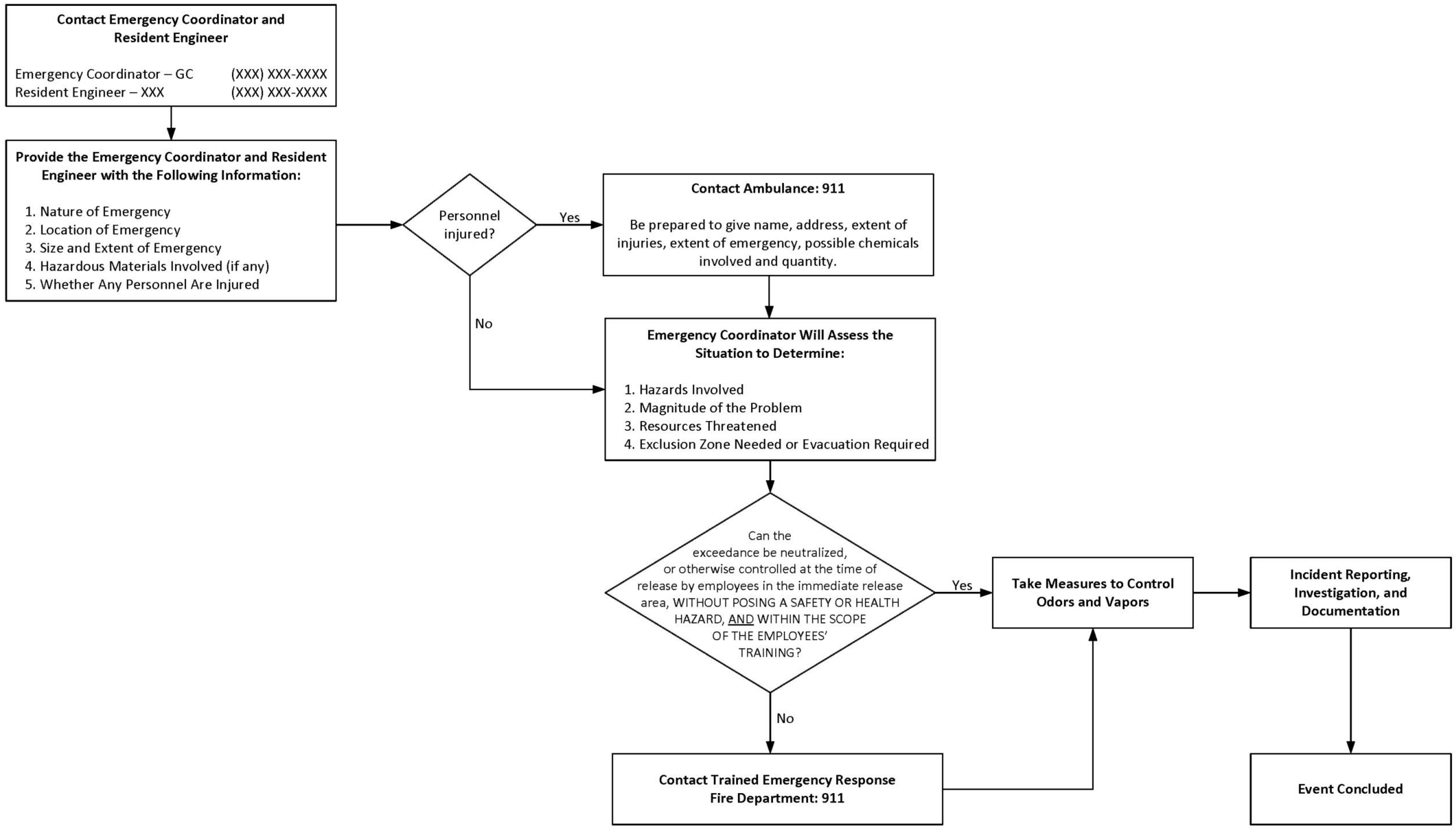
Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure B.2.4
Site Evacuation Map

06/12/2020

Procedures for Air Quality Exceedance



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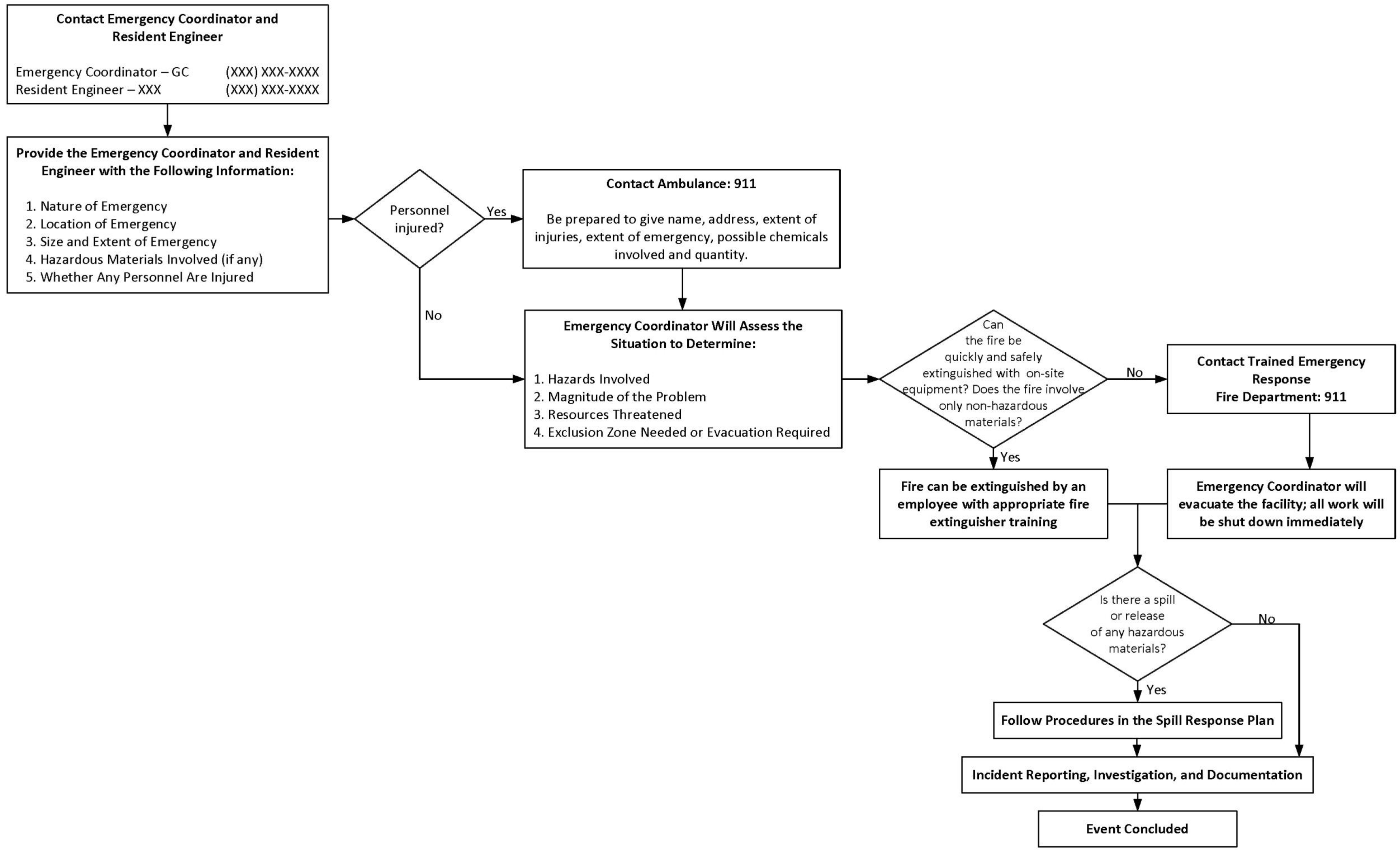
Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure B.2.5
Procedures for Air Quality Exceedance

6/15/2020

Procedures for Fire and/or Explosion



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Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure B.2.6
Procedures for Fire and/or Explosion

6/15/2020

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.3
Perimeter Air Monitoring Plan

FINAL

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
BDI	Basin Disposal Inc.
CAP	*Cleanup Action Plan – Pasco Landfill NPL Site*
CIH	Certified Industrial Hygienist
COI	Compound of Interest
DCA	Dichloroethane
DCE	Dichloroethene
Ecology	Washington State Department of Ecology
EDR	Zone A Removal Action Engineering Design Report
EO	Enforcement Order No. DE 16899
eV	Electron volt
GC	General Contractor
HASP	Health and Safety Plan

Acronym/ Abbreviation	Definition
HI	Hazard index
HQ	Hazard quotient
IWAG	Industrial Waste Area Generators Group III
NPL	National Priorities List
PAMP	Perimeter Air Monitoring Plan
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PFAS/PFOA	Perfluoroalkyl and polyfluoroalkyl substances
PID	Photoionization detector
PLC	Programmable Logic Controller
ppmv	Parts per million by volume
QAPP	Quality and Assurance Project Plan
RE	Resident Engineer
RTO	Regenerative thermal oxidizer
SAP	Sampling and Analysis Plan
Site	Pasco Sanitary Landfill National Priorities List Site
SOW	Scope of Work and Schedule
SQER	Small quantity emission rate
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WISHA	Washington Industrial Safety and Health Act
Zone A	Industrial Waste Area Zone A

1.0 Introduction

1.1 REGULATORY BASIS

This Zone A Removal Action Engineering Design Report (EDR) Perimeter Air Monitoring Plan (PAMP) describes the perimeter air monitoring that will be conducted for the Removal Action to be completed at the Industrial Waste Area Zone A (Zone A) at the Pasco Sanitary Landfill National Priorities List (NPL) Site (Site). This PAMP has been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) to fulfill the requirements of Enforcement Order No. DE 16899 (EO) and the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP) for the Site (Ecology 2019). The PAMP is required as part of the Scope of Work and Schedule (SOW) in Exhibit C of the EO under Task A.2 Preparation of a Zone A Removal Action Compliance Monitoring Plan, Sub plan B Contingency Plan. The Site location is presented on Figure B.3.1. The location of Zone A at the Site is presented on Figure B.3.2.

Part of Task A.2 Sub plan B of the SOW states, "The Contingency Plan shall include a Site Perimeter Air Monitoring Plan. The Site Perimeter Air Monitoring Plan will include details for continuous air monitoring within Zone A and at the Site perimeter, and will present action levels and conditions that warrant Contingency Plan implementation."

1.2 PROJECT AND MONITORING OVERVIEW

The Zone A Removal Action will include the removal of approximately 35,000 drums, the removal of approximately 30,000 cubic yards of fill composing the Zone A cap, stockpiling of the engineered fill, and temporary onsite storage of covered roll-offs containing drummed waste and overpack drums. Approximately 4 to 6 acres of the Site will be disturbed and will constitute the active work areas for the remediation project. Additional background information regarding the Site and Zone A is presented in the main report text of the EDR.

The IWAG will be taking extensive measures to proactively mitigate the potential for volatile organic compounds (VOCs), odors, and airborne particulate matter resulting from the Zone A Removal Action. During all phases of work, a combination of mitigation measures will be used to ensure that the removal action remains protective of the general public and worker safety. These measures are described within the EDR and include the following:

- Continuous operation of the soil vapor extraction (SVE) system
- Establishment of a vapor barrier and working platform across the entire Zone A following removal of the cover system
- Use of a Temporary Structure equipped with an air treatment system for all drum excavation, opening, sampling, and bulking activities
- Work processes and control measures implemented during excavation within the structure that minimize gas/vapor/particulate emissions.

- Placing material for offsite disposal in covered containers (e.g., drum overpacks or "burrito wrapped" covered roll-offs)
- Installation of a clean, compacted soil cover over completed areas of the drum removal prior to relocating the Temporary Structure

The use of the Temporary Structure during the drum removal activities is the primary engineering control to contain potential emissions during the work (refer to Sections 6.5 and 6.15.1 in the EDR). The Temporary Structure will be equipped with granulated activated carbon units (air handling and treatment system) to adsorb potential VOCs as the air stream passes through the carbon beds. As demonstrated in the Temporary Structure Air Treatment Memorandum (GHD et al. 2020), calculated emissions from the Temporary Structure were shown to be less than small quantity emission rates (SQERs; WAC 173-460-150), indicating that emissions from the system are expected to be within acceptable source impact levels.

1.2.1 Perimeter Air Monitoring Program Objectives

The perimeter air monitoring program was designed to monitor air quality at the perimeter of the Site to ensure that the neighboring property and surrounding community are not impacted by activities conducted within the Zone A work area. The primary potential offsite receptors (i.e., surrounding community) are workers at Basin Disposal, Inc. (BDI) facility south of Zone A. Additional potential offsite receptors surrounding the property boundary (presented on Figure B.3.1) include agricultural workers on the landfill property to the west of Dietrich Road; light industrial and commercial businesses to the south and southwest; and the residential area further away from the property boundary to the south and southwest. The closest residential and school properties are approximately 0.5 miles southwest of the landfill property boundary.

The PAMP for the Zone A Removal Action remediation work includes establishing baseline and background ambient air quality prior to the remediation work. Baseline air monitoring will be performed in order to establish ambient air concentrations from existing sources prior to the General Contractor (GC) mobilizing to the Site (refer to Section 3.2). During the remediation work, background (i.e., upwind) conditions will additionally be monitored in order to distinguish potential air emissions unrelated to the remediation work from air emissions potentially as a result of Zone A drum removal work. Both the baseline and background data will be used to differentiate Zone A Removal Action impacts from existing and upwind ambient sources (i.e., ongoing regenerative thermal oxidizer [RTO] treatment unit emissions associated with SVE operations, municipal solid waste landfill flare emissions, off-site agriculture, and odor/emissions from the adjacent BDI transfer station).

The PAMP will serve to monitor the effectiveness of the GC's work practices and control measures within the Zone A area to maintain acceptable air quality at the property boundary and between Zone A and BDI (closest potential receptors), hereafter referred to as "Work Area Perimeter."

IWAG's Resident Engineer (RE) will implement and maintain the PAMP throughout the duration of the Zone A Removal Action excavation work. The objectives of the PAMP are the following:

- Establish Work Area Perimeter action levels for total VOCs that are protective of potential offsite receptors, primarily workers at BDI.
- Measure the total VOCs associated with Zone A Removal Action remedial construction and confirm that they remain at concentrations less than specific action levels at the Work Area Perimeter.
- Establish monitoring methods and controls for particulate matter (dust) generated by construction activities occurring outside the Temporary Structure positions.
- Establish procedures to evaluate impacts to ambient air quality from the Zone A Removal Action and determine if a corrective measure is warranted based on the evaluation of air quality data.
- Establish corrective measures to mitigate impacts to ambient air quality at the Work Area Perimeter that are attributed to the Zone A Removal Action. This includes procedures for evaluating the effectiveness of the engineering control measures described in Section 1.2, as well as additional control measures and/or changes in work practices (corrective measures).

This PAMP presents details for ambient air monitoring at the Work Area Perimeter stations during the work, specific action levels greater than background, and conditions that will warrant corrective measure by the GC to reduce emissions related to the Zone A Removal Action remedial construction.

1.2.2 Other Relevant Air Monitoring Programs

In addition to the perimeter air monitoring detailed in this PAMP, the final EDR and project work plans will include air monitoring regarding the SVE and RTO systems, worker health and safety, container management area, and air monitoring within the Temporary Structure including inspections of the structure itself. These programs in support of the PAMP but outside their purview. A brief overview of these programs is provided in the following sections.

1.2.2.1 Soil Vapor Extraction and Regenerative Thermal Oxidizer Monitoring

Ongoing SVE and RTO system monitoring will continue in accordance with the existing operations and maintenance program, which will be updated following completion of the reconfigured system testing and demonstration that the systems are functioning in accordance with the RTO air permit, EDR, and operations and maintenance manuals.

1.2.2.2 Health and Safety Air Monitoring

Action levels, equipment, and monitoring procedures for worker health and safety will be presented in the GC's Health and Safety Plan (HASP). A summary of the HASP components is presented in Appendix B.1 of the EDR.

1.2.2.3 Temporary Structure Air Monitoring and Inspections

The GC will monitor the performance of the containment provided by the Temporary Structure and air emissions controls connected to the Temporary Structure. The program will include quality control requirements to demonstrate ongoing compliance with U.S. Environmental Protection Agency (USEPA) Method 204 (e.g., monitoring of negative pressure in the Temporary Structure using streamers or similar) to ensure that the air within the structure is being captured and routed through the air handling and treatment system. The Temporary Structure's operations and maintenance plan will address inspection of the outer skin integrity of the structure, closure of personnel doors and equipment doors during the work as well as the inspection of the particulate filters, and carbon beds. In addition, each carbon vessel will be monitored for breakthrough to ensure that the air exiting the structure is being treated. Air monitoring and sampling of the carbon beds will be in conformance with the Temporary Structure Air Treatment Memorandum (GHD et al. 2020).

A work area monitoring system similar to the perimeter air system will be deployed within the Temporary Structure to record and transmit VOC data in real time. The monitor will be placed between the work face and the closest exhaust outlet. The area monitor will be used to verify that the loading assumptions for the temporary treatment and air handling system and for notification when Temporary Structure action levels established for health and safety have been exceeded. Samples for speciated laboratory analysis will also be collected periodically within the Temporary Structure, using SUMMA® canisters for sample collection. These samples will be collected in accordance with the methods and procedures described in Section 3.3.3. This work area monitoring and sampling program will be managed by the RE, and all collected data will be shared between the various air monitoring programs.

1.3 ROLES AND RESPONSIBILITIES

IWAG's RE and designated staff will implement the PAMP. Key roles and responsibilities related to air monitoring are expected to be as follows:

- **IWAG Project Coordinator or designated staff:** Overall project management and communication with Ecology including updates regarding emissions controls and perimeter air monitoring reporting to Ecology (refer to Section 5.4).
- **RE:** Management of Work Area Perimeter air monitoring and reporting system. Designated staff will be responsible for monitoring and compliance with the requirements of this PAMP.

- **GC:** Management of Zone A emissions controls, HASP air monitoring program, and operations and maintenance of Zone A Removal Action work areas inside and outside the Temporary Structure including air monitoring. The GC will be responsible for implementing corrective measures within the Zone A Removal Action work areas for exceedances not attributable to background ambient air quality.

The RE, GC, and air monitoring personnel will be in communication via radio. If real-time air data from any of the monitoring programs indicate a potential concern, or an action level is exceeded, the data will be communicated between the RE and GC and a corrective action will immediately be implemented.

In addition, laboratory analytical data from the air monitoring programs will be shared between the GC and the RE on a regular basis. The data will be used to facilitate understanding of ambient air quality within and around the Zone A work area, and how activities may affect the air quality within Zone A and at the Work Area Perimeter. The intent will be to implement corrective measures before issues arise and periodically validate that the monitoring methods are appropriate to site observations.

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2.0 Compounds of Interest and Development of Action Levels

2.1 COMPOUNDS OF INTEREST FOR PERIMETER AIR MONITORING

The primary goal of the perimeter air monitoring plan is to protect offsite receptors from the dispersion of contaminants caused by remediation activities. Existing Site data include an extensive dataset from field measurements and laboratory analysis of soil, groundwater, and soil vapor samples collected within or beneath Zone A during operations and investigations since the 1980s.

The Temporary Structure Air Treatment Memorandum included an evaluation of emissions from the Zone A excavation that included all constituents detected in soil within or beneath Zone A as contaminants of potential concern (GHD et al. 2020). Emissions estimates of VOCs, semivolatile organic compounds (SVOCs), mercury, polychlorinated biphenyls (PCBs), pesticides, and herbicides from the Zone A excavation were calculated using methods described in USEPA-450/1-92-00: Estimation of Air Impacts for the Excavation of Contaminated Soil. Results of the analysis indicated that the estimated emissions for SVOCs, mercury, PCBs, herbicides, and pesticides would be less than the de minimis thresholds, which are defined in WAC 173-460-150 as "trivial levels of emissions that do not pose a threat to human health or the environment." However, emissions estimates for 18 VOC compounds are at levels that exceed the de minimis thresholds. The memorandum concluded that all contaminants of potential concern would be less than the acceptable source impact levels following treatment, which are established under WAC 173-460 to represent a threshold less than which no adverse human health impacts are expected. Based on the results of the Temporary Structure evaluation, VOCs are considered the primary risk driver for the perimeter air monitoring program.

The most representative data for VOCs that are likely to be encountered are the analytical results from the RTO influent testing. The RTO receives vapors from the SVE system that is a mixture of VOCs from Zone A, and it is expected that emissions during the excavation work will be a mixture of similar VOCs. Therefore, these VOCs represent compounds of interest (COIs) for the PAMP.

As part of RTO air permit (Approval Order No. 16AQ-E031) compliance requirements, influent vapors to the RTO have been analyzed for VOCs. The percent contribution of the majority (approximately 99 percent) of VOCs detected in a sample collected on January 28, 2019 (PBS 2019) along with hazard quotients (HQs) can be found in Table B.3.1.

The HQ is a useful tool to determine which COIs present a significant potential to impact Work Area Perimeter air quality based on available data related to Zone A. The following shows how HQ is calculated for each compound detected in the sample:

- Dividing its vapor pressure (potential to volatilize) by the Washington Industrial Safety and Health Act (WISHA) permissible exposure limit (PEL) to establish a hazard ratio for each VOC.
- Adjust the hazard ratios for Zone A-specific data using the VOC fraction in the RTO influent by multiplying the hazard ratio by the measured percent contribution in RTO influent.

- Dividing the hazard ratio of each individual component by the sum of all hazard ratios to normalize the values to a total hazard index (HI) of 1.

The 10 most abundant compounds found in the RTO influent comprise approximately 98 percent of the VOCs in the vapor stream and 45 percent of the HI. The lowest PEL for the 10 most abundant compounds is 25 parts per million by volume (ppmv), which is 5 times higher than the proposed 5 ppmv conservative action level. Also, the four compounds with the lowest PELs of 1 ppmv (benzene, 1,1-dichloroethene [DCE], vinyl chloride, and 1,2-dichloroethane [DCA]) make up a combined total of approximately 0.16 percent of the vapor stream. This combined contribution is equivalent to approximately 0.008 ppmv at the Site action level of 5 ppmv, which is several orders of magnitude less than any of their respective PELs of 1 ppmv. Refer to Section 2.2 for individual compound estimates.

The VOCs are ranked in the table from the highest to lowest hazard ratio and HQ. The higher the hazard ratio and HQ, the higher the potential for the COI to potentially impact air quality at the Work Area Perimeter. Benzene has the highest potential to be an exposure concern because its PEL is the lowest and it has a low vapor pressure, even though its overall mass contribution was measured at approximately 0.1 percent (Table B.3.1). Toluene, which has a lower vapor pressure than benzene and has the highest overall mass contribution at approximately 34 percent, is third on the list because it has a higher PEL of 100 ppmv.

As stated in the Temporary Structure Air Treatment Memorandum, the emissions from the Temporary Structure were shown to be less than the SQERs (WAC 173-460-150; GHD et al. 2020).

2.2 ACTION LEVELS FOR TOTAL VOCS AND CHEMICALS FOR SPECIATED MONITORING

The development of the action levels was informed by evaluation of an extensive dataset from Zone A soil, groundwater, and air sampling; the operation of the RTO at the Site; and the drum removal work performed in 2008 at the Grant County Ephrata Landfill 1 (Parametrix 2016). An action level of 5 ppmv total VOCs greater than background has been established for the work based on the following three significant and overriding considerations:

1. The RTO currently operating on Site is permitted to emit total VOCs less than 20 ppmv as methane (condition 2d), which is equivalent to approximately 5 ppmv as isobutylene (standard calibration gas for photoionization detectors [PIDs]; RAE Systems ND).
2. A 5 ppmv action level for total VOC PID measurements was used at the Ephrata Landfill for drum excavation, sampling, staging, and disposal work conducted in Ephrata, Washington.
3. Both the RTO permit limit and the Ephrata Landfill action level were established based on a mixture of VOCs, which are the type of potential emissions reasonably expected for the Zone A Removal Action.

Based on the proposed action level, a PID measurement of 5 ppmv or greater than background, sustained for 5 minutes, at one of the five perimeter air monitoring stations will constitute a need to check all emissions controls (e.g., confirm SVE and Temporary Structure air handling and treatment systems are operational, confirm negative pressure in Temporary Structure, check for breach in structure, check air treatment system and carbon units) and perform chemical-specific field monitoring. Table B.3.2 presents the total VOC action level and response actions, which are described in more detail in Section 4.0.

Speciated field monitoring will be conducted to qualitatively validate that the chemicals of greatest concern (i.e., VOCs with PELs less than 5 ppmv) that are not significant contributors to the total VOC measurement. This will be performed using the methods discussed in Section 3.3.3.2.

Table B.3.2
Total VOCs Action Level and Response Actions

Parameter	Equipment	Action Level	Response Actions
Total VOCs	PID	5 minutes sustained > 5 ppmv	• RE notifies GC of exceedance to begin evaluating potential sources and initiates corrective measures to mitigate emissions. • RE monitors speciation at location of exceedance and background location using indicator tubes (for benzene, 1,2-DCA, 1,1-DCE, and vinyl chloride) and air sampling for laboratory analysis (e.g., SUMMA® canisters [refer to Section 3.3.3.2], 24-hour turnaround time, Method TO-15).

The 5 ppmv total VOCs action level greater than background is acceptable because the concentrations of the compounds with the lowest PELs (i.e., 1 ppmv) can be confidently projected to contribute minimally to the overall vapor content. To demonstrate, for an action level of 5 ppmv greater than background and using the percent contributions in the RTO influent from the January 28, 2019, sampling event as an example, Table B.3.3 presents approximate ratios of concentrations to PELs.

**Table B.3.3
Predicted Concentrations of COIs with PELs Less Than 5 ppmv
at the Action Level of 5 ppmv Total VOCs**

VOC	Contribution in RTO Influent 1/28/2019	Predicted Concentration at 5 ppmv of Total VOCs	WISHA PEL 8-hour Time-Weighted Average (ppmv)	Ratio (WISHA PEL Predicted Concentration) (ppmv)
Benzene	0.11	0.0060	1	1:167
1,2-DCA	0.03	0.0014	1	1:714
1,1-DCE	0.02	0.0008	1	1:1,250
Vinyl chloride	0.002	0.0001	1	1:10,000

Table B.3.3 demonstrates that at a total VOC concentration equivalent to the 5 ppmv action level, the approximate concentrations of chemicals with the lowest PEL would be several orders of magnitude less than the PEL's numerical value of 1 ppmv. If the action level greater than background is sustained for 5 minutes, corrective measures would be implemented and the 8-hour time-weighted average for the same compounds would be much lower than those predicted in Table B.3.2.

At the start of intrusive activities and periodically during the progress of work, samples will be collected from the Work Area Perimeter air monitoring stations (refer to Figure B.3.3 and Section 3.3.3) and laboratory analyzed to determine the makeup and distribution of VOCs associated with the Zone A Removal Action. These data will be used to confirm that the action levels and COIs established for the Site are appropriate. The frequency and methods for collecting work area ambient air samples for laboratory analysis is discussed in Section 3.3.3. Although it is not required as part of the PAMP, the RE will collect additional analytical samples from within the Temporary Structure concurrent with the perimeter air monitoring samples to aid in evaluating the makeup and distribution of VOCs associated with the Zone A Removal Action.

Following receipt of laboratory results, the detected mass concentrations of VOCs will be used to calculate HQs as described in Section 2.1 to demonstrate conditions protective of human health. Although not anticipated, total VOC action levels may be reduced if the compounds and/or concentrations within the Temporary Structure or at Work Area Perimeter air monitoring stations pose a greater potential exposure risk from what is currently anticipated based on historical Zone A soil and soil vapor sampling. In addition, the compounds for speciated monitoring may be revised based on results of analytical sampling. Reasons for removing compounds from the list for speciated monitoring are that they are not being detected or are detected infrequently and/or much less than a PEL and have hazard ratios that are less than other compounds. Reasons for adding compounds to the list for speciated monitoring are that they make up a significant portion of the total VOCs reported in the air samples and/or have hazard ratios that are greater than other compounds.

2.3 PARTICULATE MATTER ACTION LEVEL

Because the excavation areas will be within the Temporary Structure, which has an air handing and treatment system, particulate matter or dust that may be potentially detected by Work Area Perimeter air monitoring stations will be generated by Zone A activities associated with clearing activities, Zone A cap removal, stockpiles, construction of the interim cover, traffic on Dietrich Road, traffic associated with the improved gravel roads, or offsite sources. The work area is bordered on the south by BDI and is surrounded by agricultural land that can contribute significant particulate matter during certain farming operations; therefore, a Work Area Perimeter action level of 1 milligrams per cubic meter of total particulates sustained for 5 minutes at concentrations greater than background levels has been established. Particulate matter will be measured with a particulate monitor (DustTrak™ from TSI Incorporated or equivalent). The action level is based on the National Ambient Air Quality Standard for particulate matter with aerodynamic diameter of 10 micrometers or less on a 24-hour basis, scaled to a 5-minute peak value.

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3.0 Perimeter Air Monitoring Methods

3.1 OVERVIEW

This PAMP has been developed to monitor the performance of VOC and particulate matter control measures and work practices implemented by the GC during the Zone A Removal Action to mitigate potential impacts of COIs at the Work Area Perimeter. During the progress of active drum removal and excavation activities occurring within the Temporary Structure, ambient air quality at the Work Area Perimeter will be monitored. Perimeter air monitoring will be conducted during working hours throughout the active drum removal/excavation by performing real-time air monitoring with direct-read equipment capable of detecting VOCs and particulate matter. Station locations and types of equipment to be used are addressed in Section 3.3.

At the end of each workday, vapor and odor control measures such as soil cover or Rusmar foam (or equivalent perfluoroalkyl and polyfluoroalkyl substance (PFAS/PFOA)-free and fluorine-free suppressant) will be applied over the active areas of the excavation to control emissions. During non-working hours, the air handling system of the Temporary Structure will remain running. Real-time monitoring for particulate and vapor emissions at the Work Area Perimeter during non-working hours (e.g., nights and weekends) will not be performed. Although perimeter air monitoring needs to occur only during working hours, datalogging will begin prior to the start of daily ground-disturbing activities to evaluate background conditions. Data will be recorded from the on property meteorological station on each workday, as well as during non-work hours.

A total of five Work Area Perimeter air monitoring stations will be used. Each of the five monitoring stations will consist of one PID and one particulate monitor and will be powered with a solar-powered battery source. Each monitoring station will be equipped with telemetry hardware and will transmit real-time data to the RE and GC and will alarm when action levels are exceeded. The placement of the Work Area Perimeter air monitoring stations was determined based on meteorological data (from 2015 through 2019, from the Tri-Cities Airport, located in Pasco, Washington) and may be modified if significant changes to the wind direction occur. The Work Area Perimeter stations will be placed at an upwind location and at locations where the highest likelihood of a complete offsite exposure pathway exists.

Prior to removal of the Zone A cover system, background ambient air quality conditions will be quantified by conducting baseline air monitoring. Baseline sampling will be conducted over a 2-week period for total VOCs (using a PID), speciated VOCs (using USEPA Method TO-15 laboratory analyses), and particulate matter (using a TSI DustTrak™ particulate monitor or equivalent).

Perimeter air monitoring results will be maintained in an electronic system managed by the RE or designated staff. All equipment will be calibrated in accordance with manufacturers' recommendations. The GC will be provided with the monitoring results to assess potential impacts from its operations. Any concentrations over action levels will be directly communicated with the GC in order to identify the source of emissions and work with the GC to evaluate the need to modify control measures and/or work practices.

3.2 BASELINE AIR MONITORING

As described in Section 3.1, baseline air monitoring will be conducted at the Work Area Perimeter air monitoring station locations for a 2-week period prior to the GC mobilization activities. Baseline monitoring will be performed to establish background ambient air quality conditions before excavation and drum removal activity starts, for comparison to air concentrations during excavation. This process will be used to differentiate Zone A Removal Action impacts from existing ambient sources (i.e., ongoing RTO emissions, municipal solid waste landfill flare emissions, offsite agriculture, and the BDI transfer station). The baseline monitoring will also be used to confirm that the proposed locations are viable locations for monitoring stations and confirm proper operation of equipment.

During the 2-week baseline monitoring period prior to the GC mobilizing to the Site, SUMMA® canisters equipped with laboratory-supplied vacuum flow regulators will be deployed to measure an 8-hour sample at each station during five separate precipitation-free working days. The data from the canisters will be used to determine an average concentration of each individual VOC in ambient air. The samples will be analyzed using USEPA Method TO-15.

3.3 PERIMETER AIR MONITORING METHODS AND EQUIPMENT

The types of equipment that may be used for the air monitoring stations are discussed in the following sections.

3.3.1 Meteorological Monitoring

An on-property meteorological station (e.g., MetOne Sonic Weather Station AI02, Lufft WS600 Compact Weather Station, or similar) will be placed in a representative, unobstructed location approximately 10 feet above ground surface during baseline monitoring and intrusive activities. A rain gauge will also be placed on-site. The meteorological station will provide, at a minimum, temperature, relative humidity, barometric pressure, wind direction, and wind speed. These parameters will be monitored and recorded at a frequency of once per minute throughout the duration of remediation work activities. These data will be communicated to a Programmable Logic Controller (PLC), which can be accessed for review.

The main purpose of the meteorological station is to assist with any source investigation and evaluate background and weather-related impacts on the perimeter air monitor stations. Meteorological data may be used to determine which air monitoring location is downwind during a discrete sampling period and to account for the possible influence of offsite air impact sources. This is important because action level exceedances are based on the sum of the site-specific contribution and the background upwind contribution. If there is a concentration that is greater than the action level (greater than background) at a monitoring station, the wind direction will be noted as part of the evaluation. To supplement the meteorological station data, a windsock will be available as a visual tool for verifying wind direction at the location of the action level exceedance, because wind direction and speed may vary. If the emission source is from a background source (e.g., upwind of Zone A), then no response action will be required by the GC. For a Zone A emission source, a response action will be initiated by the GC as described in Section 4.0.

Continuous weather monitoring will alert staff of atmospheric conditions such as large sudden drops in barometric pressure that may influence fugitive emissions and require corrective action to be taken.

3.3.2 Real-Time Air Monitoring Stations

Each of the five Work Area Perimeter air monitoring stations will consist of a PID and particulate matter monitor. Real-time perimeter air monitoring will be performed on a continuous basis during drum removal and excavation. The equipment will be connected to the internet via a modem or telemetry to a network accessible on the Site (system to be determined), through which all data will be available. The real-time total VOCs and particulate matter concentrations, adjusted for background concentrations, at each Work Area Perimeter air monitoring station will be compared to Zone A-specific action levels and will be used to guide appropriate responses to measured concentrations (refer to Section 4.0).

Data will be recorded from each station each workday. The placement of the air monitoring stations, as shown on Figure B.3.3, were determined based on wind direction data and established at the outer margins of active work support areas. The location of an air monitoring station will be modified only if the wind direction is significantly different from the historical data. The placement of air monitoring stations is to ensure adequate coverage over a range of expected wind directions such that the stations are between the Work Area Perimeter and the closest receptors. The following air monitoring station locations will be used:

- Station P1, located between Zone A and BDI (i.e., the closest potential receptor).
- Station P2, located southwest of Zone A. This station will be used as an upwind or background air monitoring station when winds come from the southwest and will be used as a downwind-right station when winds come from the northwest (i.e., toward potential receptors in nearby residences and schools).
- Station P3, located to the northwest of Zone A. This station will be used as a downwind-left station when winds come from the southwest and as an upwind or background station when winds come from the northwest.
- Station P4, located northeast of Zone A. This station will be used as a downwind station when the prevailing wind direction is from the southwest and as a downwind-left station when wind direction is from the northwest.
- Station P5, located southeast of Zone A. This station will be used as a downwind station when the prevailing wind direction is from the northwest or as an upwind station if winds come from the southeast.

Figure B.3.3 presents the locations for air monitoring stations based on the locations of work activities and meteorological data from 2015 through 2019, from the Tri-Cities Airport, located in Pasco, Washington. The airport is within sight of Zone A and is located approximately 2.4 miles to the west. The wind rose shown on Figure B.3.3 summarizes the airport wind data and illustrates the expected direction, frequency, and speed of wind at the Site. The placement of the air monitoring locations was informed by these data.

3.3.2.1 Particulate Matter

Particulate monitors capable of measuring the concentrations of airborne particulate matter in real-time will be located at each air monitoring station. A TSI DustTrak II Aerosol Monitor light-scattering laser photometer, TSI DustTrak DRX™ nephelometer, or equivalent is recommended for monitoring. Particulate matter monitors will data log measurements and display instantaneous, maximum, and 5-minute time-averaged results for a determination of a "sustained" measurement in ambient air. Data from the stations will be recorded and automatically screened so if a 5-minute concentration exceeds an action level, the RE will be promptly notified.

3.3.2.2 Total Volatile Organic Compounds

PIDs will be located at each air monitoring station. PIDs will be equipped with a 10.6 electron volt (eV) lamp that will detect a majority of the expected VOCs including benzene and vinyl chloride, which have the lowest PELs and are the most significant COIs based their hazard ratios (refer to Section 2.1). An additional PID will be available and equipped with an 11.7 eV lamp that will detect COIs with higher ionization potentials (e.g., methylene chloride, 1,2-DCA, and 1,1,1-trichloroethane).

The PID instruments will measure total VOCs and display a 5-minute running average concentration of total VOCs for a determination of a "sustained" total VOC measurement in ambient air. When an action level is exceeded, the PLC system will automatically notify the RE as well as other stakeholders.

3.3.3 Speciation Sampling

To supplement real-time measurements performed with PIDs, air samples will be collected as described in the following sections. A Sampling and Analysis Plan (SAP) for this sampling and an associated Quality Assurance Project Plan (QAPP) are presented as Attachment B.3.1.

3.3.3.1 Periodic 8-hour Time-Weighted Perimeter Air Sampling

Periodically during the progress of remediation work, additional data will be collected at the Work Area Perimeter air monitoring station locations to quantitatively understand the types and concentrations of contaminants at the Work Area Perimeter. This monitoring will be performed during the start of ground-disturbing activities for each structure position, and periodically thereafter. This sampling will be used to determine the makeup and distribution of VOCs associated with the Zone A Removal Action and verify that the action levels and COIs for speciated monitoring continue to be appropriate.

Samples will be collected in 8-hour time-weighted SUMMA® canisters at all five perimeter air monitoring stations and analyzed using USEPA Method TO-15 for VOC speciation (refer to SAP and QAPP, Attachment B.3.1) during the following phases of remediation work:

- Baseline sampling before the GC mobilizes to the Site as described in Section 3.2
- For 1 day during the first week of ground-disturbing activities for each Temporary Structure position, currently anticipated to be six times

Additional samples will be collected at upwind and downwind perimeter air monitoring stations at the discretion and direction of the RE. These supplemental sampling events would be performed periodically to evaluate the mix of VOCs present at the Work Area Perimeter.

Following receipt of laboratory results, the detected mass concentrations of VOCs will be used to calculate HQs as described in Section 2.0.

3.3.3.2 Speciated Sampling in Response to Exceedances of Total VOC Action Levels

Based on the proposed action levels, a total VOC reading of 5 ppmv or greater than background, sustained for 5 minutes, will trigger the need to collect chemical-specific data. The purpose of the sampling will be to qualitatively understand the types and concentrations of contaminants at the Work Area Perimeter contributing to the exceedance.

Data will be collected at both the perimeter station where the exceedance was observed and the relative background station. Samples collected for speciation will rely on near-real-time monitoring equipment, as well as laboratory analytical methods, using the following approach:

- Colorimetric indicator tubes (Draeger tubes) specific to compounds with PELs less than 5 ppmv (i.e., benzene, 1,2-DCA, 1,1-DCE, and vinyl chloride)
- 15-minute SUMMA® cannister grab samples, analyzed using USEPA Method TO-15 for VOC speciation (refer to the SAP and QAPP, Attachment B.3.1)

Analytical samples will be submitted to the laboratory with a 24-hour turnaround time. A comparison of results will be made between the cannister and tube sampling methods to confirm/validate the use of Draeger tubes for the four risk-based compounds (those with PELs less than 5 ppmv). Following comparison of the results, one of the sampling methods may be eliminated based on correlation between the cannister and tube results.

Samples may be collected at additional locations or times at the discretion of the RE.

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4.0 Field Response Action

Timely and responsive approaches to control potential emissions are critical to the success of the Zone A Removal Action. Reporting, review, and verification of the air monitoring results will be performed in a timely manner.

In the event of an exceedance of action levels or nuisance odor or particulate/dust not attributable to background ambient air quality, the GC will coordinate with the RE to verify all emissions control measures are working properly and identify the onsite source, and the GC will mitigate the onsite source.

The primary goal of the PAMP is to protect offsite receptors from the dispersion of contaminants caused by remediation activities. Nuisance odor refers to those compounds that may present an olfactory response but do not necessarily indicate a health risk. An evaluation of odor thresholds from USEPA and other agencies for compounds detected in SVE system combined line samples was performed (Table B.3.4). The evaluation looked at average concentrations, published odor thresholds, and the quantity of each compound required to exceed each threshold. The evaluation concluded that none of the odor thresholds would be exceeded at concentrations less than the 5 ppmv action level proposed for perimeter air monitoring. Therefore, if odor was detected, the same process of source investigation and control measure verification would be triggered.

The type of control used will be specifically dependent upon several parameters, including the location of the source or sources, the type and concentration of the contaminant, the frequency with which the elevated concentrations occur, and the past effectiveness of various control measures with respect to the specific event. Any one control measure or combination of control measures may be used to mitigate potential future exceedances above background of the defined action levels. Specific types of response actions for particulates/dust and VOCs/odors are described in the following sections.

4.1 RESPONSE ACTIONS FOR PARTICULATE MATTER

Particulate matter or dust control measures will be proactively implemented during construction to limit generation of particulate matter from Zone A work activities. Preventive measures to control particulate matter are anticipated to include the following:

- Stockpile management (such as covering or other stabilization method)
- Gravel road surfaces for Zone A work area access and haul routes
- Water application on temporary road surfaces in the support areas
- Construction vehicle speed limits
- Track-out controls
- Work restrictions on high wind days

In the event of an exceedance of the particulate action level not attributable to background conditions, the following field response actions will be taken to identify the source:

- Visually inspect field operations such as loading, excavation and transportation activities.
- Visually inspect traffic and work areas for visual signs of airborne particulate closest to the air monitor with the action level in alarm mode.
- Visually inspect stockpiles closest to the air monitor with the action level in alarm mode.
- Inspect Dietrich Road surface.

When the source is confirmed, the following actions will be taken:

- Modify work activity to reduce particulate matter/dust emissions.
- Cover inactive work areas or stockpiles with a plastic tarp and weigh it down. Other approved equivalent stabilization methods (e.g., tackifiers, paper mulch, polymers to stabilize the soil surface) may be used instead and are described in EDR Appendix D.1.
- Re-wet gravel roads and/or Dietrich Road.
- Stop work in the immediate area contributing to the emission source.

4.2 RESPONSE ACTIONS FOR VOCS AND ODORS

As discussed in Section 4.0, the use of the SVE system, vapor barriers in the working surface, and a Temporary Structure equipped with an air handling system over active excavations will proactively mitigate the potential for VOCs and odors resulting from the drum removal activities. Waste material staged outside of the Temporary Structure will be containerized and/or covered to proactively mitigate VOCs and nuisance odors.

In the event of an exceedance of a VOC action level or nuisance odor not attributable to background ambient air quality, verification of emission control measures will include confirmation of the following:

- The SVE and RTO systems are working properly.
- The vapor barriers on the working surface are in place.
- The Temporary Structure is under negative pressure and no breach of containment has occurred.
- The Temporary Structure air handling and treatment systems are operational.
- The carbon units are functioning properly, are not plugged from condensate or other material, and breakthrough has not occurred.
- Controls are functional at the Container Management Area, outside the Temporary Structure, at the decontamination area, at the laboratory area, and at the stockpile areas.

Additional control measures and/or changes in work practices (corrective measures) will be implemented if the primary controls listed above are working as designed but an exceedance of the action level occurs that is not attributable to background ambient air quality.

Typical corrective measures may include non-toxic, bio-degradable odor counteractants (e.g., Ecosorb); temporary liner covers; soil cover; PFAS/PFOA-free foam suppressant (e.g., Rusmar), and limiting earth work when certain meteorological conditions apply (e.g., high winds).

The following responses may be necessary:

1. When the source is confirmed at the RTO and SVE:
   A. Perform inspection of system components to determine source and perform maintenance or repair plan as needed.
2. When the source is confirmed at the Temporary Structure:
   A. Ensure that all openings are secure and outer skin shows no signs of wear or tears in the fabric. Make repairs as encountered.
   B. Apply foam to work surfaces within the Temporary Structure.
   C. Reducing the footprint or number of active areas of excavation.
3. When the source is confirmed to be air treatment system or a carbon bed:
   A. Bring identified unit offline and make required repairs.
   B. Bring carbon bed with breakthrough offline and replace.
4. When source has been identified at the Container Management Area:
   A. Identify container.
   B. Check for leaks, check for bulging, and check seals.
   C. Reseal, overpack, or bring into Temporary Structure for further repair.
5. When source has been identified at the decontamination area:
   A. Inspect sump and drain if required.
   B. Use monitoring equipment to evaluate air space in frac tanks.
   C. As necessary, use foam to suppress vapors.
6. When source is coming from laboratory area:
   A. Stop work.
   B. Use monitoring equipment to evaluate air in hood.
   C. Check sink and wastewater area.

The GC may also modify work practices, stop specific activities, or possibly shut down all activities causing the exceedance above background if engineering controls do not sufficiently mitigate the issue.

The controls used by the GC to manage VOCs will also be effective and used for managing odors.

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5.0 Reporting and Record Keeping

5.1 REAL-TIME MONITORING RESULTS

Results from the meteorological station and the VOC and particulate matter monitors will be continuously logged and monitored during remediation work activities. VOC and particulate monitoring data will be reviewed by the RE or designate during each day. The upwind concentration will be used to evaluate whether offsite sources may be impacting the Zone A work area or contributing to elevated values at the downwind Work Area Perimeter. If upwind concentrations are determined to have an impact on the Zone A work area, the difference between upwind and downwind concentrations will be used to evaluate the Zone A work area.

Air monitoring data from the GC's work area and health and safety monitoring programs and from the perimeter air monitoring program will be shared between the RE and GC and/or designated staff. These data will be shared in real time to ensure that potential concerns are confirmed and addressed in a timely manner and work practices and control measures are modified or implemented as needed to provide protection for workers, the general public, and the environment.

Data evaluation will consider the magnitude and persistence of concentrations over action levels. Air monitoring data indicating potential short-term high-magnitude events and long duration events will trigger additional source investigation and implementation of control measures including evaluating the need for possible shutdown.

5.2 LABORATORY ANALYTICAL RESULTS

Laboratory analytical results will be reviewed by the RE or designated staff for completeness in accordance with the SAP and QAPP (Attachment B.3.1). The data will be shared between the RE, GC, IWAG representatives, and Ecology (as indicated in Section 5.4). Any deviations from the plan or quality control issues that may affect the data will be identified and made available with the data.

5.3 DAILY AND WEEKLY REPORTING

As part of the daily field records, the GC and RE will document monitoring activities, laboratory and field results, action level exceedances, and resulting response actions (e.g., inspections and source investigations, changes in engineering controls, VOC/particulate/dust control measures, station location changes, reduced activity, stop work). Air monitoring results will be discussed during daily and weekly onsite progress meetings, including measurements above of concentrations greater than the action levels (above background) that occurred during the previous week and the corrective measures implemented.

5.4 REPORTING TO ECOLOGY

Data from the air monitoring program will be shared with Ecology as part of monthly progress reports, including the following:

- A map showing actual monitoring locations and receptors (if different from this PAMP)
- Contaminants monitored
- Action levels and their basis (if modified from this PAMP)
- Summaries of real-time data
- Summaries of laboratory analytical data
- Action level exceedances with brief explanation of how they were resolved

6.0 Quality Assurance/Quality Control

The PAMP will be managed by personnel with experience in soil remediation construction projects and the air sampling and monitoring described in Section 3.0.

A Certified Industrial Hygienist (CIH) or other qualified designated staff familiar with this plan will be on site during the set-up of the meteorological station and the perimeter air monitoring to ensure proper operations and calibration are being implemented in accordance with the PAMP and to make any necessary modifications to the PAMP based on observed field conditions not originally anticipated. At that time, the CIH or staff will train local personnel to continue implementation of the PAMP for the duration of the project.

All manually collected direct-read data and integrated sampling information will be reviewed on a daily basis to ensure accuracy and completeness. All data entry forms and field notes will be retained for reference upon completion of the project. Any errors identified during the quality assurance and quality control process will be annotated appropriately, while retaining original information to ensure a proper historical record. The RE, CIH, or designated staff familiar with this PAMP will periodically review the data and documentation to ensure compliance with the PAMP.

Per the SAP and QAPP (Attachment B.3.1), quality assurance and control measures will be used to maintain records of instrument calibration and ensure proper sample collection and handling procedures. All instrumentation will be calibrated according to manufacturer's recommendations. Records of these calibrations will include equipment manufacturer and model, serial number, factory calibration date, and daily field calibration information.

Sampling and laboratory analyses will be conducted in accordance with accredited methods, laboratory procedures, and the SAP and QAPP.

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7.0 References

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Appendix B
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Appendix B.3
Perimeter Air Monitoring Plan

Tables

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Table B.3.1
Volatile Organic Compound Hazard Quotients

Volatile Organic Compounds	Contribution in RTO Influent 1/28/2019 (%)	Vapor Pressure (mm Hg)	WISHA PEL 8-hour TWA (ppmv)	Hazard Ratio (VP/PEL)	Hazard Ratio Times Percent Contribution	Hazard Quotient
Benzene	0.11	94.8	1	94.8	10.74	0.17
1,1 Dichloroethylene	0.02	600	1	600	9.71	0.16
Toluene	34	28.4	100	0.28	9.66	0.16
Vinyl chloride	0.002	2980	1	2,980	7	0.11
4 Methyl 2 Pentanone (MIBK)	12.14	19.9	50	0.4	4.83	0.08
2 Butanone (MEK)	9.71	90.6	200	0.45	4.4	0.07
Methylene chloride (1)	0.23	435	25	17.4	4.08	0.07
Trichloroethylene	2.83	69	50	1.38	3.91	0.06
1,2 Dichloroethane (1)	0.03	78.9	1	78.9	2.24	0.04
Acetone	6.56	231	750	0.31	2.02	0.03
Xylenes (m, p, and o)	20.88	8.8	100	0.09	1.84	0.03
Ethylbenzene	5.83	9.6	100	0.1	0.56	0.009
1,1 Dichloroethane	0.13	227	100	2.27	0.29	0.005
Tetrachloroethylene	0.4	18.5	25	0.74	0.29	0.005
Ethanol	4.45	59.3	1000	0.06	0.26	0.004
1,2,4 Trimethylbenzene	1.05	2.1	25	0.08	0.09	0.001
1,3,5 Trimethylbenzene	0.57	2.48	25	0.1	0.06	0.0009
cis 1,2 Dichloroethylene	0.03	200	200	1	0.03	0.0004
Isopropylbenzene (cumene)	0.19	4.5	50	0.09	0.02	0.0003
N Propylbenzene (2)	0.37	3.42	100	0.03	0.01	0.0002
1,1,1 Trichloroethane (1)	0.02	124	350	0.35	0.01	0.0001
					Total Hazard Index	**1**

Notes:

1 Requires an 11.7 electronvolt lamp for PID.
2 Used ethylbenzene PEL.

Abbreviations:

mm Hg Millimeters of mercury
PEL Permissible exposure limit
PID Photoionization detector
ppmv Parts per million by volume
RTO Regenerative thermal oxidizer
TWA Time-weighted average
VP Vapor pressure
WISHA Washington Industrial Safety and Health Act

Table B.3.4
Odor Threshold Evaluation

Compound	CAS No.	Molecular Weight	Odor Threshold (ppmv)	RTO Max Contribution (%) (1)	RTO Concentration x 5 ppmv ÷ MW < OT? (2)	Source	Reference for Odor Threshold
Toluene	108-88-3	92.15	2.9	0.453459899	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/toluene.pdf
2-Butanone (MEK)	78-93-3	72.12	5.4	0.200862033	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/methyl-ethyl-ketone.pdf
Xylenes	179601-23-1	106.18	1.1	0.474699401	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/xylenes.pdf
Acetone	67-64-1	58.09	20	0.283556901	OK	NJ	https://www.nj.gov/health/eoh/rtkweb/documents/fs/0844.pdf
4-Methyl-2-pentanone (MIBK)	108-10-1	100.18	0.68	0.146088481	OK	NAP	https://www.nap.edu/read/9786/chapter/19
Methylene chloride	75-09-2	84.93	260	0.015404226	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/methylene-chloride.pdf
Ethanol	64-17-5	46.07	80	0.321061956	OK	NJ	https://www.nj.gov/health/eoh/rtkweb/documents/fs/0844.pdf
Trichloroethene	79-01-6	131.38	28	0.044455876	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/trichloroethylene.pdf
Ethylbenzene	100-41-4	106.17	2.3	0.2095982	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/ethylbenzene.pdf
Tetrachloroethene	127-18-4	165.82	5	0.003667969	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/1810.pdf
1,1,1-Trichloroethane	71-55-6	133.396	44	0.000295263	OK	ATSDR	https://www.atsdr.cdc.gov/MMG/MMG.asp?id=427&tid=76
1,1-Dichloroethane	75-34-3	98.96	120	0.002725462	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/ethylidene-dichloride.pdf
1,2,4-Trimethylbenzene	95-63-6	120.19	0.4	0.075223036	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/2716.pdf
1,2-Dichloroethane	107-06-2	98.96	6	0.001687218	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/ethylene-dichloride.pdf
1,3,5-Trimethylbenzene	108-67-8	120.19	2.4	0.035672658	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/2716.pdf
2-Hexanone (MBK)	591-78-6	100.18	0.076	0	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/1280.pdf
n-propylbenzene	103-65-1	120.2	--	0.004890625	OK	--	--
Trichlorofluoromethane (CFC-11)	75-69-4	137.36	5	0.008343253	OK	NAP	https://www.nap.edu/read/9786/chapter/17
Isopropylbenzene (cumene)	98-82-8	120.21	0.88	0.003866541	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/cumene.pdf
cis-1,2-Dichloroethene	156-59-2	96.95	0.08	0.001459373	OK	NH	https://www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-ehp-8.pdf
Chloroethane	75-00-3	64.51	4	0.002578316	OK	ATSDR	https://www.atsdr.cdc.gov/phs/phs.asp?id=825&tid=161
Benzene	71-43-2	78.12	1.5	0.002276621	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/benzene.pdf
Tertiary butyl alcohol	75-65-0	74.12	47	0	OK	NAP	https://www.nj.gov/health/eoh/rtkweb/documents/fs/1787.pdf
Chloromethane	74-87-3	50.49	10	0.00095787	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/methyl-chloride.pdf
Chloroform	67-66-3	119.38	85	0.000527518	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/chloroform.pdf
1,2-Dichlorobenzene	95-50-1	147	0.7	0.002070372	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/0642.pdf
1,1-Dichloroethene	75-35-4	96.94	190	0.000408624	OK	NJ	https://nj.gov/health/eoh/rtkweb/documents/fs/2006.pdf
1,1,2,2-Tetrachloroethane	79-34-5	167.848	1.5	0	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/1-1-2-2-tetrachloroethane.pdf
Dichlorodifluoromethane (CFC-12)	75-71-8	120.91	--	0.00371211	OK	NAP	https://www.nap.edu/read/9786/chapter/18
n-butylBenzene	104-51-8	134.22	--	0.002714433	OK	--	--
Naphthalene	91-20-3	128.1705	0.44	0.000583749	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/naphthalene.pdf
1,2,3-Trichloropropane	96-18-4	147.43	--	0	OK	--	--
Vinyl chloride	75-01-4	62.498	3000	0.000161159	OK	ATSDR	https://www.atsdr.cdc.gov/MMG/MMG.asp?id=278&tid=84
p-Isopropyltoluene	99-87-6	134.21	--	0.001692872	OK	--	--
Chlorobenzene	108-90-7	112.56	1	0.000700499	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/chlorobenzene.pdf
Carbon disulfide	75-15-0	76.139	0.16	0.000224743	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/carbon-disulfide.pdf
Bromomethane	74-83-9	94.94	20.6	0.000174158	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/methyl-bromide.pdf
1,4-Dichlorobenzene	106-46-7	147	0.18	0.000379437	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/1-4-dichlorobenzene.pdf
Sec-Butylbenzene	135-98-8	134.22	0	0.002013934	OK	--	--
1,2,3-Trichlorobenzene	87-61-6	181.5	3	0	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/1-2-4-trichlorobenzene.pdf
Dichlorobromomethane	75-27-4	163.8	1.3	2.39468E-05	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/bromoform.pdf
1,2,4-Trichlorobenzene	120-82-1	181.44	3	4.74699E-05	OK	EPA	https://www.epa.gov/sites/production/files/2016-09/documents/1-2-4-trichlorobenzene.pdf
trans-1,2-Dichloroethene	156-60-5	96.95	0.08	0.000122587	OK	EPA	https://www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-ehp-8.pdf
1,3-Dichlorobenzene	541-73-1	147	50	0.000268525	OK	EPA	https://www.atsdr.cdc.gov/ToxProfiles/tp10-c4.pdf

Notes:

-- No odor threshold was available.

Compounds are listed as presented in Monthly Status Reports.

Indicates compound was specified in the RTO Approval Order.

BOLD Indicates compound was specified in the RTO Approval Order and is a top 10 compound.

1 The RTO Max Contribution is the maximum percentage of total VOCs from SV-BRTO sample data from 10/5/2015 through 2/25/2020.

2 OK indicates that the concentration at the proposed 5 ppmv action limit is less than the referenced OT.

Abbreviations:

CAS Chemical Abstracts Service

MW Molecular weight

OT Odor threshold

ppmv Parts per million by volume

RTO Regenerative thermal oxidizer

VOC Volatile organic compound

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Figures

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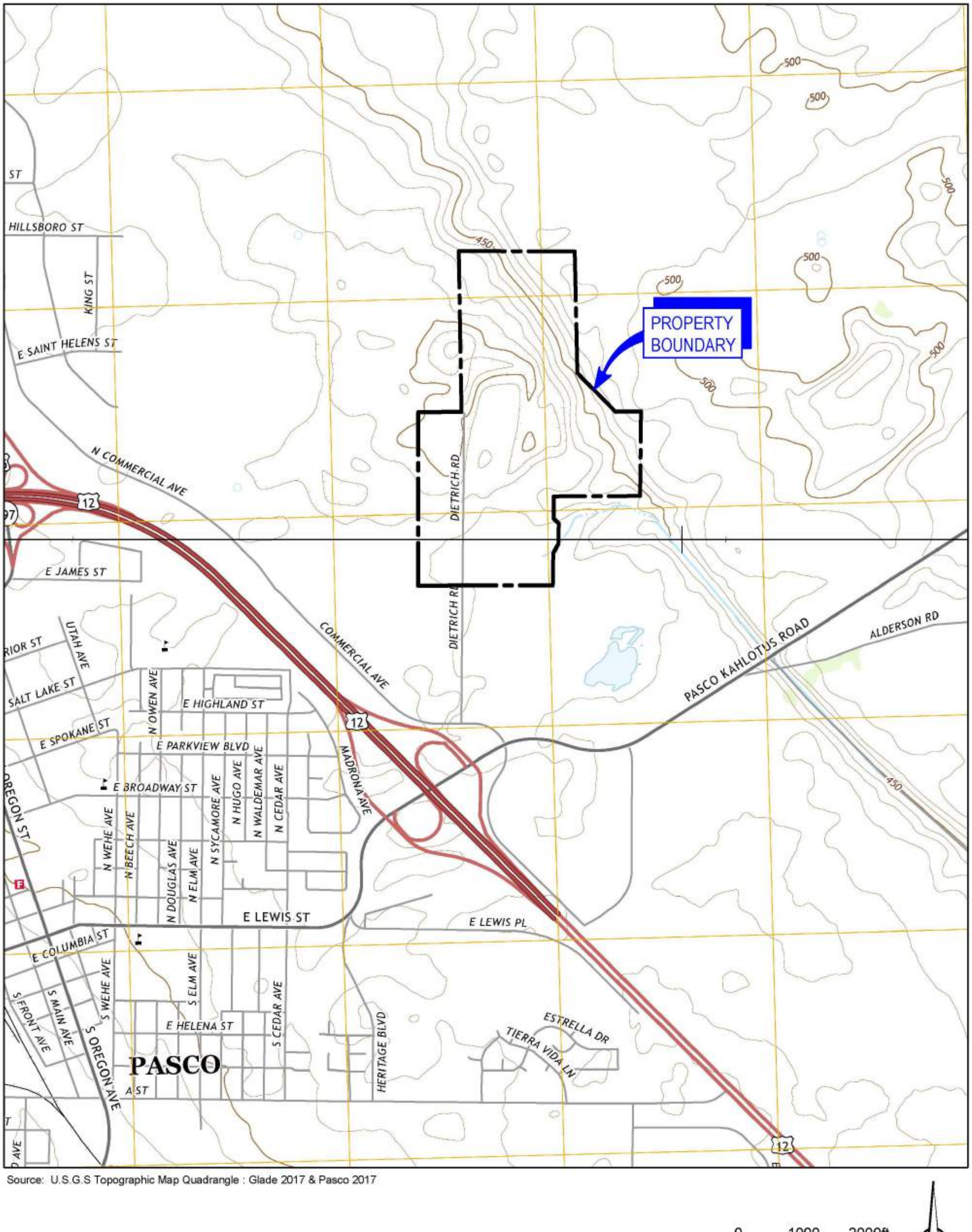

Source: U.S.G.S Topographic Map Quadrangle : Glade 2017 & Pasco 2017

Note: Figure developed with GHD.

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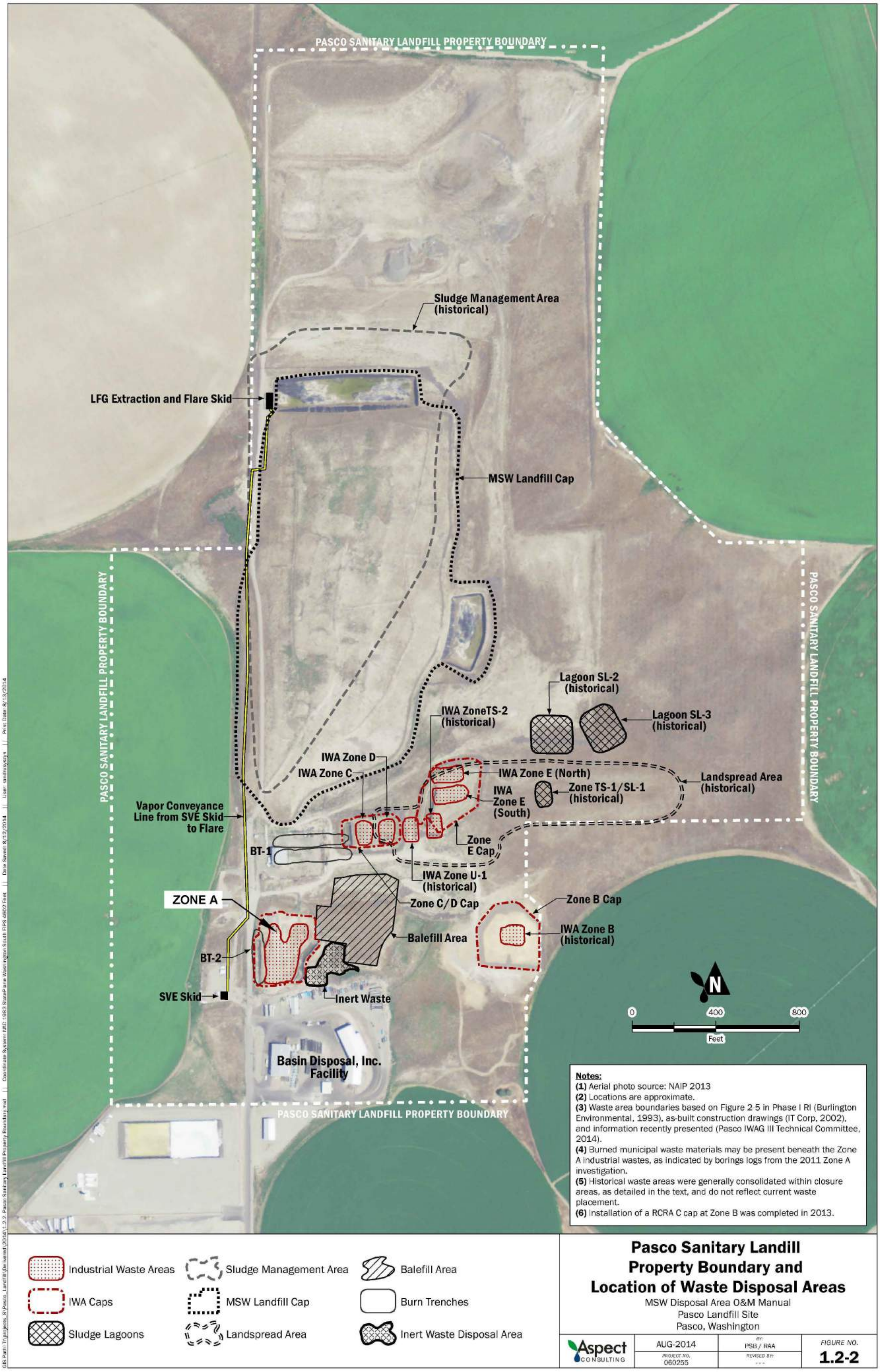
Pasco, Washington

Figure B.3.1
Pasco Sanitary Landfill
Property Location



Source: FIGURE 1.2-2 DRAFT FINAL FOCUSED FEASIBILITY STUDY, ANCHOR QEA, AUGUST 2017.

Note: Figure developed with GHD.

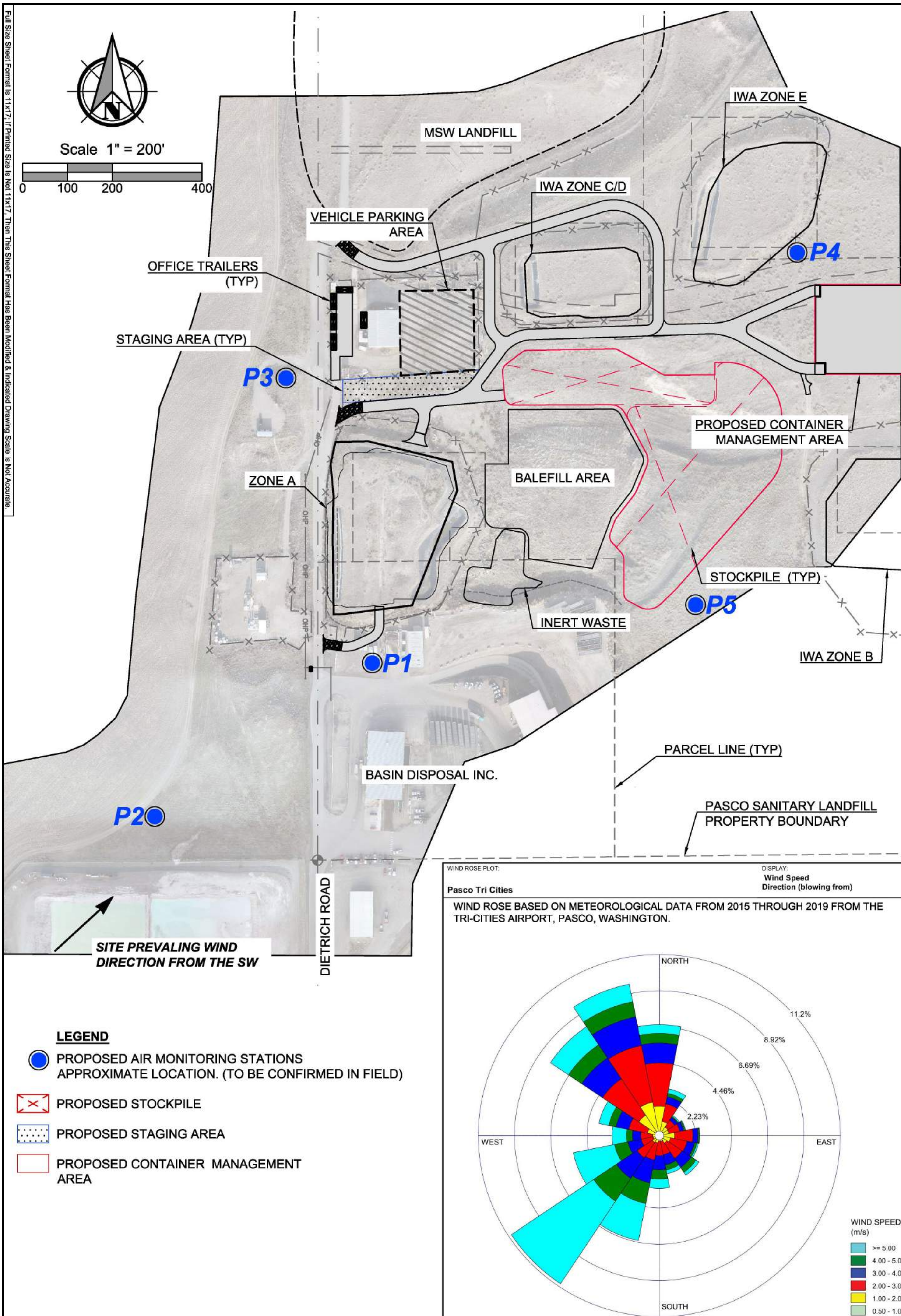


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Figure B.3.3
Proposed Locations for
Perimeter Air Monitoring Stations

08/11/2020

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Attachment B.3.1
Sampling and Analysis Plan and Quality Assurance Project Plan for Perimeter Air Monitoring

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Sampling and Analysis Plan and Quality Assurance Project Plan for the Perimeter Air Monitoring Plan

Attachment A of Appendix B.3
Engineering Design Report

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Tables

1. Introduction

This Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) describes procedures for collecting, analyzing, and reporting data from ambient air samples collected as part the *Perimeter Air Monitoring Plan* (PAMP) during excavation activities at Zone A Industrial Waste Area (Zone A) at the Pasco Sanitary Landfill National Priorities List (NPL) Site (Site). This SAP and QAPP has been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) to fulfill the requirements of an Enforcement Order (EO) dated November 8, 2019 and the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), prepared by Washington State Department of Ecology and dated August 2019. The SAP and QAPP are required as part of the *Scope of Work and Schedule* (SOW) in Exhibit C of the CAP – specifically Task A.2.F of the Compliance Monitoring Plan. This SAP and QAPP are related to sampling in the PAMP, which is part of Task A.2 Compliance Monitoring Plan (CMP) Sub-plan B. The PAMP, SAP, and QAPP are presented as part of the Zone A Removal Action Engineering Design Report (EDR).

The SOW, Task A.2, Sub-plan F. SAP states:

A SAP shall be prepared to satisfy WAC 173-340-410 and -820 requirements. The SAP shall include an appropriate quality assurance project plan (QAPP), and verify that all analyses are performed by laboratories accredited by Ecology's Manchester Laboratory…The SAP will include specific sampling procedures, analytical methods, and associated QA/QC requirements to properly guide all these various sampling and monitoring activities.

This SAP and QAPP is presented as Attachment A of the Perimeter Air Monitoring Plan (PAMP).

2. Sampling Objective

The objective of the Perimeter Air Monitoring Plan sampling program is to quantify volatile organic compounds (VOCs) in ambient air to evaluate if the excavation operation poses significant effects on the air quality at the Work Area Perimeter and between Zone A and Basin Disposal Inc. (BDI) in accordance with the requirements of the PAMP.

3. Sample Collection and Analysis

Ambient air sample collection is discussed in the PAMP. Table 1 provides a summary of field and laboratory sampling and analysis including the types of samples to be analyzed, methods, turn-around time, sample duration, container, and estimated number of samples.

4. Sample Designation

Each sample container will be labeled with a unique alphanumeric code (a.k.a. sample name) that will facilitate tracking and cross referencing of sample information. Each unique code will include the information and follow the formats outlined below:

- Each code will begin with “PLF-“ to indicate Pasco Landfill
- Each code will include a sample location that identifies the air sampling location
- If the sample is a duplicate, the code of DUP plus a sequential number will be used in place of the location identification (e.g., DUP1 for duplicate sample 1)
- Each code will end with the date the sample is collected in the format of "-MMDDYY"

As an example, a sample name of PLF-P1-092120 indicates a sample collected from station P1 on September 21, 2020. An example of a field duplicate of this sample would be PLF-DUP1-092120.

A label must be affixed to all sample containers to prevent misidentification, and at minimum, must include:

- Client name and project number
- The unique sample name (alphanumeric code)
- Date and time of collection
- Barcode number (if the sample is collected in a SUMMA® canister)

The information on each sample label (including the barcode number for SUMMA® canisters) will be recorded in the field logbook along with the analyses to be performed and other sampling information described below. Each sample will be checked then recorded on the chain-of-custody (COC) form prior to being released to the laboratory.

5. Ambient Air Sampling

5.1 SUMMA® Canisters

The date, time, sample name, location, and weather conditions (temperature, wind direction, precipitation) at time of sampling commencement at each location will be recorded in the field logbook (Section 6.1). Sampling during high winds or precipitation events should be avoided.

Ambient air samples will be collected using 6-liter evacuated SUMMA® canisters over a 8-hour period for establishing baseline or background conditions and over a 15-minute period in the case where a potential emission source is being investigated.

SUMMA® canisters will be received from the laboratory certified clean and equipped with laboratory calibrated flow regulators set to fill the canisters over the 8-hour / 15-minute period but still leave a small amount of vacuum in the canister at completion of sampling.

A pressure (vacuum) gauge will be supplied by the laboratory attached to each canister and will be used to measure the initial canister vacuum, canister vacuum during sample collection, and residual canister vacuum at the end of sample collection.

The initial vacuum within each canister will be checked using a laboratory supplied pressure gauge to ensure that each canister is evacuated prior to initiation of sample collection (initial vacuum should be approximately 30 inches of mercury (Hg)).

The canisters will be elevated such that the samples will be collected from a minimum height of approximately 2 feet above the ground. Canisters have the intake near the top so the canisters may need to sit on top of an object to position the intake at 2 feet or above. Any objects used to elevate the canisters should be selected so as to not affect the results (e.g., untreated wood would be acceptable). The regulator valve will then be opened to commence sample collection.

Twice each day, weather conditions will be recorded and the vacuum in each canister will be checked using the laboratory supplied pressure gauge to ensure that each canister is filling at approximately the expected rate. The vacuum remaining in each canister after sampling completion will be recorded (a small residual vacuum should remain at time of sampling completion and confirmed by the laboratory prior to sample analysis). The time and weather conditions at time of sampling completion will be recorded.

A maximum residual vacuum of 10 inches Hg is allowed. A canister residual vacuum above this value will require continued sampling until the vacuum reading is below this threshold. A minimum 2 inches Hg residual vacuum will be required for the sample to be considered valid, or the sampling will be repeated using a new sample canister. Once the vacuum is measured, the valve will be closed, and the safety cap will be securely tightened on the inlet of the sample canister prior to shipment to the laboratory under chain of custody procedures (see Section 6.2).

The sampler will verify the expected initial vacuum, maximum residual vacuum, and minimum residual vacuum with the laboratory before sampling. The initial and final pressures of each canister will be recorded on the field log as well as the chain-of-custody document that will be shipped along with the canisters to the laboratory.

Note that two different gauges may be supplied with the SUMMA® canisters – an analog gauge and a digital gauge. The analog gauge remains on the canister and can be used to check the pressure during and after sampling. A digital gauge may also be supplied but since it is used on multiple canisters it should not be used after the initial check since it could introduce the possibility of sample cross contamination.

5.2 Indicator Tubes

Indicator tubes for chemical specific monitoring (benzene, 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethylene (1,1-DCE), and vinyl chloride (VC)) will be operated in accordance with the manufacturer's instructions.

The time, date, sample location, colorimetric results, and other pertinent sampling information (e.g., number of pumps, flow rate, or time elapsed during testing) will be recorded in the field logbook for each indicator tube sample.

6. Sampling Documentation

6.1 Field Logbook

Field logbooks will record daily air monitoring activities and samples collected as part of the Perimeter Air Monitoring Program. Information will be kept in bound documents containing pertinent information including:

- Project number
- Sample matrix (ambient air)
- Name of sampler
- Sample location
- Sample name
- Time and date
- Pertinent data (e.g., type and size of sample container, sampling duration, canister barcode, flow controller barcode, pressure/vacuum, number of pumps or time elapsed for indicator tubes)
- Analysis to be conducted
- Sampling method
- Pertinent weather data
- Any modification or deviations from the PAMP

Each workday, the sampler will sign the last page of the notes recorded in the field logbook for that day. The field logbook will be a reference to facilitate accurate review and reporting of the field activities.

6.2 Chain of Custody

Chain of custody forms will be completed for all samples collected and submitted for laboratory analysis during the program. The chain of custody form will document the sample type, duration, canister initial and final pressure readings, laboratory analysis requested, and the custody and transfer of sample containers. The chain of custody document will be signed, timed, and dated by the sampler and a copy of the chain will be placed in zippered plastic bag inside the box when transferring the samples.

Custody seals will be placed on each box and the box will be sealed with packing tape. All samples should be delivered to the laboratory in accordance with hold time and turn-around time requirements for the project (Table 1).

The sampler will retain a copy of the chain. The laboratory, upon receiving the samples, will complete the sample receipt portion and retain a copy for their records. The laboratory will return a copy to the QA/QC Officer upon receipt of the samples. The sampler's copy will be filed in the field project file or will be scanned and stored electronically.

6.3 Sample Documentation

Documentation for the project shall consist of the following:

i) Project related plans

ii) Project logbooks

iii) Equipment calibration records

iv) Field data records

v) Sample identification documents

vi) Chain of custody records

vii) Laboratory data

viii) Photos, maps, drawings, etc.

7. Sample Handling and Analysis

Methods of analyses, sample containers, and holding times are presented in the QAPP. The pressure gauge provided by the laboratory will be returned with the samples to check residual vacuum in the laboratory prior to sample analysis and recorded on the analytical data report. This check will ensure sample integrity prior to laboratory analysis, and that the canister has not become compromised during shipment to the laboratory. Using the same pressure gauge throughout the entire sampling process will eliminate discrepancies between vacuum measurements that can arise from using different gauges with a potentially different sensitivity and/or calibration.

All samples selected for analyses will be shipped or delivered to the laboratory by courier under approved chain of custody procedures with consideration for the method hold time, which is 30 days. The QAPP identifies sample handling and custody procedures.

Project documents and records including document control will be retained in accordance with project requirements.

8. Quality Assurance/Quality Control

Field duplicate samples will be collected and used to assess the aggregate precision of sampling techniques and laboratory analysis. For every 20 investigative samples, a field duplicate sample will be collected alongside or simultaneously with the designated sample using a “T” connector between the original and duplicate canisters if possible.

The canisters will be submitted to ALS in Simi Valley, California a Washington State certified laboratory for analysis. The SUMMA® canisters will be analyzed using United States Environmental Protection Agency (USEPA 1999) Method TO-15.

The laboratory should follow all quality assurance/quality control (QA/QC) requirements specified in Method TO-15 and the laboratory standard operation procedures (SOP) whichever is more stringent, in respect to sample handling and preparation, instrumentation, sample analyses, data reduction, and reporting. As minimal, a Stage 2b (as specified in EPA 2009) laboratory report is required for all samples.

Additional requirements for QA/QC are presented in the QAPP below.

9. Quality Assurance Project Plan (QAPP)

The purpose of this QAPP is to identify QA/QC measures to be applied during the perimeter air monitoring such that the data generated will be of a known and acceptable level of quality.

Perimeter air monitoring will be conducted with a combination of (1) field measurement of total VOCs with photoionization detectors (PIDs), (2) indicator tubes for continuing monitoring of high-risk chemicals (e.g., benzene, 1,2-DCA, 1,1-DCE, vinyl chloride), and (3) where needed, time-factored SUMMA® canister sampling for laboratory analysis for a full suite of VOCs using EPA Method TO-15 at a Washington State certified laboratory.

Data collected during this monitoring effort will be evaluated against established thresholds, as stated in following sections to determine the impact of air quality resulted from the excavation operation and corrective actions as needed.

10. Program Personnel

A brief description of the duties of the key Perimeter Air Monitoring QA program personnel is presented below.

Perimeter Air Monitoring Program Manager

- Oversees perimeter air monitoring program to ensure that QA/QC procedures are followed and project DQOs are met
- Prepares and reviews perimeter air monitoring reports
- Conducts preliminary chemical data interpretation and assessment
- Communicates data with Resident Engineer, General Contractor, and other in a timely fashion

Quality Assurance/Quality Control Officer

- Reviews laboratory reports including QA/QC data
- Performs analytical data validation
- Identifies and resolves QA/QC issues throughout the data generation processes
- Provides QA/QC information for reports
- Provides technical representation for data quality activities and reporting

Field Quality Assurance Officer

- Provides immediate supervision, or performance, of perimeter air monitoring activities, and ensure all required QA/QC procedures are properly conducted and all requirements are met for field equipment and canister calibration and measurements.
- Ensure all field documents are correct and complete
- Ensure all sample handling, packing, documenting, and shipping are conducted following all QA/QC requirements set forth in this QAPP.
- Ensure that samples are received at the laboratory and issues (if any) resolved in regard to sample integrity and chain of custody document consistency.

The same person may act as the Perimeter Air Monitoring Program Manager, QA/QC Officer, and Field QA Officer.

Laboratory - Project Manager

- Coordinates and oversees all laboratory operations related to this sampling and analysis effort
- Provides collaboration between the program team and the laboratory
- Notifies Project Manager and QA Officer of any QA/QC issues occur during sample receipt and analyses in a timely manner
- Oversees laboratory data reduction and review
- Oversees preparation of analytical reports
- Approves final analytical reports

Laboratory - Sample Custodian

- Receives and inspects the sample containers immediately upon sample arrival at the laboratory
- Documents the condition of the samples upon receipt
- Verifies and signs chain of custody
- Assigns a unique laboratory identification number correlated to the field sample identification number and enters each into the sample receiving log
- Initiates transfer of samples to the appropriate lab sections with assistance from the Laboratory Project Manager
- Controls and monitors access to and storage of samples and extracts

11. Training and HAZWOPER Certification

As all field personnel will hold current hazardous waste site operation (HAZWOPER) certification required by 29 CFR 1910.120. Personnel will also have experience and/or training with ambient air sampling procedures and the calibration and operation of field instrumentation.

12. Data Quality Objectives (DQOs)

12.1 Quality Assurance Objectives

The overall quality assurance objective is to develop and implement procedures for field measurement, sample collection, and laboratory analysis, which will provide data with an acceptable level of accuracy and precision.

12.2 Field Measurement Quality Assurance

Measurement data will be generated during field activities. These activities include, but are not limited to, the following:

i) Datalogged PID measurements from air monitoring stations (equipped with 10.6 eV lamps)

ii) Readings from a handheld PID (equipped with an 11.7 eV lamp)

iii) VOC indicator tube readings

iv) Documenting sample location, time, and other conditions

The general quality assurance objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures. The PIDs and indicator tubes will be calibrated and operated following all requirements stated in the manufacturer's specification.

12.3 Laboratory Quality Assurance

The analytical laboratory selected to perform the analysis will be accredited under the State of Washington Department of Ecology (WDOE) Environmental Laboratory Accreditation Program.

The following subsections define the quality assurance goals required to meet the DQOs of the project.

12.3.1 Canister Quality Assurance

Laboratory quality assurance measures for this project will begin with sample containers. The sample canisters will be rented from the laboratory. Rented canisters will be certified batch cleaned for soil vapors according to United States Environmental Protection Agency (USEPA) Method TO-15. The laboratory will perform testing in accordance with EPA Method TO-15 to verify that the containers are clean and there are no residual contaminants from prior use. The laboratory will provide an analytical report with results of the residual testing performed for every canister used in this sampling program.

12.3.2 Accuracy, Precision, and Sensitivity of Analyses

The fundamental quality assurance objective with respect to the accuracy, precision, and sensitivity of analytical data is to meet the quality control acceptance criteria of each analytical procedure. Summaries of the targeted quantitation limits are provided in Table 2. It should be noted that these limits are targeted reporting limits only; limits are highly matrix dependent and may not always be achieved.

The method precision (reproducibility between duplicate analyses) will be determined based on duplicate analysis of an ambient air sample. Precision will be reported as Relative Percent Differences (RPDs) between duplicate results. The mathematical formula for precision is presented in Section 17.3.1.

The method accuracy (percent recovery) will be determined by spiking blank canisters with the compounds of interest. Accuracy will be reported as the percent recovery of the spiking compounds and will compare with the criteria given in the method. The mathematical formula for accuracy is presented in Section 17.3.2.

12.3.3 Completeness, Representativeness, and Comparability

A completeness requirement of 90 percent will be targeted for the program (see Section 17.3.3 for definition and mathematical formula of completeness).

Summaries of the sampling and analysis programs are presented in Table 1.

All standards used by the laboratory will be traceable to reliable sources and will be checked with an independent standard.

13. Field Procedures

The field procedures are presented in the Ambient Air Sampling section above.

The laboratory method, sample container, sample collection duration, and holding time requirements are identified in Table 1.

13.1 Field Instrumentation – Operation and Calibration

Field equipment used during this investigation will be calibrated prior to the day's use and/or operated in accordance with the manufacturer's instructions. Field equipment calibration will be recorded on a dated calibration form or in a bound field notebook.

13.2 Sample Custody and Documentation

The following documentation procedures will be used during sampling and analysis to provide chain of custody control during transfer of samples from collection through storage. Documentation will include use of the following:

i) Field logbooks (bound with numbered pages) or electronic records will be kept to document sampling activities in the field

ii) Labels to identify individual samples

iii) Chain of custody forms to document samples collected and analyses to be performed as well as custody of the samples from sample collection through laboratory receipt

iv) Laboratory information management system (LIMS) or similar

13.2.1 Field Logbook

The sampler will record information for each sample collected in accordance with Section 6.1.

Upon completion and closeout of the project, each logbook will be stored in the project files, or the contents of the logbook will be scanned and made available for electronic access.

13.2.2 Sample Labeling

A unique sample name will be used to identify each sample collected as described in Section 4. This system will provide a tracking number to allow retrieval and cross-referencing of sample information.

Sample container labels will be affixed to each sample and will include information listed in Section 4.

Field duplicates will be submitted blind to the laboratory. The field duplicate location will be specified in the field notebook and in the project database.

13.2.3 Chain of Custody Records

Chain of custody forms will be completed for all samples collected during the program as described in Section 6.2. Samples will be shipped with the chain of custody form packed inside to document custody of the samples. Custody seals will be placed on each box.

Upon receipt of the box at the laboratory, the Sample Custodian will inspect the shipping box and the custody seal and note the condition of the box and the custody seal. If the shipping box seal is intact, then the sample containers will be accepted for analyses. The Sample Custodian will document the date and time of receipt of the container and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), then they will be noted. Any damage or discrepancies will be reported to the Laboratory Project Manager and Laboratory QA/QC Officer before samples are processed.

Copies of the completed chain of custody forms with be retained in the field project files and at the laboratory.

14. Laboratory Procedures

14.1 Laboratory Sample Custody

Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number. The client name, number of samples, and date of receipt of samples will be recorded in the Sample Control Log. Samples removed from storage for analyses will be documented in the LIMS or Sample Control Log.

The laboratory will be responsible for maintaining analytical logs. Raw laboratory data produced from the analysis of samples submitted for this program will be maintained by the laboratory in accordance with project requirements.

14.2 Storage of Samples

After the Sample Custodian has completed the chain of custody forms and the incoming sample log, samples will be labeled with the laboratory sample ID and the chain of custody will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access-controlled custody room.

14.3 Analytical Methods

Ambient air samples will be analyzed for the parameters cited in Table 1. Analysis will be performed in accordance with laboratory procedures for EPA method TO-15. If the procedures listed in this QAPP are different than those in the EPA method description, the EPA method description will be followed.

Data deliverables for this program will include final results for the investigative samples and corresponding quality control parameters as specified in Section 16.2.

14.4 Calibration Procedures and Frequency

14.4.1 Instrument Calibration

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards are determined by the manufacturer guidelines, the analytical method, or the requirements of special contracts.

A record will be kept for each instrument requiring calibration in which activities associated with the laboratory's quality assurance monitoring and repairs program will be recorded. These records will be checked during periodic equipment review and internal and external QA/QC audits.

14.4.2 Gas Chromatography/Mass Spectrometry (GC/MS)

It is necessary to establish that a given GC/MS instrument meets the standard mass spectral abundance criteria prior to initiating any ongoing data collection. This is accomplished through the analyses of tuning compounds as specified in the analytical methods.

Calibration of the GC/MS system will consist of an initial calibration curve using at least five points. The initial calibration curve for each compound of interest will be verified at the beginning of the day or with each 24 hours of Method TO-15 instrument operating time.

All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of 0.99). Higher order fits will not be allowed unless the laboratory can demonstrate that the instrument is working properly and that the instrument response over the concentration range of interest is second-order.

Quantification of samples that are analyzed by GC/MS will be performed by internal standard calibration. For quantitation, the nearest internal standard free of interferences must be used.

14.5 Compound Identification

Compounds, which will be analyzed by GC/MS, will be identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard references should be obtained on the user's GC/MS within the same 24 hours for Method TO-15 as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. The following criteria must be satisfied to verify identification:

i) The relative retention time (RRT) of the sample component is within ±0.06 RRT units of the RRT of the standard component.

ii) Correspondence of the sample component and the standard component mass spectrum.

14.6 Quantitation

The procedures for quantitation of analytes are discussed in the appropriate analytical methods. Sample results are calculated using either an external standard or an internal standard technique. External standard techniques directly compare the response from the sample to the response of the target analyte in the calibration standards. Internal standard technique utilizes the addition of a compound that resembles the target compound but is not commonly found in nature. This compound is added to all standards, samples, and quality control samples. Quantitation is based on the ratio of the target compound in the sample to the response of the internal standard in the sample compared to a similar ratio derived for each calibration standard.

14.7 Quantitation Limit Requirements

Targeted reporting limits (RLs) will be consistent with those presented in Table 2. When matrix interferences are noted during sample analysis, the laboratory should demonstrate reasonable efforts, including proper dilution of the sample, to achieve the lowest-possible RLs. In cases where concentrations of selected analytes exceed calibration ranges, a smaller sample aliquot should be analyzed to ensure definitive quantitation of these analytes. Results of initial and follow-up analyses should all be reported.

15. Quality Control

15.1 Quality Control for Laboratory Analyses

The laboratory should meet all QA/QC requirements stated in the method (EPA Method TO-15). The following sections describe key elements of QA/QC for the VOCs analysis with EPA Method TO-15.

15.1.1 Method Blanks

A method blank will be analyzed by the laboratory at a frequency of one blank per each group of up to 20 samples analyzed or prepared at the same time. The method blank will be carried through the entire analytical procedure. No compound of interest should be detected at or above the practical quantitation limits. Should the method blank not meet the requirements, proper corrective actions should be taken according to the method and the laboratory standard operation procedure (SOP).

15.1.2 Laboratory Control Sample

A laboratory control sample (LCS) will be analyzed for all target analytes per analytical batch (less than 20 QC and field samples in combination). The LCS contains known concentrations (approximately at the mid-point concentration of the initial calibration) of all target analytes to monitor the accuracy of sample preparation and analysis processes. The percent recovery (%R) values should be calculated and reported for all target analytes. In cases where a %R value does not meet the laboratory's in-house statistically established control limits (laboratory control limits), proper corrective actions should be taken according to the method and the laboratory SOP.

15.1.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

MS/MSD analyses will be performed on one project sample per sample delivery group (SDG). The sample will be spiked with all target analytes at know concentrations and processed and analyzed as regular samples. The %R and relative percent difference (RPD) values for the MS/MSD analyses will be calculated, reported, and compared to the laboratory control limits. Any exceedance of the %R and/or RPD values will be flagged by the laboratory.

15.1.4 Surrogate Spikes

Surrogates are compounds are rarely present in natural environments and mimic physical and chemical behaviors of target analytes. Surrogate compounds specified in Method TO-15 should be added to all QC and field samples prior to instrumental analyses. The %R values of surrogate spikes should be calculated, reported, and compared to the laboratory control limits. In cases of any surrogate spike anomaly, proper corrective actions should be taken according to Method TO-15 and the laboratory SOP.

15.1.5 Quality Control Check Points and Data Flow

The following specific quality control checkpoints will be common to all analyses. They are presented with the decision points.

Chemist - Bench Level Checks

- Systems Check: sensitivity, linearity, and reproducibility within specified limits
- Duplicate analyses within control limits
- Blank spike results within control limits
- Calculation/data reduction checks: calculations cross-checked, any discrepancies between forms and results evident, results tabulated sequentially on the correct forms

Laboratory Project Manager

- Systems operating within limits
- Data transcription correct
- Data complete
- Data acceptable

Sample Control

- Samples returned to sample control following analysis

Laboratory Quality Assurance/Quality Control Officer

- Quality assurance objectives met
- Quality control checks are completed
- Final data and report package is complete

15.1.6 Quality Control Documentation

All quality control results will be reported as part of the data package. All results will be tabulated and reported using Contract Laboratory Program (CLP)-like forms where applicable. Section 16.2 and Table 3 describes the requirements of the data package.

15.2 Quality Control for Field Sampling

To assess the quality of data resulting from the field sampling program, field duplicate samples will be collected and submitted to the analytical laboratory as blind samples.

15.2.1 Field Duplicate Samples

Field duplicate samples will be collected and used to assess the aggregate precision of field and laboratory procedures. For every 20 investigative samples, a field duplicate sample will be collected and submitted blind to the laboratory. Field duplicates will be assessed using a criterion of RPD value ≤25%. If systematic variability is observed on a great number of target analytes, the field and laboratory procedures will be further reviewed.

15.2.2 Field Calibration

Field calibration procedures are discussed in Section 13.

15.3 Preventative Maintenance

This section applies to both field and laboratory equipment. Specific preventive maintenance procedures for field equipment will be consistent with the manufacturer's guidelines. Specific preventive maintenance protocols for laboratory equipment will be consistent with the contract laboratory's SOPs.

All analytical instruments to be used in this project will be serviced by laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Routine maintenance of the instruments will be performed as per manufacturers' recommendations. The Laboratory Project Manager is responsible for the preventive maintenance of the instruments.

15.4 Inspection/Acceptance of Supplies and Consumables

This section applies to both field and laboratory supplies. Critical supplies and consumables for this project include field equipment, such as meters and calibration standards. The laboratory follows strict SOPs that define log in, storage, handling, preparation, and analyses of samples. Field equipment that is supplied by pre-approved vendors is maintained and calibrated by the vendor. All calibrations are documented and filed. All field instrumentation is calibrated again in the field prior to use. This calibration is documented in the logbook and on the proper form, which is kept in the main project file.

15.5 Corrective Action

The need for corrective action may be identified by system or performance audits or by standard quality control procedures. The essential steps in the corrective action system will be:

i) Checking the predetermined limits for data acceptability beyond which corrective action is required

ii) Identifying and defining problems

iii) Assigning responsibility for investigating the problem

iv) Investigating and determining the cause of the problem

v) Determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses)

vi) Assigning and accepting responsibility for implementing the corrective action

vii) Implementing the corrective action and evaluating the effectiveness

viii) Verifying that the corrective action has eliminated the problem

ix) Documenting the corrective action taken

x) Follow-up audits will be performed to verify deficiencies have been corrected

For each measurement system, the laboratory QA/QC Officer will be responsible for initiating the corrective action, and the Laboratory Project Manager will be responsible for implementing the corrective action.

15.6 Audits

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The laboratory may carry out performance and/or systems audits to ensure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of field and laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational during the program or after completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC Plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the QA/QC Officer without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external quality assurance audits will only be performed if deemed necessary.

16. Data Management Procedures

16.1 General

The contract laboratory will perform internal data verification and data review under the direction of the Laboratory QA/QC Officer. The Laboratory QA/QC Officer will be responsible for assessing data quality and advising of any data which were rated 'preliminary' or 'unacceptable' or other qualifications based on the quality control criteria outlined in the relevant methods, which would caution the data user of possible unreliability. Data reduction, verification, and reporting by the laboratory will be conducted as detailed in the following:

i) Raw data produced and checked by the responsible analysts is turned over for independent review by another analyst.

ii) The area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods.

iii) Upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a computerized report will be generated and sent to the Laboratory QA/QC Officer.

iv) The Laboratory QA/QC Officer will complete a thorough inspection of all reports.

v) The Laboratory QA/QC Officer and area supervisor will decide whether any sample reanalysis is required.

vi) Upon acceptance of the preliminary reports by the Laboratory QA/QC Officer, final reports will be generated and signed by the Laboratory Project Manager.

16.2 Laboratory Reporting, Data, Presentation, and Final Report

Reporting and deliverables shall include, but not be limited to, all items listed in Table 3.

All sample data and corresponding QA/QC data as specified in the analytical methods, shall be maintained accessible either in hard copy and/or computer data files.

The laboratory will submit an electronic report of the data. An electronic copy of the results and quality control will be in Pasco Landfill database formats and will be provided within the turn-around time requested.

16.3 Document Control System

A document control system ensures that all documents are accounted for when the project is complete.

A project number will be assigned to the project. This number will appear on sample identification tags, logbooks, data sheets, control charts, project memos, analytical reports, document control logs, corrective action forms and logs, quality assurance plans, and other project analytical records. Field related documents and an electronic copy of the report(s) will be retained as required by the project.

Electronic deliverables are maintained on a secured drive of a network and are only accessible to approved personnel. Electronic data deliverables are uploaded into a main project database. The database is only accessible by approved personnel.

17. Data Review, Verification, and Validation

17.1 General

Validation of the analytical data will be performed. The data validation will be performed in accordance with the methods and guidance from the document, *Contract Laboratory Program National Functional Guidelines for Organic Superfund Data Review. Office of Superfund Remediation and Technical Innovation*. January 2017. OLEM 9355.0-136. EPA-540-R-2017-002.

Data associated with the investigation will receive a Stage 2B validation that includes assessment of analytical and in-house data, checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The results of these data validations will be reported to the Project Manager in a form of a data validation report.

Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the project report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

17.2 Data Quality Assessment

Final reports will contain a discussion on QA/QC summarizing the quality of the data collected and/or used as appropriate for each phase of the project. The Project Manager who has responsibility for these summaries will rely on written reports/memoranda documenting the data assessment activities, performance and systems audits, and footnotes identifying qualifications to the data, if any.

Each summary of sampling activities will include a tabulation of the data including:

i) Field duplicate sample results

ii) Maps showing sample locations

iii) An explanation of any sampling conditions or quality assurance anomalies and their effects on data quality

The QA/QC Officer will prepare quality assurance reports following receipt of all analytical data. These reports will include discussions of the following and their effects on the quality of the data reported:

i) Sample holding times and sample integrity upon receipt at the laboratory

ii) Instrument calibration summary results

iii) Method blank results

iv) Laboratory control sample recoveries

v) Matrix spike/matrix spike duplicate recoveries and relative percent differences

vi) Reported quantitation limits

vii) Internal standard results

viii) Surrogate recoveries

ix) Field QA/QC data

x) Audit results (if performed)

The data validation report will present the scope and findings of the validation and discuss impacts on data quality and usability in cases of QC anomalies. Impacted data will be properly flagged to provide data usability limitations to data users.

17.3 Procedures Used to Assess Data Precision, Accuracy, and Completeness

17.3.1 Precision

Precision will be assessed by comparing the analytical results between duplicate analyses. Precision as percent relative difference will be calculated as follows for values significantly greater than the associated detection limit:

$$\text{Precision} = \left| \frac{(D_2 - D_1)}{(D_1 + D_2)/2} \right| \times 100$$

- D_1 = sample result
- D_2 = duplicate sample result

For results near the associated detection limits, precision will be assessed based on the following criteria:

Precision = | Original result – duplicate result | <CRDL[1]

17.3.2 Accuracy

Accuracy will be assessed by comparing a set of analytical results to the accepted or 'true' values that would be expected. In general, laboratory control sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A - B}{C} \times 100$$

- A = The analyte determined experimentally from the spike sample
- B = The background level determined by a separate analysis of the un-spiked sample
- C = The amount of spike added

17.3.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all quality control check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{usable data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

17.3.4 QC Exceedances

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data assessed and documented.

[1] CRDL - Contract Required Detection Limit.

18. References

USEPA 1999. *EPA Method TO 15 - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition. Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters and Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS). Center for Environmental Research Information Office of Research and Development U.S. Environmental Protection Agency. January 1999. EPA/625/R-96/010b.

USEPA. 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* January 13, 2009. USEPA 540-R-08-005.

TABLES

Table 1
Summary of Ambient Air Samples and Analysis
Sampling and Analysis Plan
Perimeter Air Monitoring Plan
Zone A Removal Action EDR/CMP
Pasco Landfill NPL Site

Purpose	Analytical Parameters	Analytical Method	Sampling Duration and Container	Estimated Number of Samples	QA/QC
Baseline	Volatile Organic Compounds	EPA Method TO-15; Standard TAT	8-hour; 6 liter Summa canister	25: Collect one sample at P1 (BDI) each week day for two-weeks before contractor mobilization (10). Collect one sample at stations P2, P3, and P4 each day for five days (15).	1 field duplicate for every 20 samples analyzed
Background	Volatile Organic Compounds	EPA Method TO-15; 24-hour TAT	8-hour; 6 liter Summa canister	24: Collect one sample at all four stations at the start of work in each structure location (six locations).	1 field duplicate for every 20 samples analyzed
Action Level Response	Risk-based compounds (Potentially subject to change) ▪Benzene ▪1,2-dichloroethane (1,2-DCA) ▪1,1-dichloroethene (1,1-DCE) ▪Vinyl chloride	Field based indicator tubes	See manufacturers instructions	As needed: One sample from station with reading above action level	1 field duplicate for every 20 samples analyzed
Action Level Response	Volatile Organic Compounds	EPA Method TO-15; 24-hour TAT	15-minute; 6 liter Summa canister	As needed: Two samples (One at station above action level and one up wind)	1 field duplicate for every 20 samples analyzed

Notes:
Field duplicate will be collected from down-wind station preferably.
EDR = Engineering Design Report
CMP = Compliance Monitoring Plan
TAT = Turn-around-time

Table 2
Standard TO-15 Reporting Limits
Sampling and Analysis Plan
Perimeter Air Monitoring Plan
Zone A Removal Action EDR/CMP
Pasco Landfill NPL Site

CAS	Volatile Organic Compound	MRL/LOQ	LOD	MDL
71-55-6	1,1,1-Trichloroethane	0.54	0.17	0.066
79-34-5	1,1,2,2-Tetrachloroethane	0.53	0.17	0.074
79-00-5	1,1,2-Trichloroethane	0.53	0.17	0.054
75-34-3	1,1-Dichloroethane	0.51	0.31	0.078
75-35-4	1,1-Dichloroethene	0.53	0.17	0.074
120-82-1	1,2,4-Trichlorobenzene	0.55	0.33	0.13
95-63-6	1,2,4-Trimethylbenzene	0.53	0.17	0.074
96-12-8	1,2-Dibromo-3-chloropropane	0.53	0.32	0.1
106-93-4	1,2-Dibromoethane	0.53	0.17	0.062
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	0.51	0.31	0.084
95-50-1	1,2-Dichlorobenzene	0.54	0.17	0.079
107-06-2	1,2-Dichloroethane	0.53	0.17	0.059
78-87-5	1,2-Dichloropropane	0.53	0.17	0.066
108-67-8	1,3,5-Trimethylbenzene	0.52	0.17	0.077
106-99-0	1,3-Butadiene	0.53	0.32	0.088
541-73-1	1,3-Dichlorobenzene	0.54	0.17	0.08
106-46-7	1,4-Dichlorobenzene	0.53	0.32	0.082
123-91-1	1,4-Dioxane	0.53	0.17	0.063
78-93-3	2-Butanone (MEK)	1.1	0.32	0.11
591-78-6	2-Hexanone	0.53	0.17	0.066
67-63-0	2-Propanol (Isopropyl Alcohol)	2.1	0.63	0.22
107-05-1	3-Chloro-1-propene (Allyl Chloride)	0.53	0.17	0.072
622-96-8	4-Ethyltoluene	0.52	0.31	0.085
108-10-1	4-Methyl-2-pentanone	0.53	0.17	0.073
67-64-1	Acetone	5.3	2.7	1.2
75-05-8	Acetonitrile	0.53	0.32	0.13
107-02-8	Acrolein	1.1	0.32	0.15
107-13-1	Acrylonitrile	0.53	0.32	0.11
80-56-8	alpha-Pinene	0.52	0.31	0.082
71-43-2	Benzene	0.53	0.17	0.077
100-44-7	Benzyl Chloride	1.1	0.32	0.12
75-27-4	Bromodichloromethane	0.53	0.17	0.077
75-25-2	Bromoform	0.53	0.32	0.11
74-83-9	Bromomethane	0.5	0.16	0.074
75-15-0	Carbon Disulfide	1.1	0.53	0.16
56-23-5	Carbon Tetrachloride	0.53	0.17	0.074
108-90-7	Chlorobenzene	0.53	0.17	0.071
75-00-3	Chloroethane	0.51	0.3	0.066
67-66-3	Chloroform	0.53	0.17	0.071
74-87-3	Chloromethane	0.5	0.3	0.086
156-59-2	cis-1,2-Dichloroethene	0.53	0.17	0.075
10061-01-5	cis-1,3-Dichloropropene	0.56	0.18	0.083
98-82-8	Cumene	0.53	0.17	0.077

Table 2
Standard TO-15 Reporting Limits
Sampling and Analysis Plan
Perimeter Air Monitoring Plan
Zone A Removal Action EDR/CMP
Pasco Landfill NPL Site

CAS	Volatile Organic Compound	MRL/LOQ	LOD	MDL
110-82-7	Cyclohexane	1.1	0.34	0.15
124-48-1	Dibromochloromethane	0.53	0.17	0.07
75-71-8	Dichlorodifluoromethane (CFC 12)	0.52	0.31	0.087
5989-27-5	d-Limonene	0.5	0.3	0.11
64-17-5	Ethanol	5.3	0.84	0.37
141-78-6	Ethyl Acetate	1.1	0.64	0.28
100-41-4	Ethylbenzene	0.53	0.17	0.075
87-68-3	Hexachlorobutadiene	0.53	0.32	0.11
179601-23-1	m,p-Xylenes	1.1	0.34	0.14
80-62-6	Methyl Methacrylate	1.1	0.63	0.19
1634-04-4	Methyl tert-Butyl Ether	0.54	0.17	0.063
75-09-2	Methylene Chloride	0.53	0.32	0.15
91-20-3	Naphthalene	0.53	0.32	0.13
123-86-4	n-Butyl Acetate	0.53	0.17	0.073
142-82-5	n-Heptane	0.53	0.32	0.085
110-54-3	n-Hexane	0.53	0.32	0.11
111-84-2	n-Nonane	0.53	0.32	0.089
111-65-9	n-Octane	0.53	0.32	0.12
103-65-1	n-Propylbenzene	0.53	0.17	0.077
95-47-6	o-Xylene	0.53	0.17	0.077
115-07-1	Propene	0.52	0.31	0.13
100-42-5	Styrene	0.53	0.32	0.086
127-18-4	Tetrachloroethene	0.53	0.17	0.069
109-99-9	Tetrahydrofuran (THF)	0.53	0.17	0.067
108-88-3	Toluene	0.53	0.17	0.065
156-60-5	trans-1,2-Dichloroethene	0.54	0.17	0.074
10061-02-6	trans-1,3-Dichloropropene	0.53	0.32	0.11
79-01-6	Trichloroethene	0.53	0.17	0.072
75-69-4	Trichlorofluoromethane (CFC 11)	0.53	0.32	0.081
76-13-1	Trichlorotrifluoroethane	0.53	0.17	0.076
108-05-4	Vinyl Acetate	5.3	2.6	1.2
75-01-4	Vinyl Chloride	0.52	0.17	0.057

Notes:

Limits are in µg/m^3 and are for 6 Liter Canisters

Method Reporting Limits (MRLs) assume 1L analyzed for 6L canister

Actual reporting limits will be higher depending on the canister pressurization dilution factor and/or sample matrix effects.

Typical canister pressurization dilution factors are between 1.5-2.0.

Table 3
Laboratory Reporting Deliverables
Sampling and Analysis Plan
Perimeter Air Monitoring Plan
Zone A Removal Action EDR/CMP
Pasco Landfill NPL Site

A detailed report narrative should accompany each submission, summarizing the contents and results.

A. Detailed Narrative [(1)]

B. Sample Information
- i) date collected
- ii) date extracted or digested
- iii) date analyzed
- iv) analytical method

C. Final Results
- i) samples
- ii) laboratory duplicates [(2)]
- iii) method blanks
- iv) spikes; spike duplicates [(2)(3)]
- v) surrogate recoveries
- vi) laboratory control sample
- vii) analytical run log
- viii) summary of internal standard responses for CCV and associated QC and sample analyses
- viii) summary of instrument tuning and initial and continuing calibration verification
- ix) signed coc document and sample receipt form

D. Miscellaneous
- i) method detection limits and/or instrument detection limits
- iv) dates of extraction or digestion and analysis for method blanks and blank spikes

An electronic data deliverable (EDD) should be prepared in Washington State Department of Ecology, Environmental Information Management (EIM) format for each sample delivery group (SDG).

Notes:

(1) Any quality control outliers must be addressed and corrective action taken must be specified.

(2) Laboratory must specify applicable control limits for all quality control sample results.

(3) A blank spike must be prepared and analyzed with each sample batch.

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Appendix B
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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
BDI	Basin Disposal, Inc.
CAP	*Cleanup Action Plan – Pasco Landfill NPL Site*
CQAPP	Construction Quality Assurance Project Plan
Ecology	Washington State Department of Ecology
EDR	Zone A Removal Action Engineering Design Report
EO	Enforcement Order No. DE 16899
GC	General Contractor
HASP	Health and Safety Plan
IWAG	Industrial Waste Area Generators Group III
NPL	National Priorities List
PAMP	Perimeter Air Monitoring Plan
PMP	Performance Monitoring Plan
QAPP	Quality Assurance Project Plan
RE	Resident Engineer
RTO	Regenerative thermal oxidizer
SAP	Sampling and Analysis Plan
SCB	Soil-cement-bentonite
Site	Pasco Sanitary Landfill National Priorities List Site
SOW	Scope of Work and Schedule
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
VOC	Volatile organic compound
Zone A	Industrial Waste Area Zone A

1.0 Introduction

This Zone A Removal Action Engineering Design Report (EDR) Performance Monitoring Plan (PMP) describes the performance monitoring that will be conducted for the Removal Action to be completed at the Industrial Waste Area Zone A (Zone A) at the Pasco Sanitary Landfill National Priorities List (NPL) Site (Site). This PMP has been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) to fulfill the requirements of Enforcement Order No. DE 16899 (EO) and the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), prepared by Ecology and dated August 2019. The PMP is required as part of the Scope of Work and Schedule (SOW) in Exhibit C of the EO under Task A.2 Preparation of a Zone A Removal Action Compliance Monitoring Plan, Sub-plan C Performance Monitoring Plan.

Task A.2. Sub-plan C. Performance Monitoring Plan of the SOW states:

> *A Performance Monitoring Plan will be prepared to satisfy WAC 173-340-410(1)(b) requirements. For the Zone A removal action, the Performance Monitoring Plan will specify the metrics used to verify that the excavation activity goals and objectives have been met. This includes documenting the excavation and any additional materials that are removed to achieve the overall remedial goals of the removal action work. The plan will describe the measurement and data collection methods used to establish these excavation performance objectives (for example, surveying methods).*
>
> *The Performance Monitoring Plan will include procedures for sampling and characterizing material that will remain in the Zone A subsurface for future in-situ treatment. This includes air monitoring at and around the active construction area, at the property boundaries, at the Basin Disposal, Inc. (BDI) waste transfer station south of the Site, and potentially other offsite air monitoring stations. The BDI facility was identified during a Tier 2 health impact assessment as being one of the nearest offsite receptors potentially affected by RTO emissions coming from the Site. The Performance Monitoring Plan shall contain a SAP specific to air monitoring.*

Washington Administrative Code 173 340 410(1)(b) states:

> *Performance monitoring. Confirm that the interim action or cleanup action has attained cleanup standards and, if appropriate, remediation levels or other performance standards such as construction quality control measurements or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws.*

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2.0 Components of the Performance Monitoring Plan

The components of the PMP as required by the SOW include the following:

- Operation and maintenance of a reconfigured soil vapor extraction (SVE) system and regenerative thermal oxidizer (RTO) for treating extracted vapor during Zone A drum removal activities.
- Metrics used to verify that the excavation activity goals and objectives (i.e., defined in the SOW as the removal of drums [and other containers], drummed waste, or pooled free liquids vertically to the base of waste, as defined in the field and laterally to the SOW-extent presented Sheet 8 in Appendix E) have been met. This includes documentation of the excavation and of any additional materials that are removed to achieve the overall remedial goals of the Zone A Removal Action work, as well as the measurement and data collection methods used to establish these excavation performance objectives.
- Select gas/vapor monitoring locations will be retained after testing the reconfigured SVE system is complete and during the drum removal and thermal treatment phases. The specific wells to be retained will be determined based on data collected during system testing.
- Air monitoring at and around the active construction area/temporary structure.
- Air monitoring at the property boundaries and between Zone A and the BDI waste transfer station south of Zone A (perimeter air monitoring).
- Construction quality control measurements or monitoring.
- Procedures for post-excavation characterization of Zone A materials for future thermal in situ treatment. This requires a Sampling and Analysis Plan (SAP), including appropriate Quality Assurance Project Plan (QAPP), for this material.
- Bench-scale testing described in a Treatability Testing Plan.

In addition to the above, a summary of the SOW elements is presented in Table 2.1 that provides references to sections and appendices in the EDR where those elements are addressed.

2.1 SOIL VAPOR EXTRACTION AND REGENERATIVE THERMAL OXIDIZER

2.1.1 Goal and Objective

Section 2.0 of the EDR states that the goal of the SVE and RTO systems is to protect groundwater by operating an SVE system below Zone A and an associated RTO treatment system.

To achieve this goal, reconfiguring of the SVE system and operating the reconfigured SVE and RTO systems will be conducted to provide ongoing groundwater protection during construction consistent with current systems operations that protect groundwater.

2.1.2 Metric Used to Verify Goal and Objective

Section 6.2.2 of the EDR presents the target flow rates for the new SVE wells that will be comparable to the current target flow rates in VEW-06D and VEW-07D. Because the new vapor extraction wells will be screened within the same geological formation as the existing wells, volatile organic compound (VOC) concentrations in extracted vapors from the reconfigured system are expected to be similar to current. Therefore, the RTO will be operating within its current permitted conditions and no modifications to the existing permit are anticipated. The metrics for determining the performance of the SVE and RTO systems will be measured by the existing operation and maintenance plan and compliance with the requirements of the existing RTO permit. Startup testing of the SVE system will be performed in accordance with the SVE System Reconfiguration Plan in Appendix B.9. The testing includes VOC and semivolatile organic compound (SVOC) mass removal rate comparisons to confirm operations of the reconfigured system remain within the constraints of the existing air quality permit.

As part of the reconfiguration of the SVE system, new wells and associated conveyance piping will be installed. The control plan that is related to installation of the new components of the SVE system is the Construction QAPP (CQAPP) presented as Appendix D.3 of the EDR and discussed in Section 2.6 of this PMP. The CQAPP includes inspections that will be used to monitor the installations.

2.2 EXCAVATION

Task A. Cleanup Action at Zone A in the SOW states:

> *The required action at Zone A, to be further developed in the Zone A Removal Action EDR (Task A.1), provides for the excavation and sorting of all material, unless specifically excluded, to the agreed-upon vertical (base of waste) and the expected lateral limits of the industrial waste, shown on Figure 1. Drums, drummed waste, pooled free liquids, and readily separable (by mechanical means) potentially combustible material will be managed for offsite treatment and/or disposal. Drums and drummed waste include any sludge/solid material found immediately adjacent to a drum that clearly originated from the drum based on visual observations.* Task A further states: *In the event Ecology and the PLPs jointly determine, for any reason, that material should not remain or be placed back into Zone A, that material shall be transported offsite to an appropriate waste disposal facility (or facilities) permitted to accept the waste.*

2.2.1 Goal and Objectives

Section 2.0 of the EDR states that the goal of excavating drums in Zone A is to remove drums, drummed waste, pooled free liquids, and readily separable (by mechanical means) potentially combustible material from Zone A for offsite treatment and/or disposal.

To achieve this goal, the objectives of the excavation will be to:

- Excavate to the lateral limits of drums in Zone A (orange line on Sheet 8 in Appendix E); and
- Excavate to the vertical base of drums and drummed waste as defined in the field in Zone A.

2.2.2 Metrics Used to Verify Goal and Objectives

Verifying that the excavation goals and objectives are met will be based on visual evidence (i.e., absence of drums and drummed waste) in the field or the lateral limits shown on Figure 1 of the SOW (Sheet 8 in Appendix E) as described below.

Lateral Limits

Following removal of the existing Zone A cover and construction of the working platform, the General Contractor (GC) will conduct test trenching along approximately 550 feet of the 1,100-foot perimeter of Zone A. Test trenching will be conducted along tentatively identified sheet pile alignments: (1) in the north and northeast, inside of the existing barrier wall; (2) the northwest corner between the expected lateral extent of excavation and the potential further extent past the geomembrane; and (3) the southwest perimeter of Zone A, inside of the existing natural gas line, as shown on Sheet 8 in Appendix E. The test trenches inform the need for sheet pile shoring as well as providing information on the lateral extent of subsurface drums and drum waste in these areas.

The excavation in Zone A will proceed laterally to the limits presented on Sheet 8 in Appendix E (orange line). To the north and northeast, the lateral limit is defined by the soil-cement-bentonite (SCB) Protection Barrier Wall. Survey means will be used to identify and proceed with the excavation as close as possible to the defined limits. Excavation will occur within grids, approximately 50 feet by 50 feet that will be surveyed as work proceeds (Sheets 7, 7A, 7B, and 7C in Appendix E). It is currently anticipated that most or all of the drums and waste can be accessed, excavated, and removed within the six proposed positioning layouts of the temporary structure. However, as described in Task A of the SOW, where drums (and other containers), drummed waste, or pooled free liquids are encountered, the excavation will proceed laterally to remove these items. If potentially combustible materials separable by mechanical means are present along with the wastes described in the SOW, outside the expected lateral extent of excavation, then consistent with the SOW, the potentially combustible materials will also be removed.

The following visual evidence will be documented at the lateral extent of the excavation:

- Absence of waste; or
- If waste is present, absence of drums, absence of sludge, and absence of pooled free liquids

As described in the SOW Task A, sludge/solid material found immediately adjacent to a drum that clearly originated from the drum based on visual observations will also be removed. Alternatively, similar material that is possibly sourced from a drum but not visually definitive shall be verified by Hazard Categorization analysis. Visibly contaminated material such as soils determined to be visually impacted by waste, or directly in contact and associated with a leaking or ruptured drum, will be segregated from non-visibly contaminated material by placing into roll-off boxes. The visibly impacted soils will be analyzed as described in Appendix C to determine disposal options. If the Resident Engineer (RE) determines that, based on visual observations, drum removal is complete, then the excavation extent, sidewall, and base will be approved by the RE in coordination with Ecology and surveyed and backfilled by the GC. Field confirmation that the lateral extent of excavation along the outer perimeter of Zone A, where there is no sheet piling (approximately one-half of the perimeter of Zone A), will be done in coordination with Ecology. The GC and RE will provide Ecology 1 to 2 days' notice that the lateral excavation extent in an area is expected to be completed and will require Ecology confirmation. Photographic documentation and video from web cameras will be provided to Ecology to support their concurrence on the completion of the lateral extent of excavation.

In areas where sheet piling is not installed, if a drum, sludge, or pooled free liquids are visually identified at the lateral limits presented on Sheet 8 of Appendix E, then the excavation will proceed, as feasible, out to the slope sidewall and/or interior edge of the temporary structure. Any drums/drum-associated waste still remaining beyond these defined operational limits will be documented and discussed with Ecology. Upon completing the Zone A Removal Action (under the temporary structure positions) other methods and engineering controls will be evaluated and implemented to remove drums located outside the temporary structure's design footprint in a safe manner to protect workers and the offsite public. Contingency procedures are described in Section 6.9 of the EDR.

Vertical Limits

The SOW defines that the excavation in Zone A will proceed vertically for removal of drums (and other containers), drummed waste, and pooled free liquids. The actual depth of waste is expected to vary across the footprint of Zone A depending on actual field conditions and observed characteristics of the waste encountered. As shown in Sheets 9 through 12 in Appendix E, elevation 392 feet North American Vertical Datum of 1988 is planned for and identified as the anticipated maximum extent of excavation to remove drums and waste sourced from drums. This conservative elevation is a minimum of 2 feet below the anticipated bottom of drums and drum waste and is used in the design in order to ensure the necessary positioning of the temporary structure and excavation side slopes in the event that excavation is necessary to this depth.

Any pooled free liquids found at the excavation base will be removed by pumping and/or absorbents. The following visual evidence in the field will be used to determine whether the vertical extent of the excavation is complete:

- Absence of drums/containers and drummed waste or sludge or solid material appearing to be sourced from a drum; or
- If waste is present, then absence of sludge and absence of pooled free liquids

If the RE determines that, based on visual observations, the vertical limits of excavation have been reached, then the excavation extent within each grid will be approved by the RE and surveyed and backfilled by the GC.

Records

The visual observations at the excavation limits will be documented (written descriptions and photographs) along with sidewall and base surveys, and presented in the construction progress meetings and the Zone A Excavation, Removal, and Offsite Disposal Construction Completion Technical Memorandum.

2.3 TEMPORARY STRUCTURE AIR HANDLING AND TREATMENT SYSTEM

This EDR specifies use of a temporary structure with air management, treatment, and emission controls that will be constructed over areas subject to the drum removal activities. Because a temporary structure will be used over active excavation areas, shallow SVE wells to control potential off gassing of shallow soil vapor are not expected to be needed and are not being proposed as part of the reconfigured SVE system.

2.3.1 Goal and Objective

The temporary structure will be the primary emissions control method for potential off gassing, thereby achieving one of the objectives identified for the SVE reconfiguration (i.e., that it will be designed and operated to ensure the ongoing capture and treatment of vadose zone VOC and limited SVOC vapors).

2.3.2 Metric Used to Verify Goal and Objective

The air handling and treatment system for the temporary structure is discussed in Section 6.5.1 of the EDR. The GC will design and operate the temporary air handling and treatment system to ensure worker and public safety. A memorandum was submitted to Ecology and the Air Quality Program under separate cover to provide loading calculations for the temporary structure air handling and treatment system, along with proposed operation and monitoring requirements for the air exchange/granular activated carbon treatment unit in accordance with agency requirements and recommendations by the equipment manufacturer (IWAG 2020).

2.4 AIR/EXPOSURE MONITORING FOR WORKER PROTECTION

The GC will be responsible for preparing a Site-Specific Health and Safety Plan (HASP) with requirements for air and exposure monitoring for all on-site workers. Air monitoring within the temporary structure and around the active construction areas outside the temporary structure (e.g., container management area) will be conducted by the GC in accordance with the GC's HASP.

2.4.1 Goal and Objective

Section 2.0 of the EDR states that the goal of air monitoring at and around the active construction area in Zone A is to:

- Ensure the health and safety of workers during work activities from potential emissions.

To achieve this goal, the objective will be for the GC to conduct work area air monitoring within Zone A, inside and outside of the temporary structure, as part of its health and safety program to ensure worker safety.

2.4.2 Metric Used to Verify Goal and Objective

The GC will develop a HASP, as discussed in Section 7.1 of the EDR, based on applicable Occupational Safety and Health Administration and Washington Industrial Safety and Health Act regulations and the requirements presented as Appendix B.1 of the EDR. Implementation of the air monitoring program in the GC's HASP will ensure the health and safety of workers and the surrounding community during work activities. Air monitoring data, testing, and records provided by the GC will be used by the RE as means to document compliance with the air monitoring requirements of the GC's HASP and health and safety of workers.

Perimeter air monitoring will be conducted by the RE as described in Section 2.5.

2.5 PERIMETER AIR MONITORING

2.5.1 Goal and Objective

Section 2.0 of the EDR states that the goal of perimeter air monitoring is to ensure the protection of the surrounding community during work activities from potential emissions.

To achieve this goal, the objective will be for the RE to conduct perimeter air monitoring to measure the GC's performance relative to controlling potential emissions from the Site.

2.5.2 Metrics Used to Verify Goal and Objective

A perimeter air monitoring program is discussed in Section 7.4 of the EDR, and a Perimeter Air Monitoring Plan (PAMP) is presented as Appendix B.3 of the EDR. The metrics that will be used to verify the goal and objective are presented in the PAMP. In addition, the PAMP includes sampling and analysis and quality assurance procedures that have been developed to:

- Properly guide the sampling activities;
- Ensure that the data collected are representative of the material sampled; and
- Verify that all analyses are performed by laboratories accredited by Ecology's Manchester Laboratory.

To achieve these goals and objectives of the work, the sampling activities, laboratory analyses, and subsequent data reduction will be performed in accordance with the EDR, including the PAMP.

2.6 CONSTRUCTION QUALITY CONTROL MEASUREMENTS OR MONITORING

2.6.1 Goal and Objective

The goal of construction quality control measurements and monitoring is to ensure that implementation of the EDR is in compliance with the CAP and SOW.

To achieve this goal, the objective will be for the RE to review the GC's submittals and monitor daily activities to assess compliance with the requirements of the EDR.

2.6.2 Metrics Used to Verify Goal and Objective

The role and responsibilities of the RE are discussed in Section 5.5 of the EDR, and a CQAPP is presented as Appendix D.3 of the EDR. The metrics that will be used to verify the goal and objective are presented in the CQAPP.

2.7 POST-EXCAVATION CHARACTERIZATION OF ZONE A MATERIALS

2.7.1 Goal and Objective

The goal of post-excavation characterization of the material within the lateral limit of Zone A, including the underlying native soil down to the water table, is to inform the design and implementation of subsequent in situ thermal treatment.

To achieve this goal, the objective will be to implement a drilling and sampling program to characterize material that will remain in the Zone A subsurface (i.e., backfill, Touchet Beds, and Upper Pasco Gravels above the water table).

2.7.2 Metrics Used to Verify Goal and Objective

A plan for characterization of contaminated media and mixed debris within Zone A is presented in Section 6.12 of the EDR. The Post-Excavation Characterization SAP and QAPP is presented as Appendix B.7. The metrics used to verify the goal and objectives are met are defined in the Post-Excavation Characterization SAP and QAPP. In addition, the proposed locations of the boreholes will be marked (e.g., staked) and surveyed prior to drilling.

2.8 POST-EXCAVATION CHARACTERIZATION SAP AND QAPP FOR CHARACTERIZING MATERIAL

2.8.1 Goals and Objective

The goals of the Post-Excavation Characterization SAP and QAPP are to:

- Properly guide the sampling activities;
- Ensure that the data collected are representative of the material sampled; and
- Verify that all analyses are performed by laboratories accredited by Ecology's Manchester Laboratory.

To achieve these goals, the objectives will be to implement the work, the sampling activities, laboratory analyses, and subsequent data reduction in accordance with the EDR, including the Post-Excavation Characterization SAP and QAPP.

2.8.2 Metrics Used to Verify Goal and Objective

The metrics used to verify that the goals and objectives are met are defined in the Post-Excavation Characterization SAP and QAPP presented as Appendix B.7.

2.9 BENCH-SCALE TREATABILITY TESTING

2.9.1 Goal and Objective

Post-excavation characterization of the Zone A subsurface of is required by the SOW as part of the bench-scale treatability testing. The goal of bench-scale treatability testing is to inform the design and implementation of subsequent in situ thermal treatment.

To achieve this goal, the objective will be to collect the necessary data to permit performance of a bench-scale treatability test to determine estimated removal efficiencies of two applicable in situ thermal technologies, including Electrical Resistance Heating and Thermal Conductance Heating.

2.9.2 Metrics Used to Verify Goal and Objective

Bench-scale treatability testing is discussed in Section 6.13 of the EDR. An overview for bench-scale treatability testing for in situ thermal treatment is presented as Appendix B.5. Bench-scale treatability testing will be completed following the excavation of Zone A and post-excavation characterization of the material within the lateral limit of Zone A. The results of the bench-scale treatability testing will be included in the Post-Excavation EDR, as defined in SOW Task A.4.

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3.0 References

IWAG, 2020. *Zone A Removal Action—Temporary Structure Air Treatment Summary to Support Compliance with Air Permitting Substantial Equivalency.* Memorandum from Rob Harris and Pete Romzick, GHD; Emily Jackson, Floyd|Snider; John Browning, Bridgewater Group; and Mark Fleri, ENTACT, to Chuck Gruenenfelder, Jeremy Schmidt, and Robert Koster, Washington State Department of Ecology. 9 April.

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Table

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Table B.4.1
SOW Elements and EDR References

SOW Item	Item Description	Location in EDR
Task A.1.	**Preparing a Zone A Removal Action EDR**	Sections 1 through 6 and associated figures/tables/appendices
Task A.1.A.	**Subtask A: Drum Waste/Mixed Debris/Soil Excavation, Waste Segregation, and Excavation Area Backfilling** **Zone A Removal Action EDR Subtask A: Drum Waste/Mixed Debris/Soil Excavation and Backfilling**	Sections 3 through 7 and associated figures/tables/appendices
Task A.1.A.A.	- Documenting baseline conditions, including a detailed site plan showing existing topography, existing IA remedial components, utilities, monitoring infrastructure and the various operational areas (AOC, drum/debris staging and handling areas) defined and designated for this removal action	Section 3.4; Sheet 8 in Appendix E; Appendix B.8 Figures 2-4
Task A.1.A.B.	- Preliminary mobilization and site preparation activities	Sections 6.2 and 6.3
Task A.1.A.C.	- Decommissioning procedures and sequencing for groundwater monitoring wells, SVE wells, gas probes, temperature thermocouples, and other monitoring infrastructure.	Section 6.2.3; Appendix B.8
Task A.1.A.D.	- Installing one new groundwater monitoring well near the northeast corner of Zone A to better assess groundwater quality hydraulically upgradient of Zone A. The well location will be coordinated with Ecology before installation, and siting will include field consideration of potential MSW within this area	Section 6.2.1; Appendix B.8
Task A.1.A.E.	- Excavation area equipment, access/egress routes, loading and hauling procedures, and equipment staging	Section 6.3; Appendix B.9; Appendix C
Task A.1.A.F.	- Excavation, segregation, and onsite management (temporary staging and stockpiling) of Zone A vegetative cover and drainage layer soils	Section 6.4; Appendix B.9
Task A.1.A.G.	- Systematic removal of the existing geomembrane and geosynthetic clay liner and test trenching	Section 6.4; Appendix B.9
Task A.1.A.H.	- Excavation, segregation, and onsite management (temporary staging and stockpiling) of granular fill material lying between the existing geomembrane and the underlying Visqueen layer/engineered soil fill above the drums	Section 6.4; Appendix B.9
Task A.1.A.I.	- Engineering analysis of a variety of control options and contingencies for air quality to ensure protection of workers and the surrounding community.	Sections 6.5, 6.6, 6.11, 6.15.1, 7.1, and 7.4; Appendices B.1 and B.3
Task A.1.A.J.	- Temporary excavation area shoring or side trench stabilization measures	Section 6.7
Task A.1.A.K.	- Temperature monitoring and abatement (if required) within localized excavation area(s)	Appendix B.1
Task A.1.A.L.	- Excavation and sorting of drums, mixed debris, and waste material beneath the drums and/or mixed debris	Sections 6.8, 6.9, and 6.10
Task A.1.A.M.	- Drum/mixed debris/waste handling and segregation protocols as defined in the Performance Monitoring Plan (see Task A.2.C).	Section 6.10; Appendix B.4
Task A.1.A.N.	- Backfill selection, temporary stockpiling (as necessary), placement, and compaction requirements.	Section 6.8.3
Task A.1.A.O.	- Temporary interim surface grading	Sections 6.7 and 6.14
Task A.1.A.P.	- Characterization sampling following completion of drum/mixed debris/waste sorting and removal in accordance with the SAP	Section 6.12; Sheets 7, 7A, 7B, and 7C in Appendix E; Appendix B.7
Task A.1.A.Q.	- Applying additional soil material over adjacent MSW disposal areas (debris waste disposal area, Balefill Area, and/or Inert Waste Area) to satisfy minimum cover system requirements if Zone A excavation work impacts these covers	Section 6.14
Task A.1.A.R.	- Final post-construction surface grading, including temporary treatment area soil cover (if required).	Section 6.11
Task A.1.A.S.	- Equipment decommissioning and demobilization	Appendix B.1
Task A.1.A.Bullet1	- Identifying permits and the substantive requirements for exempted permits necessary for construction and/or operation of remedial systems	Section 5.3; Appendix A
Task A.1.A.Bullet2	- Measures to manage short-term hazards associated with cleanup action construction, including dust and volatile organic compound (VOC)/odor control	Sections 6.5 and 6.15.1; Appendices B.1, B.3, and D
Task A.1.A.Bullet3	- Stormwater runoff management plan and incidental spill response plan	Sections 6.15.2 and 6.15.3; Appendix D.1
Task A.1.A.Bullet4	- Onsite traffic control and vehicle decontamination	Section 6.15.4; Appendices B.1, B.9, and D.2
Task A.1.A.Bullet5	- A summary of required quality control testing (i.e., Construction Quality Assurance).	Section 6.15.5; Appendix D.3
Task A.1.A.Bullet6	- Additional information to address applicable or relevant and appropriate state, federal, and local requirements and the substantive requirements of any applicable permits	Section 7.3
Task A.1.A.Bullet7	- A schedule of work to be performed	Section 5.10
Task A.1.B.	**Subtask B: Modified SVE (during excavation) and Regenerative Thermal Oxidizer (RTO) System Operations** **Zone A Removal Action EDR Subtask B: Modified SVE and RTO System Operations**	Section 6.2.2; Appendix B.9
Task A.1.C.	**Subtask C: Waste Characterization, Handling, Staging, and Disposal** **Zone A Removal Action EDR Subtask C: Waste Characterization, Handling, Staging, and Disposal**	Section 6.10; Appendices B.1 and C
Task A.2.	**Preparing a Zone A Removal Action Compliance Monitoring Plan (CMP)**.	Section 7.0; Appendix B
Task A.2.A.	**A. Health and Safety Plan (HASP)**	Section 7.1; Appendix B.1
Task A.2.B.	**B. Contingency Plan** **- Site Perimeter Air Monitoring Plan**	Section 7.2; Appendix B.2 Section 7.4; Appendix B.3
Task A.2.C.	**C. Performance Monitoring Plan**	Section 7.3; Appendix B.4
Task A.2.D.	**D. Treatability Testing and Analysis Plan**	Section 7.5; Appendix B.5
Task A.2.E.	**E. Groundwater Monitoring Plan (GMP)**	Section 7.6; Appendix B.6
Task A.2.F.	**F. SAP Sampling and Analysis Plan** (including an appropriate quality assurance project plan [QAPP])	Section 7.7 Appendices B.6 and B.7
Task A.2.G.	**G. Well and Probe Installation and Decommissioning Plan**	Section 7.8; Appendix B.8

Pasco Sanitary Landfill NPL Site

Zone A Removal Action Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.5
Bench-Scale Treatability Testing Plan

FINAL

PO Box 737
Longview, WA 98632
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Bench-Scale Treatability Testing Plan

In situ thermal treatment or remediation (ISTR) creates steam in the subsurface that acts as a carrier gas to help transport volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) to vapor recovery screens. This is defined as vapor recovery. In contrast to soil vapor extraction, steam assisted vapor recovery does not require high vacuum that produces a large radius of influence. The vapor recovery system for thermal will be designed to create overlapping vacuum throughout the target treatment area to ensure complete capture of contaminant vapors generated during heating that will be conveyed to the surface for treatment.

This bench-scale test will provide data derived from heating of actual site soil to design subsurface heating and vapor recovery systems for a successful remediation.

Bench-Scale Treatability Testing Background

The objective of ISTR of waste and soils at the Industrial Waste Area Zone A (Zone A) at the Pasco Sanitary Landfill National Priorities List Site (Site) is to achieve site-specific remediation levels that are protective of groundwater quality. These target remedial levels will be established in the Post-Excavation Engineering Design Report (Task A.4, Subtask A of the Scope of Work and Schedule [SOW]). In accordance with SOW Task A.2.D, the treatability testing described in this plan will be conducted in close coordination with the Washington State Department of Ecology (Ecology).

VOCs are assumed to comprise the vast majority of contaminant mass within Zone A and are expected to be the focus of ISTR; ISTR can also treat SVOCs with low boiling points, including for example, naphthalene, a polycyclic aromatic hydrocarbons (PAHs).[1] The results of the Zone A post-excavation characterization soil sampling will be used to inform the ISTR design. After all post-excavation characterization data are collected, soil samples will be evaluated by TRS in conjunction with the design team and Ecology for selection of the most representative samples for testing, including soil data with the highest concentrations of VOCs/SVOCs. A second mobilization will occur to collect the sample volumes necessary for bench testing from the locations selected by TRS. Once these data are provided to the vendor(s), bench testing is expected to take one month. In order to determine the efficacy of ISTR at Zone A, TRS plans to perform a bench-scale treatability test to determine estimated removal efficiencies of two applicable in situ thermal technologies—Electrical Resistance Heating (ERH) and Thermal Conductance Heating (TCH). The details of the proposed bench-scale treatability test plan will be documented in a bench-scale treatability testing report after

[1] Although other compounds of concern (COCs) including polychlorinated biphenyls, pesticides, and assorted Resource Conservation and Recovery Act metals including mercury have been detected in Zone A, existing data show these COCs are not present in soil or groundwater at concentrations that would drive remediation. These other COCs are generally collocated with elevated VOCs and would be addressed as secondary components. ISTR is not effective for treatment of heavy metals and has limited effectiveness on pesticides. However, concentrations of secondary components, such as mercury, will be monitored in the vapor phase during the bench testing to inform the design of the vapor treatment system.

receipt of results from the characterization sampling proposed for remaining Zone A waste and underlying vadose soils and completion of the bench test. The characterization sampling program in conjunction with the bench-scale treatability study will inform the selection of a technology or combination of technologies, the vertical placement of heating elements, and the spatial disposition of thermal wells. Additionally, estimated total heat input (energy) and treatment duration can be calculated to estimate treatment costs. Below are the fundamental considerations involved in performance of the future bench-scale treatability study.

Chemical Properties

ISTR is an effective and proven remediation technology for VOCs and certain SVOCs. The most effective types of ISTR are ERH and TCH. Both ERH and TCH are very effective in the unsaturated and smear zone soils that contain compounds that exhibit a vapor pressure greater than 30 mm Hg at 100˚C (equivalent to a boiling point temperature below 220˚C). Vapor pressure and boiling point properties for primary COCs that are more frequently detected and have elevated concentrations and cleanup levels are shown below in **Table 1**, in order of relative volatility.

Table 1: COCs in Order of Relative Volatility

Compound of Concern	Vapor Pressure at 100˚C (mm Hg)	Boiling Point Temperature in Air (˚C)
Vinyl chloride	13,281	-14
1,1-Dichloroethene	5,150	32
Methylene chloride	4,408	41
1,1-Dichloroethane	2,602	57
cis-1,2-Dichloroethene	2,378	60
1,1,1-Trichloroethane	1,597	74
Benzene	1,350	80
1,2-Dichloroethane	1,227	84
Trichloroethylene	1,104	87
Toluene	560	111
Tetrachloroethylene	408	121

For this list of compounds, the ISTR remediates them in both soil and groundwater, if applicable, when the temperature of the subsurface approaches 100˚C.

Because Zone A contains COCs that exhibit a vapor pressure greater than 30 mm Hg at 100˚C, ERH or TCH are each suitable treatment methodologies for Zone A. Analysis of the post-excavation characterization samples will include a standard list of VOCs that include the above COCs in Table 1 and the standard USEPA Method 8270 SVOCs. VOCs, SVOCs (including PAHs) will be identified and accounted for in the bench test with estimated removal efficiencies determined. The compounds targeted for ISTR will be the COCs plus potentially other VOCs and SVOCs that require reduction in concentrations to protect groundwater. The prescribed bench-scale treatability test will evaluate the efficiencies of both ERH and TCH methodologies.

The removal rate of VOCs from soil and groundwater is influenced by the presence of petroleum hydrocarbons and soil organics. Characterization sampling will include analysis for petroleum hydrocarbons and SVOCs (including PAHs) to assess their potential site-specific influence. An example of other reported petroleum hydrocarbons are presented below in **Table 2**.

Table 2: Other Reported Petroleum Hydrocarbons

Compound of Concern	Vapor Pressure at 100˚C (mm Hg)	Boiling Point Temperature in Air (˚C)
Chlorobenzene	270	132
Ethylbenzene	265	136
Xylene	204	140
Cumene	172	152
Stoddard	< 200	154 to 202
Trimethylbenzene	93	169
Dichlorobenzene	60	180
Trichlorobenzene	33	213
Naphthalene	29	218

The presence of organic materials or petroleum hydrocarbons slows the evaporation rate as described by Raoult's Law. Bench-scale treatability testing will evaluate how the COCs react to ISTR under the site-specific organic concentrations to better define the remediation timeframe and expected energy input. ISTR is a distillation and volatilization process. Boiling off a portion of the residual moisture that is present in the soil will result in a large decrease in the COCs and other similar volatiles. Evaluating the amount of soil moisture is one of the bench-scale test parameters. The bench-scale treatability test is designed to determine the COC reduction that results from a known amount of water evaporation. The amount of water that is evaporated from a bench-scale treatability test soil sample can be directly converted to an energy density (e.g., kWh per cubic yard of treated soil). Knowing the energy density, TRS can better estimate the overall remediation energy, time, and cost to achieve the desired concentration reductions.

Evaporative Removal

The effectiveness of evaporative removal is a key question to be answered by the bench-scale test. During bench-scale treatability testing, heat will be input into soil samples collected from Zone A to cause soil moisture to boil into steam. This will also cause VOCs and other contaminants to vaporize and join the steam for removal. In this bench-scale treatability test, it is important to carefully quantify the energy density that is used, because the energy density has important implications for full scale remediation implementation and effectiveness.

Bench-Scale Testing

TRS will require one (1) one-gallon container from each of the Zone A lithologies to be tested: the Touchet Beds and the Upper Pasco Gravels. The soil samples should be collected from areas and depths of Zone A that are highly impacted with COCs and, if possible, non-aqueous-phase liquid to represent a worst-case condition. TRS will review data to determine the most appropriate sample locations, and a second mobilization will occur to collect the sample volumes necessary for bench testing. The containers should be packed to the top with minimal headspace to avoid volatilization losses during shipment. After sealing the cans, the cans should be placed inside coolers for shipment with ice inside the coolers. The shipment should be sent by FedEx or UPS for next-day delivery to preserve the integrity of the samples.

The objectives of the testing include developing a basis for site-specific design of an ISTR remediation system (target temperature, required energy density).

Contaminant reduction data will be coupled with additional electrical and physical tests for proper design of a full-scale ISTR system for Zone A. The physical testing will include electrical resistivity, moisture content, total organic carbon (TOC) content, bulk density, and porosity data.

Heating can affect soil volume and settlement if the material contains significant organic carbon. In general, if a fraction of organic matter exceeds 1%, some settlement could occur. If the characterization data indicate that materials with high organic content and void spaces exist, the laboratory testing will be amended to include mass loss and shrinkage testing.

For full-scale ISTR, the vapor cover must be designed and constructed to allow for some movement and settlement. During ISTR operation, minor repairs are expected to the cover (i.e., small cracks associated with minor shrinkage/settlement), as movement can occur around the heater borings where temperatures exceed 100°C. If significant settlement is expected, the cover will be designed so that it will shed rainwater if settlement occurs.

Bench-Scale Test Procedure

When TRS receives the cooler with samples, the soil samples from each lithology will be carefully homogenized separately to create a uniform soil sample for testing. The soil will be chilled to 4°C or 5°C before homogenization. Soil samples will be homogenized inside a walk-in refrigerated room using low energy mixing (stirring by hand). Contaminants that could potentially volatilize under these conditions are easily remediated during the ISTR process. The remaining containers will be placed inside a sample refrigerator to preserve the samples for later testing.

The homogenized soil sample will then be divided into subsamples for the bench-scale treatability test. Each of the subsamples heated in the bench-scale test will be analyzed for moisture content, electrolytic conductivity, TOC content (ASTM 2974), bulk density, and porosity prior to heating. Two of the samples from each area will serve as control samples.

Control Samples

One homogenized subsample will serve as a control sample to provide initial VOC concentrations of the soil prior to testing. This sample will be immediately placed into the sample refrigerator after the soil is homogenized. A second control sample will serve as the method control. This sample will be subjected to the same method protocols of preparation used for bench-scale treatability testing; however, the sample will not be subjected to any heating. The method control allows for quantification of VOCs that may be lost by handling and preparation rather than heating.

Soil homogenization is common industry practice for ISTR testing. It is often used during thermal treatability testing to reduce sample variability, provide a better evaluation of the treatment area rather than a small undisturbed core, and increases confidence in the analytical data. Average soil concentrations using a much larger sample population is useful for identifying the compounds to treat and monitor, not to estimate the total mass, because the analytical results represent only a few selected locations and depths. Therefore, safety factors (on the order of 3 to 10) are applied during design to account for localized areas with more contaminant mass to ensure that the system has sufficient capacity to handle the mass.

Sample Heating

TRS will prepare subsamples weighing approximately 1 pound from each of the two distinct lithologies for ERH testing. An oven is used to heat the subsamples to provide uniform heating for small soil subsamples in comparison to other heating methods. The sample will be contained in a stainless steel chamber with ports for air inlet and outlet. Outside the oven, the extracted vapors are condensed such that the volume of recovered water can be measured.

The vapor treatment system will be designed and sized based on the expected total mass to be extracted and the predicted duration of operation. Peak removal times and rates are estimated based on the COCs present in the samples and their concentrations (in pounds per hour for the dominant COCs), and then a safety factor is built in to the design to ensure that the vapor treatment system has sufficient capacity. Bench-scale testing cannot predict variation of mass removal rates over time. In the rare event that the vapor concentrations approach the maximum capacity of the system during full-scale operation, heating can be slowed temporarily to “flatten” the peak.

We anticipate testing each soil five different ways:

- Heating to 100ºC and removal of 25% of the pore water
- Heating to 100ºC and removal of 50% of the pore water
- Heating to 100ºC and removal of 75% of the pore water
- Heating to 100ºC and removal of all of the pore water, holding at temperature for 3 days
- Heating to 200ºC for 3 days

The 100ºC temperature threshold represents a key treatment threshold for all ISTR technologies, as steam stripping becomes a dominate cleanup mechanism at this temperature. The percent of pore water removal is a reference to the quantity of steam stripping achieved. For example, 50% pore water removal is twice the amount of steam stripping as 25% pore water removal. To achieve temperature values in excess of 100ºC, all the water must be removed from the matrix. Heating the sample to 200ºC provides data to represent cleanup of the sample beyond the steam stripping threshold. This testing represents the range of possible treatment aggressiveness relevant for Zone A.

VOC and SVOC Analyses

The control samples and the heated samples will be immediately refrigerated after testing is complete. The samples will be placed into glass jars and sent to an accredited analytical laboratory for testing of total VOCs and SVOCs, including PAHs. Data from the analytical reports will be provided to TRS so that a bench-scale test report may be issued summarizing the data.

Evaluation

TRS and Floyd|Snider, in coordination with Ecology, will evaluate the results of the bench-scale testing to determine which ISTR technology and target temperature is best suited for Zone A both in technical practicability and economics.

Reporting

The bench-scale treatability test will require approximately three to four weeks to complete, from receipt of soil samples to shipment of the samples to the analytical laboratory. Preliminary screening results from the testing will be provided to Floyd|Snider at the time of sample shipment.

The recommended ISTR treatment approach will be derived from evaluating the COC removal efficiencies achieved at the prescribed pore water removal targets discussed above. Each of the pore water removal targets will provide a scalable energy requirement for the full-scale treatment of the COCs. A bench-scale treatability test report will be prepared and submitted to Ecology.

TRS will use this raw bench test data to produce graphs similar to the one shown below in Figure 1 (the example data is from a previous TRS bench test for a project in Seattle, Washington).

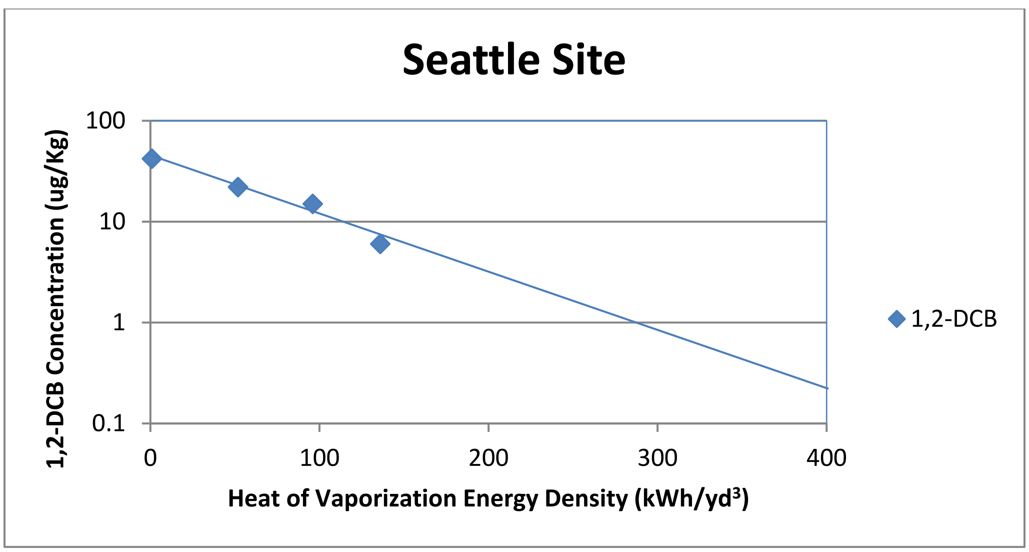

Figure 1. Example Residual 1,2-DCB vs. Steaming Energy Density

After TRS receives the analytical results from the analytical laboratory, TRS will require approximately three to four weeks to complete a bench-scale treatability test report. The bench-scale test report will discuss the results of the thermal treatment treatability testing, removal efficiencies, and a recommended treatment approach. The bench-scale treatability test report will be included in the Post-Excavation Engineering Design Report to be submitted to Ecology.

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.6
Zone A Removal Action Supplemental Groundwater Monitoring Plan

FINAL

Zone A Removal Action Supplemental Groundwater Monitoring Plan

Pasco Landfill NPL Site
Pasco, Washington

Submitted to:
Washington State Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, Washington 99205-1295

On Behalf of the:
IWAG Group III

Prepared By:
PBS Engineering and Environmental Inc.
and
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February 28, 2020

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Table of Contents

Supporting Data

TABLES

FIGURES

1 INTRODUCTION

This Zone A Removal Action Supplemental Groundwater Monitoring Plan (hereafter Groundwater Monitoring Plan or GMP) provides details needed to implement a modified groundwater monitoring program for the Zone A Industrial Waste Area (Zone A) at the Pasco Landfill NPL Site (Site) in Pasco, Washington due to the concern that Zone A remediation activities could cause short-term groundwater quality changes.

This GMP will include provisions for assessing potential short-term changes in groundwater quality during active remediation including a modified analytical suite and monitoring frequency to evaluate potential groundwater quality changes during periods of intrusive or disruptive remediation work (excavation and in-situ treatment). Monitoring results will be used to assess overall trends in groundwater quality relative to the remedial action.

This Groundwater Monitoring Plan has been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) to fulfill the requirements of Agreed Order No. DE 9240 (Agreed Order), the Ecology *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), dated August 2019, and Enforcement Order No. DE 16899, dated November 8, 2019. The GMP is required as part of the Scope of Work and Schedule (SOW) in Exhibit C of the CAP. The GMP is required as part of Task A.1 Zone A Removal Action Engineering Design Report (EDR) and as sub-plan E under Task A.2 Zone A Removal Action Compliance Monitoring Plan (CMP).

The protocols in this plan for groundwater monitoring during cleanup actions at Zone A will supplement the current *Site-Wide Groundwater Performance and Protection Monitoring Operations and Maintenance Manual* (hereafter *Site-Wide Groundwater O&M Manual)*, dated October 10, 2017, and are hereafter referred to as "supplemental monitoring." This document has been prepared in a manner consistent with the Model Toxics Control Act (MTCA) (70.105D RCW) and the MTCA Cleanup Regulation (WAC 173-340) and appropriate federal guidance.

The location of the Site and Zone A is illustrated in Figure 1.

2 ZONE A INTERIM ACTIONS AND CLEANUP ACTIONS

The following interim actions are currently being performed at Zone A:

- Operation of a soil vapor extraction (SVE) system within Zone A;
- Operation of a regenerative thermal oxidizer (RTO) to treat SVE vapors;
- Operation and maintenance of the landfill cap on Zone A; and
- Groundwater monitoring within and downgradient of Zone A.
- Removal of non-aqueous phase liquid (NAPL) from Zone A well MW-52S.

The following cleanup actions are planned for Zone A:

- Upgrades to the SVE system;
- Removal of the Zone A landfill cap (cover system);
- Excavation and removal of drums and waste from Zone A;
- Post removal in-situ treatment of residual soils;
- Backfill; and
- Replacement of the Zone A landfill cover system after successful completion of in-situ thermal treatment.

In addition to the *Site-Wide Groundwater O&M Manual* referenced above, the IWAG has prepared O&M Manuals for the SVE and RTO systems and an O&M Manual for the caps at Zone A and the other Industrial Waste Areas (IWAs). Updates to these manuals will be completed as needed.

Supplemental monitoring of Zone A groundwater during the implementation of the cleanup actions and interim actions is addressed below.

3 ZONE A GROUNDWATER MONITORING

3.1 Supplemental Monitoring Purpose and Scope

The purpose of supplemental groundwater monitoring at Zone A is to:

- Assess potential short-term changes in groundwater quality during active remediation at Zone A;
- Assess the continued effectiveness of the Zone A SVE system for ensuring groundwater protection during removal of drums at Zone A.
- Establish current baseline groundwater quality conditions in a location hydraulically upgradient of Zone A to help assess potential changes in groundwater quality directly attributable to active remediation at Zone A.
- Monitor concentrations of contaminants of potential concern (COPCs) immediately downgradient of Zone A that could be mobilized as a result of the Zone A removal action.

The scope of the supplemental Zone A groundwater monitoring includes the following additions to the existing *Site-Wide Groundwater O&M Manual*:

- Monitoring at existing Zone A wells;
- Monitoring at one new well installed in January 2020 upgradient of Zone A and two additional wells to be installed (replacement wells for the to be decommissioned Zone A source wells);
- An increased monitoring frequency for certain key analytes; and
- Additional analytes for certain key wells.

The current quarterly and semi-annual groundwater monitoring program for all other waste disposal areas at the Site will continue until Ecology review and approval of the Site-Wide Groundwater Compliance Monitoring Plan (CMP) required in Task G of the SOW. The draft Site-Wide Groundwater CMP will be submitted to Ecology 180 days after the effective date of the Enforcement Order. This CMP will provide a comprehensive groundwater program for performance and confirmational monitoring for all areas/zones. It will evaluate the existing groundwater network against changing cleanup and monitoring needs and provide for decommissioning of wells no longer needed or the expansion of the downgradient supplemental groundwater monitoring network in a stepwise fashion to evaluate conditions further from Zone A. The plan will include an analysis of appropriate constituents considering the categories of waste disposed at the Site.

3.2 Monitoring Program During Zone A Remedial Actions

Monitoring of Zone A wells is performed on quarterly and semi-annual schedules as part of the existing Site-wide groundwater monitoring program. The Zone A wells sampled, and the general analytical requirements for each well, are listed in the groundwater monitoring schedule in Table 1.

Supplemental monitoring will be performed during the Zone A removal action and will be conducted in between the existing quarterly and semi-annual events (approximately six to seven weeks after each quarterly or semi-annual event) during the duration of activities summarized in the Zone A Removal Action EDR. The schedule of Zone A wells to be sampled and analyses for each well are presented in the groundwater monitoring schedule in Table 1. The locations of the wells to be sampled are shown on Figure 2.

Monitoring as part of this supplemental monitoring will be adaptive. Analyses may be added or removed from the schedule depending upon detections reported from the supplemental monitoring events. Any changes will be first coordinated with Ecology. Additionally, as described above, at the completion of excavation activities and prior to the start of in situ thermal treatment, any changes to the Zone A Groundwater Monitoring Program will be re-evaluated with Ecology and documented in an addendum.

3.3 NAPL Monitoring Program

Procedures for NAPL monitoring in Zone A source wells MW-52S and MW-53S will be performed until these wells are decommissioned as part of site preparation for the Zone A removal activities. Details of the Site NAPL monitoring program are available in the *Site-Wide Groundwater O&M Manual*. The current NAPL recovery procedure, as approved by Ecology, calls for deployment of a sorbent sock within any well with over one-half inch of free product and monthly monitoring of NAPL and the deployed sorbent sock. The frequency of NAPL monitoring and recovery may be adjusted over time on a well-by-well basis.

3.4 Groundwater Elevation Monitoring

Groundwater elevation monitoring will be performed at all wells sampled during:

- Supplemental groundwater monitoring performed under this plan;
- Site-wide quarterly groundwater monitoring; and
- Site-wide semi-annual groundwater monitoring performed during the second and fourth quarters.

Construction details for Zone A wells, and as-built well construction drawings (borelogs) are presented in the *Site-Wide Groundwater O&M Manual*.

3.5 Analytical Methods and Reporting Limits

In addition to sampling performed as part of the existing Site-wide quarterly and semi-annual monitoring program, samples will undergo analysis for selected analytes such as pesticides, herbicides, chromium, and PCBs as detailed below and as indicated in Table 1. Supplemental sampling will be performed at the following wells:

- MW-47S
- MW-50S
- MW-56S
- MW-57S
- MW-58S
- NVM-01

Note that well MW-56S is a background well that was installed northeast of Zone A in January 2020. Wells MW-57S and MW-58S are planned replacement wells for MW-52S and MW-53S, and will be located hydraulically downgradient of Zone A. Per Ecology's request, stainless steel screens will be installed in wells MW-57S and MW-58S. The replacement well locations were determined in coordination with Ecology during a Site visit on January 7, 2020 and subsequent communication. The proposed well locations shown on Figure 2 reflect that coordination with Ecology and information from Cascade Natural Gas.

If laboratory results report no detections after four sampling events (two quarterly and two supplemental events), Ecology and the IWAG will evaluate a transition to routine semi-annual monitoring. For example, if

PCB data for a well has no detections over the reporting limit listed in the plan for four consecutive events, Ecology and the IWAG will consider transitioning PCB analysis to semi-annual. If no detections are reported for any analyses for a given well, sampling of the well will transition to semi-annual for all compounds except VOCs and SVOCs. A quarterly sampling (minimum) for VOCs and SVOCs will be maintained for all wells identified for supplemental sampling.

Samples collected from these wells will be subject to the following analyses during the supplemental sampling events:

- VOCs using EPA Method 8260C by gas chromatography/mass spectrometry (GC/MS) full scan and selective ion monitoring (SIM) techniques;
- SVOCs using EPA Method 8270D by GC/MS full scan and SIM techniques;
- Herbicides using a modified EPA Method 8151A by GC-MS/MS;
- Organochlorine pesticides using EPA Method 8081 by GC;
- Organophosphorus pesticides using EPA Method 8141B by GC;
- Polychlorinated biphenyls (PCBs) using EPA Method 8082 by GC;
- Metals:
    - Total metals (22 TAL metals plus mercury) by Methods 200.8/245.1 for two sampling events (one quarterly and one supplemental); to be followed by
    - Priority pollutant metals (13 plus mercury using the same methods) for two additional sampling events[1].
    - Upon Ecology review of the data from rounds 1 through 4, metals analysis may be scaled back to only chromium analysis.
    - Total chromium using EPA Method 200.8 or 6020 by inductively coupled plasma/mass spectrometry (ICP/MS) during subsequent sampling events.

The analyte lists and reporting limits for VOC, SVOC, herbicide, metals, pesticide, and PCB analyses are included in Table 2 of this GMP, along with the associated Site cleanup levels and/or MTCA Method B values.

Requirements for VOC, SVOC, herbicide, metals, pesticide, and PCB sample collection and analyses are included in Table 3 of this GMP. The analytical method, bottle type, preservation and handling requirements, and holding time are listed for each analysis.

4 FIELD PROCEDURES

4.1 Standard Operating Procedures for Field Sampling Methods

Details of the methods to be used for purging, stabilizing, and sampling wells is available in the *Site-Wide Groundwater Monitoring O&M Manual* in Section 4.1.

4.2 Standard Operating Procedures for New Monitoring Wells

To provide samples that are representative of groundwater quality in the vicinity of new monitoring wells, the following well development, initial sampling order, pump placement, and waste management procedures will be used:

- New wells will be installed, developed, and then allowed to stabilize for at least one week prior to purging and sampling.

[1] Due to the composition of stainless-steel screens, detections of chromium and nickel in groundwater samples from wells constructed of stainless-steel screens may be biased high.

- Consistent with existing Site wells, a dedicated stainless-steel Grundfos RediFlo2 (or similar) submersible pump will be installed to purge and sample new monitoring wells. The pump screen inlet will be positioned 2 to 3 feet below the historical low groundwater elevation.
- Water purged from each new well will be collected in 5-gallon buckets and combined with purge water from other wells. See the Waste Management procedures in Section 8 of the Site-Wide Groundwater O&M Manual for more details.

4.3 Additional Field Procedures

Details for the following field procedures are available in Section 4 of the *Site-Wide Groundwater Monitoring O&M Manual*:

Field Instrument Calibration;
Decontamination Procedures;
Pump Intake Placement;
Standard Operating Procedures for Well Maintenance Activities;
Well Installation;
Well Construction Standards;
Location Surveying;
Well Rehabilitation and Modification;
Well Decommissioning;
Sample Labelling
Field Documentation – Groundwater Monitoring;
Chain of Custody Procedures;
Sample Preservation and Handling; and,
Sample Shipping Procedures.

5 QUALITY ASSURANCE PROJECT PLAN

Details for the following QAPP procedures are available in Quality Assurance and Quality Control Procedures in Section 5 of the *Site-Wide Groundwater Monitoring O&M Manual*:

Field QA/QC Program;
Field QA/QC Samples;
Sample Custody;
Laboratory QA/QC Program;
Sample Receiving;
Method Detection Limits (MDLs) and Reporting Limits (RLs);
Analytical Turn-Around-Time;
Laboratory Calibration Procedures and Frequency;
Laboratory Data Reduction, Validation, and Reporting;
Laboratory Data Reduction;
Laboratory Data Validation;
Laboratory Reporting;
Internal Quality Control Checks;
Specific Procedures for Routine Assessment of Data Precision, Accuracy, and Completeness;
Assessment of Precision (Split, Duplicate, or Replicate Measurements);
Assessment of Accuracy (Surrogate Spike Recovery);
Assessment of Accuracy (Blank Spike and Matrix Spike Recovery);
Completeness; and

Data Validation Program.

6 DATA MANAGEMENT PLAN

Details of the following data management procedures are available in Data Management Plan in Section 6 of the *Site-Wide Groundwater Monitoring O&M Manual*:

Sources of Data;
Process Overview;
Management of Data Quality;
Data Reporting to Ecology; and
Computer System Security.

7 REPORTING

Groundwater monitoring data will be submitted to Ecology in accordance with the Enforcement Order for the Site. The results of the supplemental groundwater monitoring will be reported in the monthly reports or earlier if elevated concentrations are reported.

7.1 Monthly Progress Reports

According to Task H of the SOW, progress reports will be submitted monthly during active design and construction. Under the Enforcement Order, monthly progress reports shall be submitted by the tenth (10th) day of the month in which they are due. The frequency will change to semi-annual upon completion of all remedial construction operations and commencement of routine operations and maintenance activities. Ecology and the PLPs will coordinate on the timing of this transition.

The progress reports may include groundwater monitoring data reports as described in the final Site-wide Groundwater CMP. The groundwater monitoring portion of the progress report will be developed in accordance with WAC 173-340-720(9). It is expected that two concurrent progress reports may be submitted to Ecology when due: one report for the Industrial Waste Areas of the Site; and one report for all other areas of the Site.

Monthly or Semi-annual Progress reports will include the following information:

- A list of activities that have occurred during the reporting period.
- Detailed descriptions of any deviations from required tasks not otherwise documented in project plans or amendment request.
- A description of all deviations from the SOW, or from the applicable O&M Plans for the current reporting period, and any planned deviations for the upcoming reporting period.
- For any deviations in the schedule, a plan for maintaining compliance with the schedule.
- All raw data (including laboratory analysis) received during the reporting period.
- A brief summary of findings, including any noteworthy observations regarding changes in observed contaminants or groundwater conditions
- A list of deliverables for the upcoming reporting period if different from the schedule.

Task H.3 of the *Scope of Work and Schedule for the Cleanup Action Plan* requires submittal of Site-wide Groundwater Monitoring Reports, which may be combined with the progress report for either the Industrial Waste Area or the other areas of the Site.

7.2 Quarterly and Annual Reports

Details are available in Section 7 of the *Site-Wide Groundwater Monitoring O&M Manual*.

7.3 Data Evaluation and CULs

Cleanup levels (CULs) were set by Ecology in 2019 as part of the *Cleanup Action Plan*. While the purpose of the supplemental monitoring is to assess short term changes during the Zone A removal action, all groundwater data, reporting, and compliance will be assessed relative to CULs presented in Section 4.6 the CAP and in the following table.

Pasco Landfill NPL Site
Groundwater Cleanup Levels

Contaminant of Potential Concern	CUL (ug/l)
Tetrachloroethene	0.69
Trichloroethene	2.5
1,1-Dichloroethene	0.057
cis-1,2-Dichloroethene	12
Vinyl Chloride	0.053
1,1,1-Trichloroethane	200
1,1-Dichloroethane	7.68
1,2-Dichloroethane	0.38
Benzene	1.2
Methylene Chloride	5
Toluene	157
Total Chromium	100

8 WASTE MANAGEMENT PLAN

Details for the waste management procedures for purge water and well installation and development water are available in section 8 of the *Site-Wide Groundwater Monitoring O&M Manual*.

9 CONTACTS FOR THE GROUNDWATER MONITORING PROGRAM

Table 4 contains contact information for the groundwater monitoring program.

10 REFERENCES

State of Washington Department of Ecology *Cleanup Action Plan Pasco Landfill NPL Site - Kahlotus Road & Highway 12, Pasco - Facility Site ID 575, Cleanup Site ID 1910*, dated August 2019.

Site-Wide Groundwater Performance and Protection Monitoring Operations and Maintenance Manual – Pasco Landfill NPL Site, Pasco, Washington, prepared by PBS Engineering and Environmental Inc., dated October 10, 2017.

All laboratory analytical methods are available at the United States Environmental Protection Agency (US EPA) website for *Hazardous Waste Test Methods/SW-846 at https://www.epa.gov/hw-sw846*.

All Washington Administrative Code (WAC) referenced in this Plan are available on the Washington State Legislature website at https://apps.leg.wa.gov/wac/default.aspx?cite=173 including:

- *Dangerous Waste Regulations, Chapter 173-303 WAC;*
- *Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160 WAC; and*
- *Model Toxics Control Act—Cleanup, Chapter 173-340 WAC.*

Draft Focused Feasibility Study – Pasco Landfill National Priorities Listed Site, prepared by Anchor QEA, Aspect, Environmental Partners, Inc., and AMEC Environment & Infrastructure, Inc., dated September 2014.

National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation (OSRTI), U.S. Environmental Protection Agency (EPA), August 2014, OSWER 9355.0-132 EPA-540-R-014-002.

National Functional Guidelines for Inorganic Superfund Data Review, Office of Superfund Remediation and Technical Innovation, U.S. Environmental Protection Agency, August 2014, OSWER 9355.0.131 EPA-540-R-013-001.

State of Washington Department of Ecology *Agreed Order No. DE 9240*, signed and dated October 31, 2012.

Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 540-R-08-005), by USEPA OSWER, dated January 13, 2009.

Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers Ground Water Forum Issue Paper (EPA 542-S-02-001) by D. Yeskis and B, Zavala, USEPA Office of Solid Waste and Emergency Response (OSWER), dated May 2002.

Risk Assessment / Cleanup Level Analysis, prepared by Phillip Services Corp., dated September 1998.

TABLES

Table 1
Groundwater Monitoring Schedule
Zone A Removal Action - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

Well Grouping	Well	Existing Quarterly Monitoring (Jan/Apr/Jul/Oct)		Existing Semi-Annual Monitoring (Apr/Oct)				Supplemental Monitoring During Zone A Removal Action (~1st/2nd week of Mar/Jun/Sept/Dec)					
		Volatile Organic Compounds	Semi-Volatile Organic Compounds	Volatile Organic Compounds	Semi-Volatile Organic Compounds	Herbicides	Total Chromium	Volatile Organic Compounds	Semi-Volatile Organic Compounds	Herbicides	Pesticides	Metals	PCBs
Upgradient	MW-56S	X	X	X	X	X	X	X	X	X	X	X	X
Zone A Wells	MW-13S	X	--	X	--	--	--	X	--	--	--	--	--
	MW-47S	X	X	X	X	--	X	X	X	X	X	X	X
	MW-47I	--	--	X	--	--	--	X	--	--	--	--	--
	MW-50S	X	X	X	X	--	X	X	X	X	X	X	X
	MW-57S	X	X	X	X	X	--	X	X	X	X	X	X
	MW-58S	X	X	X	X	X	--	X	X	X	X	X	X
	NVM-01	X	--	X	--	--	--	X	X	X	X	X	X

Notes:
Supplemental sampling will occur between quarterly events.
MW-56S has been installed in the Central Area to the northeast of Zone A
MW-57S and MW-58S are planned replacement wells for MW-52S and MW-53S, and will be installed downgradient of and adjacent to Zone A.

Table 2
Analytical Methods, Analytes and Reporting Limits
Zone A Removal Action - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

Analyte (2019 Cleanup Limit)	Method Detection Limit	Current RL (µg/L)	Proposed RL (µg/L)	MTCA Method B Non Cancer Value (µg/L)	MTCA Method B Cancer Value (µg/L)
VOCs - EPA Method 8260 SIM - ALS Everett					
1,1-Dichloroethene (CUL 0.057 ug/l)	0.0035	0.02	-	400	--
1,1,2,2-Tetrachloroethane	0.0487	0.2	-	160	0.22
1,2-Dibromo 3-Chloropropane	0.0110	**0.1**	0.05*	1.6	0.06
1,2-Dibromoethane (EDB)	0.0057	0.02	-	72	0.02
1,2-Dichloroethane (CUL 0.38 ug/l)	0.0038	0.02	-	48	0.48
1,2,3-Trichloropropane	**0.0069**	**0.02**	**0.02***	32	0.00146
Benzene (CUL 1.2 ug/l)	0.0094	0.028	-	32	0.80
Tetrachloroethylene (CUL 0.69 ug/l)	0.0449	0.2	-	48	21
Trichloroethene (CUL 2.5 ug/l)	0.0178	0.0534	-	4	0.54
Vinyl Chloride (CUL 0.053 ug/l)	0.0105	**0.0315**	0.02*	24	0.03
VOCs - EPA Method 8260 - ALS Everett					
1,1-Dichloroethane (CUL 7.68 ug/l)	0.0099	2	-	1,600	7.7
1,1,1-Trichloroethane (CUL 200 ug/l)	0.0197	2	-	16,000	--
1,1,1,2-Tetrachloroethane	0.0292	1.68	-	240	1.7
1,1,2-Trichloroethane	0.0173	0.77	-	32	0.77
1,2-Dichlorobenzene	0.0095	2	-	720	--
1,2-Dichloropropane	0.0212	0.64	-	320	1.2
1,2,4-Trichlorobenzene	0.0156	**2**	1*	80	1.5
1,2,4-Trimethylbenzene	0.0179	2	-	80	--
1,3,5-Trimethylbenzene	0.0137	2	-	80	--
1,4-Dichlorobenzene	0.0150	1.82	-	560	8.1
2-Butanone (MEK)	0.4720	10	-	4,800	--
2-Chlorotoluene	0.0106	2	-	160	--
2-Hexanone	0.3120	10	-	40	--
4-Methyl-2-Pentanone (MIBK)	0.1140	10	-	640	--
Acetone	0.2250	25	-	7,200	--
Acrylonitrile	0.0191	**10**	**1***	320	0.081
Bromobenzene	0.0136	2	-	64	--
Bromodichloromethane	0.0197	0.71	-	160	0.71
Bromoform	0.0176	2	-	160	5.5
Bromomethane	0.0481	2	-	11	--
Carbon Disulfide	0.0181	2	-	800	--
Carbon Tetrachloride	0.0083	0.34	-	32	0.63
Chlorobenzene	0.0080	2	-	160	--
Chloroform	0.0462	**2**	1*	80	1.4
cis-1,2-Dichloroethene (CUL 12 ug/l)	0.0227	2	-	16	--
Dibromochloromethane	0.0248	0.52	-	160	0.52
Dibromomethane (methylene bromide)	0.0236	2	-	80	--
Dichlorodifluoromethane (CFC-12)	0.0314	2	-	1,600	--
Ethylbenzene	0.0097	2	-	800	--
Hexachlorobutadiene	0.0231	0.56	-	8	0.56
Isopropylbenzene (cumene)	0.0127	2	-	800	--
m,p-Xylene	0.0352	4	-	1,600	--
Methyl T-Butyl Ether	0.0114	2	-	--	24
Methylene Chloride (CUL 5 ug/l)	0.2260	5	-	48	22
n-Butylbenzene	0.0175	2	-	400	--
n-Propyl Benzene	0.0120	2	-	800	--
Naphthalene	0.0184	2	-	160	--
o-Xylene	0.0231	2	-	1,600	--
Styrene	0.0067	1.46	-	1,600	--
T-Butyl Benzene	0.0169	2	-	800	--
Toluene (CUL 157 ug/l)	0.0051	2	-	640	--
Trans-1,2-Dichloroethene	0.0323	2	-	160	--
Trichlorofluoromethane (CFC-11)	0.0149	2	-	2,400	--

Reporting limits over MTCA B cancer value revised to PQL/LOQ on 4/16/2020

Table 2
Analytical Methods, Analytes and Reporting Limits
Zone A Removal Action - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

Analyte (2019 Cleanup Limit)	Method Detection Limit	Current RL (µg/L)	Proposed RL (µg/L)	MTCA Method B Non Cancer Value (µg/L)	MTCA Method B Cancer Value (µg/L)
SVOCs - EPA Method 8270 SIM - ALS Everett					
Benzo[A]Anthracene	0.00596	0.02	-	--	0.12
Benzo[A]Pyrene	0.00959	**0.0288**	0.02*	4.8	0.023
Benzo[B]Fluoranthene	0.01	**0.03**	**0.02***	--	0.012
Benzo[K]Fluoranthene	0.00705	0.0212	-	--	1.2
Bis(2-Chloroethyl)Ether	0.01	0.04	-	--	0.04
Chrysene	0.00645	0.02	-	--	12
Dibenz[A,H]Anthracene	0.00619	**0.02**	**0.02***	--	0.012
Indeno[1,2,3-Cd]Pyrene	0.00498	0.02	-	--	0.12
1-Methylnaphthalene	0.0010	0.02	-	560	1.5
Pentachlorophenol	0.0438	**0.5**	0.2*	80	0.22
SVOCs - EPA Method 8270 - ALS Everett					
1,2-Dichlorobenzene	0.478	2	-	720	--
1,2,4-Trichlorobenzene	0.374	**2**	1.5*	80	1.5
1,4-Dichlorobenzene	0.342	1.82	-	560	8.1
2-Chlorophenol	0.284	2	-	40	--
2-Methylnaphthalene	0.344	2	-	32	--
2-Methylphenol (o-Cresol)	0.431	2	-	400	--
2-Nitroaniline	0.254	2	-	160	--
2,3,4,6-Tetrachlorophenol	0.352	2	-	480	--
2,4-Dichlorophenol	0.262	2	-	24	--
2,4-Dimethylphenol	0.291	2	-	160	--
2,4-Dinitrophenol	0.978	10	-	32	--
2,4-Dinitrotoluene	0.259	**2**	**1***	32	0.28
2,4,5-Trichlorophenol	0.511	2	-	800	--
2,4,6-Trichlorophenol	0.299	2	-	8	4
2,6-Dinitrotoluene	**0.607**	**2**	**2***	4.8	0.058
3&4-Methylphenol (m&p-Cresol)	0.27	2	-	400/800	--
4-Chloro-3-Methylphenol (Chlorocresol)	0.396	2	-	1,600	--
4-Chloroaniline	**0.628**	**2**	**2***	32	0.22
4-Nitroaniline	0.752	2.26	-	64	--
Acenaphthene	0.264	2	-	960	--
Aniline	0.861	5	-	56	7.7
Anthracene	0.267	2	-	4,800	--
Azobenzene	0.545	**2**	**2***	--	0.8
Benzoic Acid	0.814	10	-	64,000	--
Benzyl Alcohol	0.343	2	-	800	--
Bis(2-Ethylhexyl)Phthalate	0.269	2	-	320	6.3
Butylbenzylphthalate	0.222	2	-	3,200	46
Di-N-Butylphthalate	0.277	2	-	1,600	--
Di-N-Octylphthalate	0.291	2	-	160	--
Dibenzofuran	0.17	2	-	16	--
Diethylphthalate	0.265	2	-	13,000	--
Fluoranthene	0.311	2	-	640	--
Fluorene	0.335	2	-	640	--
Hexachlorobenzene	0.01	0.05	-	13	0.055
Hexachlorobutadiene	0.01	0.56	-	8	0.56
Hexachlorocyclopentadiene	0.98	5	-	48	--
Hexachloroethane	0.667	**2**	**2***	5.6	1.1
Isophorone	0.391	2	-	1,600	46
N-Nitroso-Di-N-Propylamine	**0.702**	**5**	**2***	--	0.013
N-Nitrosodimethylamine	**0.502**	**2**	**2***	0.064	0.00086
N-Nitrosodiphenylamine	0.308	2	-	--	18
Naphthalene	0.194	2	-	160	--
Nitrobenzene	0.396	2	-	16	--
Phenol	0.35	2	-	2,400	--
Pyrene	0.202	2	-	480	--
Pyridine	1.1	5	-	8	--

Analyte (2019 Cleanup Limit)	Method Detection Limit	Current RL (µg/L)	Proposed RL (µg/L)	MTCA Method B Non Cancer Value (µg/L)	MTCA Method B Cancer Value (µg/L)
Herbicides - EPA Method 8151A - Pacific Agricultural Lab					
2,4-D	0.009	0.04	-	160	--
2,4-DB	0.009	0.04	-	130	--
2,4,5-T	0.003	0.04	-	160	--
Dicamba	0.013	0.04	-	480	--
Dinoseb	0.009	0.04	-	16	--
MCPA	0.003	0.04	-	8	--
Mecoprop (MCPP)	0.003	0.04	-	16	--
Pentachlorophenol	0.009	0.08	-	80	0.22
Silvex (2,4,5-TP)	0.006	0.04	-	130	--
Pesticides - EPA Method 8081 - ALS Everett					
4,4'-DDD	0.014	-	0.05	0.48	0.36
4,4'-DDE	0.001	-	0.05	4.8	0.26
4,4'-DDT	0.002	-	0.05	8	0.26
A-BHC (Alpha-Hexachlorocyclohexane)	0.001	-	0.01*	130	0.014
Aldrin	**0.011**	-	**0.01***	0.24	0.0026
B-BHC (Beta-Hexachlorocyclohexane)	0.001	-	0.01*	--	0.049
Chlordane	0.022	-	0.1	8	0.25
Dieldrin	0.002	-	**0.01***	0.8	0.0055
Endosulfan Sulfate	0.001	-	0.05	96	--
Endrin	0.001	-	0.05	4.8	--
G-BHC (Gamma-BHC / Lindane)	0.001	-	0.05	4.8	0.08
Heptachlor	0.010	-	0.01*	--	0.02
Heptachlor Epoxide	0.001	-	**0.01***	0.1	0.0048
Methoxychlor	0.003	-	0.05	80	--
Toxaphene	**0.089**	-	0.05*	1.4	0.08
Pesticides - EPA Method 8141B - Pacific Agricultural Lab					
Chlorpyrifos	NA	-	0.3	16	--
Chlorpyrifos methyl	NA	-	0.3	160	--
Demeton, Total	NA	-	0.3	0.64	--
Diazinon	NA	-	0.3	11	--
Dichlorvos	NA	-	**0.3****	4	0.15
Dicrotophos (Bidrin)	NA	-	0.3	1.6	--
Dimethoate	NA	-	0.3	3.2	--
Disulfoton	NA	-	0.3	0.64	--
EPN (ethyl p-nitrophenyl phenylphosphorothioate)	NA	-	**0.3****	0.16	--
Ethion	NA	-	0.3	8	--
Fenamiphos	NA	-	0.3	4	--
Malathion	NA	-	0.3	320	--
Merphos	NA	-	0.3	0.48	--
Methidathion	NA	-	0.3	16	--
Methyl Azinphos (Guthion)	NA	-	0.3	48	--
Methyl Parathion	NA	-	0.3	4	--
Naled	NA	-	0.3	32	--
Parathion	NA	-	0.3	96	--
Phorate	NA	-	0.3	3.2	--
Phosmet	NA	-	0.3	320	--
Pirimiphos methyl	NA	-	0.3	160	--
Ronnel	NA	-	0.3	800	--
Terbufos	NA	-	0.3	0.4	--
Tetrachlorvinphos	NA	-	0.3	480	3.6

Table 2
Analytical Methods, Analytes and Reporting Limits
Zone A Removal Action - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

Analyte (2019 Cleanup Limit)	Method Detection Limit	Current RL (µg/L)	Proposed RL (µg/L)	MTCA Method B Non Cancer Value (µg/L)	MTCA Method B Cancer Value (µg/L)
TAL Metals by EPA-200.8/EPA-245.1 - ALS Everett					
Aluminum	9.6	-	50	16,000	--
Antimony	0.11	-	1	6	--
Arsenic	**0.15**	-	**0.2***	4.80	0.06
Barium	0.22	-	1	3,200	--
Beryllium	0.1	-	1	32	--
Cadmium	0.12	-	1	8	--
Chromium (CUL 100 ug/l)	0.1	-	2	--	--
Copper	0.27	-	2	640	--
Iron	5.76	-	50	11,000	--
Lead	0.09	-	1	--/MTCA A 15	--
Manganese	0.11	-	2	750	--
Nickel	0.51	-	2	320	--
Selenium	1.14	-	4	80	--
Silver	0.07	-	1	80	--
Thallium	**0.24**	-	**0.2***	0.16	--
Vanadium	0.34	-	2	80	--
Zinc	0.74	-	2.5	4,800	--
Mercury	0.0244	-	0.2	--/MTCA A 2	--
Polychlorinated Biphenyls (PCBs) - EPA Method 8082 - ALS Kelso					
PCB-1016	0.0028	-	0.005	1.1	1.3
PCB-1221	0.0028	-	0.01	--/MTCA A 0.1	0.044
PCB-1232	0.0028	-	0.005	--/MTCA A 0.1	0.044
PCB-1242	0.0028	-	0.005	--/MTCA A 0.1	0.044
PCB-1248	0.0028	-	0.005	--/MTCA A 0.1	0.044
PCB-1254	0.0028	-	0.005	0.32	0.044
PCB-1260	0.0028	-	0.005	--/MTCA A 0.1	0.044

Notes:
- = No current reporting limit or no new RL proposed
-- = No MTCA B value listed for the analyte
* = Indicates that the proposed RL is at the Practical Quantitation Limit (PQL)
** = Indicates the proposed RL is at the Limit of Quantitation (LOQ)
Bold = RL or MDL exceeds MTCA B value
CUL = Site cleanup level specified in November 2019 Enforcement Order No. DE 16899
NA = MDL not available
RL = Reporting limit

TABLE 3
Sampling Requirements
Zone A Removal Action EDR - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

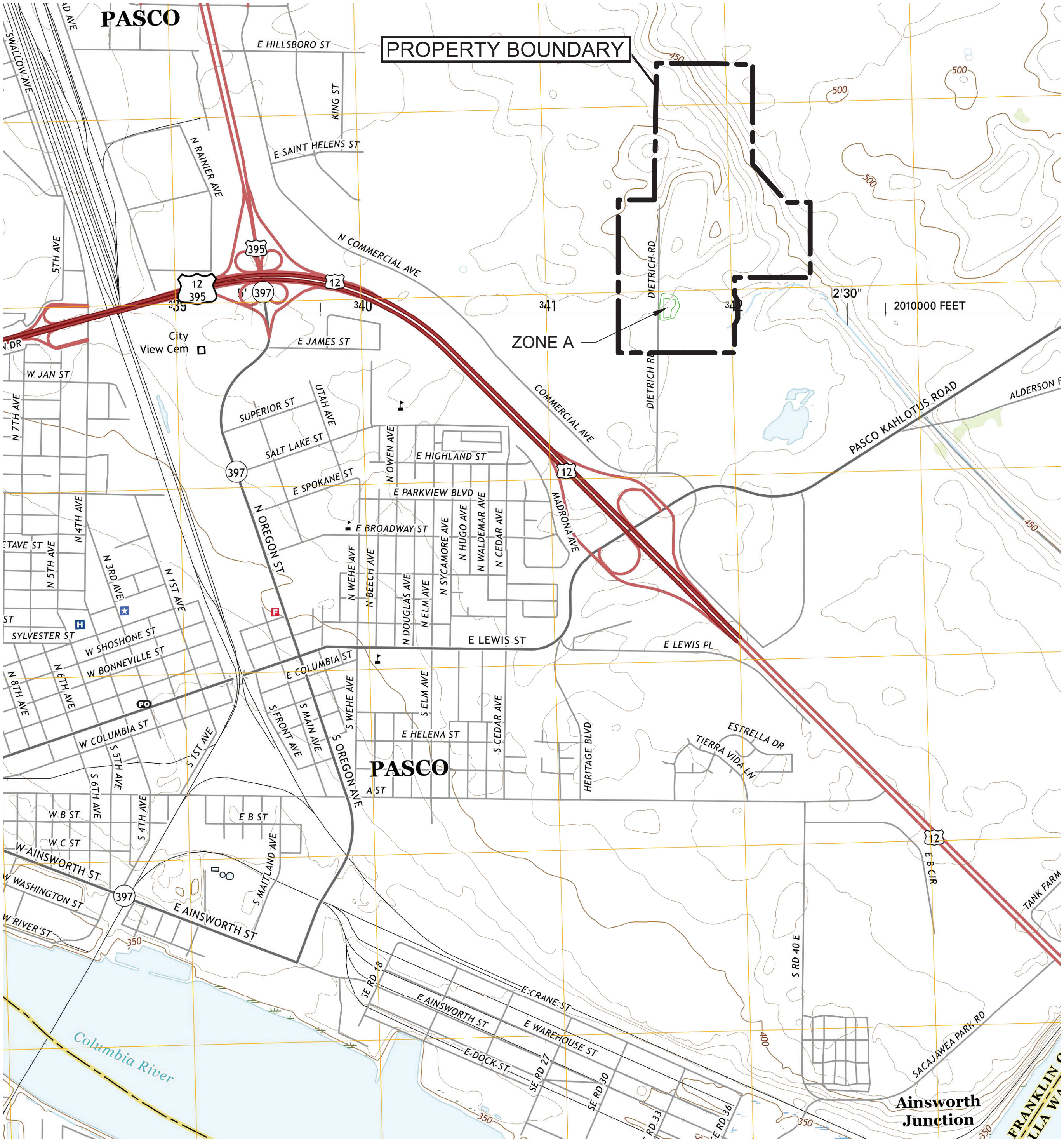
SAMPLE GROUP	ANALYTICAL PARAMETER	ANALYTICAL METHOD	BOTTLE TYPE	PRESERVATION AND HANDLING	HOLDING TIME
VOCs	Volatile Organic Compounds	EPA 8260C and 8260-SIM	Three 40-mL Glass Vials with Teflon-Lined Silicon Septa	No headspace; HCl; Cool 4 °C	14 Days
SVOCs	Semi-Volatile Organic Compounds	EPA 8270D and 8270-SIM	One 1-Liter Amber Glass Bottle	Unpreserved; Cool to 4 °C	7 Days to Extract and 40 Days to Analyze
Herbicides	Chlorophenoxy Herbicides	EPA 8151A MOD	Two 1-Liter Amber Glass Bottles	Unpreserved; Cool to 4 °C	7 Days to Extract and 40 Days to Analyze
Pesticides	Organochloride Pesticides	EPA 8081	One 1-Liter Amber Glass Bottle	Unpreserved; Cool to 4 °C	7 Days to Extract and 40 Days to Analyze
Pesticides	Organophosphorus Pesticides	EPA 8141B	One 1-Liter Amber Glass Bottle	Unpreserved; Cool to 4 °C	7 Days to Extract and 40 Days to Analyze
PCBs	Low-Level Polychlorinated Biphenyls	EPA 8082	One 1-Liter Amber Glass Bottle	Unpreserved; Cool to 4 °C	One Year
Metals	22 TAL Metals or 13 Priority Pollutants	EPA 200.8 or 6010 or 6020	One 500 ml HDPE Bottle	HNO_3; Cool to 4 °C	6 Months
	Mercury	EPA 245.1 or 7470			28 Days
	Total Cr	EPA 6020 or 200.8	One 500 ml HDPE Bottle	HNO_3; Cool to 4 °C	6 Months

Bottles and analytical methods subject to change.

Table 4
Contact Information
Zone A Removal Action EDR - Supplemental Groundwater Monitoring Plan
Pasco Landfill NPL Site, Pasco, WA

Job Description	Name	Company and Mailing Address	Telephone Number	E-Mail Address
Groundwater Program Manager and Site Manager	Mary McElheron	PBS Engineering and Environmental Inc. 400 Bradley Blvd., Suite 106 Richland, WA 99352	509-492-6593	mary.mcelheron@ pbsusa.com
IWAG Project Coordinator	Jessi Massingale	Floyd Snider 601 Union Street, Suite 600 Seattle, Washington 98101	206-683-4307	jessi.massingale@ floydsnider.com
Ecology Project Coordinator	Chuck Gruenenfelder	Washington State Department of Ecology 4601 N. Monroe St., Suite 100 Spokane, WA 99205-1295	509-329-3439	CHGR461@ ecy.wa.gov

FIGURES



SOURCES: USGS PASCO, WA QUADRANGLE 2017,
USGS GLADE, WA QUADRANGLE 2017.

N

Scale 1" = 1/2 MILE

0' 1/4 mi 1/2 mi 1 mi

PREPARED FOR: IWAG GROUP III

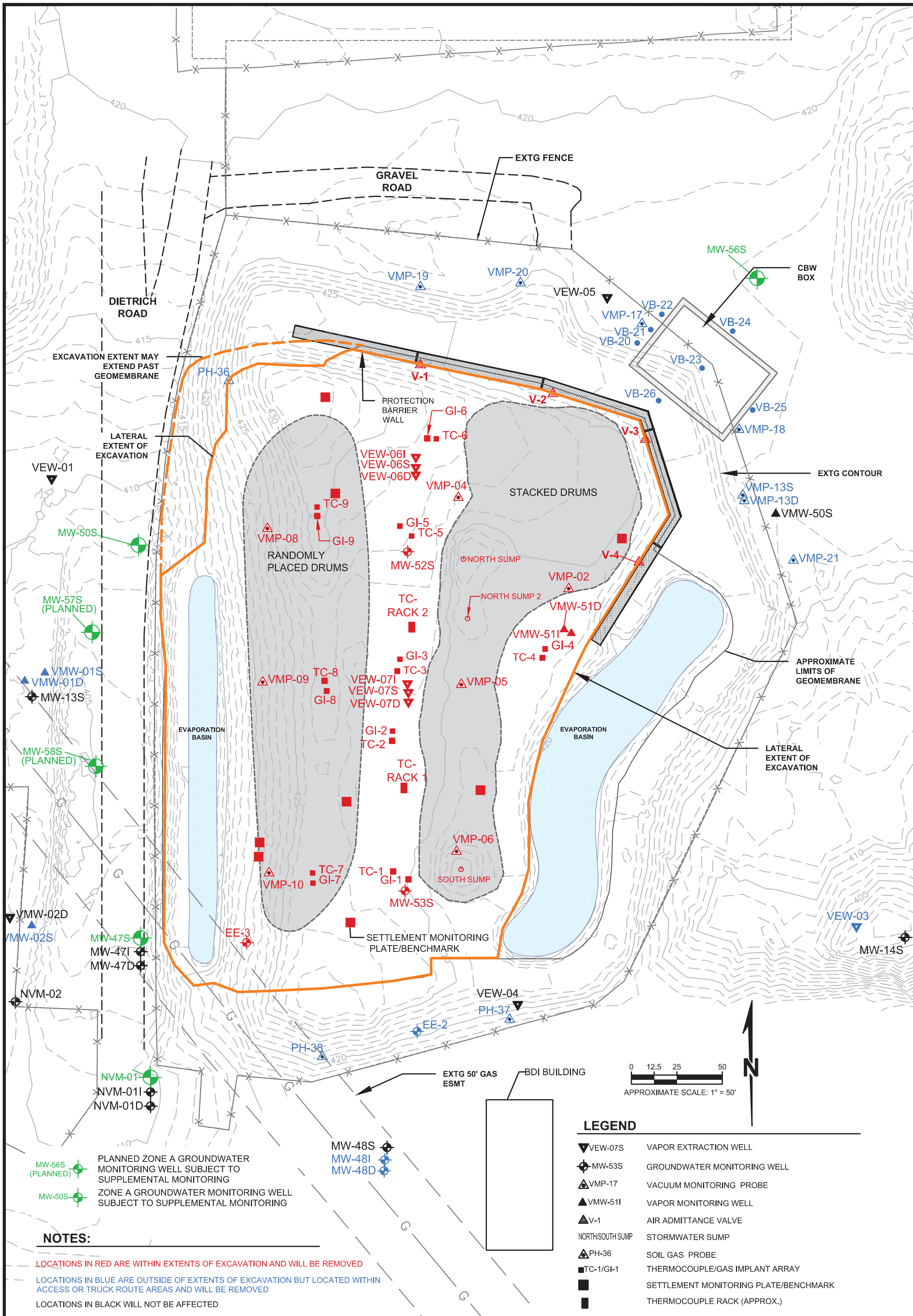
PBS

SITE LOCATION MAP

PASCO LANDFILL NPL SITE
PASCO, WASHINGTON

JUN 2019
64180.019

FIGURE
1



PBS

PBS Engineering and Environmental Inc.
400 Bradley Blvd, Ste 300
Richland, WA 99352
509.942.1600
pbsusa.com

ZONE A GROUNDWATER MONITORING WELLS (AND OTHER ON-PROPERTY WELLS)

PASCO LANDFILL NPL SITE
PASCO, WASHINGTON

PROJECT: 64180.020
DATE: FEB 2020
FIGURE: 2

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.7
Post-Excavation Characterization Sampling and Analysis Plan and Quality Assurance Project Plan

FINAL

Post-Excavation Characterization Sampling and Analysis Plan and Quality Assurance Project Plan

Pasco Landfill NPL Site
Pasco, Washington

Submitted to:
Washington State Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, Washington 99205-1295

On Behalf of:
Industrial Waste Area Generators Group III

August 18, 2020
PBS Project 64180.20

PBS
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509.942.1600 MAIN
PBSUSA.COM

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ATTACHMENTS

1 INTRODUCTION

This plan outlines the sampling and analysis and quality assurance procedures for work related to characterization of materials remaining in the Industrial Waste Area Zone A (Zone A) after completion of excavation and drum removal at Zone A of the at the Pasco Landfill NPL Site (Site) in Pasco, Washington. The post excavation sampling will be performed to support the design of future in-situ thermal treatment. Additional sampling and analysis and quality assurance procedures specific to air monitoring inside the temporary structure, around the perimeter of the work area, and for soil and waste removed from Zone A are available in the Zone A Removal Action Engineering Design Report (EDR). Additional sampling and analysis and quality assurance procedures specific to perimeter air monitoring are provided in the Perimeter Air Monitoring Plan (Appendix B.3). Additional sampling and analyses information pertaining to the characterization of waste removed from Zone A is provided in the Waste Handling, Characterization, and Disposal Plan (Appendix C).

This Post-Excavation Characterization Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) was prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) to fulfill the requirements of an Enforcement Order (EO) dated November 8, 2019, and the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), prepared by Ecology and dated August 2019. The SAP is required as part of *the Scope of Work and Schedule (SOW)* in Exhibit C of the CAP. The SAP and QAPP are part of the Task A.2 Zone A Removal Action Compliance Monitoring Plan (CMP) under Sub-plan F. This plan also addresses requirements listed for Sub-plan C Performance Monitoring Plan.

This Post-Excavation Characterization SAP and QAPP (hereafter SAP/QAPP) follows the requirements of WAC 173-340-410 and 173-340-820. This SAP/QAPP requires that laboratory analysis will be performed by laboratories accredited by Ecology.

2 SITE BACKGROUND

Details on the Site background and project description are presented in the main text of the Zone A Removal Action EDR including a summary of the characterization of materials remaining that will be targeted for post excavation in situ treatment (Section 6.13). Figure 1.1 shows the location of the Site within the State of Washington. Figure 1.2 shows the location of Zone A where sampling activities will occur.

3 POST EXCAVATION CHARACTERIZATION SAMPLING

3.1 Sampling Objective

The objective of the post-excavation characterization sampling program is to characterize materials remaining in Zone A following excavation and backfilling activities in Zone A to support design of future in situ thermal treatment. Subsurface samples of any remaining contaminated media, mixed debris, and underlying soils will be collected via Rotosonic drilling. The soil and/or waste will be screened for non-aqueous phase liquid (NAPL) and volatile organics. Selected soil/waste samples will be collected and submitted for laboratory analyses of both conventional and chemical parameters. An additional objective of the field activities is collection of quality data.

All field sampling activities will be conducted in accordance with the Site-Specific Health and Safety Plan submitted in EDR Appendix B.1.

3.2 Sample Location and Frequency

In order to evaluate the conditions below Zone A following the excavation and backfilling activities, borings and sample collection are proposed to characterize the backfilled material, the remaining contaminated media, mixed debris, and the underlying Touchet Beds, and the Upper Pasco Gravels (material zones) in Zone A above the water table. Proposed boring locations are shown on Figure 6.1 of the EDR.

As presented in Sections 6.12 and 6.13 of the EDR, the post-excavation characterization sampling will include:

- Continuous core drilling of 30 boreholes within Zone A to the depth of the water table based on a maximum 50-foot x 50-foot grid as shown on Figure 6.1 of the EDR.
    - Additional step-out soil borings will be advanced as necessary based on field observations during drilling (e.g., observed NAPL or other field observations of contamination) to fully define the lateral limits of contamination and the thermal treatment area; the need for additional borings will be determined in the field and therefore step out locations are not shown on Figure 6.1 of the EDR
- Field logging and field screening (PID readings with a 10.6 electron volt PID lamp) and presence of contaminated media) of every borehole.
- The following samples will be collected from each borehole:
    - One sample from the remaining mixed debris – selected based on the highest PID measurement and/or the potential presence of contaminated media;
    - Two samples from the Touchet Beds layer; one near the base of the excavation (expected highest concentrations) and one selected at least 5 to 10 feet below the first sample based on the highest PID measurement and/or the potential presence of contaminated media; and
    - One to two samples from the Upper Pasco Gravels; the first selected near the top of the unit and the second selected at least 5 to 10 feet below the first sample, depending on thickness and variability within the layer and based on the highest PID measurement and/or the potential presence of contaminated media.
    - Additional soil samples will be collected from near the capillary fringe/water table, with ten soil borings in the vicinity of MW-52S and in the southwestern portion of Zone A, as shown on Figures 6.1 and 6.2 of the EDR. The information about contaminant distribution gained from these ten initial borings can be used to select up to six additional locations that may be sampled near the capillary fringe/water table if evidence of contamination is observed, such as elevated PID readings or the presence of contaminated media in this zone.
- Sample submission to the laboratory, using chain of custody (COC) procedures, for analysis for volatile organic carbons (VOCs), semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), porosity, and moisture content.
- Laboratory analysis of organochloride pesticides, polychlorinated biphenyls (PCBs), and RCRA 8 metals plus mercury from samples collected from the six locations shown on Figure 6.1 and up to an additional 10 samples if contaminated media is observed.

After all post-excavation characterization data are collected, soil samples will be evaluated by the thermal vendor performing bench-scale testing for selection of the most representative samples for testing, including soil data with the highest concentrations of VOCs, SVOCs (including PAHs), and/or TPH. A second mobilization will occur to collect the sample volumes necessary for bench-scale testing from the locations selected by the thermal vendor, and samples will be collected in 1-gallon containers, packed with minimal headspace, from the Touchet Beds and the Upper Pasco Gravels. Containers will be sealed and placed on ice for shipment by next-day delivery. Once these samples are provided to the vendor, bench testing is expected to take one month. Site-specific design of an in situ thermal treatment or remediation system, including target temperature and required energy density, will be determined as part of the bench-scale treatability testing.

Table 1 provides a sampling and analysis summary for the post-excavation characterization including laboratory analysis, number of investigative samples, and number of quality assurance (QA) and quality control (QC) samples consistent with the QAPP.

3.3 Sample Designation

Each sample container will be labeled with a unique alphanumeric code (a.k.a. sample name) that will facilitate tracking and cross referencing of sample information. Each unique code will include the information and follow the formats outlined below:

- Each code will begin with "PLF-" to indicate Pasco Landfill.
- Each code will include a sample location that identifies the soil boring and depth (e.g., SB1-15 for soil boring number 1 at 15 feet).
    - If the sample is a duplicate, the code of DUP plus a sequential number will be used in place of the soil boring ID (e.g., DUP1 for duplicate sample 1).
    - If the sample is a trip blank, the code TripBlank will be used in place of the soil Boring ID. Since multiple coolers may be shipped in a day, a number will be used after TripBlank (e.g., TripBlank1).
- Each code will end with the date the sample is collected in the format of "-MMDDYY".

As an example, a sample name of PLF-SB1-15-022220 indicates a sample collected from soil boring 1 at a depth of 15 feet on February 22, 2020. An example of a duplicate of this sample would be PLF-DUP1-022220.

A label must be affixed to all sample containers to prevent misidentification, and at minimum, must include:

- Client name and project number
- A unique sample name (alphanumeric code)
- Date and time of collection
- Preservative

The information on each sample label will be recorded in the field logbook along with the analyses to be performed. Each sample will be checked and recorded on the COC form prior to being released to the laboratory.

3.4 Sampling Equipment and Procedures

The following sections describe step-by-step instructions for sampling to enable the field team to gather consistent data that will meet the sampling program objectives.

3.4.1 Standard Operating Procedures

The following field standard operating procedures (SOPs) are provided in Attachment A:

- Drilling and Soil Sampling Procedures
- Soil Boring Log Procedures

3.4.2 Fieldwork Activities

3.4.2.1 Utility Clearance

The utility clearance process is a logistical requirement performed to identify utility presence, utility location, and special hazards that may exist when working in close proximity to public or private utilities. The utility check itself does not prevent all incidents but is one component of many activities that, if all performed correctly, will minimize the potential for utility conflicts. Prior to conducting any intrusive work, it is imperative that utility clearance procedures be completed.

Within Zone A, the post-excavation characterization sampling will be conducted within areas that will have been recently excavated and backfilled. As long as characterization sampling is conducted in the same spatial area as the excavation, no subsurface utilities should be encountered. Nonetheless, the proposed drilling locations will be field verified to confirm that the locations are accessible and free of underground and aboveground utilities.

The final locations of the boreholes may be adjusted for accessibility and as needed to avoid utilities.

3.4.2.2 Survey Borehole Locations

The soil borings will be spatially distributed on a 50-foot by 50-foot grid as shown in Figure 6.1 of the EDR with step-out borings, as previously indicated. Following installation, all borehole locations will be temporarily marked to allow a licensed land surveyor to survey all new boreholes in the NAVD 88 and NAD 83 coordinate systems. Surveyed locations will ensure that the collected field and laboratory data are accurately used for project planning.

3.4.2.3 Field Logbook

Bound field logbooks or Daily Field Report forms will be used to record field notes along with a borehole log for each boring. Information recorded will include:

- Time and date
- Project number
- Name or initials of sampler(s), drillers, and others present on-site
- Borehole name
- Drilling refusal depth, if encountered, and name of new borehole
- Sample matrix (soil, waste, etc.)
- Sample source (borehole number or other source designation)
- Pertinent data (e.g., depth, sampling duration)
- Analyses to be conducted
- Preservative added, if any
- Number of sample containers filled
- Sampling method
- Appearance of each sample (e.g., color, staining, odor)
- Pertinent weather data
- Pertinent instrument readings (e.g., PID reading in ppm)

If a refusal is encountered, the new borehole will be recorded on a separate borelog indicating the starting depth for the new boring. At the end of each workday, the sampler(s) will sign the last page of field notes recorded in the logbook. The field logbook will be scanned and kept as a reference to facilitate accurate review and reporting of the field activities.

3.4.3 Equipment Decontamination Procedures

The drill rig, drill casing and rods, core barrels, and any other equipment that will be in direct contact with soil or waste material will be steam cleaned before startup of field operations and between each boring using a high pressure, high temperature, hot water cleaner or similar. Sampling equipment will be washed before each sample is collected using a brush and laboratory grade non-phosphate detergent, such as Alconox, thoroughly rinsed with potable water, and allowed to air dry.

Appropriate personal protective equipment (PPE) will be worn during drilling equipment decontamination.

Samples will be collected directly from the borehole sample sleeve into sample containers using disposable gloves. Field staff must don a new pair of disposable nitrile gloves or equivalent prior to collecting each sample. Any knives or cutting tools will be decontaminated by washing with Alconox, or similar, before beginning and between each sample.

3.4.4 Sampling

The specific boring locations are presented in Figure 6.1 of the EDR, and the proposed intervals for post excavation characterization sampling are shown on Figure 6.2 of the EDR.

A suitable location, organized to inspect contents of core barrels and to collect samples, will be set up with field logs, PPE, sample containers, labels, COC forms, coolers with ice, a white board for labeling cores, a camera, a PID, and other equipment as needed. Drill cuttings and decontamination fluids will be managed consistent with Section 3.4.6 and current practices at the Site.

Rotosonic drilling will be used to advance boreholes. Rotosonic drilling is accomplished with a truck-mounted or limited-access, track-mounted drill rig. The driller will then advance a core barrel to collect a soil core continuously over the casing depth interval (approximately 10 feet). To minimize the potential for cross-contamination between sample locations, the core barrel will be lined with a core-barrel sleeve. A new sleeve will be used for each interval advanced.

Discrete samples will be collected from the drilling sampler using the following procedures:

1. Don a new pair of disposable nitrile gloves or equivalent for each discrete sample;
2. Prepare and label (see Section 4.4.2.2 of this plan) sample containers for filling;
3. Remove the sleeved core from the core barrel;
4. Slice open the sleeve that encloses the soil core;
5. Inspect the core for evidence of visual discoloration or sheen;
6. Scan the PID across the length of the sampler. Record the value, location, and depth of the peak PID measurement;
7. If warranted, perform a shaker test using an indicator dye or other direct-detection field method to assist with identifying potential organic-based NAPL on selected interval(s) if the presence of NAPL is suspected based on visual observations and PID measurements. Methods that may be used to confirm the presence of NAPL include:

   a. Shake Test: Place suspect soil and water in a clean container and shake to cause separation of NAPL from the soil for visual identification.
   b. Dye Test: Similar to Shake Test. Add a hydrophobic dye (e.g., Sudan IV, Red Azo Dye, blue anthraquinone dye) to the sample. The dye will dissolve into the NAPL for visual identification.
   c. Other Field Test: An alternate direct-detection field method if approved by the IWAG and Ecology.
8. Collect one sample from each core based on the highest PID measurement and/or the presence of NAPL as follows:
   a. At the selected interval, remove the outer layer of material that was in contact with the core sleeve;
   b. Sample directly from the core for samples requiring VOC analysis;
   c. For samples designated for non-VOC analysis, transfer material from the inner core directly into the laboratory supplied sample container(s);
9. Store the sample in a cooler with ice (or equivalent) to keep the sample cold for potential chemical analysis;
10. Inspect the material core and classify soil using the Unified Soil Classification System (USCS) in accordance with the visual manual method described in ASTM Method D2488 (17e1), and record information on a Boring Log, an example of which is contained in Attachment B;
11. Discard the contents of the shaker jar with the material cuttings, and discard the jar and nitrile gloves with used PPE; and
12. Collect additional quality control samples for chemical analysis, as needed, in accordance with the QAPP.

Upon completion of each boring, instruct the drillers to backfill each boring with bentonite grout.

3.4.5 Field Quality Control Sampling
Details regarding field quality control samples are presented in Section 4.6.1.

3.4.6 Management of Investigation-Derived Waste (IDW)
Wastes generated must be properly handled and disposed of in accordance current IDW management at the Site. The Site-specific procedures are to prevent contamination of clean areas and to comply with regulations. The IDW that is expected to be produced during the investigative activities includes drill cuttings, decontamination water, disposable sampling tools, and used PPE.

3.5 Sample Handling and Analyses
Sample containers will be individually wrapped and placed on ice or cooler packs in laboratory-supplied coolers immediately after filling and labeling. Sample labeling procedures are presented in Section 4.4.2.2. Field personnel performing sample collection activities must communicate any changes or deviations from procedures to the Site Project Manager and/or to the laboratory so corrective measures can be applied. Potential sampling problems include:

- Partial boring or drilling refusal;
- Sample collected contains less than required volume;
- Issues with sample shipping;

- Issues with sample containers or preservatives;
- Equipment malfunction;
- Severe weather; and
- Incorrect or incomplete paperwork.

All samples selected for analyses will be delivered to the laboratory by courier or shipping provider under approved COC procedures. The QAPP identifies sample handling, custody, and disposal procedures. In general, samples will be properly packaged on ice at 4 °C, if needed, for shipment and dispatched to the laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be sealed and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached across the opening of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.

A copy of COC forms and shipping receipts will be retained in the project record.

Additional details on analytical methods, sample containers, sample preservation methods, and holding times are presented in the QAPP.

3.6 Reporting

Following the completion of the post excavation characterization sampling, a summary of sample locations, analyses performed, and reported data will be prepared for use in design and planning for the post-excavation in situ thermal treatment.

3.7 References

ASTM D2488. *Standard Practice for Description and Identification of Soils (Visual Manual Procedure)*, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428 2959.

4 QUALITY ASSURANCE PROJECT PLAN

The purpose of this QAPP is to identify QA/QC components and procedures to be applied during the post-excavation characterization sampling such that data generated in this sampling effort are of a known and acceptable quality and usability.

This QAPP identifies key personnel and their responsibilities, data quality objectives (DQOs), field and laboratory QA/QC procedures, data review and data validation procedures, and document control requirements.

4.1 QA/QC Team Organization

Key project personnel and their responsibilities in respect to QA/QC implementation are identified below.

Project Manager

- Oversees project progress to ensure that QA/QC procedures are followed and project DQOs are met
- Provides managerial guidance to the QA/QC Officer and Field Sampling Supervisor
- Conducts preliminary chemical data interpretation and assessment
- Manages project report preparation and review project reports

- Is responsible for project completion in accordance with the approved design
- Keeps up to date training records of field personnel training and certification

Field Sampling Supervisor

- Provides immediate supervision of all on Site activities
- Provides field management of sample collection and field QA/QC
- Responsible for maintenance of the field equipment
- Provides technical representation for field activities

Project Quality Assurance/Quality Control Officer

- Oversees field and laboratory QA/QC implementation
- Reviews laboratory reports
- Performs analytical data validation
- Reviews laboratory QA/QC reporting
- Identifies and resolves QA/QC issues
- Assists in preparation and review of final project report
- Provides guidance to the Field Sampling Supervisor, as needed
- Maintains officially approved QAPP documents

Laboratory Project Manager

- Coordinates and oversees all laboratory operations related to this sampling and analysis effort
- Acts as contact between the project team and the laboratory
- Notifies, in a timely manner, Project Manager and Project QA/QC Officer of any QA/QC issues occur during project sample receipt and analyses
- Oversees laboratory data reduction and review
- Oversees preparation of analytical reports
- Approves final analytical reports
- Keeps up to date training records of analysts

Laboratory Quality Assurance/Quality Control Officer

- Overviews laboratory QA/QC
- Overviews QA/QC documentation
- Conducts detailed data review
- Decides laboratory corrective actions, if required
- Provides technical representation for laboratory QA/QC procedures

Laboratory Sample Custodian

- Receives and inspects the sample containers immediately upon sample arrival at the laboratory
- Documents the condition of samples upon sample receipt
- Verifies and signs COC and coordinates with project staff as needed
- Assigns a unique laboratory identification number correlated to the field sample identification number and enters each into the sample receiving log
- Initiates transfer of samples to the appropriate lab sections with assistance from the Laboratory Project Manager
- Controls and monitors access to and storage of samples and extracts

The analytical laboratory selected to perform the analyses will be accredited under Ecology Environmental Laboratory Accreditation Program.

4.2 Data Quality Objectives

4.2.1 Quality Assurance Objectives for Measurement Data

The overall QA objective is to develop and implement procedures for sample collection and analyses, which will provide data with an acceptable level of accuracy and precision.

The following subsections define the quality assurance goals required to meet the DQOs of the project.

4.2.2 Laboratory Quality Assurance

QA measures for this project will begin with sample containers. Soil and liquid sample containers will be purchased from a certified manufacturer and will be pre cleaned.

4.2.2.1 Accuracy, Precision, and Sensitivity of Analyses

The fundamental QA objective with respect to the accuracy, precision, and completeness of analytical data is to meet the QC acceptance criteria of each analytical procedure. Summaries of the targeted quantitation limits are provided in Table 2. It should be noted that these limits are targeted quantitation limits only; limits are highly matrix dependent and may not always be achieved.

The precision of the method (reproducibility between duplicate analyses) will be determined based on the duplicate analysis of matrix spike (MS) samples of soil/waste and duplicate analysis of a vapor sample. Precision will be reported as Relative Percent Differences (RPDs) between duplicate results. The mathematical formula for precision is presented in Section 4.11.1.1.

The accuracy of the method (percent recovery) will be determined by spiking blank canisters or selected soil/waste samples (MSs) with compounds of interest. Accuracy will be reported as the percent recovery of the spiking compounds and will be compared with the criteria given in the appropriate methods, as identified in Section 4.6. The mathematical formula for accuracy is presented in Section 4.10.1.2.

4.2.2.2 Completeness, Representativeness, and Comparability

A completeness requirement of 90 percent will be targeted for the program (see Section 4.10.1.3 for definition and mathematical formula of completeness).

The quantity of samples to be collected has been estimated in an effort to effectively represent the population being studied. Summaries of the sampling and analysis programs are presented in Table 1.

Analytical methods selected for this study are consistent with those used for previous studies (if applicable) to assure comparability of the data. All standards used by the laboratory will be traceable to reliable sources and will be checked with an independent standard.

4.2.3 Field Measurement Quality Assurance

Measurement data will be generated during field activities. These activities include, but are not limited to, the following:

- PID readings
- Screening for NAPL
- Documenting time and weather conditions
- Observation of sample location appearance and other conditions

The general QA objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

4.3 Special Training and Certification

Field personnel shall hold current Hazardous Waste Operations and Emergency Response (HAZWOPER) certification required by 29 CFR 1910.120. Field personnel also undergo training including sampling procedures and the calibration and operation of field instrumentation.

Analytical laboratories performing sample analysis will be accredited by Ecology. Laboratory personnel shall undergo training for the instruments and analyses being performed.

4.4 Field Procedures

The following sections describe documentation required for samples during collection, transport, and storage at the laboratory and equipment calibration procedures. The field procedures (PBS SOPs for drilling and soil sampling) are presented in Attachment A of this plan.

The sample container, shipping, and packaging requirements are identified in Table 3 and in Section 3.5.

4.4.1 Field Instrument Calibration and Operation

Field equipment used during this investigation will be calibrated at the beginning and/or end of each day in accordance with the manufacturer's instructions. Records of calibration measurements from field equipment will be recorded in the field notebook or on a calibration form.

Field equipment will be operated in accordance with the manufacturer's instructions.

4.4.2 Sample Custody and Document Control

The following documentation procedures will be used during sampling and analysis to provide COC control during transfer of samples from collection through storage. Recordkeeping documentation will include use of the following:

1. Field logbooks (bound with numbered pages) to document sampling activities in the field
2. Labels to identify individual samples

3. COC record sheet to document analyses to be performed
4. Sample documentation

4.4.2.1 Field Logbook

In the field, the sampler will record information in a field logbook or Daily Field Report (DFR) and borehole log for each sample collected as outlined in Section 3.4.2.3.

The final page in the field logbook or DFR will be signed by the sampler. Upon completion and closeout of the project, each logbook/DFR/borelog will be stored in the PBS office, or the contents of the logbook will be scanned and made available for electronic access.

4.4.2.2 Sample Labeling

A label must be affixed to all sample containers to prevent misidentification, and at minimum, must include:

- Client name and project number
- A unique sample name (alphanumeric code)
- Date and time of collection
- Preservative

A unique alphanumeric code or sample name will be used to identify each collected sample, duplicate, and trip blank. This system provides a tracking number to allow retrieval and cross referencing of sample information. The sample numbering system is described in Section 3.3 of this SAP/QAPP.

Field duplicates will be submitted blind to the laboratory. The field duplicate location will be specified in the field notebook and on a field sample key submitted to data management.

4.4.2.3 Chain of Custody Records

COC forms will be completed for all samples collected during the program. COC forms will document the transfer of sample containers.

Sample container labels will include sample number, place of collection, and date and time of collection. The COC record, completed at the time of sampling, will contain, but not be limited to, the sample name, date and time of sample collection, analyses to be performed, and the name of the sampler. The COC document will be signed, timed, and dated by the sampler when transferring the samples. Each sample cooler being shipped to the laboratory will contain a COC form. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. All samples should be delivered to the laboratory by same day or overnight delivery.

The COC form will be distributed as follows: The field staff (Project QA/QC Officer) will maintain a copy while another copy will be enclosed in a waterproof envelope within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will sign and date their copy and return a copy to the Project QA/QC Officer. The laboratory will retain a copy for their records. A copy will be included with the data deliverable package. The shipper's copy will be filed in the field project folder located in the project office or will be scanned and stored electronically.

Upon receipt of the cooler at the laboratory, the Sample Custodian will inspect the shipping cooler and the custody seal. The Sample Custodian will note the condition of the cooler and the custody seal on the COC record sheet.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated, and signed. Any damage or discrepancies will be reported to the Laboratory Project Manager and Project QA/QC Officer before samples are processed.

4.4.2.4 Sample Documentation

Evidentiary files for the entire project shall be maintained by the Project QA/QC Officer and consist of the following:

1. Project-related plans
2. Project logbooks
3. Field data records
4. Sample identification documents
5. COC records
6. Report notes, calculations, etc.
7. Lab data, etc.
8. References, copies of pertinent literature
9. Photos, maps, drawings, etc.
10. A copy of all final reports pertaining to the project

4.5 Laboratory Procedures

4.5.1 Laboratory Sample Documentation

Each sample shipped to the laboratory for analysis will be given a unique identification number. The Sample Custodian will record the client name, number of samples, sample names, analyses requested, date of receipt of samples, and other information in the laboratory information management system.

The laboratory will be responsible for maintaining analytical logbooks and laboratory data as well as a sample (on hand) inventory for submittal to the Project QA/QC Officer on an as-required basis. Raw laboratory data produced from the analysis of samples submitted for this program will be inventoried and maintained by the laboratory for a period of 5 years, at which time the Project QA/QC Officer will advise the laboratory regarding the need for additional storage.

4.5.2 Laboratory Sample Storage

After the Sample Custodian has completed the COC forms and the incoming sample log, the COC will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access-controlled custody room.

4.5.3 Analytical Methods

Investigative samples will be analyzed for the parameters listed in Tables 1 and 2 using the methods cited in Table 1. These methods have been selected to meet the DQOs for each sampling activity.

Data deliverables for this program will include results for the investigative samples and corresponding QC parameters as specified in Section 4.6.2.

4.5.4 Calibration Procedures and Frequency

4.5.4.1 Instrument Calibration

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards are determined by the manufacturer guidelines, the analytical method, or other requirements.

A maintenance log will be kept for each instrument requiring calibration in which will be recorded activities associated with QA monitoring and repairs program. These records will be checked during periodic equipment review and internal and external QA/QC audits.

4.5.4.2 Gas Chromatography/Mass Spectrometry (GC/MS)

It is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria prior to initiating any ongoing data collection. This is accomplished through the analyses of tuning compounds as specified in the analytical methods.

Calibration of the GC/MS system will consist of an initial calibration curve utilizing at least five points. The initial calibration curve for each compound of interest will be verified at the beginning of the day or with each 12 hours of instrument operating time.

All method-specified calibration criteria must be met prior to sample analyses.

Quantification of samples that are analyzed by GC/MS will be performed by internal standard calibration. For quantitation, the nearest internal standard free of interferences must be used.

4.5.4.3 Gas Chromatography (GC)

Quantification for samples that are analyzed by GC with element selective detectors will be performed by external standard calibration. Standards containing the compounds of interest will be analyzed at a minimum of five concentrations to establish the linear range of the detector. Single-point calibration will be performed at the beginning of each day and at every 10th injection. The response factors from the single point calibration will be checked against the average response factors from multi-level calibration. If deviations in response factors are greater than those allowed by the analytical method protocols, then system recalibration will be performed. Alternatively, fresh calibration standards will be prepared and analyzed to verify instrument calibration.

4.5.5 Compound Identification

Compounds, which will be analyzed by GC/MS, will be identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard references should be obtained on the user's GC/MS within the same 12 hours as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. The following criteria must be satisfied to verify identification:

1. The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
2. Correspondence of the sample component and the standard component mass spectrum.

4.5.6 Quantitation

The procedures for quantitation of analytes are discussed in the appropriate analytical methods. Sample results are calculated using either an external standard or an internal standard technique. External standard techniques directly compare the response from the sample to the response of the target analyte in the calibration standards. Internal standard technique utilizes the addition of a compound that resembles the target compound but is not commonly found in nature. This compound is added to all standards, samples, and QC samples. Quantitation is based on the ratio of the target compound in the sample to the response of the internal standard in the sample compared to a similar ratio derived for each calibration standard.

4.5.7 Quantitation Limit Requirements

Targeted reporting limits (RLs) will be consistent with those presented in Table 2. When matrix interferences are noted during sample analysis, actions will be taken by the laboratory to achieve the specified RLs. In cases where a sample or sample extract dilution is required, the dilution factor should be properly justified to attain to the project RLs if possible. Dry weight corrections will increase RLs.

Samples may be diluted to a greater extent if the concentrations of analytes of concern exceed the calibration range of the instrument. In such cases, the Laboratory QA/QC Officer will assure that the laboratory demonstrates good analytical practices and such practices are documented in order to achieve the specified RLs.

4.6 Quality Control

This section describes the different types of field and laboratory QCs required for the project.

4.6.1 Quality Control for Field Sampling

To assess the quality of data resulting from the field sampling program, field duplicate samples will be collected and submitted to the analytical laboratory as blind samples.

4.6.1.1 Field Duplicate Samples

Field duplicate samples will be collected and used to assess the aggregate precision of sampling techniques and laboratory analysis. For every 20 investigative samples, a field duplicate sample will be collected and submitted blind to the laboratory. Field duplicates will be assessed using an RPD of 100 percent.

4.6.1.2 Quality Control Documentation

All QC results will be reported as part of the data package. All results will be tabulated and reported using Contract Laboratory Program (CLP)-like forms where applicable. Section 4.7.2 describes the requirements of the data package.

4.6.1.3 Inspection and Acceptance of Equipment and Consumables

Critical supplies and consumables for this project include field equipment, such as meters and pumps, decontamination reagents, sample bottles, and laboratory standards. The laboratory follows strict SOPs that define log in, preparation, and tracking of standards. Field equipment that is supplied by preapproved vendors is maintained and calibrated by the vendor. All field equipment and reagents used in the field are ordered through the equipment manager. The equipment manager is responsible for maintaining and calibrating all field instruments. All maintenance and calibrations are documented. All field reagents are maintained by the equipment manager. All field instrumentation is calibrated again in the field prior to use. This calibration is documented in the logbook, which is kept in the project file.

4.6.2 Quality Control for Laboratory Analyses

Specific procedures related to internal laboratory QC samples are described in the following subsections. The types and frequency of QC samples is presented in Table 1.

4.6.2.1 Method Blanks

A method blank will be analyzed by the laboratory at a frequency of one blank per each group of up to 20 samples analyzed or prepared at the same time. The method blank will be carried through the entire analytical procedure. No compound of interest should be detected above the quantitation limit. If a positive result is calculated, the laboratory will contact the Project QA/QC Officer for further instructions.

4.6.2.2 Laboratory Control Sample/Duplicate Analyses

A laboratory control sample will be analyzed for all compounds of interest. A laboratory duplicate will be analyzed at a minimum frequency of one per analytical batch. Where method specified limits were not available, general control limits will be used. Percent recoveries will be used to evaluate analytical accuracy while the RPD between duplicate analyses will be used to assess analytical precision.

4.6.2.3 Matrix Spike/Matrix Spike Duplicate Analyses

An MS/MS duplicate (MSD) sample will be analyzed for all parameters, where applicable. MS/MSD or laboratory duplicate will be analyzed at a minimum frequency of one per analytical batch. Acceptable criteria and analytes that will be used for MSs are identified in each method. Where method specified limits are not available, general control limits will be used. Percent spike recoveries will be used to evaluate analytical accuracy, while the RPD between duplicate analyses will be used to assess analytical precision.

4.6.2.4 Surrogate Analyses

Surrogates are organic compounds that are similar to the analytes of interest, but that are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard, and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

The compounds that will be used as surrogates and the levels of recommended spiking are specified in each method. Surrogate spike recoveries must fall within the control limits specified in the method. If any recoveries are excessively low (<10 percent), or if all recoveries in a sample are low, the laboratory will reanalyze the sample.

4.7 Data Management Procedures

4.7.1 General

The contract laboratory will perform internal data verification and data review under the direction of the Laboratory QA/QC Officer. The Laboratory QA/QC Officer will be responsible for assessing data quality and advising of any data which were rated 'preliminary' or 'unacceptable' or other qualifications based on the QC criteria outlined in the relevant methods, which would caution the data user of possible unreliability. Data reduction, verification, and reporting by the laboratory will be conducted as detailed in the following:

1. Raw data produced and checked by the responsible analysts is turned over for independent review by another analyst.
2. The area supervisor reviews the data for attainment of QC criteria presented in the referenced analytical methods.
3. Upon completion of all reviews and acceptance of the raw data by the Laboratory Project Manager, a computerized report will be generated and sent to the Laboratory QA/QC Officer.

4. The Laboratory QA/QC Officer will complete a thorough inspection of all reports.
5. The Laboratory QA/QC Officer and area supervisor will decide whether any sample reanalysis is required.
6. Upon acceptance of the preliminary reports by the Laboratory QA/QC Officer, final reports will be generated and signed by the Laboratory Project Manager.

4.7.2 Laboratory Reporting, Data, Presentation, and Final Report

Reporting and deliverables shall include, but not be limited to, all items listed in Table 4.
Sample data and corresponding QA/QC data, as specified in the analytical methods, shall be maintained accessible either in hard copy and/or computer data files.

The laboratory will submit an electronic submission of the data within 10 business days of receipt of the final sample included in the sample delivery group (SDG) unless another reporting schedule is requested. Contracted laboratories will be required to deliver all analytical results in an electronic data format that is compatible with the project database.

4.7.3 Document Control System

Original electronic data reports will be saved in the Pasco Landfill project files. If necessary, a copy will be made for working purposes. The data, along with appropriate identifiers and qualifiers necessary to complete the master data record, will be checked to ensure that data quality is maintained. The following steps will be taken to ensure the quality of analytical data that are entered into the master database files:

The IWAG stores data in an environmental database. Electronic Data Deliverables (EDDs) and other electronic sources will be used to compile field measurements and laboratory analytical data for all media.

The data management process carries out the following steps.

- Laboratory or field data in each EDD is internally validated and checked for completeness and accuracy by the laboratory or PBS respectively then submitted for loading.
- Laboratory or field data are checked for invalid database values and corrected in coordination with the laboratory or PBS as necessary. Any discrepancies between the EDD files and the sampling plan or original data will be noted, investigated, and corrected in coordination with the laboratory or PBS as necessary.
- Data files will be imported into the project database. If necessary, data files may be rolled back out of the database for additional corrections and subsequently re-imported.
- Laboratory analytical data are validated and revisions and/or data qualifiers resulting from the data validation process are incorporated.
- Data quality checks will be performed. Once the master data file containing quality-assured data is created, the data are available for query, tabulation, analyses, and report generation. All data tabulations and statistical analysis results are traceable to the secured master data file. The master file in turn is fully traceable to the original source of data.

EDDs are maintained on a secured drive of the PBS network and are accessible only to approved personnel. The database is accessible only to approved database personnel.

4.7.4 Quality Control Check Points and Data Flow

The following specific QC checkpoints will be common to all analyses. They are presented with the decision points.

Chemist Bench-Level Checks

- Systems check: sensitivity, linearity, and reproducibility within specified limits
- Duplicate analyses within control limits
- Blank spike results within control limits
- Calculations and data reduction checks: calculations cross checked, any discrepancies between forms and results evident, results tabulated sequentially on the correct forms

Laboratory Project Manager

- Systems operating within limits
- Data transcription correct
- Data complete
- Data acceptable

Sample Control

- Samples returned to sample control following analysis

Laboratory Quality Assurance/Quality Control Officer

- QA objectives met
- QC checks are completed
- Final data and report package is complete

4.8 Audits

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The Laboratory QA/QC Officer may carry out performance and/or systems audits to ensure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of field and laboratory QC measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational during the program or after completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC plan described herein, with activities scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the Laboratory QA/QC Officer without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external QA audits will only be performed if deemed necessary.

4.9 Data Review, Verification, and Validation

Validation of the analytical data will be performed by the Project QA/QC Officer. The data validation will be performed in accordance with the methods and guidance from the document, USEPA *National Functional Guidelines for Organic Superfund Methods Data Review*, EPA 540 R 2016 002, January 2017 (or subsequent versions).

Data associated with the investigation will receive a Stage 2A validation that includes assessment of analytical and in house data, checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The results of these data validations will be reported to the Project Manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

4.10 Data Quality Assessment

Final reports will contain a discussion on QA/QC summarizing the quality of the data collected and/or used as appropriate for each phase of the project. The Project Manager who has responsibility for these summaries will rely on written reports/memoranda documenting the data assessment activities, performance and systems audits, and footnotes identifying qualifications to the data, if any.

Each summary of sampling activities will include a tabulation of the data including:

1. Field duplicate sample results
2. Maps showing sample locations
3. An explanation of any sampling conditions or QA problems and their effect on data quality

The Project QA/QC Officer will prepare QA reports following receipt of all analytical data. These reports will include discussions of the following and their effects on the quality of the data reported:

1. Sample holding times
2. Laboratory/method blank data
3. Laboratory control sample recoveries
4. Surrogate recoveries
5. Field QA/QC data
6. Audit results (if performed)

In addition, the QA reports will summarize all QA problems, and give a general assessment of QA results versus control criteria for such parameters as accuracy, precision, etc. The QA reports will be forwarded to the Project Manager.

4.10.1 Specific Routine Procedures Uses to Assess Data Precision, Accuracy, and Completeness

4.10.1.1 Precision

Precision will be assessed by comparing the analytical results between duplicate analyses. Precision as RPD will be calculated as follows for values significantly greater than the associated detection limit:

$$\text{Precision} = \frac{(D_2 - D_1)}{(D1 + D_2) / 2} \quad X\ 100$$

- D1 = sample result
- D2 = duplicate sample result

For results near the associated detection limits, precision will be assessed based on the following criteria:

Precision = Original result – duplicate result less than contract-required detection limit (<CRDL)

4.10.1.2 Accuracy

Accuracy will be assessed by comparing a set of analytical results to the accepted or 'true' values that would be expected. In general, laboratory control sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A - B}{C} \quad X\ 100$$

- A = The analyte determined experimentally from the spike sample
- B = The background level determined by a separate analysis of the unspiked sample
- C = The amount of spike added

4.10.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{Usable data obtained}}{\text{Total data planned}} \quad X\ 100\%$$

4.10.1.4 QC Exceedances

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data assessed and documented.

4.11 Preventative Maintenance

This section applies to both field and laboratory equipment. Specific preventive maintenance procedures for field equipment will be consistent with the manufacturer's guidelines. Specific preventive maintenance protocols for laboratory equipment will be consistent with the contract laboratory's SOPs.

All analytical instruments to be used in this project will be serviced by field or laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Routine maintenance of the instruments will be performed as per manufacturers' recommendations. The Laboratory Project Manager is responsible for the preventive maintenance of the instruments.

4.12 Corrective Action

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system will be:

1. Checking the predetermined limits for data acceptability beyond which corrective action is required
2. Identifying and defining problems
3. Assigning responsibility for investigating the problem
4. Investigating and determining the cause of the problem
5. Determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses)
6. Assigning and accepting responsibility for implementing the corrective action
7. Implementing the corrective action and evaluating the effectiveness
8. Verifying that the corrective action has eliminated the problem
9. Documenting the corrective action taken
10. Follow up audits will be performed to verify that deficiencies have been corrected

For each measurement system, the Laboratory QA/QC Officer will be responsible for initiating the corrective action, and the Laboratory Project Manager will be responsible for implementing the corrective action.

TABLES

Table 1
Summary of Post Excavation Characterization Sampling Program
Sampling and Analysis Plan - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco, Washington

Sampling Type	Analytical Parameter	Analytical Method	Estimated Number of Samples	Field Duplicates	Trip Blanks	MS/MSD/Dup Analyses
Soil Core Field Screening	PID Reading [1]	Field Parameter	As needed at 5-foot intervals	n/a	n/a	n/a
	Inspect core for evidence of visual discoloration or sheen	Field Screening		n/a	n/a	n/a
	Shake Test, Dye Test, or other approved direct-detection field method for field identification of NAPL	Field Screening	If PID and visual inspection indicate potential NAPL	n/a	n/a	n/a
Soil/Mixed Debris Sampling	Volatile Organic Compounds (VOCs)	SW-846 8260	120 to 150 (a)	1 for every 20 samples	1 of 20	1 MS/MSD/Dup for every 20 samples.
	Semi-Volatile Organic Compounds (SVOCs) including Polycyclic Aromatic Hydrocarbons (PAHs)	SW-846 8270	120 to 150 (a)		n/a	
	Total Petroleum Hydrocarbons - Gasoline Range Organics	NWTPH-Gx	120 to 150 (a)		n/a	
	Total Petroleum Hydrocarbons - Diesel Range Organics	NWTPH-Dx	120 to 150 (a)		n/a	
	Moisture	ASTM D2216	120 to 150 (a)	1 for every 20 samples	n/a	1 Dup every 20 samples. No MS/MSD.
	Porosity	ASTM D7263	120 to 150 (a)		n/a	
Capillary Fringe/Water Table Soil Sampling	Organochloride Pesticides	SW-846 8081	10 to 16	1	n/a	1/1/1
	Polychlorinated Biphenyls (PCBs)	SW-846 8082	10 to 16	1	n/a	1/1/1
	RCRA 8 Metals including Mercury	EPA 200.8/245.1	10 to 16	1	n/a	1/1/1

Notes:
Soil/Mixed Debris Sampling - Includes 4 to 5 samples from 30 boreholes. Totals do not count samples from step-out borings. See Section 3.2 of plan.
Capillary Fringe/Water Table Soil Sampling - At 10 selected borings (Fig. 6.1). Totals do not count samples from additional locations. See Section 3.2 of plan.

(a) = Estimated number of samples based on 30 locations and 4 to 5 samples per boring
(1) = Calibrated to isobutylene. 10.6 eV lamp
Dup = Laboratory duplicate
MS = Matrix spike
MSD = Matrix spike duplicate
n/a = Not applicable
PID = Photoionization detector
TBD = To be determined
NWTPH-Dx = Northwest Total Petroleum Hydrocarbon Method - diesel range organics
NWTPH-Gx = Northwest Total Petroleum Hydrocarbon Method - gasoline range organics

Table 2
Target Reporting Limits for Soil Sampling
Post Excavation Characterization SAP/QAPP - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco Washington

Volatile Organic Compounds (VOCs)	**Proposed Reporting Limit (mg/kg)**	**MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)**
1,1,1-Trichloroethane	0.01	0.084
1,1,2,2-Tetrachloroethane	0.0001[D]	0.00008
1,1,2-Trichloroethane	0.001[D]	0.0011
1,1-Dichloroethane	0.001[D]	0.0026
1,1-Dichloroethene	0.001[D]	0.0025
1,2,4-Trichlorobenzene	0.01	0.029
1,2-Dibromo-3-chloropropane	0.05	--
1,2-Dibromoethane (EDB)	0.0001[D]	**0.000018**
1,2-Dichloroethane	0.001[D]	0.0016
1,2-Dichloropropane	0.001[D]	0.0017
2-Butanone (MEK)	0.05	--
2-Hexanone	0.05	--
4-Methyl-2-pentanone (MIBK)	0.05	--
Acetone	0.05	2.1
Benzene	0.001[D]	0.0017
Bromodichloromethane	0.001[D]	0.0024
Bromoform	0.01	0.023
Bromomethane	0.001[D]	0.0033
Carbon disulfide	0.01	0.27
Carbon tetrachloride	0.001[D]	0.0022
Chlorobenzene	0.01	0.051
Chloroethane	0.01	--
Chloroform	0.001[D]	0.0048
Chloromethane	0.01	--
cis-1,2-Dichloroethene	0.001[D]	0.0052
cis-1,3-Dichloropropene	0.01	--
Dichlorodifluoromethane (CFC-12)	0.01	--
Ethylbenzene	0.01	0.34
Isopropylbenzene (Cumene)	0.01	--
m-Dichlorobenzene	0.01	--
Methyl tert-Butyl Ether	0.001[D]	0.0072
Methylene chloride	0.001[D]	**0.0015**
o-Dichlorobenzene	0.01	0.4
p-Dichlorobenzene	0.01	0.068
Styrene	0.01	0.12
Tetrachloroethylene	0.001[D]	0.0028
Toluene	0.01	0.27
trans-1,2-Dichloroethylene	0.01	0.032
trans-1,3-Dichloropropene	0.01	--
Trichloroethylene	0.001[D]	0.0015
Trichlorofluoromethane (CFC-11)	0.01	--
m,p-Xylene	0.02	0.83
o-Xylene	0.01	0.84
Vinyl Chloride	0.00008[D]	0.000089

Table 2
Target Reporting Limits for Soil Sampling
Post Excavation Characterization SAP/QAPP - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco Washington

Semi-Volatile Organic Compounds	Proposed Reporting Limit (mg/kg)	MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)
1,2,4-Trichlorobenzene	0.1	**0.029**
1,2-Dichlorobenzene	0.1	0.4
1,3-Dichlorobenzene	0.1	--
1,4-Dichlorobenzene	0.1	**0.068**
1-Methylnaphthalene	0.25	--
2,3,4,6-Tetrachlorophenol	0.1	--
2,4,5-Trichlorophenol	0.1	1.5
2,4,6-Trichlorophenol	0.034[D]	**0.0027**
2,4-Dichlorophenol	0.034[D]	**0.01**
2,4-Dimethylphenol	0.034[D]	0.079
2,4-Dinitrophenol	0.17[D]	**0.0092**
2,4-Dinitrotoluene	0.034[D]	**0.00011**
2,6-Dichlorophenol	0.25	--
2,6-Dinitrotoluene	0.034[D]	**0.000021**
2-Chloronaphthalene	0.1	--
2-Chlorophenol	0.25	**0.027**
2-Methylnaphthalene	0.25	--
2-Methylphenol (o-Cresol)	0.1	0.15
2-Nitroaniline	0.1	--
2-Nitrophenol	0.1	--
3&4-Methylphenol (m&p-Cresol)	0.1	--
3,3-Dichlorobenzidine	0.034[D]	**0.0002**
3-Nitroaniline	1	--
4,6-Dinitro-2-Methylphenol	0.1	--
4-Bromophenyl-Phenylether	0.1	--
4-Chloro-3-Methylphenol (Chlorocresol)	0.5	--
4-Chloroaniline	0.17[D]	**0.000077**
4-Chlorophenyl-Phenylether	0.1	--
4-Nitroaniline	0.25	--
4-Nitrophenol	0.1	--
Acenaphthene	0.1	5
Acenaphthylene	0.1	--
Aniline	0.1	--
Anthracene	0.1	110
Azobenzene	0.1	--
Benz(a)anthracene	0.1	0.19[A]
Benzo(a)pyrene	0.1	0.19[A]
Benzo(b)fluoranthene	0.1	0.19[A]
Benzo[G,H,I]Perylene	0.1	--
Benzo(k)fluoranthene	0.1	0.19[A]
Benzoic Acid	1	18
Benzyl Alcohol	0.1	--
Bis(2-Chloroethoxy)Methane	0.25	--
Bis(2-Chloroethyl)Ether	0.034[D]	**0.000014**
Bis(2-Chloroisopropyl)Ether	0.25	--
Bis(2-Ethylhexyl)Phthalate	0.1	0.67
Butylbenzylphthalate	0.1	0.65
Carbazole	0.25	--

Table 2
Target Reporting Limits for Soil Sampling
Post Excavation Characterization SAP/QAPP - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco Washington

Semi-Volatile Organic Compounds	**Proposed Reporting Limit (mg/kg)**	**MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)**
Chrysene	0.1	0.19[A]
Dibenz(a,h)anthracene	0.1	0.19[A]
Dibenzofuran	0.1	--
Diethylphthalate	0.1	4.7
Dimethylphthalate	0.1	--
Di-N-Butylphthalate	0.1	3
Di-N-Octylphthalate	0.1	13000
Fluoranthene	0.1	32
Fluorene	0.1	5.1
Hexachlorobenzene	0.034[D]	0.044
Hexachlorobutadiene	0.034[D]	**0.03**
Hexachlorocyclopentadiene	0.1	9.6
Hexachloroethane	0.034[D]	**0.0023**
Indeno(1,2,3-cd)pyrene	0.1	0.19[A]
Isophorone	0.034[D]	**0.015**
Naphthalene	0.1	0.24
Nitrobenzene	0.034[D]	**0.0065**
N-Nitrosodimethylamine	0.1	--
N-Nitroso-Di-N-Propylamine	0.034[D]	**0.0000039**
N-Nitrosodiphenylamine	0.034[D]	**0.028**
Pentachlorophenol	0.17[D]	**0.00088**
Phenanthrene	0.1	--
Phenol	0.1	0.76
Pyrene	0.1	33
Pyridine	0.1	--
Organochloride Pesticides	**Proposed Reporting Limit (mg/kg)**	**MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)**
A-BHC	0.01	--
G-BHC	0.01	--
B-BHC	0.01	--
Heptachlor	0.0005	0.0019
D-BHC	0.01	--
Aldrin	0.0005	**0.00013**
Heptachlor Epoxide	0.0005	0.004
Chlordane	0.02	0.1
Endosulfan I	0.01	0.22
4,4'-DDE	0.01	0.02
Dieldrin	0.0005	**0.00014**
Endrin	0.01	0.022
4,4'-DDD	0.01	0.02
Endosulfan II	0.01	--
4,4'-DDT	0.01	0.17
Endrin Aldehyde	0.01	--
Endosulfan Sulfate	0.01	--
Methoxychlor	0.01	3.20
Toxaphene	0.05	0.08

Table 2
Target Reporting Limits for Soil Sampling
Post Excavation Characterization SAP/QAPP - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco Washington

PCBS	Proposed Reporting Limit (mg/kg)	MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)
PCB-1016	0.1	--
PCB-1268	0.1	--
PCB-1221	0.1	--
PCB-1232	0.1	--
PCB-1242	0.1	--
PCB-1248	0.1	--
PCB-1254	0.1	--
PCB-1260	0.1	--
Metals	**Proposed Reporting Limit (mg/kg)**	**MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)**
Arsenic	0.025	0.15
Barium (CLARC value for Ba and compounds)	0.5	83
Cadmium (* Affected by hardness)	0.25	**0.035**^{C}
Chromium	0.5	24000/0.93^{B}
Lead (* Affected by hardness)	0.5	150^{C}
Selenium (CLARC value for Se and compounds)	0.5	**0.26**
Silver (* Affected by hardness)	0.5	0.69
Mercury	0.02	0.10
Total Petroleum Hydrocarbons	**Reporting Limit (mg/kg)**	**MTCA Method B - Soil Protective of Groundwater - Saturated (mg/kg)**
NWTPH-Gx	25	--
NWTPH-Dx	50	--

Geotechnical Parameters
Moisture
Porosity

Notes:
MTCA Method B values in **bold** are below the laboratory's reporting limit.
-- = No value listed in CLARC table
A = Default is 0.19 mg/kg for cPAH mixtures and benzo(a)pyrene. Use TEFs in MTCA Table 708-2.
B = Chromium values are for Cr3 (24,000 mg/kg) and Cr6 (0.93 mg/kg)
C = See notes in CLARC table
D = Value represents the laboratory PQL.

Table 3
Sample Containers, Preservation, and Holding Times
SAP/QAPP - Zone A Removal Action EDR
Pasco Landfill NPL Site
Pasco, Washington

Analyses	Sample Containers	Preservation	Maximum Holding Time
Volatile Organic Compounds	One 5g EnCore Sampler (or equiv) plus 3 vials for field preservation	Cool <6°C one methanol vial	48 hours from collection to preservation 14 days from preservation to analysis
Total Petroleum Hydrocarbons-Gasoline Range Organics	One 5g EnCore Sampler (or equiv) plus 3 vials for field preservation	Cool <6°C one methanol vial	48 hours from collection to preservation 14 days from preservation to analysis
Total Petroleum Hydrocarbons-Diesel Range Organics	One 4oz glass jar	Cool <6°C	14 days from collection to extraction 40 days from extraction to analysis
Semi-volatile Organic Compounds	One 4oz glass jar	Cool <6°C	14 days from collection to extraction 40 days from extraction to analysis
Organochloride Pesticides	One 4oz glass jar	Cool <6°C	14 days from collection to extraction 40 days from extraction to analysis
Poly-chlorinated Biphenyls	One 4oz glass jar	Cool <6°C	NA
RCRA metals including Hg	One 4oz glass jar	Cool <6°C	6 months from collection to analysis 28 days from collection to analysis (Hg)
Moisture	One 4oz glass jar	Cool <6°C	NA
Porosity	Shelby tube	Cool <6°C	NA

Notes:
HCL = Hydrochloric Acid
HDPE = High Density Polyethylene
VOCs '= Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
°C = Degrees Celcius

Table 4

Laboratory Reporting Deliverables

SAP/QAPP - Zone A Removal Action EDR

Pasco Landfill NPL Site

Pasco, Washington

A detailed report narrative should accompany each submission, summarizing the contents and results.

A. Chain of Custody Documentation and Detailed Narrative [(1)]

B. Sample Information
- i) date collected
- ii) date extracted or digested
- iii) date analyzed
- iv) analytical method and reference

C. Final Results
- i) samples
- ii) laboratory duplicates [(2)]
- iii) method blanks
- iv) spikes; spike duplicates [(2)(3)]
- v) surrogate recoveries

D. Miscellaneous
- i) method detection limits and/or instrument detection limits
- ii) percent solids (where applicable)
- iii) metals run logs
- iv) dates of extraction or digestion and analysis for method blanks and blank spikes

Sample data and its corresponding QA/QC data shall be maintained electronically.
All solid sample results must be reported on a dry-weight basis.

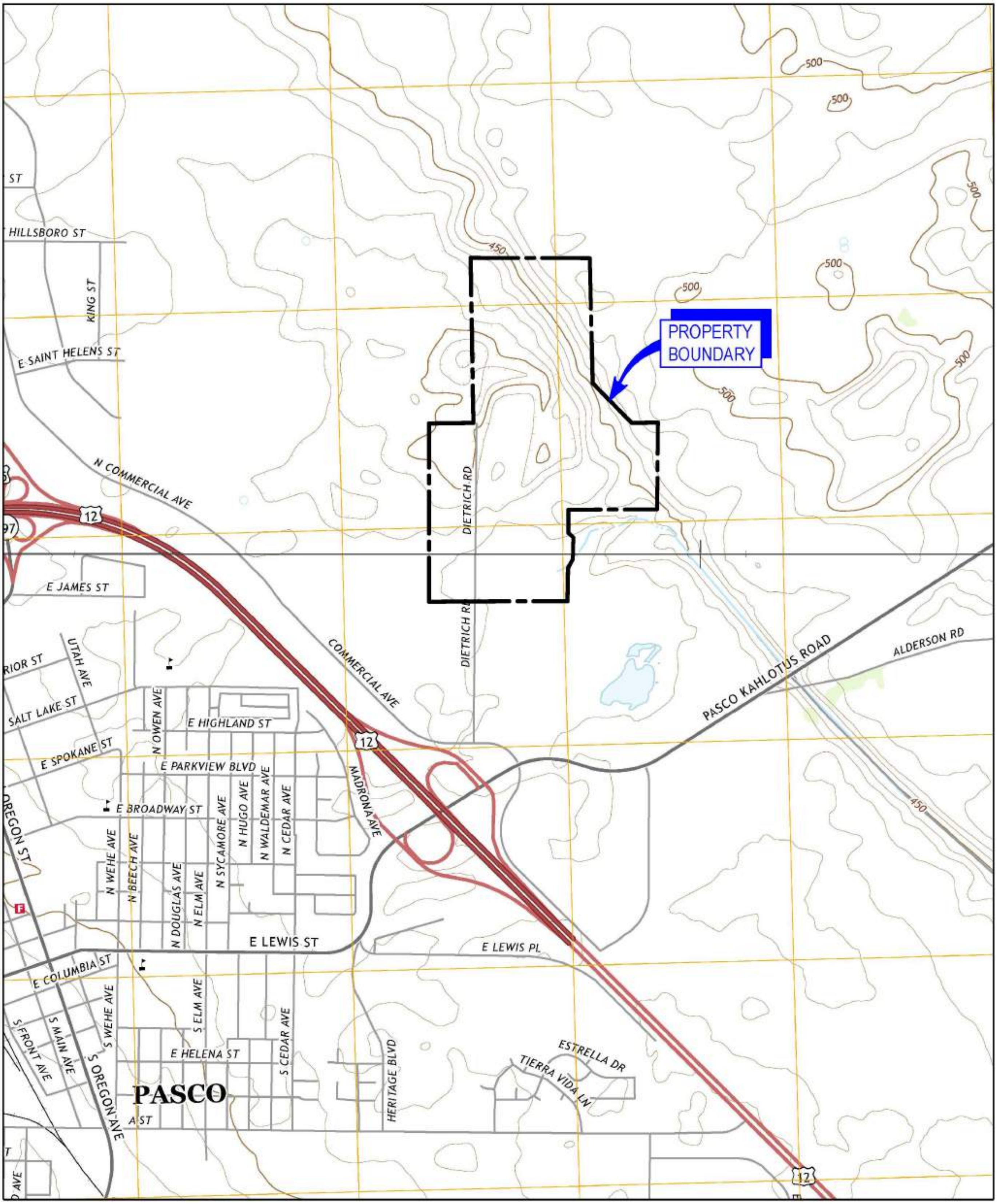
Notes:

(1) Any quality control outliers must be addressed and corrective action taken must be specified.

(2) Laboratory must specify applicable control limits for all quality control sample results.

(3) A blank spike must be prepared and analyzed with each sample batch.

FIGURES

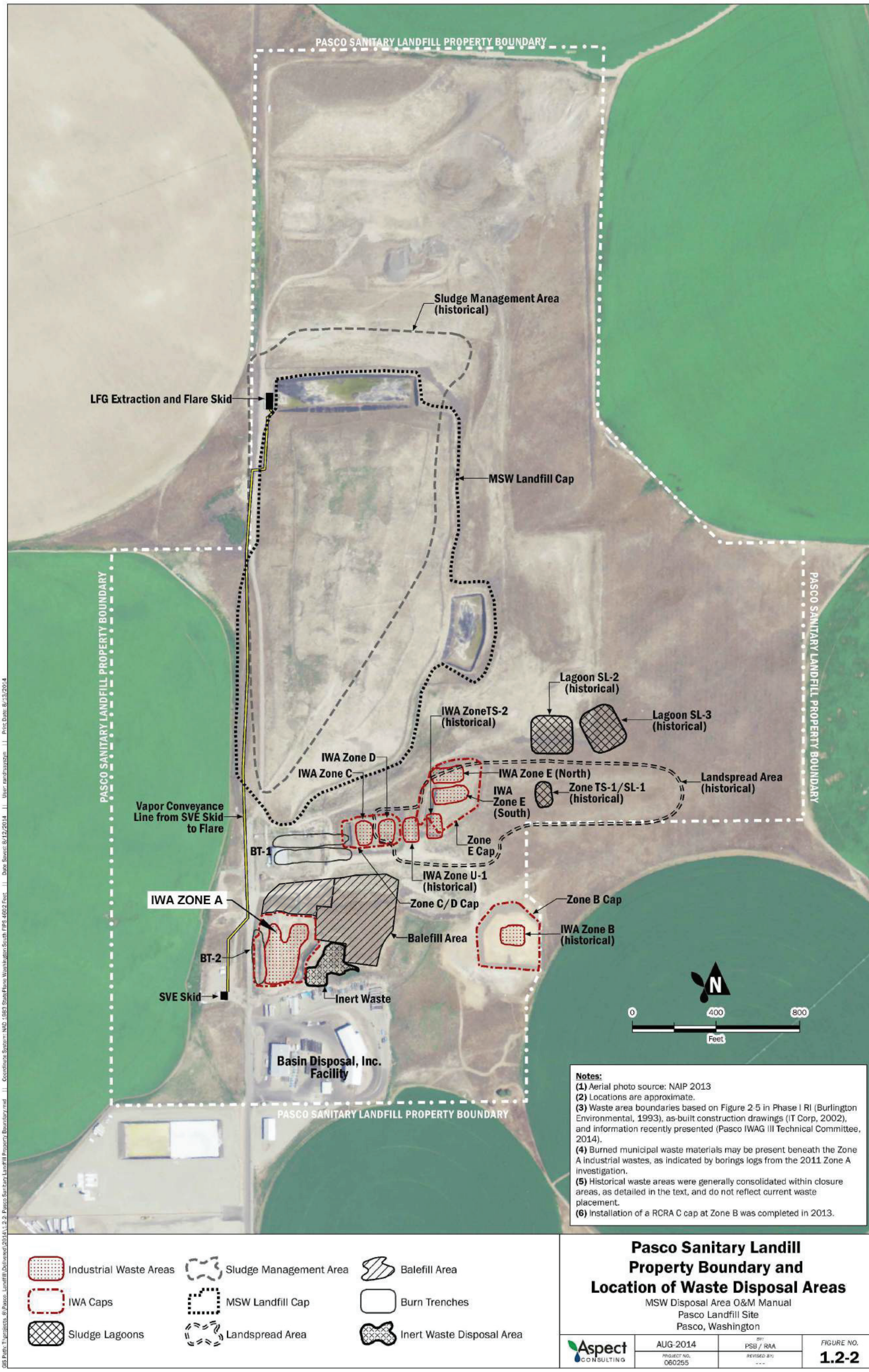


Source: U.S.G.S Topographic Map Quadrangle : Glade 2017 & Pasco 2017

Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure 1.1
Pasco Sanitary Landfill
Property Location

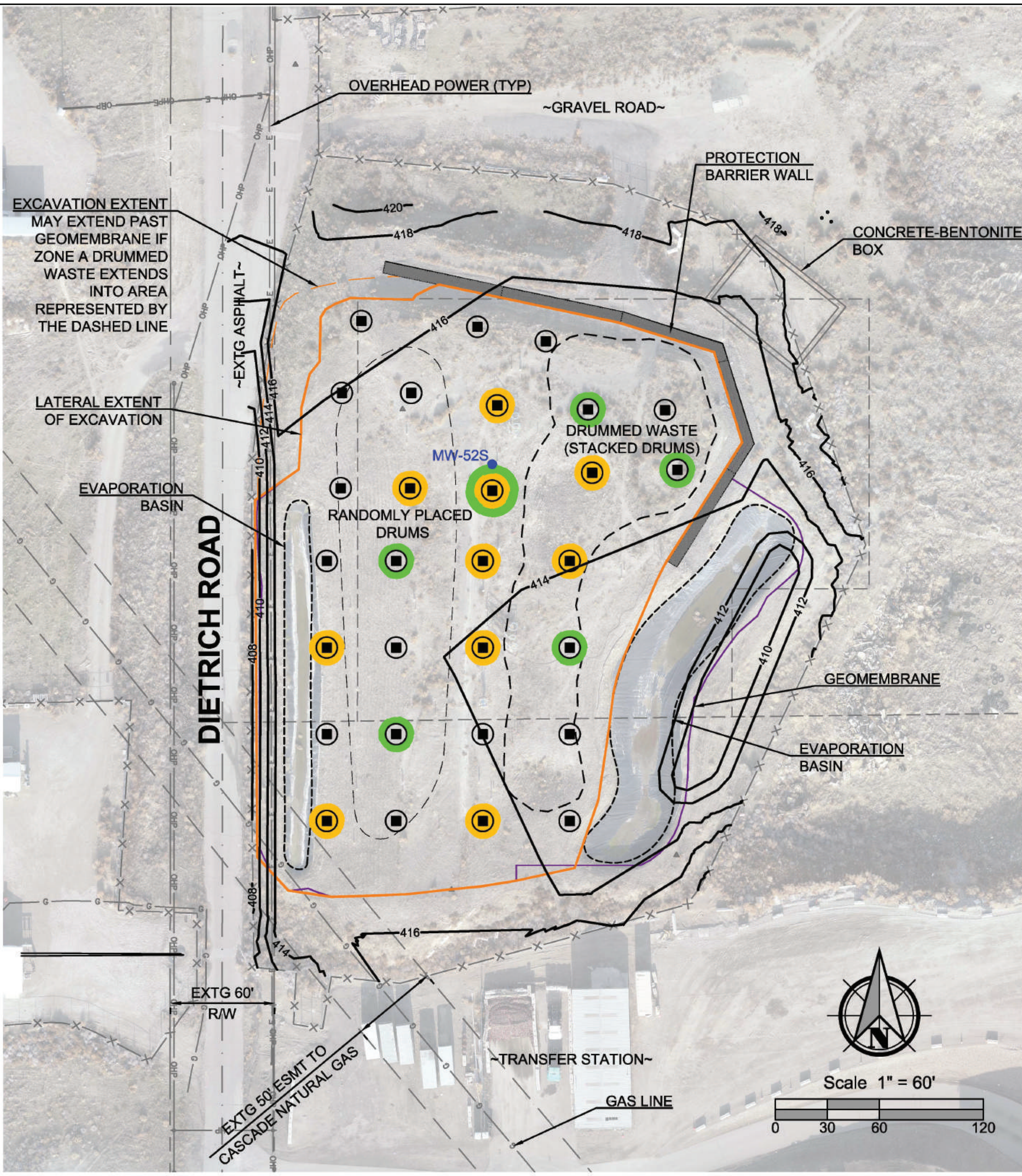
I:\GIS\Projects\IWAG-Pasco\AI\Draft EDR\Figure 1.1 Pasco Sanitary Landfill Property Location.ai
12/02/2019



Source: FIGURE 1.2-2 DRAFT FINAL FOCUSED FEASIBILITY STUDY, ANCHOR QEA, AUGUST 2017.

Zone A Removal Action Engineering Design Report **Pasco Sanitary Landfill NPL Site** **Pasco, Washington**	Figure 1.2 Zone A Location at the Site

I:\GIS\Projects\IWAG-Pasco\AI\Draft EDR\Figure 1.2 Zone A Location at the Site.ai
12/02/2019 MSW shape added by PBS 5/29/2020



NOTES:

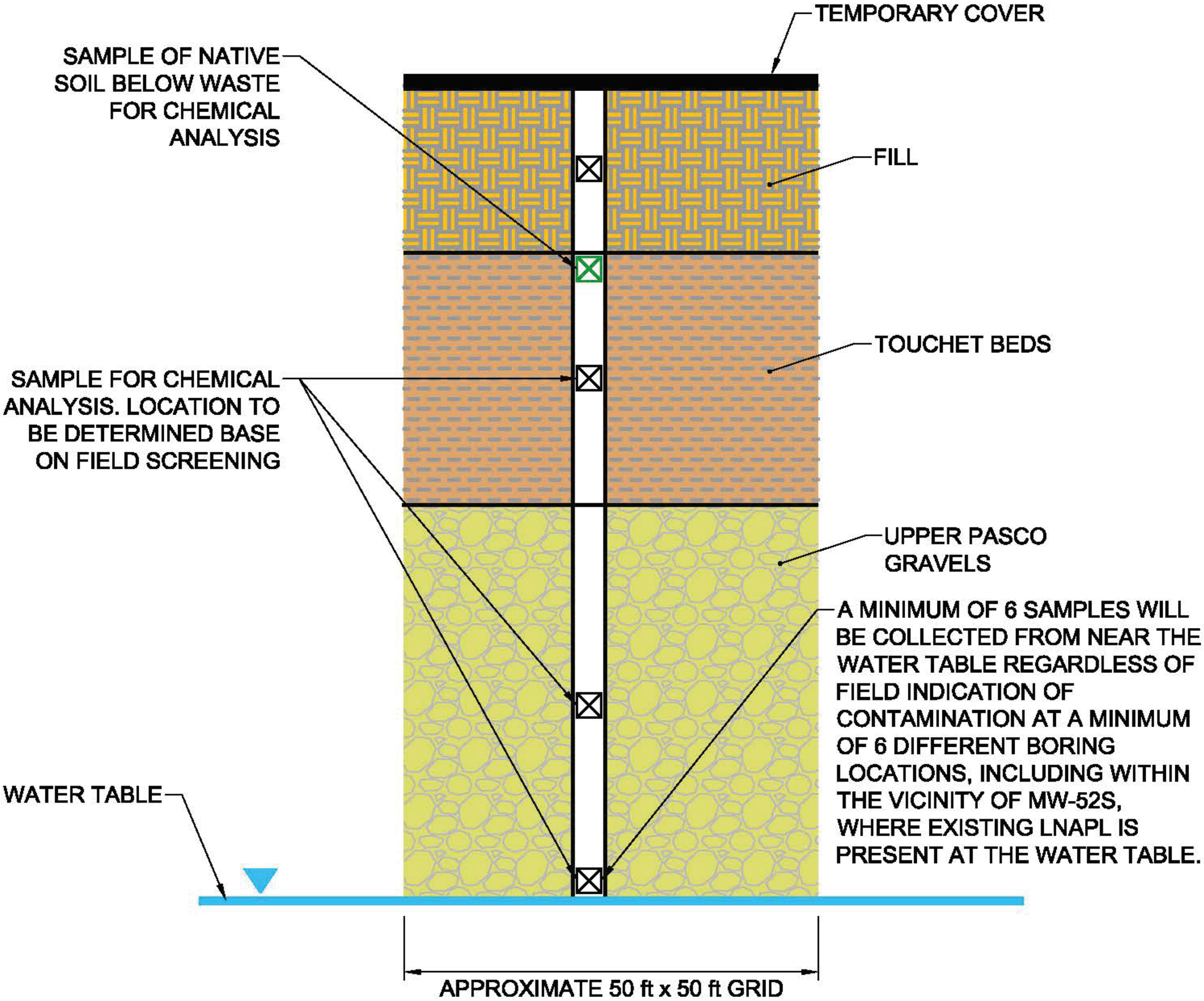
1. LOCATIONS ARE APPROXIMATE AND MAY NEED TO BE ADJUSTED IN THE FIELD DEPENDING ON ENCOUNTERED CONDITIONS
2. A MINIMUM OF 6 SAMPLES WILL BE COLLECTED FROM THE LOCATION SHOWN. UP TO 10 ADDITIONAL SAMPLES MAY BE COLLECTED FOR PCB, RCRA METALS, AND PESTICIDE ANALYSES FROM ADDITIONAL LOCATIONS IF NAPL IS OBSERVED.
3. A MINIMUM OF 10 SAMPLES WILL BE COLLECTED FROM THE LOCATIONS SHOWN, REGARDLESS OF FIELD INDICATIONS OF CONTAMINATION. ADDITIONAL SAMPLES MAY BE COLLECTED FROM THIS ZONE FROM OTHER BOREHOLE LOCATIONS IF EVIDENCE OF CONTAMINATION IS OBSERVED SUCH AS ELEVATED PID READINGS OR THE PRESENCE OF NAPL.
4. ADDITIONAL STEP-OUT SOIL BORINGS MAY BE ADVANCED AS NECESSARY TO DEFINE THE LATERAL EXTENTS OF CONTAMINATION BASED ON FIELD OBSERVATIONS.

LEGEND

- EXISTING FENCE
- EXISTING GAS LINE
- EVAPORATION BASIN
- XXX PROPOSED CONTOUR
- GROUNDWATER MONITORING WELL TO BE ABANDONED
- PROPOSED BOREHOLE
- ADDITIONAL SOIL SAMPLE FOR PCB, RCRA METALS, AND PESTICIDE ANALYSIS TO BE COLLECTED FROM DEPTH INTERVAL WITH GREATEST FIELD EVIDENCE OF CONTAMINATION. (SEE NOTE 2).
- ADDITIONAL SOIL SAMPLE TO BE COLLECTED AT THE WATER TABLE. (SEE NOTE 3).

Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure 6.1
Proposed Locations of Post-Excavation Characterization Boreholes



NOT TO SCALE

Zone A Removal Action Engineering Design Report
Pasco Sanitary Landfill NPL Site
Pasco, Washington

Figure 6.2
Proposed Intervals for Post-Excavation Characterization Samples

I:\GIS\Projects\IWAG-Pasco\AI\Draft EDR\Figure 6.2 Proposed Intervals for Post-Excavation Characterization Samples.ai
06/08/2020

ATTACHMENTS

STANDARD OPERATING PROCEDURE
Drilling and Soil Sampling Procedures

1 PURPOSE
This Standard Operating Procedure (SOP) provides an overview of mobile drilling methods typically used during environmental investigations along with associated health and safety issues. This document outlines procedures to be followed by PBS personnel during drilling and soil sampling activities. Groundwater and soil gas sample collection through the use of drill rigs are covered under separate SOPs.

2 TYPES OF DRILL RIGS
There are three types of drilling methods that are typically used for environmental investigations: direct push, auger, and sonic. Each type of drilling method is described below. A fourth option, discussed in Section 2.4, is a hand auger tool.

2.1 Direct-Push Drilling
Direct-push drilling methods are a common drilling technology used in environmental investigations due to the small diameter borehole (two and one-quarter inch (2.25”)) that generates significantly less investigation-derived waste (IDW). The rigs are hydraulically powered, and use static and percussion force to advance the drill rods. Limited access rigs are available for interior locations while track-mounted rigs allow for sampling in locations with unimproved roads.

The rods are equipped with disposable plastic liners that contain the soil retrieved for observation and sampling. The entire column of rods is removed from the ground each time to retrieve soil for sampling. The rod lengths can be 3, 4, or 5 feet. Because of this, if caving or excessive slough is a concern, the borehole may be temporarily cased to keep it clear and open during soil sample retrieval.

2.2 Hollow Stem Auger Drilling (HSA)
Hollow stem auger drilling methods use hollow corkscrew drilling flights to advance into the subsurface. The borehole is typically 11 inches in diameter, with the flights having a 6-inch inner diameter space in which to retrieve samples or construct wells. The hollow stem auger drill rigs have better capability to penetrate higher density deposits that the direct push probe method. Some direct-push rigs have the capacity to drill with hollow stem auger flights, but these rigs typically do not have the mechanical power to drill through challenging soil. The use of auger drill rigs for environmental investigations is typically for the installation and decommissioning of monitoring wells.

Soil sampling with an auger drill rig is conducted through the use of split spoon samplers or Shelby tubes deployed through the inner hollow space. Split spoon samplers are typically 2.5 feet in length and advanced by hammer weight blow into the undisturbed soil. Shelby tubes are typically used in soft deposits such as clays. Soil brought to the surface on the exterior of drilling flights is considered drill or soil cuttings. Soil samples should not be collected and analyzed from the cuttings because that soil may have come in contact with other soil or contamination from varying depths.

2.3 Rotosonic Drilling
Rotosonic drilling methods (hereafter referenced as sonic method) advance drill rod flights into the ground through the use of vibration, and full-size sonic rigs can advance rods through very challenging unconsolidated geologic formations including large cobbles. The borehole size varies but typically is 4 to 6 inches in diameter.

Due to the nature of the drilling technology, the soil can be disturbed by the vibrations, so consistency and compaction are unreliable. Soil is vibrated out of the lead flight into plastic bags for observation and sampling. The entire column of rods is removed from the ground each time to retrieve soil for sampling; if caving or excessive slough is a concern, the borehole may be temporarily cased to keep it clear during soil sample retrieval.

2.4 Hand Auger Tool

A fourth drilling option is the use of a hand auger tool, sometimes called a handheld auger. This tool, made of steel, is used to bore a hole in soil or sediments. It is intended for use only by hand and is powered by human force by twisting or screwing the tool into the soil. The soil is retrieved through a short barrel that attaches to the base of the auger rods. This tool is used for sites where the soil is relatively easy to penetrate, and when sampling is limited to the upper 5 to 10 feet of the shallow surface. Different barrels are available for coarse-grained or fine-grained material.

3 HEALTH AND SAFETY PLAN

A Health and Safety Plan (HASP) must be developed prior to fieldwork commencing. Typically, a site-specific HASP is prepared from a PBS template for drilling investigations. In all cases, pertinent safety information must be relayed to field personnel, including subcontractors, to communicate mandatory elements from the federal code for hazardous waste operations and emergency response (29 CFR 1910.120(b)(4)).

4 UTILITY LOCATES

Utility locates will be completed on all drilling projects including hand-augered sampling. The property owner or site manager should be interviewed regarding the potential location of buried utilities or other subsurface obstructions on the property. The call-in numbers are provided below. Alternately, PBS personnel can obtain log-ins to file locate requests on-line (Internet Ticket Processing, http://www.callbeforeyoudig.org/index.asp).

Oregon Utility Notification Center: 1-800-332-2344
Washington Utility Notification Center: 1-800-424-5555

The Utility Notification Center needs to be contacted at least 48 hours (two business days) in advance to locate utility-owned lines up to the meter (e.g., water, gas, electric), and public utilities within the public right-of-way (e.g., sewer). In addition, a private utility locating company is typically contracted to survey for private utilities such as utility lines from meters to buildings, drain lines, buried electric cables, or irrigation and sprinkler lines.

When filing utility notification requests, PBS personnel should be as specific as possible about where to locate. Washington law requires that the proposed excavation/drilling work areas are field-marked with white paint prior to the locating event.

When beginning a project, PBS personnel must carefully think through where boreholes can be safely drilled, considering both subsurface and overhead obstructions. A site walk may be prudent once the utilities have been marked and prior to the drilling fieldwork. If safe drilling conditions cannot be confirmed, the PBS Project Manager should determine if engineering controls should be implemented, such as shielding or shutting down utility and/or power lines.

SAFETY NOTE: Drill rig masts must be a safe distance from overhead power lines to prevent mast lines and power lines being moved together by wind. Occupational Safety and Health Administration (OSHA) rules for drillers require a minimum distance of 10 feet, with additional spacing required depending on the voltage carried by the power line. The drill rig subcontractor is responsible for ensuring sufficient clearance. However, PBS personnel should verify that potentially unsafe conditions do not exist.

5 SAFETY EQUIPMENT REQUIREMENTS

The following safety equipment is required for all drilling investigations:

- Hard hat
- Hearing protection (ear muffs or plugs, must be worn when drill rig is in operation)
- Safety-toe work boots
- Safety vest
- Gloves (typically disposable)
- Safety goggles or glasses
- Life vests (only when working over water)

6 FIELD EQUIPMENT AND SUPPLIES REQUIREMENTS

The following equipment is typically required for drilling projects when soil sampling will occur. Groundwater or soil gas sampling is discussed in separate SOPs. PBS personnel should confirm that the drilling contractor will provide decontamination water, soap, brushes, and buckets.

General field supplies/equipment includes:

- 5-gallon buckets
- Bags (garbage)
- Bags (plastic zipper-type)
- Camera
- Cellular telephone and phone numbers of client, project laboratory, subcontractors, etc.
- Field notebook or daily log
- Measuring tape
- Paper towels
- Pens
- Spray paint (optional)

Soil sampling supplies/equipment includes:

- Project proposal/scope of work
- Alconox/Liquinox or similar decontamination detergent
- Distilled water (for decontamination)
- Environmental borehole log forms
- Hand auger (if required by scope)
- Ice chest with blue ice or party ice
- Nitrile or other chemically compatible gloves
- Photoionization detector (PID)
- Sample chain-of-custody forms
- Sample containers (ask lab about sample volume, preservatives, etc.)
- Sampling spade or spoons (if required by scope)

7 PRE-DRILLING ACTIVITIES

The following tasks must be performed before beginning work:

- Conduct tailgate safety meeting with all field personnel, including visitors such as the client or regulator; review Health and Safety Plan.
- Install traffic cones/barrier tape or other barrier to control pedestrian and vehicle access to work area as necessary.

The drilling subcontractor is responsible to ensure that the area on which the rig is to be positioned is cleared of removable obstacles and the rig should be leveled if parked on a sloped surface. The cleared/leveled area should be large enough to accommodate the rig and supplies. PBS personnel must confirm that the work area is cleared and safe for work prior to initiating drilling activities.

8 SOIL SAMPLING PROCEDURES

8.1 Logging and Field Screening Soil

Upon retrieval of the soil, describe as per the Geo-Environmental Field Classification chart for soil (included as an attachment). Record observations on an environmental borehole log.

If conducting head-space screening with a PID, remove one-quarter to one-half cup of soil and place in a sealable plastic bag. Seal the bag, break up the soil, and let sit for a minimum of five minutes (in colder weather, either wait for 15 to 30 minutes or put into a warm car or room). The purpose of the headspace screening is to measure what is off-gassing from the sample, and sufficient time must be allowed for that to occur. After the appropriate interval, place the end of the PID probe into the bag (through a small opening in the "zipper") and record the peak value.

If performing sheen testing, place a small sample volume (preferably darker or stained material) in a bowl partially filled with water and observe sheen indicative of petroleum contamination.

8.2 Collecting Soil Samples for Laboratory Analysis

Prior to collecting a sample for laboratory analysis, the sampler should don new gloves. If there are multiple samples to be collected from a single borehole, the gloves should be replaced to avoid cross-contamination.

Collect soil samples using a gloved hand or a clean sampling tool and place directly into the sample jar(s). For volatile organic compounds (VOCs), pack the soil to minimize jar headspace, or field preserve for VOCs using EPA Method 5035 (the field kit is obtained from the laboratory). Label samples as described under Section 8.3 Sample Numbering. Place labeled sample container(s) in the cooler with ice.

8.3 Sample Identification

Sample labels will be completed and attached to the jars in the field to prevent misidentification. All sample labels will include the following information:

- Project name or number
- Sample identification
- Sample collection date and time

The sample identification is unique to a particular sample and the format must be consistently used for all samples collected at the site. The sample identification typically includes the sample location and the collection depth. The sample location is the soil boring number or otherwise designated sample location. Standard abbreviations for sample location types are:

- DP = Direct push
- MW = Monitoring well
- SB = Soil boring
- SE = Sediment
- SO = Surface soil
- SS = Soil sample
- TP = Test pit
- WP = Well point

Examples of sample identifications are: DP-5 (4'), SS-22 (1'), and MW-3 (15')

Other naming conventions may be used, as long as the labeling is consistent and each location is clearly identifiable.

9 BOREHOLE ABANDONMENT

The licensed driller is responsible for abandoning boreholes in compliance with state regulations. PBS personnel should ensure that this occurs, and that the sealing material (typically bentonite chips) is sufficiently hydrated for a proper seal. State regulations governing this are:

- Oregon Administration Rule (OAR) 690-240
- Washington Administrative Code (WAC) 173-160

10 DECONTAMINATION PROCEDURES

Minimizing the possibility of cross-contamination between samples is a critical component of a successful soil sampling project. This is achieved by consistent and thorough decontamination of sampling equipment, such as drill rods, sampling devices (split spoons, trowels, etc.), and other tools that may come in contact with soil to be sampled.

For drilling equipment, the drilling contractor is responsible for the decontamination procedures. Typically, a pressure washer with hot water or water with added detergent is used to clean drill rods and other equipment. The use of a steam cleaner is not appropriate because of the risk of burns, and steam cleaners do a poor job of removing soil particles from equipment.

For equipment and supplies used by PBS personnel, water with added detergent is typically used for decontamination. Alternately, disposable supplies, such as gloves and sampling scoops, can be used to avoid having to decontaminate them.

PBS field personnel should work with the PBS Project Manager to confirm the appropriate decontamination procedure for each project. For example, it may be important to know the source of the driller's water used for decontamination, and distilled or deionized water may need to be used to clean hand tools.

All water and sludge generated during decontamination will be captured for later disposal. Release of water directly onto the ground or into drains or catch basins is not allowed.

11 INVESTIGATION-DERIVED WASTE

Investigation-derived waste consists of soil cuttings, decontamination water, purge water (if groundwater is encountered), and personal protective equipment (e.g., nitrile gloves, rags, paper towels, Tyvex suits, disposable bailers, and tubing). All disposable personal protective equipment may be disposed of as general refuse unless otherwise instructed by the PBS Project Manager.

Soil cuttings are typically placed in 5-gallon buckets or other appropriate containers during the execution of the fieldwork, and transferred to 55-gallon drums as the project progresses. If appropriate, the cuttings may remain in buckets as long as tight-fitting lids are placed on each bucket. For some projects, the PBS Project Manager may request that decontamination/purge water be placed into the same drums as the soil, instead of keeping the two media separate. Depending on the type of contamination, this may result in cost savings for the client during disposal. Field personnel should confirm how to contain soil and water prior to each field event.

11.1 Drum Labeling

The storage containers must be labeled as hazardous, non-hazardous, or unknown pending laboratory results. The labels must be completed using an indelible marker and include:

- Date that the contents were generated
- Nature of the contents - for example:
    - Drill cuttings
    - Purged groundwater
    - Decontamination water and/or sludge
- Contact phone number in the event emergency response personnel need to identify the contents of the container.

Drums or other storage containers should be placed in as secure a location as possible, which may be a building if the exterior area is not secure from vandalism.

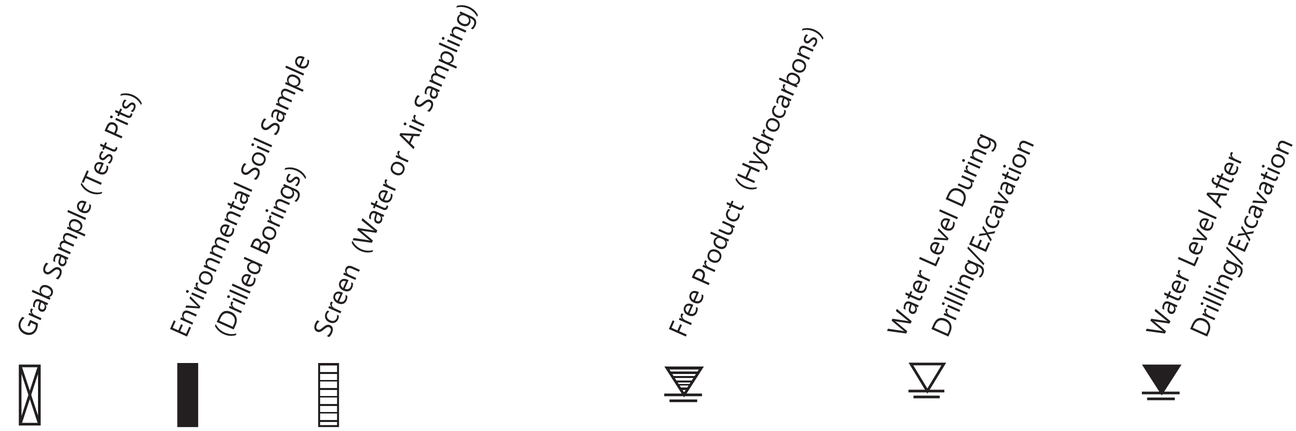
12 POST-DRILLING ACTIVITIES

Upon return to the office, PBS personnel should:

- Clean and calibrate equipment prior to placing back into storage. If there were any operational issues noted, they should be reported immediately to the equipment manager.
- Submit field borehole logs for electronic formatting for future reports.
- Submit the daily field notes to the PBS Project Manager for placement into the project file. If a field notebook was used, and that notebook is not dedicated to that project, a copy of those notebook pages should be submitted.

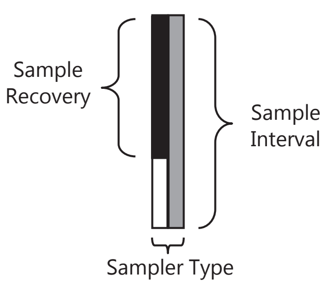
Key To Test Pit and Boring Log Symbols

SAMPLING DESCRIPTIONS

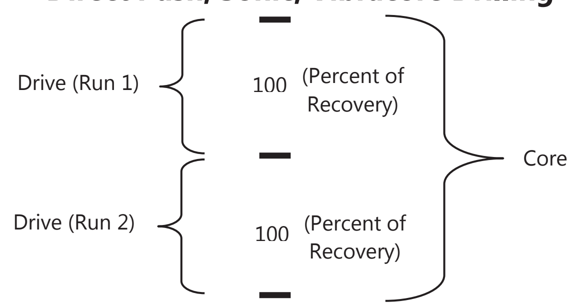


LOG GRAPHICS

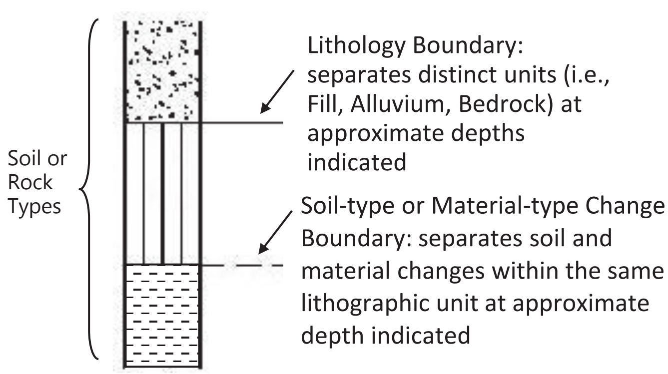
Sampling Symbols



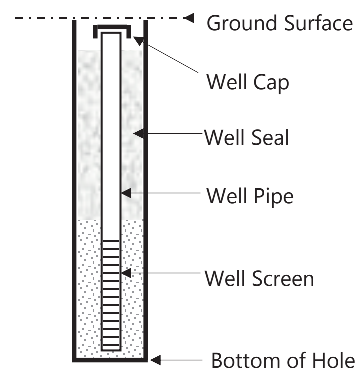
Direct Push, Sonic, Vibracore Drilling



Soil and Rock Divisions



Well Detail



ENVIRONMENTAL TESTING EXPLANATIONS

ATD	At Time of Drilling	PPM	Parts PerMillion
BGS	Below Ground Surface	ND	Not Detected
MSL	Mean Sea Level	NS	No Sheen
MW	Monitoring Well (Water Sampling)	SS	Slight Sheen
OD	Outside Diameter	MS	Moderate Sheen
PID	Photoionization Detector Headspace Analysis	HS	High Sheen

Observations presented on the logs are based on limited field data and are not intended to be used for site engineering or construction decision purposes.

GEO-ENVIRONMENTAL FIELD CLASSIFICATION

(Based on USCS Soil Classification)

SOILS

SOIL DESCRIPTION ORDER	
(1) consistency or relative density,	(6) odor;
(2) color,	(7) sheen (if present);
(3) Soil Type and Symbol secondary PRIMARY (XX) with additional constituents;	**(8) moisture;**
(4) plasticity of fines;	(9) indicate if fill material (suspect or known;
(5) size range of sand; size range, angularity of gravel;	(10) presence and angularity of cobbles and boulders
Note: Bolded items are the minimum required descriptors	

(1) RELATIVE DENSITY – COARSE-GRAINED

Term	Field Test (using trowel)	SPT Blow Counts
Very loose	Easily excavated with trowel	0 – 4
Loose		5 – 10
Medium dense	Difficult to excavate with trowel	11 – 30
Dense		31 – 50
Very dense	Must be loosened with pick to excavate with trowel	>50

(1) CONSISTENCY – FINE-GRAINED

Term	Field Test	SPT Blow Counts
Very soft	Easily penetrated several inches by fist	<2
Soft	Easily penetrated several inches by thumb	2 – 4
Medium stiff	Can be penetrated several inches by thumb with moderate effort	5 – 8
Stiff	Readily indented by thumb but penetrated only with great effort	9 – 15
Very stiff	Readily indented by thumbnail	16 – 30
Hard	Difficult to indent by thumbnail	>30

(2) COLOR

Use common colors. For combinations use hyphens.
To describe tint use modifiers: light, medium, and dark.

EXAMPLE: red-brown; or pale green with orange mottling.

(4) PLASTICITY

Term	Observation	Soil Type
non-plastic	A 1/8″ thread cannot be rolled	SILT
low	a thread can barely be rolled	SILT
medium	The thread is easy to roll but cannot be re-rolled	SILT or CLAY
high	The thread can be re-rolled several times	CLAY

(5) GRAIN SIZE DESCRIPTION

Description		Approximate Size Scale	Sieve	Observed Size
boulders		larger than a basketball	--	>12″
cobbles		fist to basketball size	--	3″ – 12″
gravel	coarse	thumb to fist size	¾″ – 3″	¾″ – 3″
	fine	pea to thumb size	#4 – ¾″	4.75 mm(0.19″) – ¾″
sand	coarse	rock salt to pea size	#10 – #4	2.0 – 4.75 mm
	medium	sugar to rock salt size	#40 – #10	0425 – 2.0 mm
	fine	flour to sugar size	#200 – #40	0.075 – 0.425 mm
fines		flour size and smaller	<#200	<0.075 mm

(8) MOISTURE

Term	Field Test
dry	absence of moisture
damp/moist	without visible water but leaves moisture on hand
wet	visible free water, usually saturated

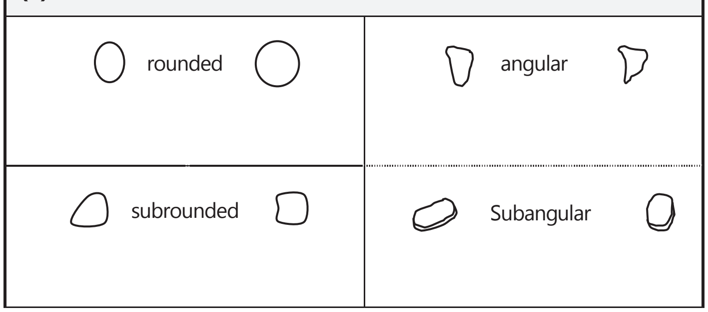
(6) ODOR

Terms such as: organic, petroleum-like, sulfur, etc.
no odor
slight odor
moderate odor
strong odor
very strong odor

(7) SHEEN

Observation
no sheen
slight sheen
moderate sheen
heavy sheen

(5) ANGULARITY



EXAMPLES:

- Stiff brown SILT (ML) with sand; non-plastic; fine sand; moist.
- Dense gray-brown poorly graded GRAVEL (GP-GM) with silt; low plasticity; fine to coarse, rounded gravel; wet.
- Loose gray well-graded SAND (SW); fine to coarse sand; moist.
- Medium stiff dark yellow-brown sandy SILT (ML) with gravel; non-plastic; fine sand; fine, angular gravel; weakly cemented; strong odor, heavy sheen; occasional rootlets; moist.
- Loose, medium brown with black mottling clayey SAND (SC); low plasticity; fine to medium with occasional coarse sand; damp to moist.

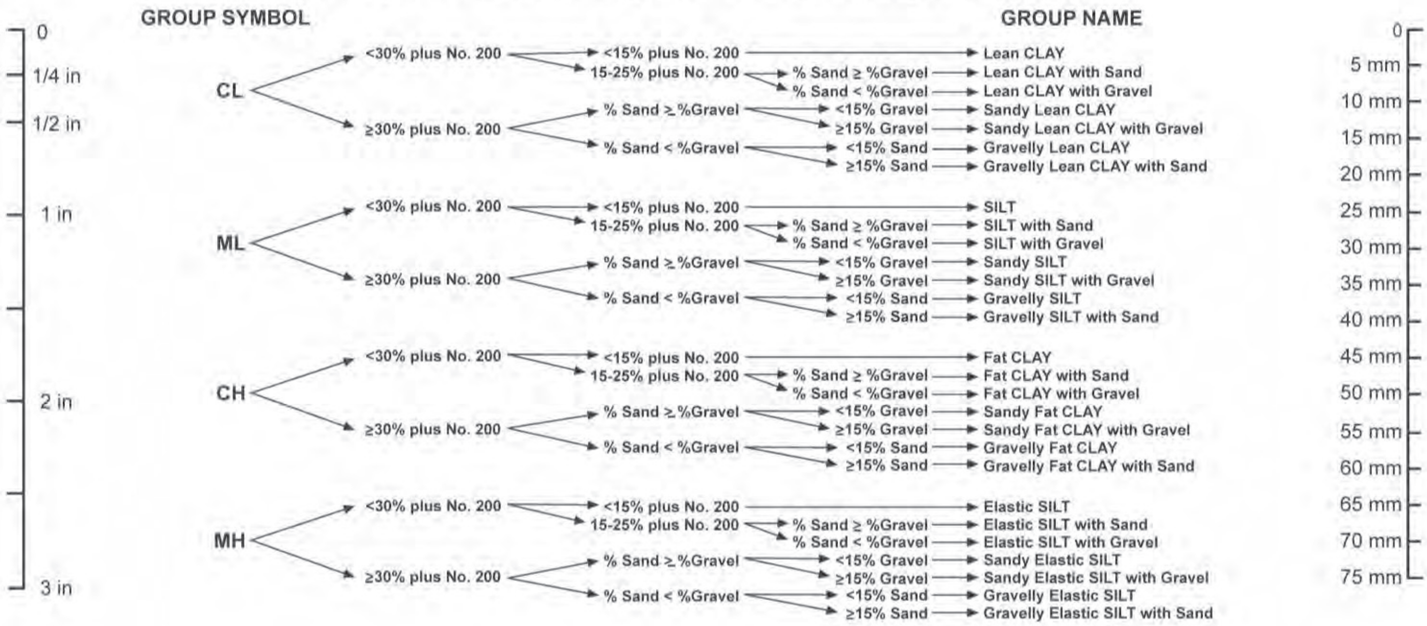
GEO-ENVIRONMENTAL FIELD CLASSIFICATION

(Based on USCS Soil Classification)

SOILS

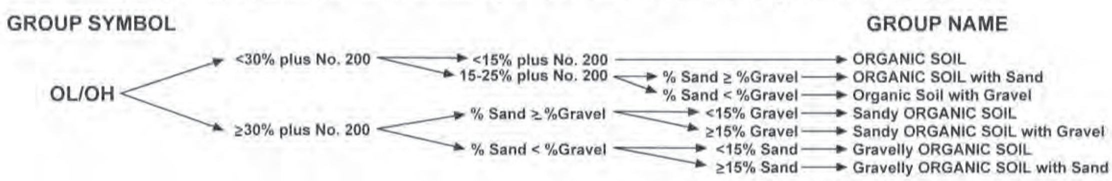
Flow Chart for Identifying Inorganic Fine Grained Soil, 50% or more fines (ASTM D2488)

Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%.



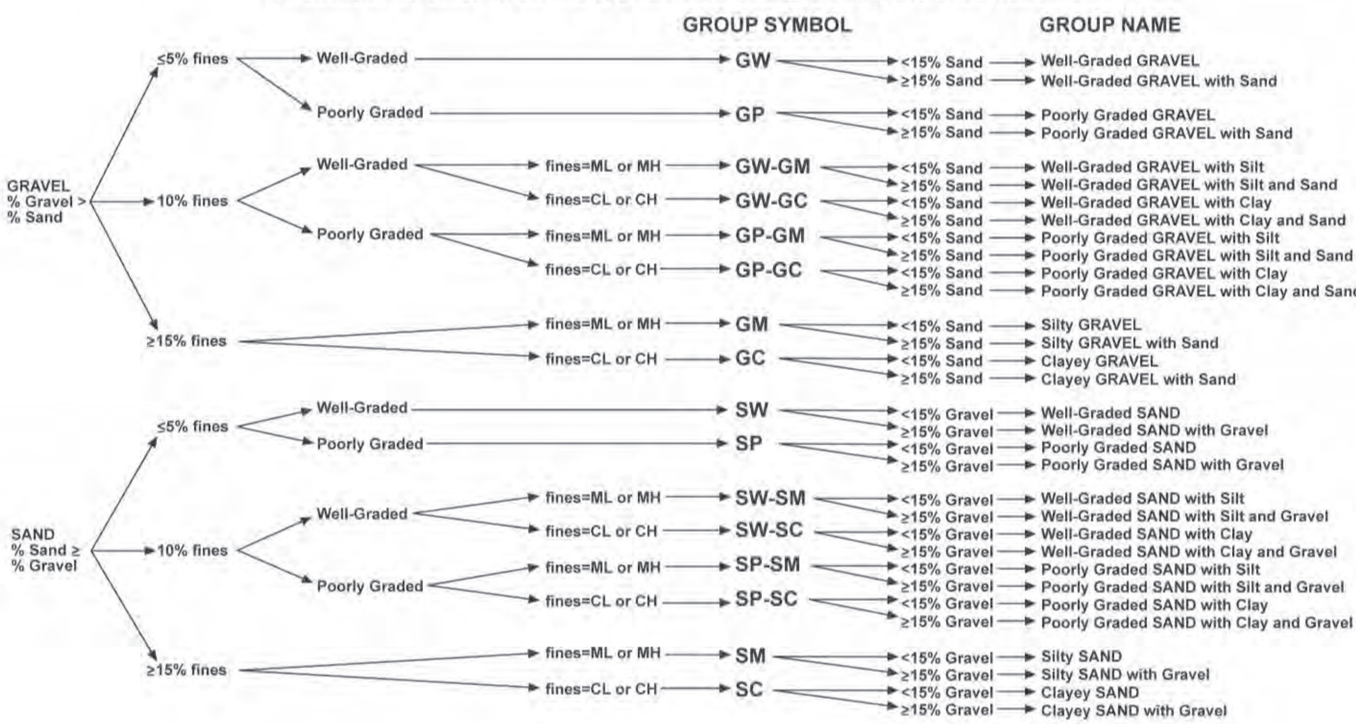
Flow Chart for Identifying Organic Fine Grained Soil, 50% or more fines (ASTM D2488)

Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%.



Flow Chart for Identifying Coarse Grained Soils, less than 50% fines (ASTM D2488)

Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%.



ENVIRONMENTAL SOIL BORING FIELD LOG

Boring No.: _______

Project Number:	**Project Name:**	**Drilling Equipment/Method:**
Date Begin/End:	**Location:**	**Drilling Company/Driller:**
Boring Total Depth:	**Coordinates (X/Y, Lat/Lon, Sta.):**	**Outer Hole Diameter (in.):**
Surface Type:	**Sample ID Prefix:**	**Field Meter (units):**
Logged By:	**Groundwater (ft.): During Drilling DTW / Time: /**	**After Drilling DTW / Time: /**

Recovery (%)	Depth / Sample Interval	Sample ID	Field Meter Reading	Consistency / R.D.	Field Soil Description & Classification (ASTM D 2488)							Field Notes
					Color, ASTM Soil Name (USCS Symbol)	Plasticity (NP, LP, MP, HP)	Size Range Sand (F, M, and/or C)	Size Range Gravel (F and/or C)	Shape of Gravel (R, SR, SA, A)	Moisture Content (Dr, D, M, W)	Fill (Y/N)	Conditions, Organics, Odor, Sheen? Cobbles/Boulders, Cementation? Other Notes?
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	0											
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											

Sheet: _____ of _____

DAILY FIELD REPORT

PROJECT INFORMATION

Project Number:		Date:	
Project Name:		PBS Staff:	
Purpose:		Time Arrive:	
Weather:		Time Depart:	

FIELD OBSERVATIONS AND COMMENTS

Attach (as appropriate): Photographs, copy of field notes from permanent notebook, laboratory chain-of-custody

SIGNATURE

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.8
Zone A Decommissioning and Well Installation Plan

FINAL

Zone A Decommissioning and Well Installation Plan

Pasco Landfill NPL Site
Pasco, Washington

Submitted to:
Washington State Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, Washington 99205-1295

On Behalf of the:
IWAG Group III

Prepared By:
PBS Engineering and Environmental Inc.
and
Floyd | Snider

February 28, 2020

PBS Project No. 64180.020

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Table of Contents

Supporting Data

FIGURES

1 INTRODUCTION

This *Zone A Decommissioning and Well Installation Plan* provides a guide for groundwater monitoring well installation and removal or decommissioning procedures for monitoring equipment in the Zone A Industrial Waste Area at the Pasco Landfill National Priorities Listed (NPL) Site (hereafter Site), investigation derived waste (IDW) management protocols, and testing requirements for contaminated materials or liquids generated during the planned activities. Decommissioning procedures and sequencing are provided for groundwater monitoring wells, SVE wells and associated aboveground and subsurface conveyance piping within Zone A, gas and vapor monitoring wells and probes, gas implant arrays, thermocouple arrays, and other monitoring infrastructure that will be impacted by Zone A construction activities. Figure 1 illustrates the location of the Pasco Landfill property and Zone A.

This *Zone A Decommissioning and Well Installation Plan* is part of the *Zone A Removal Action Engineering Design Report* (EDR) and the *Zone A Removal Action Compliance Monitoring Plan* (CMP). These plans have been prepared for the Washington State Department of Ecology (Ecology) on behalf of the Industrial Waste Area Generators Group III (IWAG) in fulfillment of the requirements of the *Cleanup Action Plan – Pasco Landfill NPL Site* (CAP), prepared by Ecology and dated August 2019 and Enforcement Order DE 16899, dated November 8, 2019. The plan has been prepared as required in Task A.1 Subtask A and Task A.2 sub-plan G of the Scope of Work and Schedule (SOW) in Exhibit C of the CAP.

The planned installation and decommissioning activities will be performed as part of site preparation activities for the Zone A removal action, which will require the following:

1. Installation of one new groundwater monitoring well near the northeast corner of Zone A named **MW-56S**. This monitoring well will be used to assess groundwater quality conditions hydraulically upgradient of Zone A. With Ecology approval, MW-56S was installed in January 2020 in the Central Area outside the immediate influence of Zone A. The new well location is presented in Figure 2.

2. Installation of two new deep horizontal SVE wells as part of the planned SVE system reconfiguration. Installation of these horizontal wells will occur prior to abandoning the existing deep SVE wells. The installation of new SVE system components is described in the SVE Reconfiguration Section (Section 7) of the *Zone A Removal Action EDR* and will not be discussed further in this plan.

3. Installation of replacement wells for MW-52S and MW-53S next to and hydraulically downgradient of Zone A and outside of the limits of the final Zone A cover system. The new wells will be named **MW-57S** and **MW-58S**. The proposed new well locations are presented in Figure 2. The locations of the replacement groundwater monitoring wells were decided jointly by the IWAG and Ecology during a January 7, 2020 Site visit and subsequent collaboration.

4. The following monitoring locations and infrastructure, within the extents of the planned Zone A Removal Action limits of excavation, will be decommissioned. These locations are indicated with red symbols on Figure 3.

   - Three groundwater monitoring wells (MW-52S, MW-53S, and EE-3). Well EE-3 was previously abandoned but the casing remains and will be removed;
   - Six vapor extraction wells (VEW-06S, VEW-06I, VEW-06D, VEW-07S, VEW-07I, and VEW-07D) and
   - Associated aboveground and shallow subsurface vapor conveyance piping;
   - Seven vapor monitoring probes within the Zone A cover system (VMPs 2, 4, 5, 6, 8, 9, 10);
   - Nine gas implant arrays (GIs 1 through 9);

- Nine thermocouple arrays (TCs 1 through 9) will be removed during excavation;
- Two thermocouple racks and wiring on the surface of Zone A;
- Three sumps in the subsidence depressions (north, north2 [middle], south), which extend to the geomembrane layer; and
- All remaining subsidence monitoring survey plates and benchmarks (several locations) on the surface of Zone A or extending to the geomembrane layer.

5. The following Zone A monitoring locations, which are outside the footprint of the Zone A cover, will also be decommissioned to facilitate operations associated with excavation and removal activities (These locations are shown with blue symbols on Figure 3):

- Three groundwater monitoring wells (EE-2, MW-48I, and MW-48D) at the south end of Zone A.
- Nine vapor monitoring wells (PH-36, PH-37, PH-38, VEW-02, VMW-02S, VMW-03D, VMW-03S, VMW-51I, and VMW-51D) will be decommissioned after SVE system startup testing is complete;
- Seven vapor monitoring probes (VMP-13S, 13D, and 17 through 21) located north and east of Zone A will be decommissioned after SVE system startup testing is complete; and
- Seven thermocouple arrays (VB-20 through 26) located northeast of Zone A.

Vapor monitoring wells and probes will be retained as needed to collect pressure measurements as part of startup testing for confirmation of the radius of influence for the proposed horizontal replacement SVE wells.

This plan presents applicable background information, procedures, methods, contingencies, and implementation schedules. The plan is designed to comply with State decommissioning methods in WAC 173-160, monitoring requirements in WAC 173-340-410, Section VI of the Enforcement Order (Work to be Performed), and requirements in Exhibit C of the CAP. The Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP) requirements incorporated into this plan shall meet WAC 173-340-410 and -820 requirements.

2 GROUNDWATER MONITORING WELL INSTALLATION

Installation of groundwater monitoring well MW-56S occurred on January 14, 2020 following Ecology approval. The well location was discussed and decided in collaboration with Ecology on January 7, 2020 and was installed hydraulically upgradient of the Zone A landfill near the northeast corner. The location of well MW-56S is indicated on Figure 2. The well was installed as required by Task A of the SOW to assess groundwater quality conditions in the Central Area upgradient of Zone A and outside the immediate influence of Zone A and to establish baseline groundwater conditions immediately upgradient of Zone A prior to drum removal activities.

Siting of this new well was considered through review of previous geophysical survey investigations of the area to be outside areas of high magnetic response. The objective was to install the new well in a location in as much native soil as possible and away from any localized potential wastes. Double casing was installed through the layer of municipal solid waste encountered in the borehole and extends below the waste.

Installation of groundwater monitoring wells MW-57S and MW-58S is planned as to replace wells MW-52S and MW-53S as part of drum removal site prep activities. These replacement wells will be located as discussed and decided on January 7, 2020, during the Site visit with Ecology and subsequent collaboration with Ecology and Cascade Natural Gas. The wells will be hydraulically downgradient of Zone A on the west edge of Dietrich Road, outside the extent of the drum removal excavation, and outside the extent of the final Zone A cover system. To minimize worker safety concerns from sampling wells within the road during drum removal activity, the wells will be installed, with stick-up monuments, north of the gas pipeline easement between the edge of pavement and the surface water drainage ditch on the west side of Dietrich Road. The proposed locations of MW-57S and MW-58S are indicated on Figure 2.

All new wells will be drilled and constructed under the supervision of a driller licensed by the State of Washington and a licensed geologist or engineer. A Notice of Intent will be filed with Ecology before well installation and decommissioning. Standard USCS logging conventions and protocols will be used when preparing soil boring logs for all drilled boreholes. The final construction of each well will be documented in a Well Completion Log and the well driller will file the necessary completion documentation with Ecology.

2.1 Well Construction Standards

All new groundwater monitoring wells will be installed in accordance with Chapter 173-160 WAC, *Minimum Standards for Construction and Maintenance of Wells*. The new wells will be developed and then allowed to stabilize for 48 hours to one week prior to sample collection.

2.2 Installation Procedures and Well Construction

All three new wells, MW-56S, MW-57S, and MW-58S will be drilled using Rotosonic drilling and will be completed in accordance with WAC 173-160. During drilling activities, soil cuttings will be placed in a plastic zipper bag and field screened for VOCs using a photoionization detector with measurements being recorded. MW-56S was constructed of 2-inch diameter Schedule 40 PVC with 0.010-inch machine slotted screen. Due to the presence of municipal waste the borehole was double cased through and below the waste. MW-57S and MW-58S will be constructed of 2-inch diameter Schedule 40 PVC riser piping with 0.010-inch stainless steel screens[1]. See Figure 4. The wells will be constructed with 15 feet of screened interval set so that approximately 10 feet of the screened interval is below the water table at the time of drilling.

The annulus around the well screen will be filled from the bottom up with a filter pack consisting of #10/20 clean-washed Colorado silica sand or equivalent. The filter pack material will extend upward to not less than 2 feet above the upper screen. The well annulus above the filter pack will be filled with bentonite to within 2 feet of the ground surface. The remaining portion of the well annulus will be filled with concrete as a surface seal and as the support for a stick-up type well monument. The well monument will be constructed of mild steel with a lockable lid set high enough to allow the lid to close over a dedicated Grundfos pump with connectors sticking up approximately 4" above the top of casing. An appropriate number of protective bollards, based on the final well location, will be placed around the well monument.

2.3 Well Development

Upon completion each new well will be developed using both surging and pumping techniques. Well development will continue until approximately 10 wetted well volumes have been removed or the turbidity of the extracted water is less than 10 nephelometric turbidity units (NTU). After which general field parameters including pH, conductivity, dissolved oxygen, oxidation-reduction potential, and temperature will be measured until stable measurements are achieved and recorded. During this time notable observations such as sheen or odors will be noted.

Development water will be drummed or containerized and labeled with the boring location(s) and date pending characterization and offsite disposal.

[1] Note: Due to the composition of stainless-steel screens, detections of chromium and nickel in groundwater samples from wells constructed of stainless steel may be biased high by the composition of the screen material.

2.4 Dedicated Pump Installation and Intake Placement

After development, a new dedicated stainless steel Grundfos Redi-Flo 2 pump with Happy Hose consistent with pumps in other wells at the Site will be installed.

As requested by Ecology during past pump maintenance, the pump intake depth within each monitoring well will be based on the following protocol in use at the Site:

- For shallow water table wells, the pump intake shall be 2 to 3 feet below the inferred historical low water level for the well. This placement depth is reasonably close to the water table, allowing monitoring of contaminants that may be transferred from vapor phase processes.
- For intermediate and deep aquifer wells, the pump intake shall be set at the approximate mid-point of the screened interval. Contaminant stratification is not of concern in the intermediate and deep portions of the aquifer therefore, a mid-screen placement is reasonable.

2.5 Sampling

Baseline sampling will occur as part of the next scheduled quarterly monitoring event after well development. Samples will be analyzed for VOCs, SVOCs, metals, PCBs, pesticides and herbicides. Details of baseline and routine sampling are presented in the *Zone A Removal Action EDR – Supplemental Groundwater Monitoring Plan*.

Monitoring results for this well will be evaluated consistent with the *Groundwater Monitoring Plan* for both Zone A and the On-Property Central Area cleanup action in Task D of the SOW.

2.6 Well Location Surveying

The new monitoring wells will be surveyed for both horizontal and vertical coordinates. The top of the well casing and the ground surface elevations will be surveyed to the nearest 0.01 foot. A mark will be placed on the casing indicating the location that was surveyed. Horizontal positions will be surveyed to the nearest 0.1 foot. All points will be surveyed under supervision of a licensed surveyor and referenced to the semi-permanent monuments set on-Site during the Phase I Remedial Investigation, and/or NGS Tri-Stations "Sacajawea 2" and "Fourteen." The points will be tied to the Washington Coordinate System (WCS), NAD 1983-91 and the North American Vertical Datum, NAVD 1988. All survey measurements since 2007 have been surveyed using NAD 83-91 and NAVD 88.

3 DECOMMISIONING PROCEDURES

3.1 Types of Monitoring Locations and Infrastructure to be Decommissioned

The Zone A removal action will require the abandonment of existing monitoring locations associated with the Zone A landfill. It is currently anticipated that all monitoring infrastructure installed on or through the Zone A cover and within the planned extents of excavation will require decommissioning consistent with good practice and with applicable regulations including decommissioning methods in WAC 173-160. Any modifications to the procedures below will be documented in the field notes. Materials such as monuments and piping that are in good condition following removal may be set aside for potential reuse and repurposing at the Site.

The following types of monitoring locations and infrastructure will be decommissioned as part of Site preparation activities for the drum removal action:

- Groundwater monitoring wells (MW);
- SVE wells (VEW);

- Associated aboveground vapor and fresh air piping racks and subsurface vapor conveyance piping;
- Vapor monitoring wells (VMW);
- Vapor monitoring probes (VMP);
- Gas implant arrays (GI);
- Thermocouple arrays (TC);
- Associated aboveground thermocouple racks and subsurface wiring;
- Stormwater monitoring sumps in the subsidence depressions; and
- Subsidence monitoring survey benchmarks and plates (SB and SP).

3.2 Decommissioning Procedures

The intermediate and deep wells were installed with casings and screens that are completed below the drummed waste. It will be necessary to seal each borehole that terminates below the depth of drummed waste and the excavation to prevent vertical contaminant migration and groundwater impacts. Therefore, decommissioning of intermediate and deep groundwater, vapor extraction, and vapor monitoring wells will be performed by over drilling the entire depth of completion using a hollow stem auger drill rig. Boreholes will be backfilled from the bottom up, in a manner to avoid bridging an incomplete seal, using pressure grouting to at least 2 feet below the existing ground surface.

The well decommissioning activities will be performed by a licensed driller. A Notice of Intent will be filed with Ecology before decommissioning groundwater, vapor extraction, and vapor monitoring wells and any other monitoring locations recorded in the Ecology Well Report Viewer. In accordance with State reporting requirements, the final decommissioning of each well will be documented in a well decommissioning report and the well driller will file the necessary decommissioning documentation with Ecology.

3.2.1 Groundwater Monitoring Wells and Decommissioning Procedures

MW-52S and MW-53S are located within the extents of Zone A excavation (See Figure 3). They are constructed with a 4-inch 316 stainless steel casing and a 4-inch 316 stainless steel 0.10-inch wire wound well screen. The wells are 85 to 86 feet in depth. Before decommissioning begins, the dedicated Grundfos pump will be removed from each well and decontaminated for potential reuse or spare parts.

Groundwater monitoring wells EE-2, EE-3, MW-48S, MW-48I, and MW-48D are located at the south end of Zone A (See Figure 3). Well EE-2, is located outside the footprint of the Zone A cover and is currently monitored as part of the Site-wide monitoring program. The well will be in the excavation support area and therefore will be removed. EE-3 is within the footprint of the Zone A cover and excavation extents but is not monitored. While EE-3 was abandoned in place years ago, the casing will need to be removed and the borehole sealed, in the same manner as MW-52S and MW-53S. MW-48S, I, and D are located south of Zone A within BDI's recycling operation. The MW-48 wells have not been sampled since 2012 and only MW-48S has been monitored for water elevations since then. They will be in an active excavation support area and MW-48I and MW-48D will be removed. MW-48S will be retained and may need to be modified to a flush mount completion directly prior to or during excavation. Sampling of MW-48S will be adaptive and performed if, after IWAG and Ecology evaluation of supplemental groundwater data from nearby wells, a potential concern is identified.

EE-2 and EE-3 were installed in 1985 before the Zone A cover was installed. They were constructed with a 2-inch stainless steel casing and a 2-inch stainless steel 0.010-inch well screen. The 1985 borelogs indicate that the wells were 85 to 87 feet in depth. MW-48S/I/D are constructed with a 2-inch schedule 40 PVC casing and a 2-inch PVC 0.010-inch well screen.

The groundwater monitoring wells will be decommissioned in accordance with Washington Administrative Code (WAC) Chapter 173-160, *Minimum Standards for Construction and Maintenance of Wells*. The procedure for decommissioning groundwater monitoring wells **within the extents of excavation** (EE-3, MW-52S, and MW-53S) will include the following:

- Remove all debris, accumulated sediments, equipment and obstructions from the well casing, except well screens and packers.
- The well(s) will be completely removed by over drilling the well casing using hollow-stem auger methods to the entire depth of well completion, thereby removing the grout and filter pack materials from the hole. The well casing will then be removed by either pulling or over drilling (over-reaming).
- The borehole will then be pressure grouted with appropriate material (bentonite slurry). To seal below the static water level in the well, the material shall be placed from the bottom up by methods that avoid segregation or dilution of the material. When used to place bentonite slurry the discharge end of the tremie tube shall be submerged in the sealing material to avoid breaking the seal while filling the annular space.

The procedure for decommissioning wells **outside the extents of excavation** (EE-2, MW-48I, and D) will include the following:

- Remove all debris, accumulated sediments, equipment and obstructions from the well casing, except well screens and packers.
- Perforate the casing from the bottom to within 5 feet of the ground surface and pressure seal the casing.
- Perforations shall be at least four equidistant cuts per row, and one row per foot. Each cut shall be at least 1.5 inches long. The perforations must be sufficient enough to allow neat cement grout or neat cement, or bentonite slurry to migrate outside the casing and effectively prevent the movement of water.
- Apply enough pressure to force the sealing material through the perforations, filling any voids on the outside of the casing.
- The casing shall be filled completely from the bottom up to the land surface with neat cement grout, neat cement, or bentonite slurry. The screen and up to five feet of riser pipe may be filled with dry bentonite, then watered. The remainder of the riser pipe must be removed.
- The casing may be cut off at a maximum of five feet below land surface;

3.2.2 Intermediate/Deep Vapor Extraction/Monitoring Wells and Decommissioning Procedures

Six vapor extraction wells (VEWs) with associated aboveground and subsurface conveyance piping located within the planned extents of the Zone A drum removal excavation will be decommissioned. Four additional vapor extraction wells and one vapor monitoring well located outside the extents of planned excavation and adjacent to the excavation area will be retained. Five vapor monitoring wells (VMW-51I/D and PH-36, 37, 38) are located either within or adjacent to the excavation area. Seven additional VEWs and VMWs are located near Zone A, some within excavation support areas. (See Figure 3)

The six extraction wells within Zone A (VEW-06S, VEW-06I, VEW-06D, VEW-07S, VEW-07I, and VEW-07D) have been or are used to extract vapors from the Zone A subsurface and are connected to the SVE and RTO systems. The wells are constructed with a 4-inch 316 stainless steel casing and a 4-inch 316 stainless steel 0.02-inch wire wound well screen. The shallow wells are 11 feet in depth, the intermediate wells are 34 feet in depth, and the deep wells are 65 feet in depth. (See Figure 3) After the two planned replacement SVE wells are installed, radius of influence testing is complete, and the reconfigured system is functioning (See Zone A Removal Action EDR), all six extraction wells, their associated aboveground piping racks, and the runs of subsurface vapor conveyance piping between the wells and the south slope of Zone A, will be removed as part of drum removal excavation site preparation activities. The conveyance piping from the bottom of the slope to Dietrich Road will be capped at the south end of Zone A and remain in place.

The four extraction wells VEW-01, VEW-04, VEW-05, and VMW-02D were formerly used to extract vapors from Zone A. These vapor extraction wells along with vapor monitoring well VMW-50S will be used to establish that the new horizontal SVE wells and system are running with sufficient radius of influence and for ongoing vadose zone monitoring during Zone A excavation and as needed during in-situ thermal treatment.

Vapor monitoring wells VMW-51I and VMW-51D, located within the extents of excavation, are currently in use for vacuum and vapor monitoring associated with the Zone A SVE system. These wells will be decommissioned after SVE system startup testing as part of drum removal excavation site preparation to facilitate operations associated with excavation and removal activities. VMW-51I and VMW-51D are constructed with a 4-inch 316 stainless steel casing and a 4-inch 316 stainless steel wire wound well screen. VMW-51I is 35 feet in depth, and VMW-51D is 63 feet in depth.

Vapor monitoring wells PH-36, PH-37, and PH-38 were used for vapor monitoring, may be used for SVE system startup testing, and will be decommissioned as part of drum removal excavation site preparation to facilitate operations associated with excavation and removal activities. They were constructed with1-inch PVC casing and 0.010 slotted screen. All three PH wells were installed in 1995 before the Zone A cover was in place. PH-36 is located on the NW side slope of Zone A and PH-37 and PH-38 are located near the bottom of the southern slope of Zone A. The 1995 borelogs indicated that PH-36 and PH-37 were installed at a depth of 45 feet and PH-38 was 35 feet in depth.

Vapor extraction and monitoring wells VMW-02S, VMW-03D, VMW-03S, and VEW-02 are not in use and will be decommissioned as part of drum removal excavation site preparation to facilitate operations associated with excavation and removal activities. These vapor monitoring wells will be removed after establishing that the new horizontal SVE wells and system are running with sufficient radius of influence. Vapor monitoring wells VMW-01D, and VMW-01S are not in use and are located adjacent to the actively monitored groundwater monitoring well MW-13S, and therefore, will only be decommissioned if the procedure will not disturb MW-13S. Vapor extraction well VEW-03 is not in use. It is located in the topographical depression between the balefill area and the BDI transfer station and will be decommissioned if access is possible. These vapor extraction and monitoring wells may be used for SVE system startup testing.

The intermediate and deep VEWs, VMWs, and PH wells located within Zone A, that are completed below the depth of waste and/or planned extents of excavation, will be decommissioned using the same overdrilling procedures outlined for decommissioning groundwater monitoring wells within the extents of excavation as described in Section 3.2.1 above. This applies to wells VEW-06I, VEW-06D, VEW-07I, VEW-07D, VMW-51I, VMW-51D, and PH36.

The VEW, VMW, and PH wells outside the cover and extents of excavation will be decommissioned using the same grouting procedures outlined for decommissioning groundwater monitoring wells outside the extents of excavation as described in Section 3.2.1 above. This applies to wells VEW-02, VEW-03, VMW-02S, VMW-03D, VMW-03S, PH-37, and PH-38. VEW-01D and VMW-01S will be decommissioned using this procedure if decommissioned.

The procedure will be modified for the shallow depth extraction wells (VEW-06S and VEW-07S) since they are only 11 feet deep and completed entirely within the Zone A cover system. The well boots will be cut away from the casings, the surface seal materials (concrete, bentonite or soil) surrounding the casing will be loosened by mechanical means, and the casing will be pulled by cable connected to casing and the drill rig mast, or similar. Since the entire Zone A cover system will also be removed as part of site preparation for the drum removal excavation, backfilling and sealing these shallow well boreholes is unnecessary.

3.2.3 Vapor Monitoring Probes and Decommissioning Procedures

The VMPs are used to monitor vacuum beneath and outside of the Zone A cover. They are constructed of 1-inch steel pipe with a 1-foot wire mesh wound stainless steel screen with a pointed tip. The VMPs located within the footprint of the Zone A cover (VMPs 2, 4, 5, 6, 8, 9, 10) and extend approximately 5 feet below the geomembrane liner. The VMPs located north and east of the Zone A cover (VMPs 13S, 13D, and 17 through 21) are approximately 10 to 35 feet deep. VMPs will be retained as needed to collect pressure measurements as part of startup testing for confirmation of radius of influence for the proposed horizontal replacement SVE wells. When testing is complete and the reconfigured system is running, these monitoring points will be decommissioned.

The procedure for decommissioning the VMPs will include the following:

- The valve assembly and fittings in the monument at the top of the each VMP will be removed, if possible, and collected for potential re-use.
- The above grade monument will be removed using a skid steer or similar. A strap will be connected to the monument allowing it to be lifted out of the ground.
- A nylon strap (or equivalent) will be connected to the piping and a backhoe will be used to lift the piping about 5 feet.
- Sections of piping will be removed, and the strap will be reconnected to extract and disconnect additional piping. Piping under tension will not be disconnected. Piping connections will be unscrewed above the connecting strap. Pipe wrenches or other supports will be used as necessary to prevent the piping from falling into the hole following removal and as a health and safety precaution of working on equipment under tension.
- If undamaged, and practical, the screen/point will be retained for potential reuse.
- As noted above, since the entire Zone A cover system will be removed as part of site preparation for the drum removal excavation, backfilling and sealing these shallow probe holes is unnecessary.

3.2.4 Thermocouple Arrays and Decommissioning Procedures

The thermocouple (TC) arrays are used to monitor subsurface temperatures within Zone A. Temperature is monitored at multiple depths at each location. The arrays are constructed of multiple stainless steel (or possibly fiberglass) wrapped thermocouple wires attached to an approximately 1-inch diameter PVC pipe. The total depth of each borehole is approximately 30 to 45 feet. The thermocouple arrays will be retained until the material surrounding each array is excavated. Reasonable efforts to protect thermocouples during cover removal will be taken, however if they are inadvertently damaged, they will not be replaced. Once the contractor enters an excavation grid with a thermocouple by direct excavation or sloping, the thermocouple will be decommissioned.

The procedure for decommissioning TCs will include the following:

- Thermocouple wire extensions will be detached. The wire extensions, boxes, and data-logger assemblies will be removed for potential re-use.

- The above grade monuments and concrete pads will be removed using a skid steer or similar. A strap (or equivalent means) will be connected to the monument and it will be lifted out of the ground.
- The polyvinyl chloride (PVC) support column and attached thermocouples will be removed. A nylon strap will be connected to the PVC support and an attempt will be made to pull the PVC and thermocouples from the subsurface. Once removed, the open portion of the borehole will be filled with powdered bentonite and hydrated.
- If the PVC breaks or otherwise does not come completely out of the ground, the remaining open portion of the borehole will be backfilled with powdered bentonite and hydrated.
- If the PVC breaks at less than 5 feet below grade, the skid steer will be used to excavate down to 5 feet for removal.

3.2.5 Landfill Gas Monitoring Implants and Decommissioning Procedures

The Gas Implants (GIs) are used to monitor subsurface landfill gas concentrations within Zone A. Gas concentrations are measured at several depths at each location. The arrays are constructed similar to the TCs, with multiple small diameter tubes attached to an approximately 1-inch diameter PVC pipe. The total depth of each borehole is 30 to 40 feet.

The procedure for decommissioning GIs will include the following:

- Connectors will be removed for potential reuse.
- The same procedures listed in Section 3.2.4 for thermocouple array decommissioning will be followed.

3.2.6 Stormwater Sumps and Decommissioning Procedures

Three stormwater accumulation monitoring sumps are located in the depressions on Zone A. The sumps are used to monitor stormwater accumulation within the low points of each subsidence depression and remove water as needed. Two sumps are located in the northern depression and one sump is located in the southern depression. The sumps consist of a capped PVC pipe extending down to the geomembrane layer.

The procedure for decommissioning sumps will include the following:

- The soil around the PVC pipe will be removed with a shovel or a skid steer (or similar), as needed.
- The PVC pipe will be removed from the ground by lifting or using a nylon strap (or equivalent means) in conjunction with a skid steer (or similar) as needed.
- The open portion where the sump is removed will be filled with soil. Since the sumps do not extend below the geomembrane layer, and the landfill cover will be removed, backfilling of the hole will be performed for the purpose of worker safety using adjacent cover soil.

3.2.7 Survey Benchmarks and Plates and Decommissioning Procedures

Survey benchmarks and plates are located in multiple locations on Zone A. These monitoring points formerly served as consistent monitoring points for surveyors conducting routine subsidence monitoring. Each benchmark or plate consists of a steel base that sits on the geomembrane layer with a pipe or rod extending vertically upward for survey measurements.

The procedure for decommissioning survey plates will include the following:

- The soil around the steel plate and pipe or rod will be removed using a shovel or a skid steer (or similar) as needed.
- The plate will be removed from the ground by lifting or employing a nylon strap (or equivalent means) in conjunction with a skid steer (or similar), as needed, to pull the assembly out.

- The open portion where the plate is removed will be filled with soil. Since the monitoring benchmarks and plates do not extend below the geomembrane layer and the landfill cover will be removed backfilling of the hole will be performed for the purpose of worker safety using adjacent cover soil.

4 DECONTAMINATION

Equipment that is used in multiple borings will be decontaminated as follows:

- Drilling equipment will be cleaned of any off-site contaminants before use to minimize potential for cross contamination.
- Equipment will be cleaned in a designated containment area such as a decontamination pad, tank, or trailer.
- A steam cleaner or high-pressure washer will be used.
- Equipment will be washed thoroughly with tap water and a phosphate free detergent, such as Alconox, using a brush if necessary. Threaded joints will be disassembled as necessary before cleaning.
- Equipment will be rinsed thoroughly with tap water.
- Cleaned equipment will be air dried and covered with plastic if storing overnight.
- See the Site Health and Safety Plan (HASP) for additional decontamination procedures.

Decontamination water will be drummed or containerized and labeled with the boring location(s) and date and stored pending characterization and offsite disposal.

5 INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT

The decommissioning of groundwater monitoring wells and probes will result in excess materials that will need to be characterized and managed consistent with that characterization. The procedures outlined below will be followed when handling wastes generated during well installation and decommissioning.

5.1 Storage and Characterization Sampling

Soil cuttings, development water, and decontamination water will be drummed on a boring-by-boring basis and placed on pallets in rows spaced at least three feet apart. It is possible that individual borings will use more than one drum to containerize the drilling waste. Each container will be labeled with the following information:

- Drum number;
- Date collected;
- Medium contained in container (i.e. soil or water);
- Borehole designation (monitoring well name or monitoring location name);
- Depth interval of the contained soil or water; and,
- Other appropriate information such as significant MSW that may affect waste disposal.

Each drum will be numbered with a permanent paint pen or equivalent, and a log will be created containing all information in the above list. Drums will be staged on-site until the results of the analytical testing have been reviewed.

Depending on the type of waste, drums will be sampled for waste characterization purposes by either grab or composite methods and the sample will be sent to an approved laboratory for analysis. A list of analytes requested is available in the Sampling and Analysis Plan section of this plan. Upon receipt of results decisions will be made regarding potential further analysis and/or appropriate disposal.

Waste will be staged on-site until the results of the analytical testing have been reviewed. If soil cuttings appear to be native soil with background detections of metals and/or no concentrations of contaminants of concern above MTCA A or B cleanup levels, then the cuttings will be spread out on-site. A hazardous or dangerous waste designation label will be attached to the waste upon receipt of analytical data and determination indicating such a waste status. Steps will be taken to limit on-site storage of confirmed hazardous or dangerous wastes to within regulatory established storage time limitations (e.g. 90 days).

If a concentration of a regulated contaminant is greater than 20 times its Toxicity Characteristic Criteria, the sample will be submitted for follow up extraction by EPA SW-846 Method 1311, Toxicity Characteristic Leaching Procedure (TCLP) and for appropriate analysis of the leachate to determine appropriate disposal. Following such testing, the IDW drums will be classified as either dangerous or solid wastes in accordance with Dangerous Waste Regulations (WAC 173-303).

5.2 Waste Designation, Profiling, Transport, and Treatment or Disposal

If the IDW does not classify as a dangerous waste (e.g., exceed the Characteristic or Criteria limits in WAC-173-303-090 or -100) those wastes will be disposed off-site as a non-regulated solid or liquid waste. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

For waste determined to be dangerous or hazardous, the waste will be profiled as required by the accepting facility. All applicable state and federal hazardous waste regulations for waste characterization, segregation, handling, and temporary on-site storage will be followed. Wastes will be transported using a Uniform Hazardous Waste Manifest and will comply with the requirements of the Resource Conservation and Recovery Act (RCRA) and the requirements of the receiving facility. If required by the receiving facility, a representative sample may be collected for each different waste stream and submitted along with the corresponding profiles for additional testing. The receiving facility may require analyses in addition to those discussed herein.

Personnel at the disposal or treatment facility will verify that the waste stream samples are consistent with the information on the completed profiles. Following profile approval, the transportation, treatment, and disposal methods will be finalized.

Applicable state and federal hazardous and dangerous waste regulations will be followed during the actual waste transport, treatment, and disposal (40 CFR 261, 49 CFR 170-178, and WAC 173-303), including selection of appropriate transport companies and destination facilities.

Excavated and stored MSW will be subject to disposal at an off-site facility. Those materials will be disposed of as MSW at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill facility unless evidence suggests the presence of hazardous substances sourced from Zone A industrial wastes. If the MSW materials are thought to be impacted by Zone A industrial wastes, additional characterization testing may be necessary to determine its proper disposal.

Following final waste treatment or disposal, a certification will be provided that specifies the treatment or disposal method used. Final disposal documentation will be provided to Ecology in the *Zone A Excavation, Removal, and Offsite Disposal Construction Completion Technical Memorandum* as required in SOW Task A.3, however preliminary or summary information regarding disposal may be communicated with Ecology sooner.

6 IDW SAMPLING AND ANALYSIS PLAN (SAP)

Samples collected for waste characterization are anticipated to be submitted to ALS Environmental in Everett, Washington and undergo laboratory analysis for:

- VOCs by EPA method 8260 full scan;
- SVOCs by EPA method 8270 full scan;
- PCBs by EPA method 8082;
- Metals by ICP (The analyte list will be adjusted according to requirements of the receiving landfill); and,
- Possible follow up extraction by EPA SW-846 Method 1311, Toxicity Characteristic Leaching Procedure (TCLP) and appropriate analysis of the leachate if a concentration of a regulated contaminant is greater than 20 times its Toxicity Characteristic Criteria [WAC 173-303-090(8)(c)].

The turn-around-time (TAT) for sample analysis and reporting will be the standard TAT, unless a rush is specifically requested. While the turn-around time for laboratory data is generally two weeks, preparation of data packages subject to full data validation may take up to four weeks.

6.1 Sample Preparation

Samples will be collected in laboratory supplied sample containers.

Each sample container will be labeled with a sample name indicating the Site, borehole name, depth (for multiple samples), and date (e.g. PLF-MW56S-20'-122519). Alternately, the sample name for a composite sample from a group of drums will indicate the Site, group number, and date (e.g. PLF-Group1-122519). Duplicate samples will be named with DUP followed by a letter or number in place of the borehole or sampling group name (e.g. PLF-DUP1-122519). The duplicate sample name and type will be recorded in the field notebook. One duplicate sample will be collected for every 20 samples. Sufficient volume for one matrix spike and one matrix spike duplicate sample (MS/MSD) will be collected for every 20 samples.

Each cooler containing VOC samples will include a trip blank. Trip blanks will be labeled as a trip blank with a number and date (e.g. PLF-TripBlank1-122519). Samples will be shipped or transported with sufficient time for laboratory analysis within holding times.

A chain of custody form (COC) will be completed for each shipment of samples to the laboratory. Sample possession will be traceable from the time of sample collection until receipt of samples at the analytical laboratory. Samples will be in the custody of the field sampler(s) from the time of sample collection until the samples are transferred to the shipper. Each sample ID will be listed on the COC along with the date and time of sample collection, analysis requested, and number of sample containers for each sample ID.

Samples will be packaged in a cooler with sufficient ice to keep cool until they reach the laboratory and sufficient cushioning to avoid breakage. The COC will be taped to the inside lid of the cooler. Samples will be shipped to the laboratory via FedEx for overnight delivery. Each sample cooler should be sealed with fiber tape and a signed custody seal.

7 QUALITY ASSURANCE PROJECT PLAN (QAPP)

7.1 Laboratory Analysis

Only laboratories accredited by the Department of Ecology will be utilized. ALS Environmental of Everett, Washington, is expected to be the primary laboratory. The laboratory will follow all required analytical procedures including equipment calibration and tuning procedures. Internal quality control checks such as method blanks, laboratory control samples, surrogate spikes, internal standards, and duplicates will be followed as required. The laboratory will analyze all samples within method-specified holding times. All data reductions will be performed by the laboratory according to procedures specified by the appropriate analytical method.

7.2 Quality Control

Quality control (QC) measures will be taken to evaluate field collection techniques, laboratory precision, potential matrix interferences, and potential contamination from the ambient air.

Field QA/QC: Field duplicate samples, trip blank samples, and matrix spike/matrix spike duplicate (MS/MSD) samples will be the QC samples collected as part of the field QC program.

Duplicate Samples: Laboratory and field sampling precision will be evaluated by collecting blind field duplicate samples. One field duplicate sample will be collected per every 5 percent (1 per 20 samples), or fraction thereof, of the total number of samples per sampling event. Field duplicate samples will be collected under conditions as nearly identical as possible to the original sample. Field duplicate samples will be labeled like standard samples. The field duplicate sample will be analyzed for the same constituent list as the original sample. Duplicate samples will be noted on the borelog and in the field notebook.

Trip Blank Samples: The potential for contamination from the ambient air will be evaluated using trip blank samples. The trip blank will originate at the contract laboratory and will be labeled at the site. One set of trip blanks will accompany each cooler of samples submitted for VOC analysis. Trip blanks will be listed on the chain-of-custody and analyzed for VOCs only.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples: Potential interferences from the sample matrix will be evaluated with MS/MSD samples. A triple volume will be collected for samples subject to MS/MSD analysis. One MS/MSD sample will be obtained for every five percent, or fraction thereof, of the total number of samples collected per event. MS/MSD samples will be given sample names identical to the original field sample but will have “MS/MSD” written next to the analysis requested on the sample bottle label and will also be noted on the chain-of-custody and on the borelog or field notebook. MS/MSD samples will be analyzed for the same constituent groups as the original sample.

Laboratory QA/QC: Upon laboratory receipt, the COC will be signed with the date and time and samples will be checked against the COC. The TAT for sample analysis and reporting will be the standard TAT (typically four weeks) unless a rush is specifically requested. Any issues will be reported to the samplers or project manager for immediate resolution. Samples will be tracked by internal custody procedures. Laboratory QA/QC will be performed in accordance with the procedures for each method. QA/QC procedures include calibration procedures and frequency, analysis of laboratory control and blank samples, recovery of surrogates and spikes, and data reduction and validation. Lab control, blank, surrogate, and spike data will be included in the report.

7.3 Laboratory Data Reduction and Reporting

The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratories to resolve any QC problems in a timely manner. The analytical laboratories will be required, where applicable, to report the following:

- **Cover letter**: A summary, in the form of a cover letter, will discuss problems, if any, encountered during analysis.

- **Chain-of-Custody Records**: Legible copies of the chain-of-custody forms will be provided as part of the data package. This documentation will include a receiving signature and the time of receipt of each sample received by the laboratory. The laboratory sample identification number will also be documented.
- **Sample Data Results**: The laboratory report will summarize the results for each sample analyzed. This section of the report will include the following information, when applicable:

  - Field sample ID and the corresponding laboratory sample number;
  - Analytical method;
  - Reporting limit for each analyte;
  - Dilution factor for each analyte;
  - Analysis dates for each analyte;
  - Analytical results reported with reporting units identified;
  - Data qualifiers and their definitions;
  - Electronic data deliverables; and
  - Surrogate spike percent recovery for each method analyzed, as appropriate.

- **Quality Assurance/Quality Control Summaries**: This section will contain the results of QA/QC analysis. No recovery or blank corrections will be made by the laboratory.
- Trip blank data will be reported in the same manner as the field sample results.
- Method blank analyses associated with each sample and the results for each analyte will be reported.
- Matrix spike and matrix spike duplicate recovery data will be reported. The name and concentration of all compounds added, percent recoveries, relative percent difference, and limits of recoveries will be listed. The relative percent difference (RPD) for all duplicate analyses will be reported.
- Laboratory control sample data will be reported.
- Field duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

7.4 Data Validation

Once data are received from the laboratory a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

Compliance screening data validation will be performed on all data. The laboratory reports will be reviewed for internal consistency, transmittal errors, laboratory protocols, and adherence to the data quality objectives, as specified in this sampling and analysis plan.

A data quality review of the analytical data will follow the USEPA National Functional Guidelines (USEPA 2017). All chemical data will be reviewed for the following:

- Chain-of-custody documentation;
- Sample holding times;
- Reporting limits;
- Surrogate recoveries;
- Method blanks;
- MS/MSD recoveries and RPDs;
- LCS/LCSD recoveries and RPDs;
- Laboratory and field duplicate RPDs; and

- Trip blanks.

A data validation summary will be presented in the report discussed below.

8 RECORDKEEPING

Copies of the laboratory report, electronic data, and signed chain-of-custody forms will be retained in the project files.

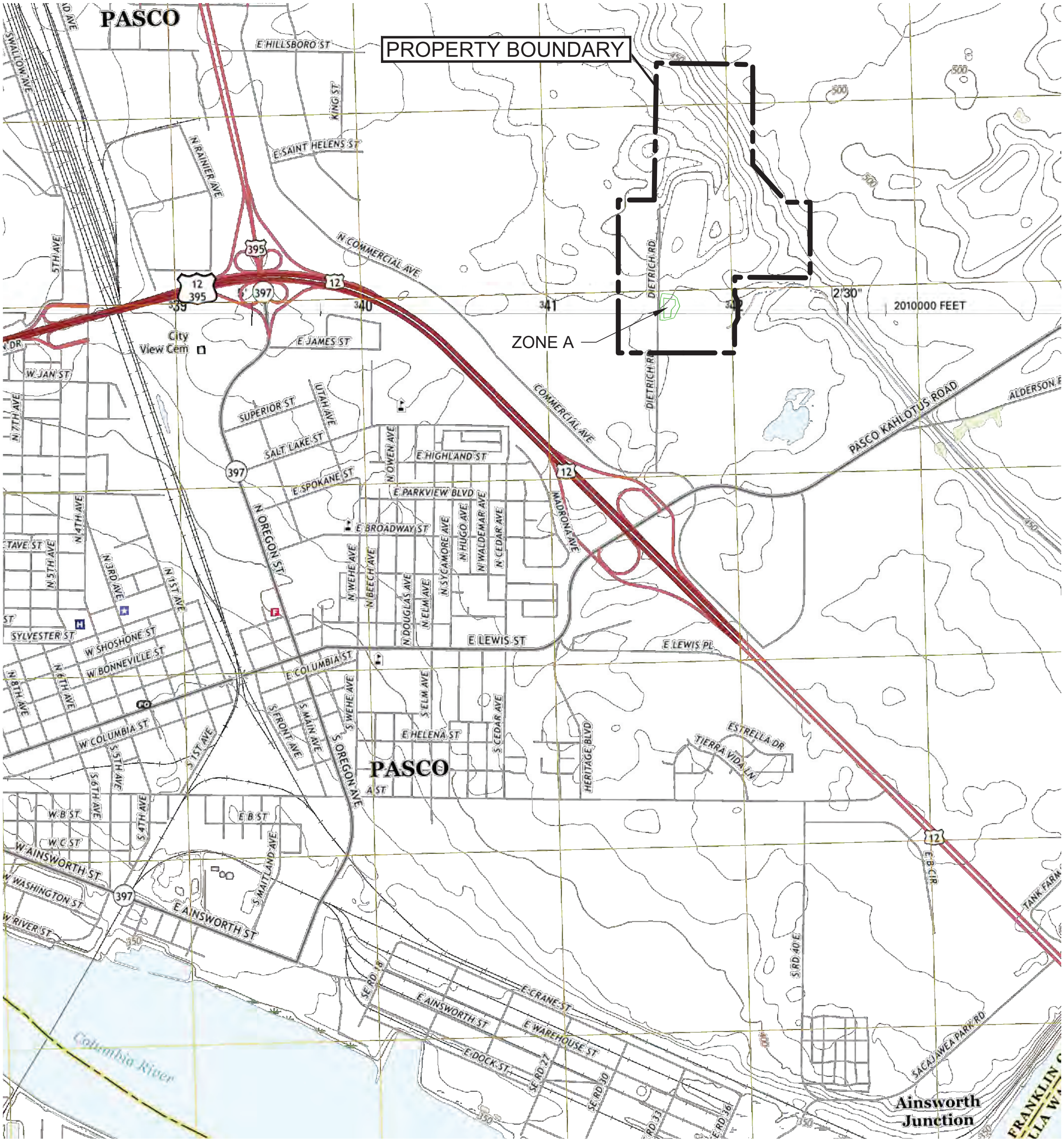
9 SCHEDULE AND REPORTING

The following milestones are anticipated after submittal of this plan:

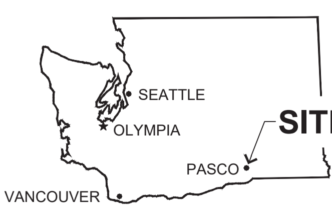
- Ecology acceptance of revised plan;
- Receipt of Ecology comments on SVE system reconfiguration plan;
- Revision and Ecology acceptance of revised SVE system reconfiguration plan;
- SVE system well installation, system reconfiguration;
- SVE system testing;
- Decommissioning of monitoring locations as part of site preparation activities; and
- Installation of MW-57S and MW-58S as part of site preparation activities .

Activities will be scheduled after Ecology approval and as subcontractor schedules allow. A brief memo will be prepared documenting installation of MW-56S, MW-57S, and MW-58S as part of the quarterly progress report for the month each well is installed or final laboratory data is received, as part of reporting required by the SOW. The summary will include maps of actual drilling locations, construction details for the wells, borelogs for each well, a summary of waste sampling and characterization, and disposal documentation.

FIGURES



SOURCES: USGS PASCO, WA QUADRANGLE 2017,
USGS GLADE, WA QUADRANGLE 2017.



WASHINGTON

Scale 1" = 1/2 MILE

0' 1/4 mi 1/2 mi 1 mi

PREPARED FOR: IWAG GROUP III

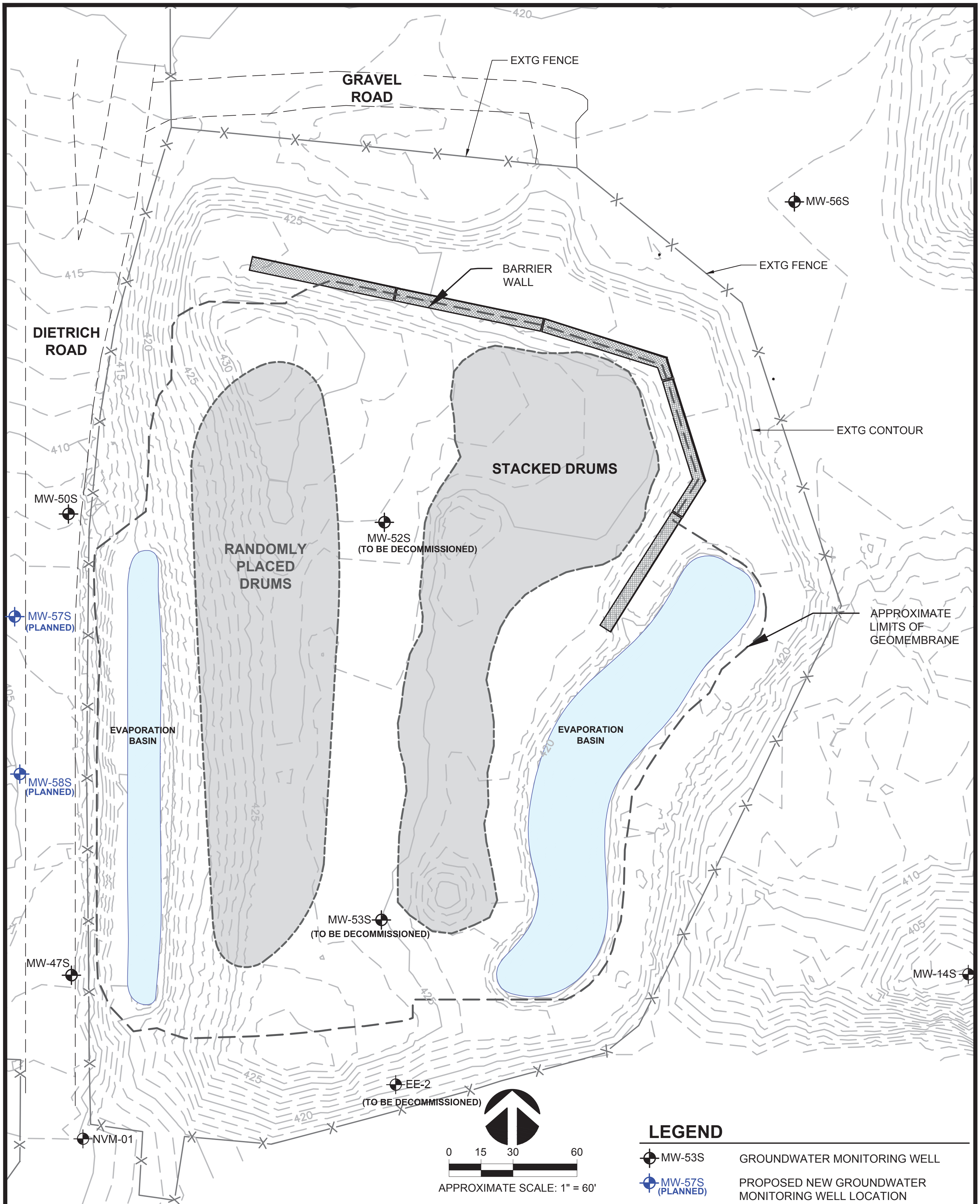
PBS

SITE LOCATION MAP

PASCO LANDFILL NPL SITE
PASCO, WASHINGTON

JUN 2019
64180.019

FIGURE
1

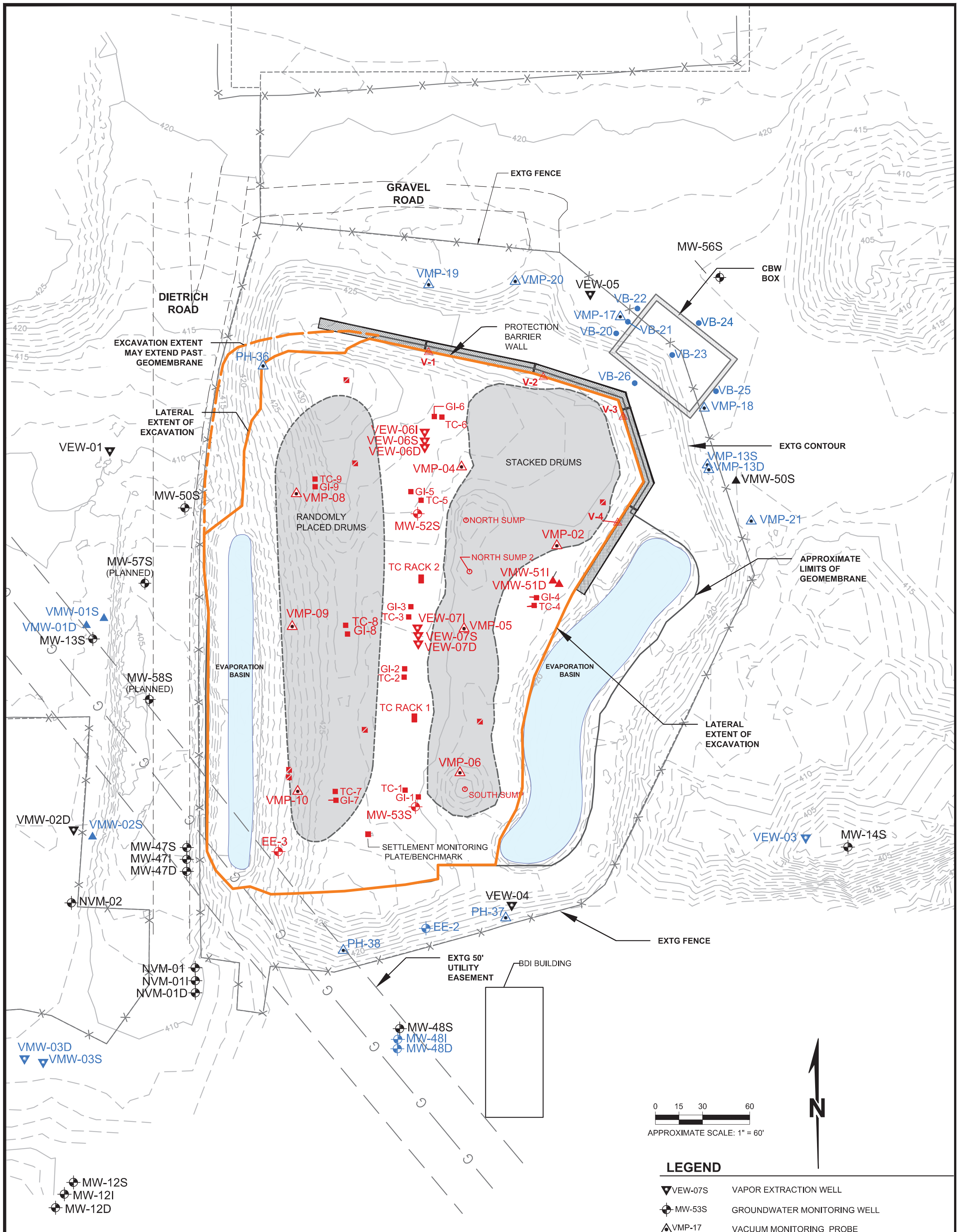


PLANNED GROUNDWATER MONITORING LOCATIONS

PASCO LANDFILL NPL SITE
PASCO, WASHINGTON

02/25/2019
64180.020

FIGURE
2



NOTES:

LOCATIONS IN RED ARE WITHIN EXTENTS OF EXCAVATION AND WILL BE REMOVED

LOCATIONS IN BLUE ARE OUTSIDE OF EXTENTS OF EXCAVATION AND WILL BE REMOVED

LOCATIONS IN BLACK WILL NOT BE AFFECTED

VAPOR MONITORING LOCATIONS WILL BE RETAINED UNTIL SVE SYSTEM STARTUP TESTING IS COMPLETE

LEGEND

VEW-07S	VAPOR EXTRACTION WELL
MW-53S	GROUNDWATER MONITORING WELL
VMP-17	VACUUM MONITORING PROBE
VMW-51I	VAPOR MONITORING WELL
V-1	AIR ADMITTANCE VALVE
SOUTH SUMP	STORMWATER SUMP
PH-36	SOIL GAS PROBE
TC-1/GI-1	THERMOCOUPLE/GAS IMPLANT ARRAY
	SETTLEMENT MONITORING PLATE/BENCHMARK
	THERMOCOUPLE RACK (APPROX.)

PBS

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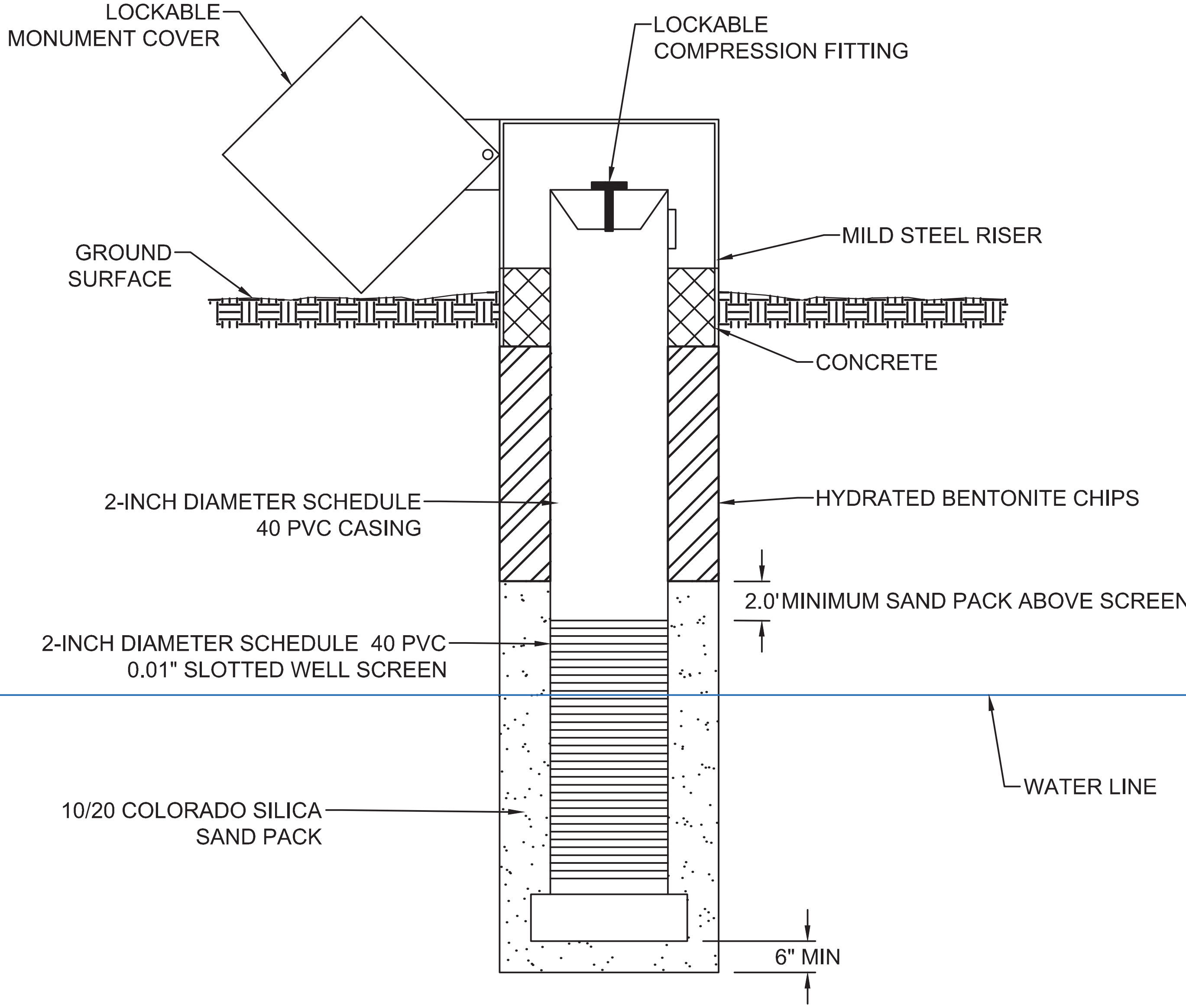
MONITORING LOCATIONS TO BE DECOMMISSIONED FOR ZONE A EXCAVATION

PASCO LANDFILL NPL SITE
PASCO, WASHINGTON

PROJECT: 64180.020
DATE: 02/25/2020
FIGURE: 3



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PBS

GROUNDWATER
MONITORING WELL DETAIL

Scale: N/A	**Date:** 10/21/2019	**Drawing:** GroundWater_WellDetail.dwg
Job #: 64180	**Reference:** FIGURE 4	

Pasco Sanitary Landfill NPL Site

Zone A Removal Action
Engineering Design Report

Appendix B
Compliance Monitoring Plan

Appendix B.9
Soil Vapor Extraction System
Reconfiguration Plan

FINAL

SVE System Reconfiguration Plan

Pasco Landfill NPL Site
Pasco, Washington

Prepared for:

Washington State Department of Ecology
and
IWAG Group III

Prepared by:

PBS Engineering and Environmental Inc.

June 18, 2020
PBS Project No. 64180.020

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SUPPORTING DATA

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1 INTRODUCTION

This SVE System Reconfiguration Plan provides information regarding modifications planned for the Soil Vapor Extraction (SVE) System for the Zone A Industrial Waste Area (Zone A) at the Pasco Landfill National Priorities Listed (NPL) Site (hereafter Site) in Pasco, Washington. The modifications will involve installation of new horizontal wells beneath Zone A and removal of the existing vertical wells located within Zone A to allow planned drum removal and excavation activity to proceed within Zone A.

This plan has been prepared on behalf of the Industrial Waste Area Generators Group III (IWAG) for submittal to the Washington State Department of Ecology (Ecology) as a component of the *Zone A Removal Action Engineering Design Report* (EDR). An Ecology review draft of the EDR was prepared by Floyd|Snider, GHD, and PBS Engineering and Environmental Inc. and submitted to Ecology on December 9, 2019 in fulfillment of Enforcement Order DE 16899 (EO). This plan is being submitted as an Appendix of the EDR to address Ecology comments on the draft EDR and provide details related to requirements in Task A.1, Subtask B of the EO and the Scope of Work and Schedule in Exhibit C of the EO. This document also satisfies the specific requirements of WAC 173-340-400(4)(a) for preparation of an engineering design report.

The SVE system has been in operation since 1997. Major SVE system upgrades were made in 2011 and 2012 and the design was presented in the *Engineering Design Report for SVE System Upgrades*, prepared by Environmental Partners, Inc. (EPI), dated July 2, 2010. Data collected and evaluated during the years of operation have informed the engineering design criteria for the SVE system reconfiguration to be implemented.

The SVE system reconfiguration is intended to replace the existing deep vertical vapor extraction wells (VEW-06D and VEW-07D) with two horizontal vapor extraction wells (VEW06H and VEW-07H) in the same zone as the existing D-VEWs. The purpose of installing horizontal replacement wells is to maintain the capture and extraction of volatile organic compounds (VOCs) under Zone A during the planned excavation and removal of the drums. The horizontal VEWs are designed to draw similar flow rates and affect a similar radius of influence in the Upper Pasco Gravel (UPG) zone and throughout Zone A. Ongoing SVE operations will also help to reduce the potential for off gassing and provide ongoing groundwater protection during construction.

This plan presents information for the engineering design, plans, calculations, assumptions, and specifications to reconfigure the existing SVE system to support the Zone A removal action. Selected general engineering principles and guidelines of the US Army Corps of Engineers (USACE) document *Engineering and Design – Soil Vapor Extraction and Bioventing* (EM-1110-1-4001), dated 2002 (USACE 2002) have been utilized during the development of this design document.

2 GEOLOGICAL UNITS AND WELL DESIGN CRITERIA

2.1 Geological Units

2.1.1 Touchet Beds of the Hanford Formation

The natural ground surface at Zone A was replaced with fill during construction of the waste repository area. The uppermost named soil unit at Zone A is the Touchet Beds, which is generally encountered at or near the surface beneath a sandy loam topsoil cover. The Touchet Beds consist of late Pleistocene glaciofluvial slack-water deposits. The Touchet Bed soils are typically gray-brown, poorly graded, fine- to medium-grained sands that can be locally silty and gravelly. Bedding layers range from a millimeter to several centimeters. Clastic dikes consisting of nearly vertical sand and silt layers within the Touchet Beds have been sporadically observed. No such clastic dikes have been observed within the Touchet Beds at the Zone A.

Within the area of Zone A the Touchet Beds are expected to be approximately 30 feet thick, based upon drilling activities associated with the installation of monitoring well MW-50S.

2.1.2 Upper and Lower Pasco Gravels

The Pasco Gravels consist of gray to dark gray, mostly unconsolidated silts, sands, and gravels originating during cataclysmic floods during the Pleistocene Epoch. The Upper Pasco Gravels are generally described as fine- to medium-grained sands with the percentage of gravel increasing with depth. The Upper Pasco Gravels immediately underlie the Touchet Beds. The bedding contact between the Touchet Beds and the Upper Pasco Gravels is not easily discernable and has been encountered at the SVE-06 and -07 wells beneath Zone A at elevations ranging between 387 to 383 feet relative to the North American Vertical Datum (NAVD) 1988. A thin (i.e., one to two feet thick) marker bed has occasionally been observed at the contact between the Touchet Beds and the Upper Pasco Gravels. At Zone A, the Upper Pasco Gravels are unsaturated.

The underlying Lower Pasco Gravels are generally sandy gravel to gravelly sands with some localized cementation being possible. The Lower Pasco Gravels immediately underlie the Upper Pasco Gravels and were first encountered at elevations ranging between 356 and 366 feet at the SVE-06 and -07 wells.

In the area of Zone A, the Upper Pasco Gravels are expected to be approximately 28 feet thick based upon the installation of monitoring well MW-50S.

The elevation of the water table beneath Zone A is generally 352 to 354 feet, or approximately 70 to 76 feet below the existing top of Zone A. The unconfined water table aquifer is typically first encountered in the Lower Pasco Gravels and extends through the older Middle Ringold unit, which underlies the Lower Pasco Gravels.

2.2 SVE Effectiveness

The current SVE system removed an average of approximately 64 pounds per day of total volatile organic compounds (VOCs) in 2019. Since February 20, 2019, all induced flow at Zone A has been directed to SVE wells VEW-06D and VEW-07D. The resulting soil vapor is treated by the regenerative thermal oxidizer (RTO) in the SVE operations yard. The upgraded system is expected to have similar contaminant mass loadings since the horizontal wells (VEW-06H and VEW-07H) will be screened within the same formation and in similar locations relative to the vertical wells currently in place. The RTO system currently treats a total of approximately 500 standard cubic feet per minute (scfm) of soil vapor from the deep wells operating within Zone A. For the purposes of this EDR, 500 scfm of soil vapor is considered typical for the design and operation for the modified SVE system.

The data used in evaluating the current radius of influence and performance of the existing deep SVE wells was collected during routine performance monitoring of the SVE system. These data were previously submitted to Ecology in monthly reports.

The calculations herein present the findings of critical elements evaluated during the design process that demonstrate the anticipated equivalency of the SVE system in its proposed configuration with horizontal wells. Further analysis of predicted flow paths, the effects of anisotropy within the soils and well construction design considerations are included in *Appendix A - Air Flow Modeling in Support of Upgrade, Revised 100% Submittal Engineering Design Report for SVE System Upgrades, Phase II Additional Interim Actions,* Environmental Partners, Inc., July 2, 2010. The Appendix A - Air Flow Modeling has been primarily used as a tool to help evaluate potential vertical and horizontal airflow pathways under differing well construction design scenarios.

2.2.1 Radius of Influence of Current Deep SVE Wells

Currently two deep vertical VEWs, (06D and 07D) are used to extract vapor from the UPG at the extraction rates, as recorded on February 17, 2020. The screened intervals of the two deep VEWs are within the UPG exclusively. Each of the deep VEWs (06D and 07D) operate within similar wellhead flow rates and vacuum parameters to present an effective combined radius of influence greater than 200-feet from each respective well (see Table1).

The measured radius of influence (ROI) from the existing deep VEW wells (06D and 07D) screened in the Upper Pasco Gravels (UPG) stratigraphic zone are provided by bi-weekly vacuum pressure readings from 19 vapor monitoring wells or probes (see Table 2). Vacuum monitoring probes or wells screened at depths of 50 to 65 feet below ground surface are in the UPG unit, while the monitoring points screened in shallower intervals are in the overlying Touchet Beds. Vacuum pressures recorded in the UPG monitoring points VEW-04, VEW-05, VMW-51D, and VMW-50S on February 17, 2020 range from -2.6 to -3.1 inches of water column, indicating vapor extraction in the UPG is highly effective.

The vapor extraction ROI is determined when vacuum pressure at monitoring points is at least 1% of the pressure induced at the extraction well head. Since VEW-06D and VEW-07D have vacuum pressure readings of -53.9 and -58.8 inches of water, the effective vapor pressure at the ROI limits would need to be greater than 0.539 and 0.588 inches of water. Therefore, any pressure reading greater than 0.5 inches of water is an indication of vapor extraction influence. The radius of influence from the VEW-06D extraction well is at least 200 feet, as the measured vacuum at VMW-05 is -3.0 inches of water. The ROI from the VEW-07D extraction well is at least 180 feet, as the measured vacuum at VEW-04 is -2.6 inches of water. The effective ROI by the combined extraction wells, VEW-06D and -07D is at least 200 feet. The 200-foot ROI extends beyond the entirety of the Zone A area.

The differential in vacuum readings in the UPG versus the overlying Touchet Beds indicates significant vapor flow patterns occur in the higher permeability UPG zone and not the lower permeability Touchet Beds. The Touchet Beds act as a low flow cap to the UPG due to low permeability of the unit.

2.2.2 Horizontal SVE Well Design Considerations and Performance

The SVE system is intended to operate in the UPG. Given the UPG is a homogeneous unit the horizontal versus vertical intrinsic permeability ratio is relatively high, implying the preferred vapor flow is horizontal through the UPG unit. Since the UPG is an order of magnitude more permeable than the upper (Touchet Beds) and the water table provides a lower no-flow vapor boundary, vacuum distribution in the UPG is uniform and has a preferred horizontal vapor flow orientation. The horizontal well design also accounts for gradation in permeability conditions between the upper zone of the UPG and the overlying Touchet Beds interface. Based on boring logs, diminishing fine silt lenses extend approximately 10 feet into the UPG before soils grade to the homogeneous sandy gravel composition.

The UPG acts as a high permeable unit and vapor within the UPG will move to the low-pressure zone created at the extraction well(s) by lowering the vapor pressure. There is no significant difference in calculation of vapor flow to a horizontal versus a vertical vapor extraction well orientation. The vapor flow calculations use the same input parameters (soil porosity, pore-gas velocity, soil permeability) and center of screen as the model factors. Given the monitored flow and vacuum data under Zone A associated with current SVE conditions, and thickness of the UPG, a horizontal well configuration can be expected to provide similar extraction rates and radius of influence. The radius of influence calculation for the proposed horizontal wells is shown in Calculation 1 (Attachment 1).

The placement of the new horizonal well screens must have separation above the water table interface to avoid potential submergence of the well screen and to minimize upwelling of the water table by the induced vacuum pressure from the extraction well. There have been no groundwater mounding observations under the current VEW configuration which indicates that the vacuum pressures induced in the permeable UPG have negligible influence on the water table interface. The seasonal variation in the groundwater table elevation has been less than (-/+) 2 feet over a decade of monitoring the water levels. The recommended separation between the horizontal well screen and the water table (elevation ~356 ft) to prevent inundation or mounding is 14-feet. Therefore, the horizontal well(s) should be placed at an elevation of 370 ft (-/+ 2 feet).

The excavation and removal of the Zone A geomembrane and cover, overburden material and drums and drum waste from Zone A may create the potential for some air leakage through the overlying Touchet Beds into the UPG from below any temporary cover of 6-mil polyethylene sheeting installed as part of the General Contractor working surface. While there will be a layer of lower permeability Touchet Beds remaining during the excavation activity, the potential for air leakage could affect the horizontal radius of influence in the UPG created by the horizontal extraction wells. If vertical leakage from the surface through the Touchet Beds increased by 10%, the effective horizontal radius of influence may reduce by 10%. Therefore, if the current ROI is greater than 200 feet from the extraction well, a reduced ROI under surface leakage conditions may be 180-feet in the UPG unit.

2.2.3 Comparison to Prior SVE Model

2.2.3.1 Air Flow Modeling in Support of the 2010 SVE Upgrades

The air flow modeling conducted in support of the Phase II Additional Interim Actions document, *100% Submittal Engineering Design Report for SVE System Upgrades* (hereafter 2010 EDR) (EPI, 2010) used the ModAir software (S.S. Papadopulos & Associates, Inc. (SSPA), 1996), which is an adaptation of the U.S. Geological Survey MODFLOW groundwater modeling code, presented several scenarios for vapor extraction flow pathways. One of the cases modeled (Case 5) included extraction from a single deep well screened in the UPG. The predicted Case 5 model shows the horizontal flow in the UPG to the extraction well. The flow path lines to the vapor well and radius of influence under the Case 5 model have been verified using actual monitoring data. The Case 5 model is a good representation of the vapor response for the site conditions. The air flow model predicted relatively conservative estimations of flow rates, wellhead vacuum pressures and radius of influence in comparison to actual field data measurements collected between 2012 and 2019.

2.2.3.2 Modeling Approach

The previous modeling approach used a simple 2-dimensional configuration representing one of the two SVE well clusters presented in the EDR. The model conditions consisted of a surface layer representing the geomembrane liner within Zone A and an atmospheric boundary condition outside Zone A, the Touchet Beds, and the Upper Pasco Gravels. The bottom boundary of the model was the water table which represents a no flow boundary as there is no air flow through the saturated zone. The model did not evaluate up-coning of the water-table due to SVE operation as the amount of up-coning was not expected to have any significant effect on the air transmissivity of the Upper Pasco Gravels.

2.2.3.3 Air Flow Analysis

The model results under the Case 5 analysis predicted air flow to a deep extraction well with 10-ft screen completed in the middle of the Upper Pasco Gravels as shown in Figure 3 of the 2010 EDR. Case 5 had no induced vacuum in the shallow Touchet Bed extraction well(s). The flow lines indicated that most of the air flow would be to the UPG deep well with very little vertical air flow from the overlying Touchet Beds.

2.2.4 Head Loss

Head loss (friction loss) calculations are presented as a component of this EDR in Calculation 2 (Attachment 1). The head loss calculations currently predict that sufficient vacuum will be available to achieve target flow rates in the upgraded SVE system. Head loss calculations were performed using the USACE 2002 friction loss charts for PVC pipe and by converting friction losses incurred through various fittings into equivalent pipe lengths. Attachment 2 contains the USACE friction loss charts for various sizes of piping, several tables of equivalent pipe length head loss coefficients through various fittings, and a pressure drop curve for a moisture separator comparable to the ones used at the Site. Current information suggests that roughness coefficients are similar for PVC and high-density polyethylene (HDPE) piping (the material used at the Site for conveyance piping); therefore, friction losses through the piping will be estimated using the charts for PVC pipe. In some cases, the friction losses through some of the fittings such as flex pipe have been estimated using conservative values.

The head loss calculations use planned SVE well VEW-06H as the model due to its distance from the equipment compound compared to the VEW-07H well location. It is assumed that all of the discharge piping downstream of the blower will remain unchanged. As a result, the head loss calculations use the anticipated vacuum that will be induced at the flow rates presented in the calculations and ignores the pressure side of the blower, which will remain unchanged. Friction losses across various system components have been compiled through published data, information provided by vendors, or by conservative estimations. Current estimations of the anticipated head loss at 250 scfm from VEW-06H (with VEW-07H also removing 250 scfm) is roughly 14 inches of water column (w.c.). This 14-inch w.c. head loss, plus the currently measured vacuum at the active VEW-06D wellhead of about 51 inches w.c., totals to about 65 inches w.c. of total vacuum. This value is below the current measured vacuum at the blower (i.e., head loss plus induced vacuum) of around 74 inches w.c. This allows additional available vacuum at the well heads if necessary.

The maximum sustained operating vacuum for the existing blowers is about 80 inches w.c. Each horizontal SVE well will be operated on individual blowers. If necessary, the wells can be operated on a single blower, as they currently are. All system components that will be used in the upgrades will be capable of withstanding the maximum foreseeable applied vacuums.

2.2.5 Condensate Generation

Condensation in the horizontal well casing is expected to be minimal, as little vapor cooling will occur in the subsurface during its conveyance to the surface in the well casing, and the majority of the cooling of the vapors will occur at the above ground wellhead completion and along the near surface conveyance piping to the BGMS and SVE equipment building. Any small amounts of condensate that collect on the subsurface well casing is expected to be pushed to the surface with the vapor flow or temporarily return to the formation in the screened portion and be re-extracted with future vapors. Existing conditions at VEW-06D and VEW-07D have been used to estimate the amount of condensate that could potentially form in the operation of the proposed horizontal wells.

Temperatures of soil vapor at the existing VEW-06D wellhead have been measured between about 88 °F and 108 °F, with an average of about 95 °F, from October 5, 2015 through March 31, 2020. Temperatures measured at the existing VEW-07D wellhead during the same time period ranged from 84 °F and 110 °F, with an average of 94 °F. The water saturation percentage (humidity) of the recovered soil vapor is assumed to be 100% during this time period. The average annual condensate generation from 2012 through 2018 was 23,484 gallons. PBS has estimated the theoretical volume of condensate that may be generated during operation of the upgraded SVE system in Calculation 3 (Attachment 1). In the proposed reconfigured SVE system, each moisture separator could accumulate up to approximately 92 gallons of condensate per day during winter ambient temperatures of 32 °F from the humid extracted vapors cooling in the near surface conveyance lines from the wellhead to the SVE equipment building. Condensate generation in the winter months since 2016 has shown to be about 76 gallons or less per day in each BGMS, and it is expected that VEW-06H and VEW-07H will produce a similar amount of condensate to VEW-06D and VEW-07D. The conservative volume estimate of 92 gallons per day is based upon a total flowrate of 500 scfm, 50 inches w.c. vacuum, 100 percent humidity at 95 °F, and an ambient temperature of 32 °F. Condensate accumulation has been shown to be significantly less during summer months when ambient temperatures are higher. The psychrometric chart used in the determination of humidity ratios is included in Attachment 2 to this document. The moisture separators have an approximate 140-gallon capacity for each unit, and at this rate of condensate accumulation, the volume of each unit would turn over in about one and a half days. These separators have been designed to pump condensate while the SVE system is operating, to allow for the continual SVE operation.

SVE system condensate generated by VEW-06H and VEW-07H will be sampled for waste characterization and profiling prior to disposal of the first shipment off-site after the reconfiguration is complete. Subsequent sampling and analysis will be conducted semi-annually at the oil-water separator, and condensate sampling will be performed in accordance with procedures in *Addendum No. 4 to the SVE System O&M Manual (2017 Upgrades): Below Grade Moisture Separator Upgrades and Condensate Sampling*, dated December 18, 2019.

2.3 Below Ground Well Completion Details

As discussed above, the SVE reconfiguration at Zone A will consist of the placement of two horizontal SVE wells with intake screens underneath the footprint of Zone A, with each horizontal well intended as an equivalent replacement for the deep wells in the VEW-06 and VEW-07 SVE well clusters presently installed. Exact locations of the screens may be altered depending on the field conditions encountered beneath Zone A during drilling.

Sheet 2 in the design drawings is a general depiction of where the SVE wells and new conveyance lines will be placed with regard to the SVE wells currently installed in the Zone A landfill. Sheet 3 depicts the plan and profile view for the horizontal SVE wells. These figures comprise the basic model for the completion details and screened intervals for the horizontal SVE wells. Sheet 4 depicts the above ground piping detail. Sheet 5 depicts the construction details of the SVE wells as they will be installed below ground. Sheet 6 shows the proposed conveyance piping from the SVE wellheads to the SVE equipment building.

The general purpose of these wells is to provide equivalent VOC mass recovery as the presently installed deep vertical SVE wells for protection of groundwater during the Zone A Removal Action. The deep wells will also be used to monitor vacuum and vapor conditions beneath Zone A within the Upper Pasco Gravels.

An 8-inch bore hole will be constructed using horizontal drilling methods starting from a borehole located on the west side of Dietrich Road. The piping in the well will be installed with a continual negative slope from the wellhead to the screen to prevent condensate from accumulating in the riser and causing surging or blockage of air flow. The target elevation for the screens will be approximately 367 ft and be off set from the existing deep well screens by approximately 10 ft, as shown in Sheet 3. After the target location for the screen is reached, a 15-foot long screen connected to the riser piping will be pushed into the borehole with a tremie pipe temporarily attached.

Drilling methods are still under evaluation, and the borehole will be drilled with either a bentonite-based drilling fluid or a biodegradable polymer-based drilling fluid. If the polymer-based drilling fluid is used, the borehole around the screen will be developed by flushing with water and an enzyme solution to remove the bulk of the drilling fluid to the surface and accelerate the breakdown of the industry-standard biodegradable polymer drilling fluid that may be left in the boring. Once the bore flush is completed, the screen will be jetted with water through a high-pressure nozzle to remove any soil or drilling fluid that may have impacted the screen. SDS for the drilling fluid and well development enzyme are included in Attachment 3.

If the bentonite-based drilling fluid is used, the boring will be flushed with fresh water to remove the drilling fluid to the surface. After the boring has been flushed with fresh water, the boring will be flooded with a solution of an environmentally safe clay dispersant. A sufficient volume of dispersant solution will be pumped into the well to saturate the formation immediately adjacent to the wellbore and given sufficient residence time to allow the drilling fluid to de-flocculate. The well will then be flushed using fresh water with a sufficient flow velocity to ensure remaining solids are suspended and removed from the wellbore as the fresh water circulates back to the surface. The volume and physical characteristics of fluid and solid returns will be monitored to ensure the wellbore has been cleaned of drilling fluid and if additional flushing or treatment with dispersant is needed.

If the biodegradable polymer-based drilling fluid and enzyme is used for well drilling and installation, the volume of enzyme solution well be recorded as part of borehole logging. Likewise, is the drilling fluid is bentonite-based and a de-flocculant is used for drilling, the amount of de-flocculant used will be documented as part of the borehole logging. Regardless of the drilling method used, losses during the drilling and flushing processes will be documented. Borehole logging will document intervals where significant drilling fluid loss occurs, subsurface voids, and borehole intervals that show obvious evidence of contamination.

A well seal will be placed approximately 10 feet from the beginning of the screened interval using a shale trap packer pushed ahead of the tremie pipe. The annular space around the riser will be filled with cement and bentonite as the tremie pipe is slowly pulled from the borehole. Management of investigation derived waste can be found in Section 2.3.1.

SVE wells will be constructed of 4-inch diameter 316 stainless steel casing and screen. The 4-inch diameter will accommodate reasonable airflow rates in the pipe. Continuously wire-wound stainless-steel well screen was chosen for this system for the following reasons:

- Large open area. Wire-wound well screen has a relatively large open area per unit length of screen. This results in lower intake velocities as compared to slotted pipe, which should reduce frictional losses and decrease the vacuum necessary to produce the desired flow rate.

- Smooth internal surfaces. Wire-wound well screen has smooth internal surfaces compared to the machine slotted groves in slotted piping. These smooth surfaces further reduce turbulent flow and frictional losses within the piping. The smooth internal surfaces also provide surface area that is less conducive to biological growth. This reduces the need for cleaning, lengthens the interval between cleanings, and shortens the cleaning process.

- Chemical resistance. Compared to other materials, stainless steel provides the best chemical resistance and structural integrity over the broadest range of chemical conditions that could be encountered beneath Zone A.

The screened interval will be 15 feet long and will be approximately 14 feet above the average high water table. These wells will be completed with 0.02-inch wire-wound screen. Installation of a sand filter pack around the screened portion of the horizontal wells is impractical when using horizontal drilling methods, necessitating the use of a natural pack around the screen. A natural pack is allowing the annular space around the screen to be left open until the formation collapses around the screen. Given the screen interval is 15-feet in length, and the annular space between the drilled 8-inch diameter borehole and 4-inch diameter SVE screen, the void space is relatively minimal and the UPG gravels will provide a consistent permeable screen pack. This type of completion should work well for the horizontal wells due to the low viscosity and density of air.

2.3.1 Investigation-Derived Waste Management

Investigation-derived waste (IDW) will be generated during horizontal boring and SVE well installation. The IDW will include:

- Drilling muds, cuttings and spoils
- Decontamination water from drilling operations
- Development water

Section 2.3.2 details the characterization, handling, and management of IDW in accordance with applicable regulations.

Used drilling muds will be generated during drilling of the horizontal borings. The muds may encounter impacted soils beneath Zone A. As a result, the muds have the potential to be impacted with Site contaminants of concern (COCs). During drilling, clean mud is injected into the boring and used to transport the waste soils to the surface. Based on the soil types encountered it is anticipated that there will be less than ½ inch of mud penetration surrounding the borehole within Touchet Beds soils and up to 1-inch of penetration within the Upper Pasco Gravels. Therefore, only nominal mud loss is anticipated due to sidewall penetration.

The mixed mud and soil cuttings will be bulk placed into lined roll-off bins for characterization and disposal. It is currently anticipated that 2,500 to 3,200 gallons of a mud-soil slurry will be generated from the installation of the horizontal borings. To the extent practical, waste mud and soil cuttings from the borehole interval from the west of Dietrich Rd to the western edge of the N-S Burn Trench will be collected in separate roll-off bins from the mud and soil cuttings throughout the N-S Burn Trench to the end of the boring under Zone A. Waste mud, cuttings, and water used for flushing the borings and decontamination of equipment from each boring will be contained in 10 cubic yard roll-off bins and it is anticipated that a total of two to four such bins will be used. A sample of the liquid phase and a sample of the solid phase material from each of the roll-off bins will be collected and submitted for laboratory analyses to characterize the wastes for disposal. Laboratory analysis is discussed in Section 2.3.2.

There is the potential for some of the wastes to be classified as dangerous or hazardous waste based upon the toxicity characteristic criteria. Evaluation of whether these wastes designate as dangerous or hazardous wastes is discussed in detail in Section 2.3.2.

Waste samples will be analyzed for those compounds listed in the toxicity characteristics list in WAC 173-303-090(8)(c) as indicated in Section 2.3.2. Analytical results will be compared directly to the listed limits. As a high-solids liquid, these muds will require a procedure to settle solids and decant liquid for separate disposal, after which sampling will be performed. The waste muds will be handled according to applicable regulations and requirements, and all analytical results will be provided to the disposal facility for profiling and acceptance.

2.3.2 Investigation Derived Waste Management Procedures

Depending on the type of waste, drums will be sampled by either grab or composite methods and the sample will be sent to an approved laboratory for analysis. Analytes requested will be representative of the investigation program. Upon receipt of results decisions will be made regarding disposal.

Steps will be taken to limit on-site storage of confirmed hazardous or dangerous wastes to within regulatory established storage time limitations (e.g. 90 days). A hazardous or dangerous waste designation will be attached to the waste upon receipt of analytical data and subsequent characterization indicating such a waste status. Disposal certificates will be produced and provided to Ecology upon final treatment or disposal of all dangerous and hazardous wastes.

Waste from the horizontal borings will be containerized and staged on-site. Each container will be labeled with the following information:

- Well designation,
- Medium contained in container (i.e. soil, water or drilling muds)
- Depth/horizontal interval of the contained soils
- Date collected, and
- Other appropriate information.

Waste will be sampled and analyzed for:

- VOCs using EPA Method 8260,
- SVOCs using EPA Method 8270,
- PAHs using EPA Method 8270-SIM,
- Pesticides using EPA Method 8081,
- PCBs using EPA Method 8082, and
- RCRA 8 metals plus copper, nickel, and zinc using EPA Method 6020.

Containers will be staged on-site until the results of the analytical testing have been reviewed. Laboratory data will be evaluated in accordance with waste characterization procedures in WAC 173-303 and the dangerous waste Toxicity Characteristic List maximum concentrations, as identified in WAC 173-303-090(8)(c).

If the total concentration of each compound is less than 20 times the dangerous waste Toxicity Characteristic List maximum concentrations, the waste will be characterized, profiled, and disposed of off-site at an approved RCRA treatment or disposal facility.

If any concentration is greater than 20 times the Toxicity Characteristic List value the sample will be submitted for follow up extraction using EPA SW-846 Method 1311, Toxicity Characteristic Leaching Procedure (TCLP), and analysis of the leachate for the analyte group with an exceedance (e.g., VOCs, SVOCs, metals) to determine appropriate disposal.

If the analytical results from the TCLP leachate are below the Toxicity Characteristics List values, the waste will be characterized, profiled, and disposed of off-Site at an appropriate RCRA treatment or disposal facility.

If the analytical results for the TCLP leachate exceed the Toxic Characteristic List values the soil will be managed as Hazardous or Dangerous Waste and sent off-site for disposal with profiling and manifesting documentation appropriate to the accepting facility.

For containers with contents determined to be dangerous or hazardous waste, a waste profile will be completed with the appropriate facility. A separate profile form will be completed for each waste type as required by the accepting facility. Wastes will be transported using a Uniform Hazardous Waste Manifest and will comply with the requirements of applicable federal and state laws for transportation of hazardous or dangerous wastes, and the requirements of the receiving facility. The receiving facility may require analyses in addition to those discussed herein.

Personnel at the disposal or treatment facility are responsible for verifying that the waste stream samples are consistent with the information on the completed profiles. Applicable state and federal hazardous and dangerous waste regulations will be followed during waste transport, treatment, and disposal (40 CFR 261, 49 CFR 170-178, and WAC 173-303). Following final waste treatment or disposal, certification will be provided that specifies the treatment or disposal method used.

2.4 Aboveground Well Completion Details

2.4.1 SVE Wells

The SVE wellheads will be completed with vertical piping installed at a "T" a short distance from the end of the riser pipe. The wellhead will "stick-up" above grade from the subsurface riser to an elevation necessary to accommodate the appropriate fittings and maintain sufficient conveyance pipe slope. The base of each stick-up will be protected by a mild steel riser pipe of approximately 10-inch diameter with the annular space between the well casing and riser pipe filled with concrete to provide a stable base for the wellhead. Each SVE wellhead assembly will be constructed to allow independent flow control and will be instrumented to measure flow, vacuum and temperature, as shown in Sheet 4, and as described in Section 5.0.

The end of each SVE well casing (riser pipe) will be fitted with a Camlock-type cap fitting to allow for well access for inspection and cleaning. Lockable covers will be attached to the top of the riser to secure the wells in the event they are taken out of service.

2.5 Aboveground Pipe Construction Material

High-density polyethylene (HDPE) has been selected as the material of construction for the wellhead and aboveground pipe of the upgraded SVE extraction well system. HDPE has been primarily selected due to its resistivity to a wide variety of chemicals and to degradation by ultraviolet (UV) light. HDPE is typically used in conventional landfill applications for handing corrosive materials such as leachate and has performed well with the existing system. HDPE pipe of SDR (Standard Dimensional Ratio) 26 will be used at the Landfill, which is roughly the same thickness as Schedule 40 PVC pipe.

HDPE pipe is also abrasion, impact, and weather resistant. HDPE is highly durable, ductile, and has high tensile strength. It is able to withstand UV light, freezing temperatures, and high ambient temperatures without loss of strength. HDPE connections are made by heat welding and the welds have the strength of native HDPE. HDPE is non-permeable to gases and will not leak due to its heat-welded connections. This combination of material properties allows the HDPE piping to withstand the environmental conditions encountered at the Site and the chemical properties of the condensate generated within the system piping.

HDPE is a relatively easy material to work with due to its light weight, its flexible properties, and its low maintenance. The pipe is hydraulically smooth, which allows for minimal pressure drop due to frictional losses. The American Society of Testing and Materials (ASTM) standards and specifications regarding the manufacturing and installation of HDPE pipe will be followed to ensure the consistency of the material and its proper installation.

3 CONVEYANCE PIPING

There will be two main lines of horizontal carrier pipe (conveyance pipe) from the two SVE wells, as depicted in the plan view on Sheet 2. The 4-inch riser pipe in the SVE wells will each expand into 6-inch conveyance piping that will be placed under the ground surface following the access road into the SVE equipment yard and into the existing below grade moisture separators (BGMS). The conveyance piping will be installed to avoid existing utilities and other infrastructure, and in coordination with Cascade Natural Gas, as the conveyance lines will cross over a buried Cascade Natural Gas pipeline. Cascade has indicated that they will coordinate during construction to ensure a proper offset is maintained between the SVE conveyance line and their pipeline. Additionally, conveyance lines will be sloped toward the BGMS to facilitate drainage of any condensate that forms and buried at a sufficient depth (minimum of approximately 18”) to protect the piping from vehicle traffic and insulate the line to prevent condensate from freezing in sub-freezing temperatures. Existing conveyance piping between the BGMS and the blowers will be utilized for vapor transport from the BGMS. HDPE pipe and fittings will be installed according to manufacturer and/or supplier recommendations.

3.1 Piping Material

The horizontal carrier pipe for the two SVE wells will consist of HDPE pipe. Section 2.5 presents the various characteristics of HDPE pipe, including its inertness to a wide range of chemicals and physical conditions. HDPE pipe is flexible and can be installed over uneven terrain. Thickness of the HDPE conveyance pipe will be SDR 26.

3.2 Piping Installation

A subcontractor with expertise in fitting HDPE pipe will install the pipe. Pipe connections and fittings will be heat welded and pressure tested to confirm a complete seal. Welds have the strength of the native material.

3.3 Slope

As shown in the piping conveyance cross section, Sheet 6, the buried pipe will maintain a minimum 1 percent slope until connections are made to moisture separators immediately west of Dietrich Road. Buried pipe from the moisture separators to the SVE operations building will be installed to have an upward slope, making the moisture separators the lowest points along the extraction piping runs.

3.4 Minimizing Frictional Losses

Minimizing friction losses in the vapor extraction pipe and conveyance piping will maximize potential extraction flow rates and reduce the load on the SVE blower. The system has been designed to reduce friction losses as appropriate and maximize the efficiency of the system components. HDPE pipe is hydraulically smooth and is a recommended material for minimizing friction loss in this type of application. Limiting sharp turns in the piping and the sufficient removal of water in the conveyance piping will aid in minimizing friction losses. It is expected that the valve at each vapor extraction wellhead will be set either mostly open or mostly closed, depending on the productivity of each well to minimize friction losses. The continuous slope for the pipe runs away from the wellheads should prevent liquid from filling and/or blocking the pipe cross-section, and aid in minimizing friction loss. Attachment 1, Calculation 2 further details the anticipated friction losses to be expected during operation of the upgraded system.

3.5 Moisture Separators

Extracted gases that originate from the landfill are warm and retain high amounts of moisture. Upon reaching the surface, the gasses cool. The gasses continue to cool to near ambient conditions between the wellheads and the Operations Building causing moisture to condense on the sides of the pipes. Liquid within the piping collects in topographic low spots within the system. The lowest point in the system is where the piping connects with the below grade separators, which sit at an elevation beneath Dietrich Road. Each of the two new operable conveyance lines will be connected to the BGMS on the west side of Dietrich Road, as presented in Sheet 2.

HiLine manufactured and designed the two BGMSs to remove moisture through cyclonic separation. The moisture separators, shown in Sheet 8, are 140 gallons in capacity. A flange at the top of the riser can be removed for inspection. Each BGMS has a 1-inch diameter hole in the flange with a compression fitting, which provides access for collecting condensate samples. Each moisture separator is equipped with an automated pneumatic condensate pump. The compressed air line for each is fitted with an electronic pulse counter used to approximate the amount of condensate generated and pumped to the oil-water separator west of the Operation Building.

The moisture separators are located below ground for thermal stability and to maximize cooling and moisture separation. As shown in Sheet 9, each BGMS is installed within a two-piece HDPE sump, which provides secondary containment for the separator and condensate conveyance line. The sumps are constructed from 3-inch thick HDPE pipe and are 4.5-feet in diameter, and 9-feet deep. The volume of the secondary containment below the opening for the vapor conveyance piping is approximately 169 gallons. Each HDPE sump houses a moisture separator with a pneumatic pump in a drop tube, condensate conveyance line, compressed air line with air supply regulator and electronic pulse counter, valves, pressure gauge, and moisture sensor. Lines for compressed air and condensate conveyance, as well as wiring for the electronic pulse counters and leak detection sensors, are connected through the sides of the sumps, near the top. Access to the sumps, BGMSs, compressed air supply line, and condensate line is provided by a cover bolted to the top flange of the sumps. The sump cover allows access for visual inspection, maintenance, and prevention of debris entry. The sumps are sloped slightly to create a low spot if liquid were to collect. A moisture detection sensor is located at the low point of each sump and will activate when approximately 0.4-inch of liquid is collected. If a sensor is activated, an alert is sent to site personnel and the source of the moisture accumulation will be investigated. Further information and specifications of the equipment used for condensate conveyance can be found in *Addendum No. 4 to the SVE System O&M Manual (2017 Upgrades): Below Grade Moisture Separator Upgrades and Condensate Sampling*, dated December 18, 2019.

4 REMEDIATION SYSTEM EQUIPMENT COMPONENTS

Sheet 2 provides information on the overall layout of the equipment and piping for the proposed upgrades and Sheet 7 details the process and instrumentation components of the entire SVE system in its intended configuration following system upgrades.

4.1 Regenerative Blowers

The existing SVE system consists of two blowers located in the Operations Building, which extract vapors from beneath Zone A through the SVE wells. A Rotron Model DR-14, 30 horsepower (HP), 500 scfm, regenerative blower and an AirTech model 3BA1930, 30 HP, 500 scfm, regenerative blower. No changes will be made to the existing blowers. Due to the potentially flammable nature of vapors that would have been extracted from the inactive intermediate wells (VEW-06I and VEW-07I), the AirTech blower has a National Electrical Code classification as Class I Division I for electrical safety. The Rotron blower can produce a vacuum of up to 80 in. $H2O$ at 60 Hertz and a design flow rate of 500 scfm. The AirTech blower can produce a maximum flow rate of 500 scfm at the maximum vacuum. Operation of the vapor extraction wells has shown that the vacuum and flow responses of the deep wells are within the performance curve of the blowers. It is anticipated that operation of the horizontal SVE wells will be within the blower performance curves as well. Performance of the blowers with the new horizontal wells will be evaluated during system testing described later in this plan.

The SVE blower motors are equipped with variable frequency drives (VFDs), to provide consistent blower speed and maintain flow control. The human-machine interface (HMI) shows the on/off status of each blower and the speed at which each blower motor is operating. A touchscreen on the HMI allows the operator to change the status and speed of each blower motor. The HMI relays operator input into the programmable logic controller (PLC), which in turn changes the status and speed of the blower motor. The VFDs also decrease the power consumption and reduce mechanical wear by eliminating motor starters.

The HDPE piping between the BGMSs and both blowers can be configured to apply vacuum to either or both VEW-06H and 07H wells. For example, the Rotron blower can be used for vapor extraction from both wells at the same time while the AirTech blower is idle or one well can be connected to the Rotron blower and the other to the AirTech blower. The same is true of the AirTech blower. Piping changes to allow the blowers to pull vapor from different well heads are made adjacent to and outside the Operations Building. Control of the airflow through each well, and fresh air dilution, can be controlled by gate valves at the wellheads. Airflow is also controlled with the VFDs.

4.2 Moisture Knockout Tank

Condensate is also collected within the Operations Building using moisture separators immediately upstream of both blowers. These moisture separators produce a cyclonic swirling of the process vapors that separates the condensate from the vapor stream due to immediate pressure drops and increased residence times. Liquids that settle out of these moisture separators gravity drain through 1-inch diameter stainless steel piping into 55-gallon stainless steel tanks. External pneumatic pumps are activated by float switches within the tanks pump out the contents of the moisture separators. Additional information and specifications can be found in the *Operations and Maintenance Manual, Soil Vapor Extraction System and Regenerative Thermal Oxidizer, Volume 1: SVE System O&M Manual (2017 Upgrades)*, dated December 13, 2017.

4.5 Thermal Destruction

The IWAG operates a Model 25 Regenerative Thermal Oxidizer (RTO) designed, installed, and commissioned by Anguil Environmental Systems, Inc. in July 2017 to treat SVE gases extracted from Zone A. The RTO system was designed to treat up to 1,000 scfm of soil vapor from Zone A with a minimum 98 percent VOC destruction efficiency. Additional information and specifications can be found in the *Operations and Maintenance Manual, Soil Vapor Extraction System and Regenerative Thermal Oxidizer, Volume 2: RTO System O&M Manual (2017 Upgrades)*, dated December 13, 2017, and in the *2019 Annual Report: Regenerative Thermal Oxidizer Performance Monitoring*, dated January 31, 2020.

5 SYSTEM OPERATIONAL COMPONENTS

5.1 Well Head Operational Components

Configurations of the pipe racks at the wellheads will be similar to the existing pipe racks with some potential modifications. The stainless-steel or HDPE well casing will be connected to above ground 4-inch diameter HDPE piping. The above ground HDPE piping will have a sweep that brings the piping to horizontal. At the end of the sweep will be two ports - one 3/8-inch diameter for a thermometer and a ¼ inch diameter valve fitting for wellhead gas sample collection and pressure measurements. A 4-inch diameter gate valve will be installed immediately after the two ports. The valve can be used for flow control or, if closed, to stop flow. After the valve will be a 4-inch diameter straight piping run supported by a pipe rack above the ground surface. Installed in these piping runs will be Dwyer DS-300 flow sensors used to measure differential pressures to calculate well head flow rates. The piping will then turn 90 degrees downward through a polytetrafluoroethylene (PTFE) or Teflon coated hose where it will be joined with dilution air piping and then connect to the below-ground conveyance piping. The dilution air piping will be fit with a check valve, DS-300 flow sensor, and a gate valve (same set up as the piping connected to the wellhead). These allow measurement and control of dilution air and protection against atmospheric venting through the dilution piping if the SVE system is shut down. The dilution air piping is capped with screen material to prevent blockage or animal entry. A diagram of the existing wellhead assemblies is shown in Sheet 4.

5.2 Equipment Compound Operational Components

5.2.1 Flow Control

In addition to the adjustments of SVE gas removal rates from the individual upgraded SVE wells at wellheads, the flowrates through the vacuum blower and to the RTO may require periodic adjustment or modification and will be regulated at the equipment compound. Independent flow control at each conveyance line at the equipment compound will aid in optimizing system performance, performing maintenance (if necessary), and controlling vacuum conditions.

5.2.2 Flow Measurements

Flow measurements in the equipment compound are made by differential pressure meters/transmitters are Model Deltabar M PMD55 connected to Dwyer DS-300 flow sensors for lines leading to the Rotron blower and the dilution air piping leading to the Airtech blower. The Dwyer flow sensors are made of 316 stainless steel and indicate flow by measuring the differential pressure between the sidewall of the pipe and the center of the airstream. The Deltabar meters are connected to the high-pressure and low-pressure legs of the Dwyer DS-300 flow sensors and measure the differential pressure of the flowing gas in the line. The differential pressure that is exerted on a sensor within an oil medium encased between two diaphragms translates that pressure signal into a 4-20 milliamp (mA) electrical output. The transmitters send the signal to the PLC. The differential pressure value is combined with temperature and static line pressure readings within the pipe, and the PLC converts that information into a total flow value in scfm that is displayed on the HMI. The flow value is the total wellhead and dilution air flow for all wells flowing through the measured line. The calculation of flow in the piping leading to the Rotron blower and at the wellheads is shown in Calculation 4, Attachment 1.

5.2.3 Vacuum/Pressure Measurements

Four stainless steel and Viton static pressure transducers are installed in the Operations Building on each of the process lines. The static pressure transducers are manufactured by IFM Efector, Inc., of Exton, Pennsylvania, and are Model PX3229.

The static pressure transducers measure the static pressures within the process lines and send the signals to the PLC. These static pressure transducers provide two functions: providing stand-alone vacuum (or pressure) conditions within the process lines; and combining temperature and line differential pressure readings to generate a total corrected flow value in scfm that is displayed on the HMI.

6 STARTUP VACUUM MONITORING AND VAPOR SAMPLING

Consistent with the SVE system testing performed in 2011 and 2012, the operation of the SVE system during the startup of VEW-06H and VEW-07H will be monitored through measurements taken at each vapor extraction well and at the SVE equipment skid. System parameters that will be monitored include barometric pressure, vacuum, airflow, temperature, carbon dioxide, oxygen, carbon monoxide, and total VOCs. The lower explosive limit is continually monitored downstream of the blowers and prior to introduction to the RTO for thermal treatment. Vapor samples will be collected at each wellhead and from the existing combined SVE system effluent piping sample port (SV-BRTO), in a manner consistent with those currently used at the Site and described in the SVE Operations and Maintenance Manual.

The existing vertical wells will have been shut down during final connection of the new conveyance lines to the BGMSs. When installation is complete. The horizontal wells will be started or pre-tested one at a time in a stepwise fashion to ensure that each well and associated blower functions well. The flow rate will be increased in 50 scfm increments to establish a maximum flow no greater than 500 scfm. The system will be monitored to make sure operation is within the blower pressure curve and to verify that the LEL is below 25%. Fresh air dilution will be added if necessary, to maintain an LEL of less than 25%. Once this phase is complete, startup testing will begin.

To establish that the new horizontal SVE wells and system are running with sufficient radius of influence, locations beneath the Zone A cap and around the perimeter of Zone A will be monitored for vacuum during startup. The locations beneath the Zone A cap include VMP-02, 04, 05, 06, 08, 09, and 10 and VMW-51i, VMW-51D, VEW-06S, I, and D, and VEW-07S, I, and D. Locations outside the protective barrier wall that will be monitored for vacuum are VMP-13S, 13D, 17, 18, 19, 20, and 21, VEW-05, and VMW-50S. Additionally, VEW-04 will be monitored to the south of Zone A, and VEW-01 and VMW-02D to the west of Zone A and Dietrich Road.

General flow, vacuum, and parameters will be collected at the new wellheads and the combined SVE system effluent piping (SV-BRTO) on days 1, 2, 4, 7, and 14. Flow rate adjustments may be made during testing to balance the flows or vacuum. Vapor samples will be collected from the new wellheads and SV-BRTO on days 2, 7, and 14. Pressure measurements will be collected from the VMPs, VMW-50S, -51I, and -51D, VEW-01, VMW-02D, VEW-04, VEW-05, VEW-06S/I/D, and VEW-07S/I/D on days 1, 2, 7, and 14.

Table 3 summarizes the measurement and sampling schedule associated with startup testing. All measurements will be collected using the same methods that are currently used during routine SVE system monitoring. Analytical testing of the SVE vapor will be conducted via EPA Method 8260 and performed as part of startup testing procedures, followed by weekly vapor sampling for four weeks consistent with procedures followed after a significant change in air flow, and then followed by bi-weekly sampling, consistent with condition 3.c of the existing RTO system Approval Order No.

16AQ-E031. The analysis and the emissions calculations required in conditions 3.c and 7.c include an evaluation of VOC and SVOC mass delivered to the RTO. These procedures along with those performed as part of the annual performance testing required in condition 4 of the permit, and other requirements of the permit will continue to be followed.

Baseline vacuum data will be collected from all monitoring locations on day 1 and/or prior to startup. Barometric pressure will be recorded from the field instrument each day measurements or samples are collected. LELs will be datalogged continuously with an LEL measurement recorded at the same approximate time of the parameter collection for each day listed. Air samples will be collected in Tedlar bags and analyzed using EPA Method 8260 using the same methods as currently used during routine SVE system monitoring.

Data from startup testing will be evaluated to confirm operation of the new horizontal wells with a radius of influence throughout Zone A.

Some monitoring locations will be retained after testing is complete and during the drum removal and thermal treatment phases. The specific wells to be retained will be determined based on data collected during system testing.

7 CONTINGENCY PLAN

If the newly horizontal wells do not perform as anticipated, meaning with an insufficient radius of influence throughout Zone A, existing vapor extraction wells VEW-04 and VEW-05 will be connected to the SVE system to increase the radius of influence of the SVE system. Vapor extraction wells VEW-04 and VEW-05 are not currently connected to the SVE system. VEW-04 was constructed in March 1997 to a total depth of 55.5 feet on the southern perimeter of Zone A. It was completed in the UPG with 15 feet of 0.01-inch slotted PVC screen. VEW-05 was constructed in February 2002 to a total depth of 57 feet on the northern perimeter of Zone A. It was also completed in the UPG with 15 feet of 0.01-inch slotted PVC screen. Both wells are screened at a similar depth to the proposed horizontal wells, and will complement their ROI on the southern and northern portions of Zone A. Additional information on the ROI of VEW-04 and VEW-05 can be found in the *2008 Annual Report: Groundwater Monitoring and Phase I of Additional Interim Actions, Volume 3*, EPI, Inc, May 2009. Soil conditions encountered during drilling of the now abandoned SVE wells are detailed in the *Revised Phase II Additional Interim Actions Sub-Zone A Investigation and Downgradient Well Installation Report,* dated May 21, 2012. Should it be necessary to reactivate VEW-04, VEW-05, or other existing SVE infrastructure to increase the radius of influence of the SVE system additional planning and discussions between the IWAG and Ecology will be necessary, and a separate supplemental plan will be submitted to Ecology.

8 RESPONSIBILITIES AND REPORTING

Site operations personnel will be responsible for implementing pretesting and startup testing based on this plan. As is the current procedure, evaluation of operational parameter measurements, analytical data from wellhead and combined line sampling, and emissions calculations will continue to be completed by PBS with assistance by the Bridgewater Group, as necessary. These data will continue to be reported to Ecology as part of the monthly reports as required by the Ecology issued Synthetic Minor Approval Order No. 16AQ-E031 for the RTO, dated May 2, 2017, or subsequent revision. Any significant changes in operation will be communicated with and/or reported to Ecology in a timely manner. Revised O&M manuals will be prepared following completion of the SVE reconfiguration.

9 REFERENCES

"*USACE Design Criteria for Full-Scale SVE and BV Systems*" (USACE 2002)

"*Environmental Engineering Reference Manual*", Second Edition, 2003, Equations 21.18 and 21.19

"Derivation of Generalized Darcy Equations for Creeping Flow in Porous Media" by Ronald G. Larson, Department of Chemical Engineering and Materials Science, University of Minnesota; May 1981

"*Practical Design Calculations for Groundwater and Soil Remediation*" Equation V.1.2, by Jeff Kuo P.H.D., P.E.; 1999

"*Phase I AIA Interim Findings and Conclusions – Soil Vapor Extraction Testing*" by Environmental Partners, Inc., February 20, 2009

Phase II Remedial Investigation Report – Pasco Landfill" by Philip Environmental Services Corporation, March 13, 1998

"*Draft Phase I Additional Interim Actions Work Plan – Volume 1*" by Environmental Partners, Inc., December 11, 2009

Revised 100% Submittal Engineering Design Report for SVE System Upgrades, Phase II Additional Interim Actions, Environmental Partners, Inc., July 2, 2010

Synthetic Minor Approval Order No. 16AQ-E031, Washington State Department of Ecology - Air Quality Program, May 2, 2017

Addendum No. 4 to the SVE System O&M Manual (2017 Upgrades): Below Grade Moisture Separator Upgrades and Condensate Sampling, PBS, dated December 18, 2019.

2008 Annual Report: Groundwater Monitoring and Phase I of Additional Interim Actions, Volume 3, EPI, Inc, May 2009

TABLES

Table 1
Zone A Vapor Extraction Wells in the Upper Pasco Gravels
(as of February 2020)
Pasco Landfill NPL Site
Pasco, WA

VEW	Wellhead Flow (ft^3/min)	Vacuum at Well (in H_2O)	Radius of Influence (ft from VEW)	Screen Elevations (ft AMSL)
06D	275	53.9	≥ 200	280 to 265
07D	221	58.8	≥ 200	280 to 265

Table 2
Zone A Vacuum Measurements in February 2020
Pasco Landfill NPL Site
Pasco, WA

Vacuum Monitoring Location	Approx. Distance from VEW-06D (ft)	Approx. Distance from VEW-07D (ft)	Approx. Depth BGS (ft)	Screen Length (ft)	Diameter (in)	Pressure Reading (in H_2O)
VMP19	114	237	25	15	0.75	-0.7
VMP 20	119	237	25	15	0.75	-0.6
VEW 05	141	246	57	15	4	-3.1
VMP 17	156	250	25	15	0.75	-0.6
VMP 18	183	240	25	15	0.75	-0.3
VMP 13S	183	220	9	1	1	-0.3
VMP 13D	184	219	17	1	1	-0.3
VMW 50S	201	231	59	15	2	-3.0
VMP 21	213	229	25	15	0.75	-0.2
VMP 02	104	108	5	1	1	-0.4
VMW 51i	123	104	35.5	15	4	-1.0
VMW 51D	128	106	63.5	15	4	-3.1
VMP 05	118	31	5	1	1	-0.6
VMP 06	207	87	5	1	1	-0.5
VEW 04	293	174	55	15	4	-2.6
VMP10	232	120	5	1	1	-0.4
VMP 09	140	79	5	1	1	-0.4
VMP 08	85	121	5	1	1	-0.4
VMP 04	27	114	5	1	1	-0.5

Note:

Pressure readings collected February 17, 2020

Monitoring point screened in the Upper Pasco Gravels.

PBS

Table 3
Start Up Testing Schedule
Pasco Landfill NPL Site
Pasco, WA

Monitoring Location	Induced and Observed Vacuum	Wellhead Airflow	LEL	Temperature, O2, CO2, CO	Vapor (VOC) Sample Collection
VEW-06H	1,2,4,7,10, and 14	1,2,4,7,10, and 14	1,2,4,7,10, and 14	1,2,4,7,10, and 14	2,7, and 14
VEW-07H	1,2,4,7,10, and 14	1,2,4,7,10, and 14	1,2,4,7,10, and 14	1,2,4,7,10, and 14	2,7, and 14
VEW-06S/I/D	1,2,7,10,14				
VEW-07S/I/D	1,2,7,10,14				
VMW-50S	1,2,7,10,14				
VMW-51I/D	1,2,7,10,14				
VEW-01	1,2,7,10,14				
VMW-02D	1,2,7,10,14				
VEW-04	1,2,7,10,14				
VEW-05	1,2,7,10,14				
VMPs (15)	1,2,7,10,14				
SV-BRTO					2,7, and 14

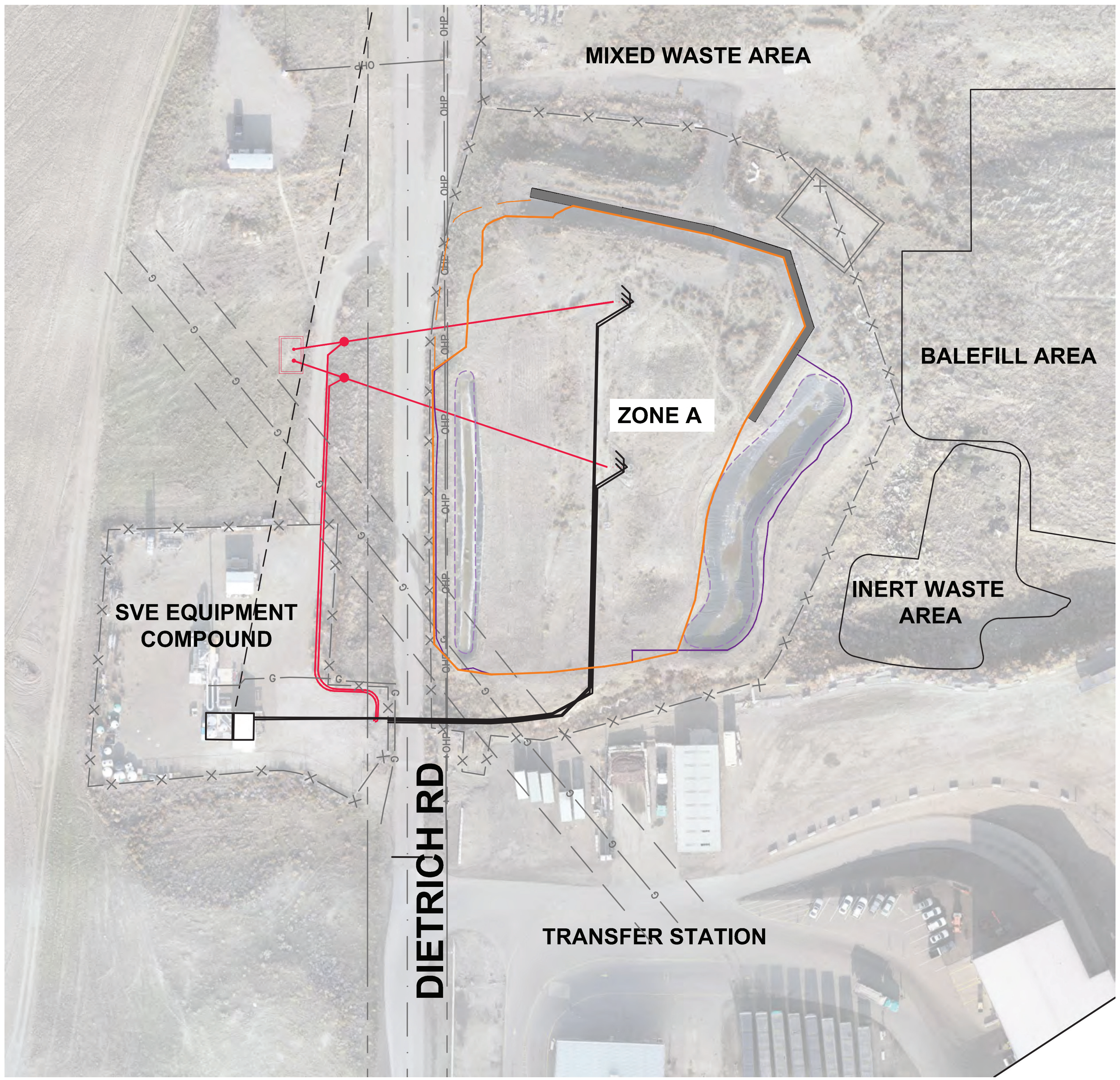
Notes:

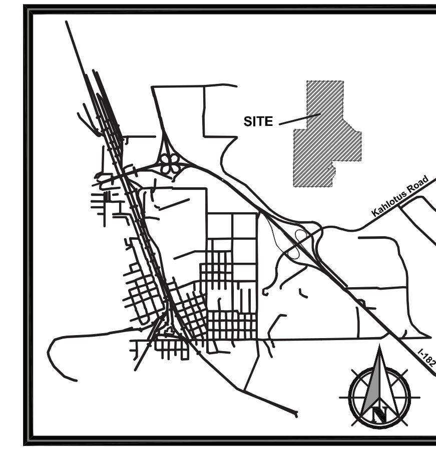
Numbers indicate day of the test

Vapor analysis will conducted via Method 8260

DESIGN DRAWINGS

SVE SYSTEM RECONFIGURATION





VICINITY MAP
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Scale 1" = 100'

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SHEET INDEX	
SHEET NUMBER	SHEET TITLE
1	GENERAL SITE PLAN AND VICINITY MAP
2	SITE SCHEMATIC PLAN VIEW
3	PLAN AND PROFILE FOR HORIZONTAL WELL LOCATION
4	ABOVE-GROUND WELL COMPLETION
5	BELOW-GROUND WELL COMPLETION
6	PLAN & PROFILE OF WELLHEADS TO BGMS
7	TYPICAL P&ID FOR SVE WELL SYSTEM
8	BGMS DETAIL DIAGRAM
9	BGMS SUMPS

LINETYPE LEGEND
SVE LINES

PRELIMINARY
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Richland, WA 99352
509.942.1600
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GENERAL SITE PLAN AND VICINITY MAP FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

DESIGNED: SB/SG
CHECKED: PB
APR 2020
64180.020
SHEET ID
1 / 9

Scale 1" = 80'

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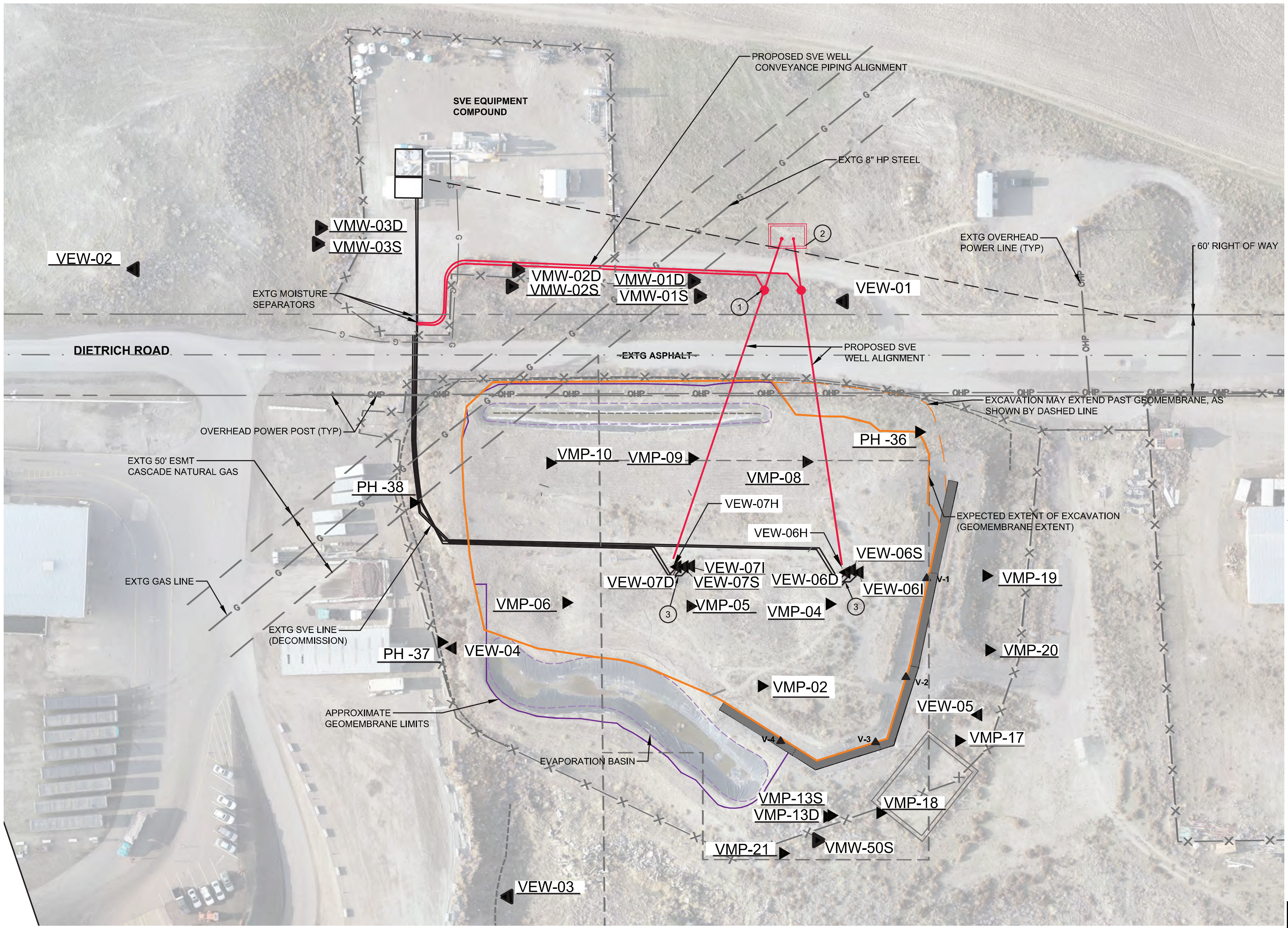

KEYED CONSTRUCTION NOTES:

1. PROPOSED LOCATION OF HORIZONTAL SVE WELLS HEADS.
2. SVE HORIZONTAL DRILLING BORE PITS
3. SVE WELL SCREEN (PROPOSED)

LINETYPE LEGEND

- EXTENT OF EXCAVATION
- GEOMEMBRANE LIMITS
- EXISTING EVAPORATION PONDS
- SVE LINES
- EXISTING EASEMENT
- EXISTING GAS LINE
- EXISTING RIGHT-OF-WAY
- EXISTING PARCEL LINE
- EXISTING FENCE
- EXISTING SECTION LINE
- EXISTING OVERHEAD POWER

MONITORING POINTS LEGEND

VEW-07S	VAPOR EXTRACTION WELL
VMP-20	VACUUM MONITORING PROBE
VMW-50S	VAPOR MONITORING WELL
VEW-07I	MONITORING POINTS TO BE DECOMMISSIONED AFTER SVE RECONFIGURATION TESTING IS COMPLETE AND NEW SYSTEM IS FUNCTIONING

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SITE SCHEMATIC PLAN VIEW FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

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APR 2020
64180.020

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2 / 9

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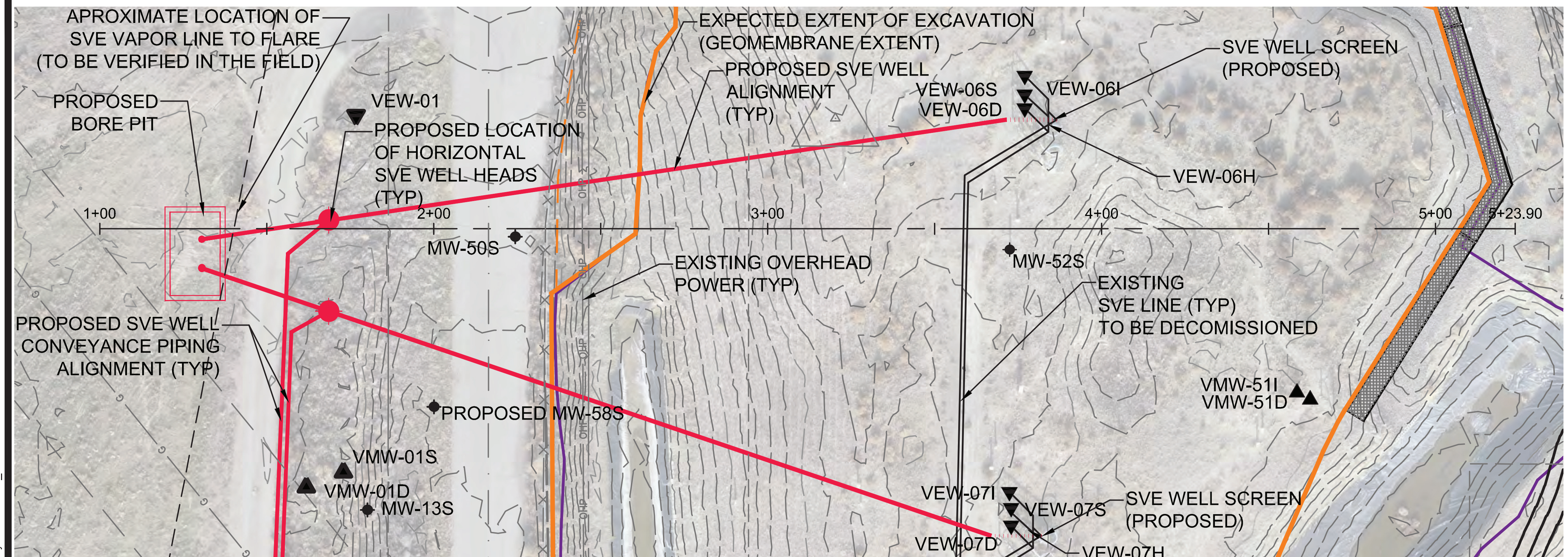

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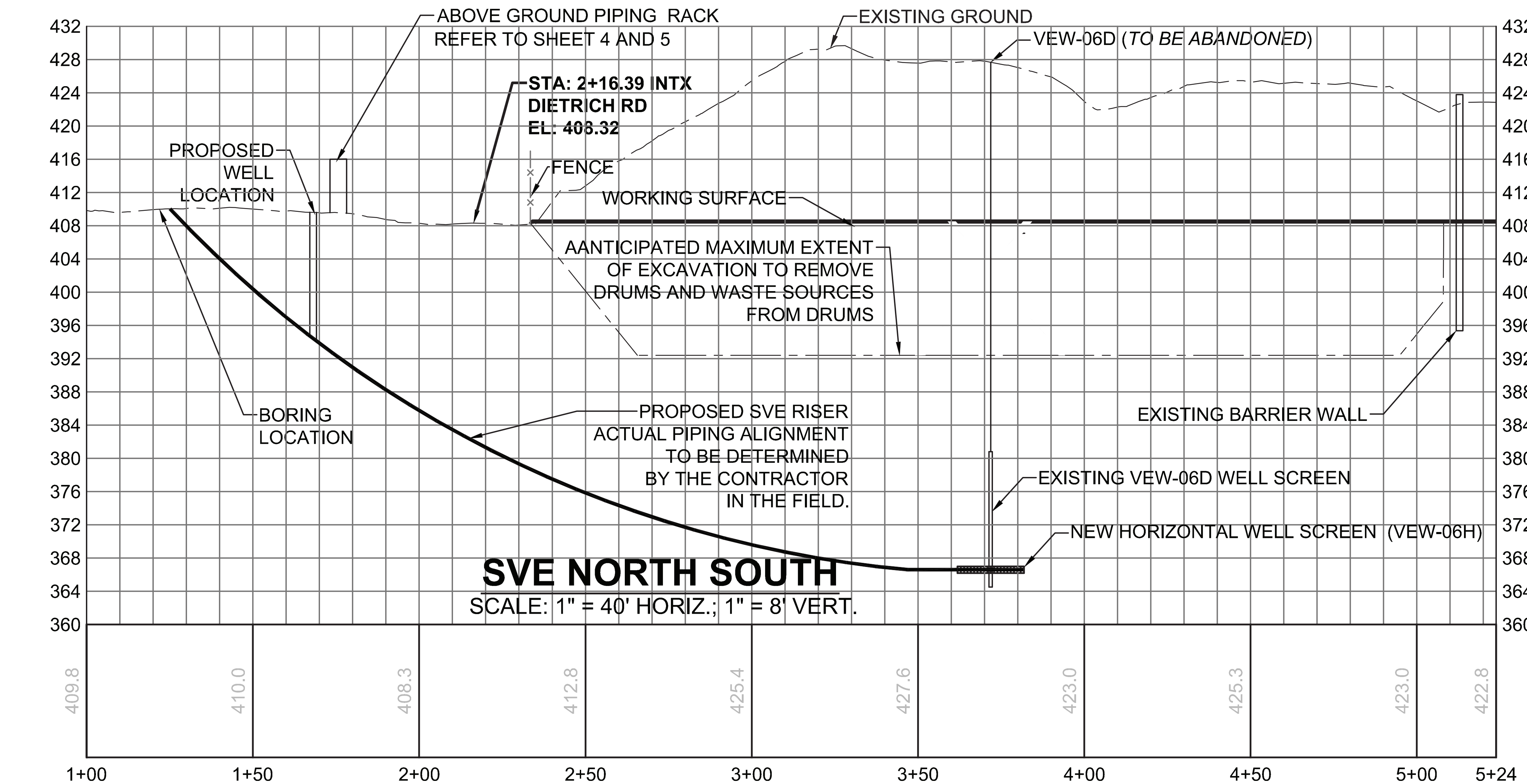
LINETYPE LEGEND
EXTENT OF EXCAVATION
GEOMEMBRANE LIMITS
EXISTING EVAPORATION PONDS
SVE LINES
EXISTING EASEMENT
EXISTING GAS LINE
EXISTING RIGHT-OF-WAY
EXISTING PARCEL LINE
EXISTING FENCE
EXISTING SECTION LINE
EXISTING OVERHEAD POWER



SVE NORTH SOUTH

SCALE: 1" = 40' HORIZ.; 1" = 8' VERT.

MONITORING POINTS LEGEND

- ▼ VEW-07S — VAPOR EXTRACTION WELL
- ◆ MW-53S — GROUNDWATER MONITORING WELL
- ▲ VMW-50S — VAPOR MONITORING WELL
- ▼ VEW-07I — MONITORING POINTS TO BE DECOMMISSIONED

GROUNDWATER ELEVATION IS 351 TO 354 FEET.

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PLAN AND PROFILE FOR HORIZONTAL WELL LOCATION
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

DESIGNED: SB/SG
CHECKED: PB
APR 2020
64180.020

SHEET ID
3 / 9

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ABOVE GROUND SVE PIPING DETAIL

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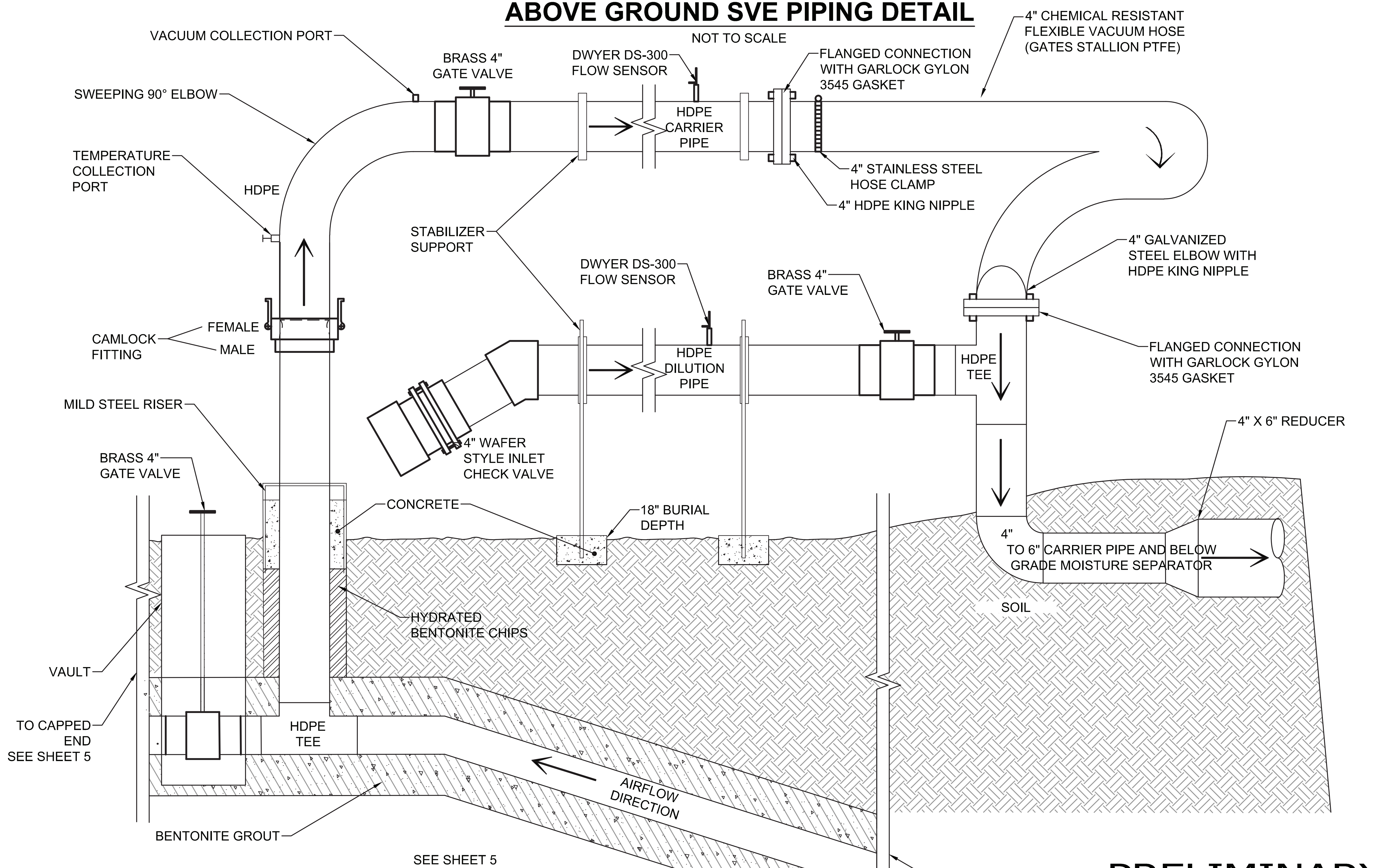

NOTE:
ACTUAL PIPING ALIGNMENT TO BE DETERMINED BY THE CONTRACTOR IN THE FIELD.

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ABOVE-GROUND WELL COMPLETION FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

DESIGNED: SB/SG
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APR 2020
64180.020

SHEET ID
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BELOW GROUND SVE PIPING DETAIL

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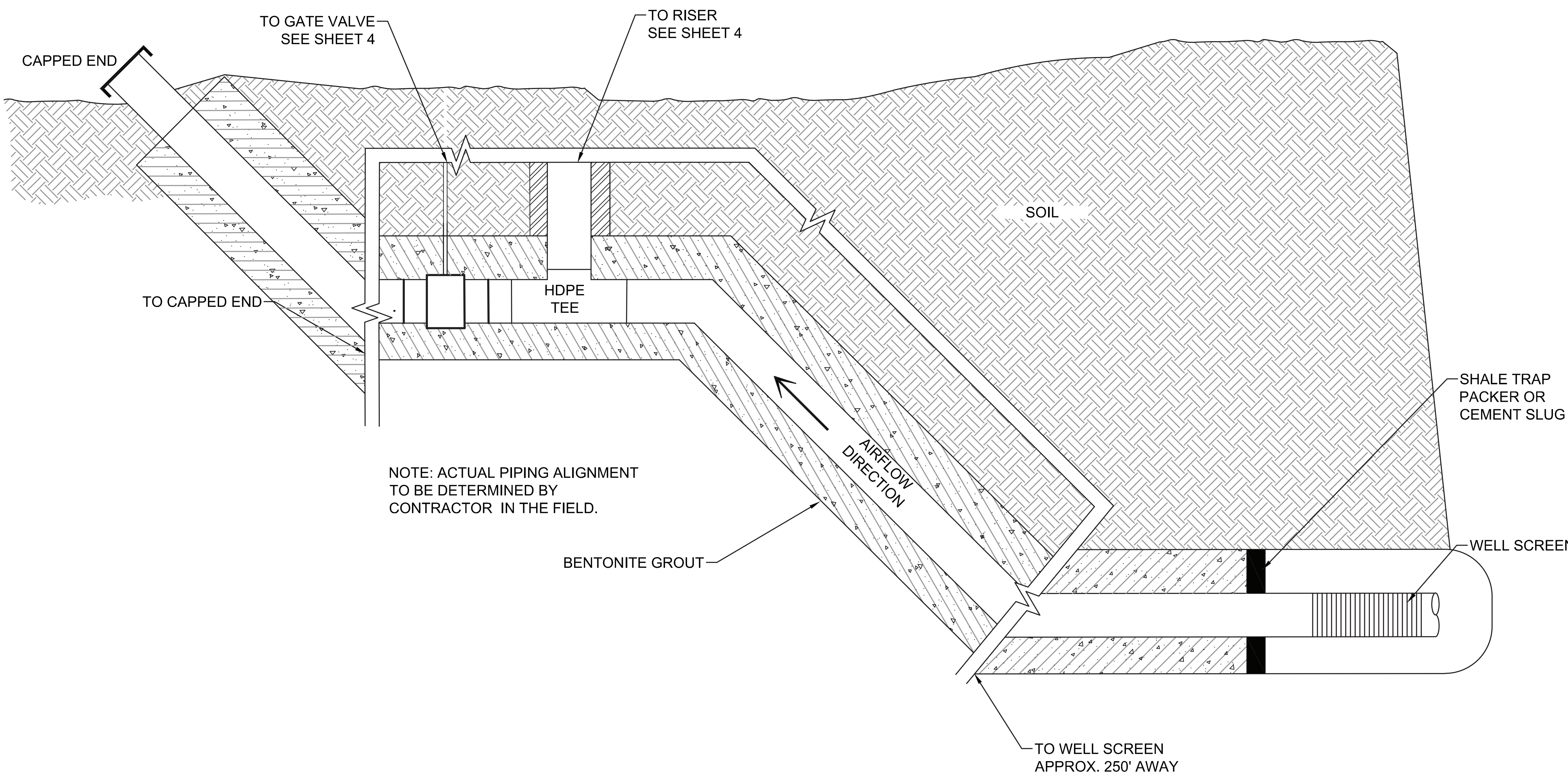

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BELOW-GROUND WELL COMPLETION
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

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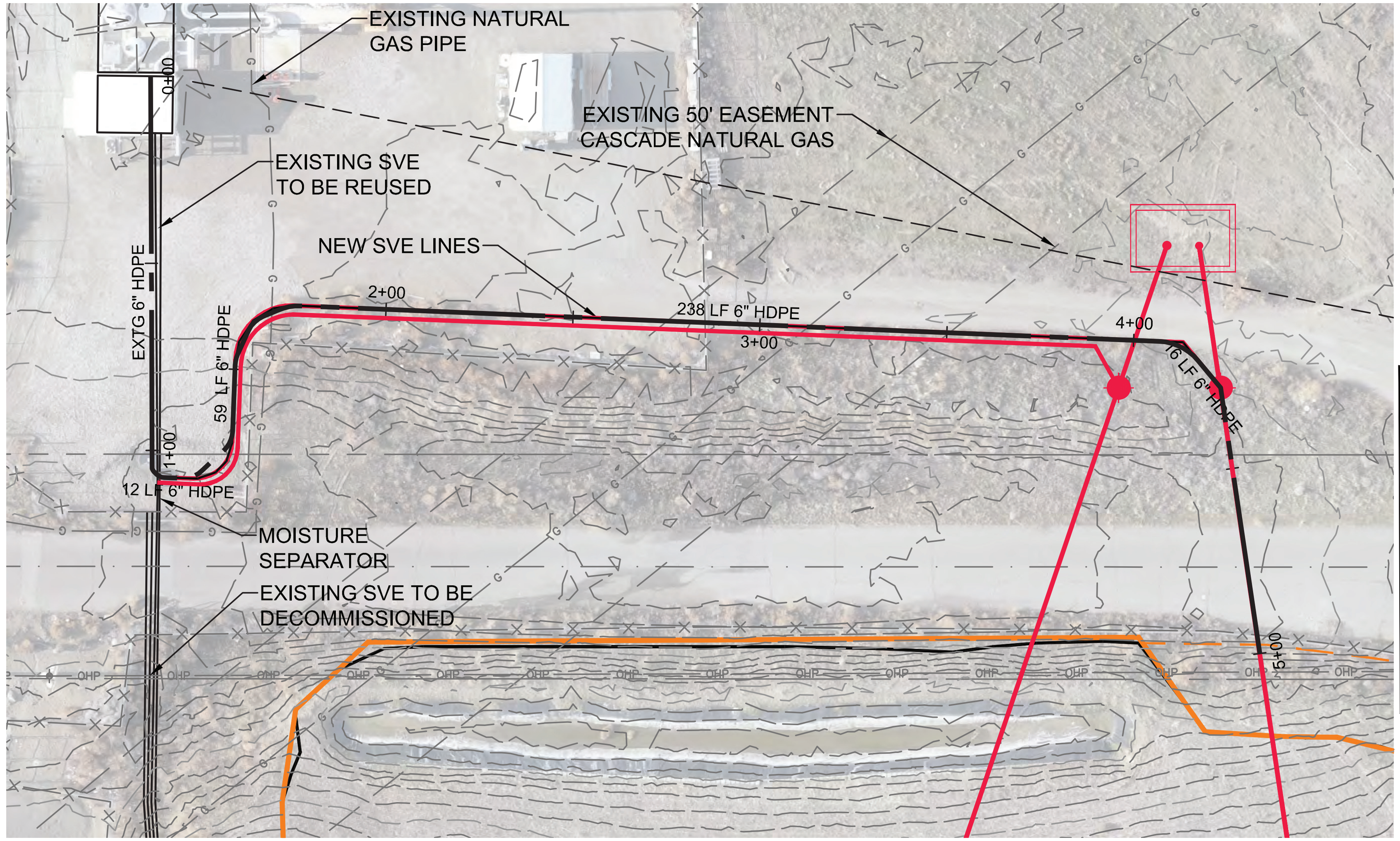

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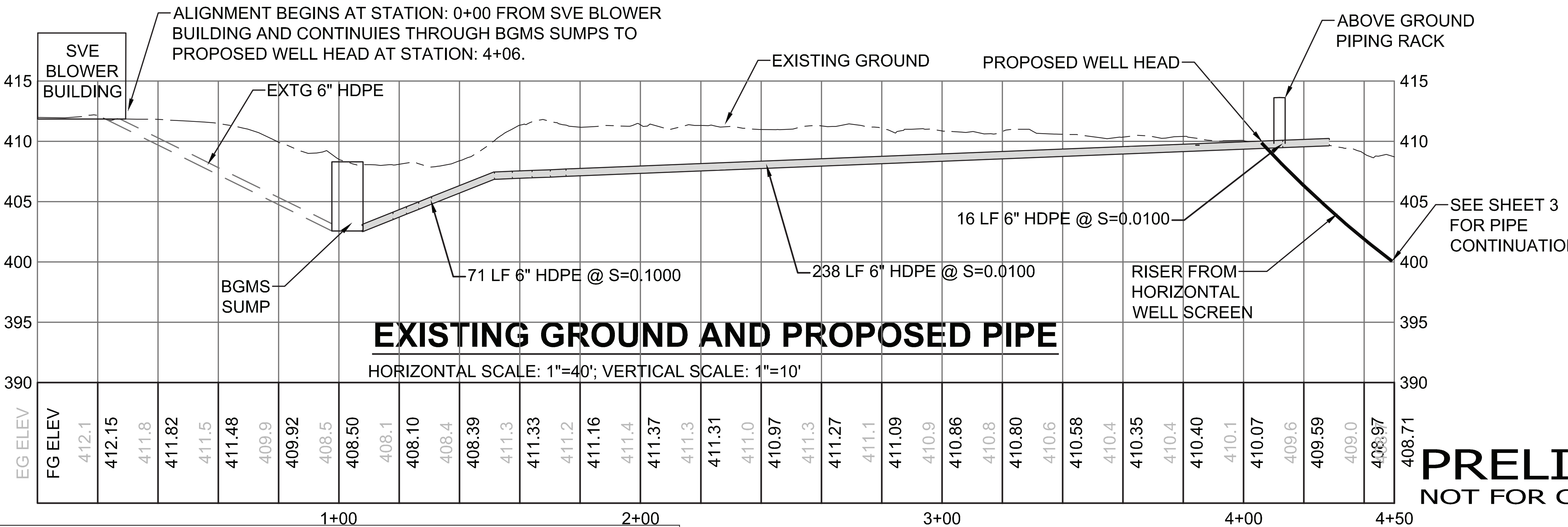
LINETYPE LEGEND
SVE LINES
EXISTING EASEMENT
EXISTING GAS LINE
EXISTING RIGHT-OF-WAY
EXISTING PARCEL LINE
EXISTING FENCE
EXISTING SECTION LINE
EXISTING OVERHEAD POWER
PIPE ALIGNMENT (0+00)



EXISTING GROUND AND PROPOSED PIPE

HORIZONTAL SCALE: 1"=40'; VERTICAL SCALE: 1"=10'

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PLAN & PROFILE OF WELLHEADS TO BGMS FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

DESIGNED: SB/SG
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APR 2020
64180.020

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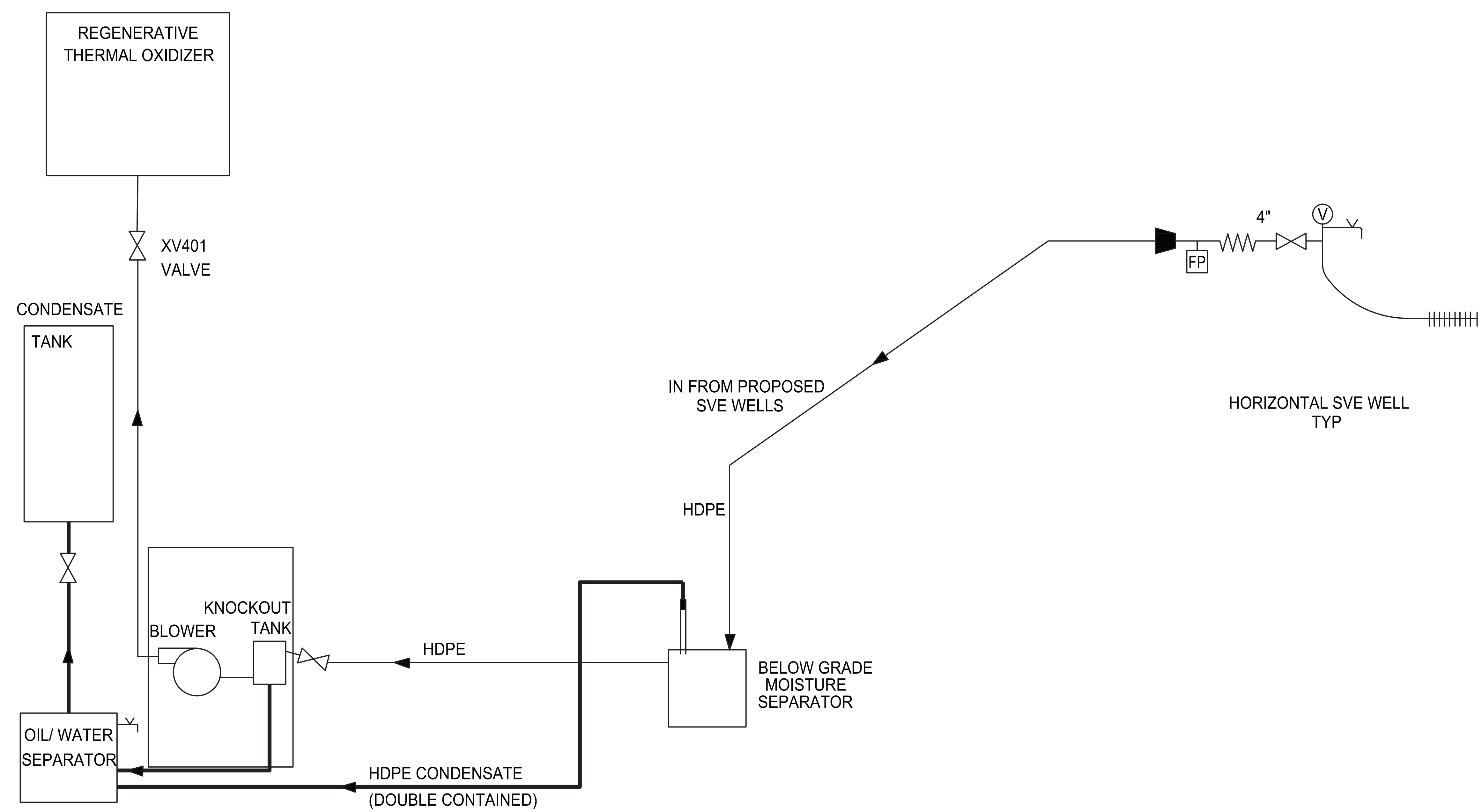

LEGEND

- CLEAN OUT
- CHECK VALVE
- FP FLOW PORT
- REDUCER BUSHING
- GATE VALVE
- V VACUUM GAUGE
- TEMP/GAS/SAMPLE COLLECTION PORT
- FLEX HOSE

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TYPICAL P&ID FOR SVE WELL SYSTEM FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

DESIGNED: SB/SG
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APR 2020
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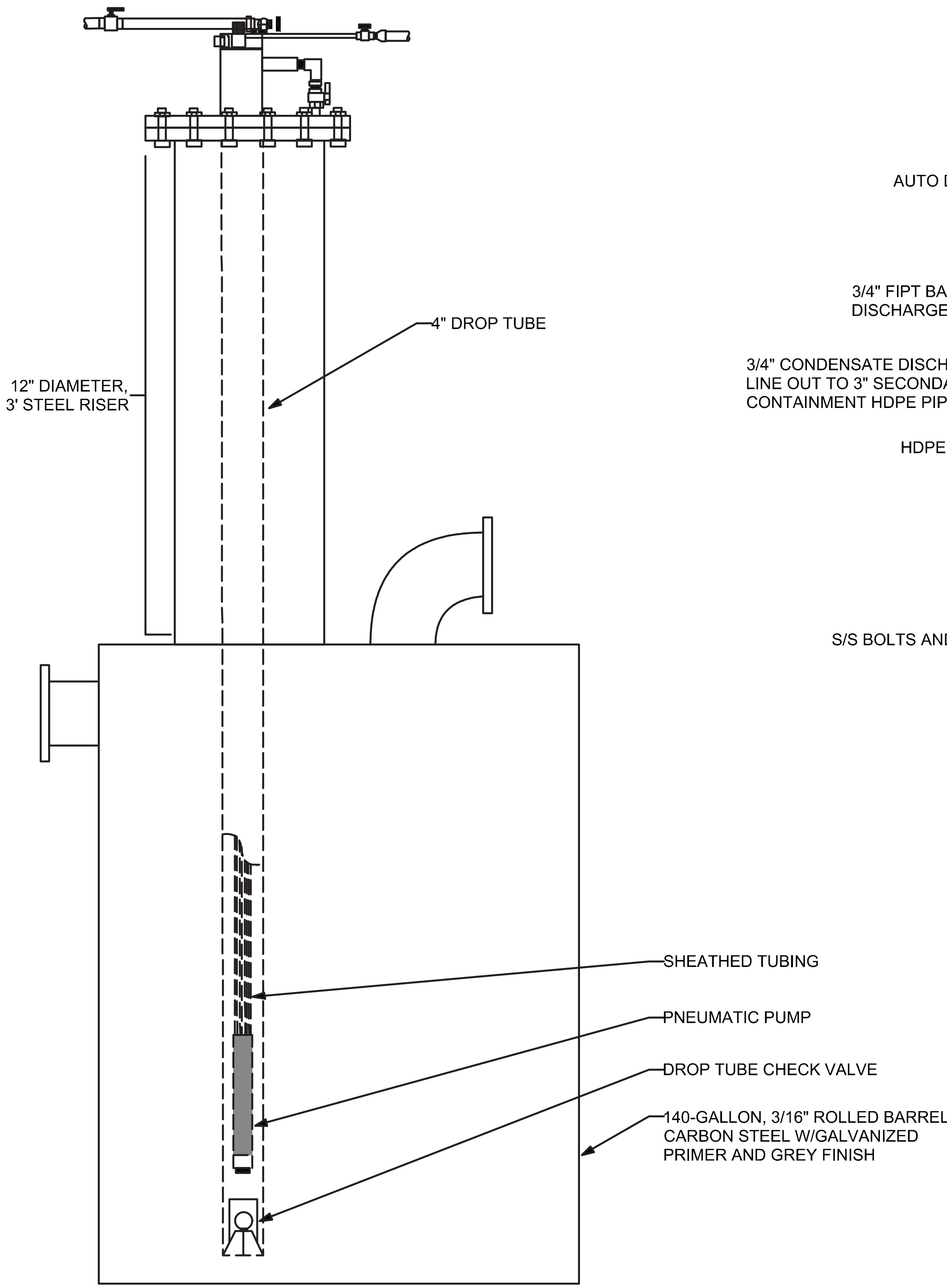
BELOW GROUND MOISTURE SEPARATOR DETAIL

NOT TO SCALE



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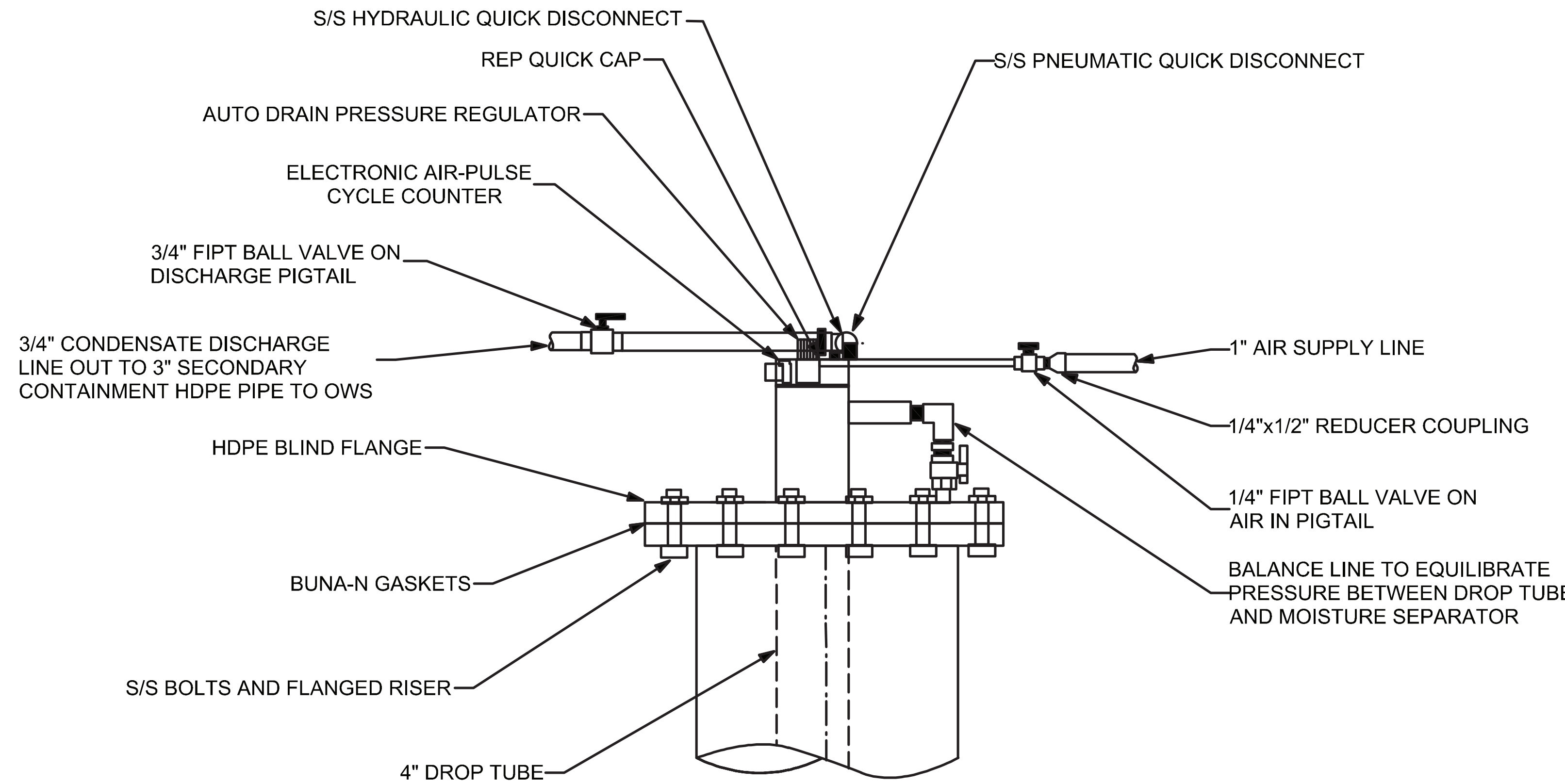

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BGMS DETAIL DIAGRAM FOR:
SVE SYSTEM RECONFIGURATION
PASCO LANDFILL NPL SITE

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APR 2020
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BELOW GRADE MOISTURE SEPARATOR SUMP DETAIL

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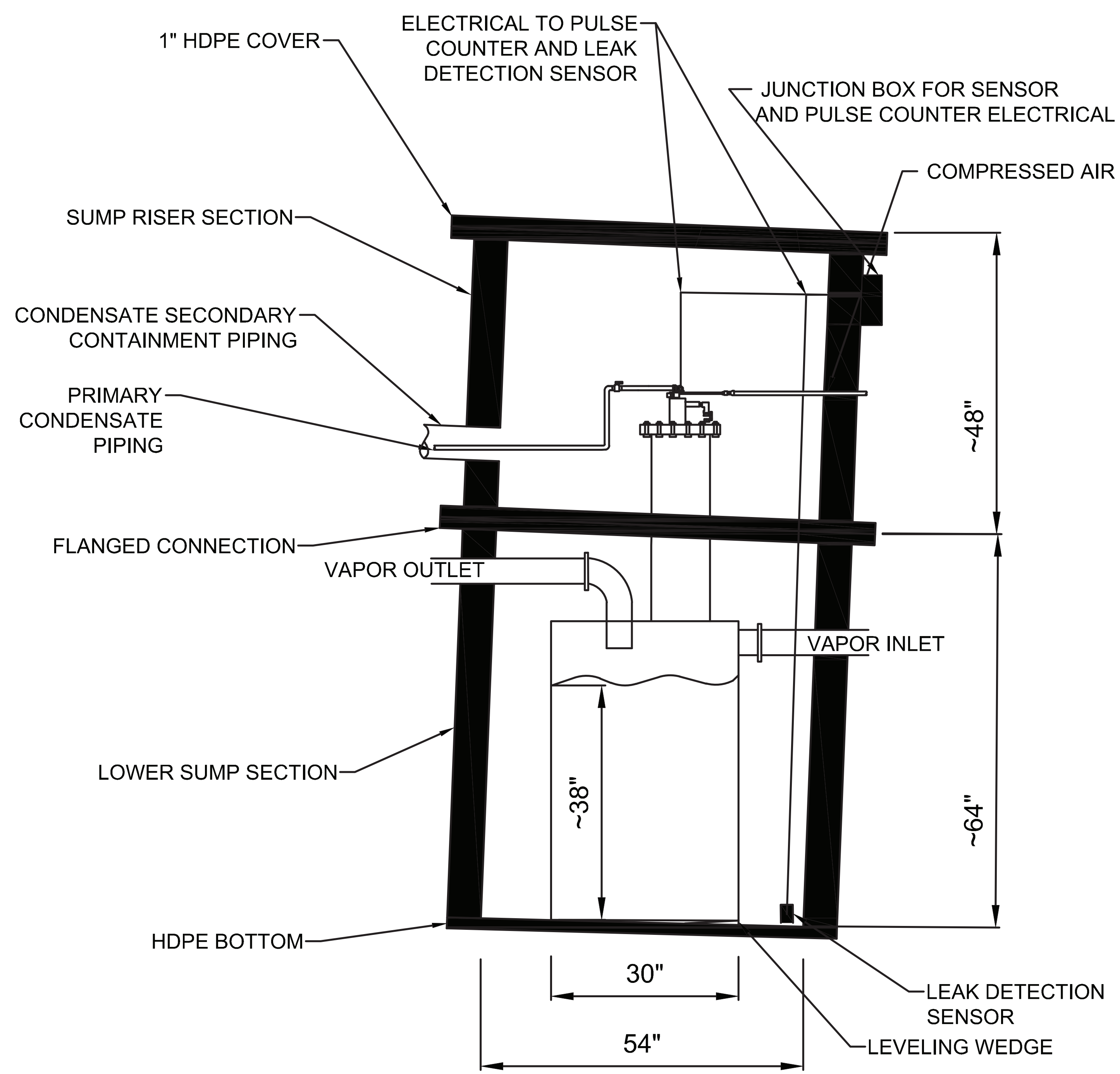

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BGMS SUMPS FOR:

SVE SYSTEM RECONFIGURATION

PASCO LANDFILL NPL SITE

DESIGNED:	SB/SG
CHECKED:	PB
APR 2020	64180.020
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ATTACHMENTS

ATTACHMENT 1

Calculation 1
Estimated Radius of Influence of VEW-06H
Pasco Landfill NPL Site
Pasco, WA

$$P_r^2 - P_W^2 = (P_{RI}^2 - P_W^2) * \frac{\ln(\frac{r}{R_W})}{\ln(\frac{R_I}{R_W})}$$

Vacuum at Observation Well 51D (in w.c.)	Vacuum at Extraction Well 06D (in w.c.)	Pressure at ROI (in w.c.)	Radius of Extraction Well (in)	Distance From Extraction Well (ft)
3.1	53.9	0.539	4	128
0.99238	0.86750	0.99867	0.3333	128
Atm	Atm	Atm	Feet	Feet

0.2323 = 0.2448 $\ln(r/R_W)$ / $\ln(R_I/R_W)$

0.2323 = 0.2448 5.950643 / $\ln(R_I/R_W)$

$\ln(R_I/R_W)$ = 6.2717932

R_I/R_W = 6.2717932 e^x

R_I = 176 feet

Notes:

1. One inch of water column = 0.0024583161485336 atmosphere @ 40 °F.
2. Pressure at the radius of influence is set at 1% of the extraction well vacuum.
3. This calculation is for general purposes only and has not been used as the primary selection criteria for the spacing of the SVE wells.
4. in w.c. means inches of water column.
5. The observed vacuum at VMW-51D was taken when both VEW-06D and VEW-07D were actively used for extraction.

P_r = Pressure at radial distance *r* from the vapor extraction well (Atmospheres)
P_W = Pressure at the vapor extraction well (Atmospheres)
P_{RI} = Pressure at the radius of influence (= 1% of extraction well's applied vacuum)
r = Radial distance from the vapor extraction well
R_I = Radius of influence where pressure is equal to atmospheric pressure or a preset value
R_W = Well radius of the vapor extraction well

Practical Design Calculations for Groundwater and Soil Remediation, 1999,
by Jeff Quo, Ph.D Equation V.1.2

Section 1; Well

4" Horizontal Well to Carrier Pipe	Length of Pipe (ft) or Number of Fittings	Equivalent Pipe Length per Fitting (ft)	Equivalent Pipe Length (ft)
Length of Pipe	230	230	230
45° Elbow	1	5	5
90° Elbow		10	
Wye Fittings		5	
Red. Bushing	1	5	5
Through Tee		7	
Branch Tee	1	20	20
Check Valves		34	
Gate Valves	1	2	2
Flex Hose	3	10	30
Total			292

Flow		Head Loss	
SCFM	L/sec	mmHg/m of pipe	In Hg/Ft of pipe
50	23.6	0.01	0.00012
75	35.4	0.02	0.00024
100	47.2	0.037	0.000444
125	59.0	0.053	0.000636
150	70.8	0.07	0.00084
200	94.4	0.12	0.00144
250	118	0.14	0.00168
300	142	0.27	0.00324
350	165	0.36	0.00432

USACE Friction Loss Chart for 100 mm D pipe, but taken from Rev 100% EDR

Flow	Total Head Loss (in Hg)	Total Head Loss (in H2O)	
50	0.035	0.477	
75	0.070	0.954	
100	0.130	1.76	
125	0.186	2.53	
150	0.245	3.34	
200	0.420	5.72	
250	**0.491**	**6.68**	**Target Flow**
300	0.946	12.9	
350	1.26	17.2	

Section 2: Well to BGMS

6" Carrier Pipe	Length of Pipe (ft) or Number of Fittings	Equivalent Length (ft)	Equivalent Pipe Length (ft)
to BGMSs	380	380	380
45° Elbow	2	8	16
90° Elbow	3	18	54
Wye Fittings		7	
Red. Bushing		7	
Through Tee	3	10	30
Branch Tee		32	
Check Valves	1	40	40
Gate Valves		2	
Total			520

Flow		Head Loss	
SCFM	L/sec	mmHg/m of pipe	In Hg/Ft of pipe
50	23.6	0.0015	1.8E-05
75	35.4	0.003	3.6E-05
100	47.2	0.0055	6.6E-05
125	59.0	0.008	9.6E-05
150	70.8	0.01	0.00012
200	94.4	0.018	0.000216
225	106	0.021	0.000252
250	118	0.022	0.000264
300	142	0.04	0.00048
350	165	0.048	0.000576
375	177	0.05	0.0006
450	212	0.075	0.0009

USACE Friction Loss Chart for 150 mm D pipe, but taken from Rev 100% EDR

Flow	Total Head Loss (in Hg)	Total Head Loss (in H2O)	
50	0.00936	0.127	
75	0.0187	0.255	
100	0.0343	0.467	
125	0.0499	0.679	
150	0.0624	0.849	
200	0.112	1.53	
225	0.131	1.78	
250	**0.137**	**1.87**	**Target Flow**
300	0.250	3.40	
350	0.300	4.08	
375	0.31199999	4.25	
450	0.467999985	6.37	

Section 3: BGMS to Building

6" Carrier Pipe	Length of Pipe (ft) or Number of Fittings	Equivalent Length (ft)	Equivalent Pipe Length (ft)
BGMS to Building	100	100	100
45° Elbow	4	8	32
90° Elbow		18	
Wye Fittings		7	
Red. Bushing	1	7	7
Through Tee	2	10	20
Branch Tee		32	
Check Valves		40	
Gate Valves	1	2	2
Total			161

Flow		Head Loss	
SCFM	L/sec	mmHg/m of pipe	In Hg/Ft of pipe
50	23.6	0.0015	1.8E-05
75	35.4	0.003	3.6E-05
100	47.2	0.0055	6.6E-05
125	59.0	0.008	9.6E-05
150	70.8	0.01	0.00012
200	94.4	0.018	0.000216
225	106	0.021	0.000252
250	118	0.022	0.000264
300	142	0.04	0.00048
350	165	0.048	0.000576
375	177	0.05	0.0006
450	212	0.075	0.0009

USACE Friction Loss Chart for 150 mm D pipe, but taken from Rev 100% EDR

Flow	Total Head Loss (in Hg)	Total Head Loss (in H2O)	
50	0.00290	0.039	
75	0.00580	0.079	
100	0.0106	0.145	
125	0.0155	0.210	
150	0.0193	0.263	
200	0.0348	0.473	
225	0.0406	0.552	
250	**0.0425**	**0.578**	**Target Flow**
300	0.0773	1.05	
350	0.0927	1.26	
375	0.096599997	1.31	
450	0.145	1.97	

Loss Across BGMS, Est. HiLine

	Est. Headloss Across BGMS at 150 scfm	Est. Headloss Across BGMS at 225 scfm	**Est. Headloss Across BGMS at 300 scfm**	Est. Headloss Across BGMS at 375 scfm	Est. Headloss Across BGMS at 450 scfm
in Hg					
in H2O	0.5	1	**2**	3	4

Section 4: Piping in Building to Knockout

4" Piping to Inside knockout	Length of Pipe (ft) or Number of Fittings	Equivalent Pipe Length per Fitting (ft)	Equivalent Pipe Length (ft)
Length of Pipe	10	10	10
45° Elbow	2	8	16
90° Elbow		10	
Wye Fittings		5	
Red. Bushing	1	7	7
Through Tee		7	
Branch Tee	1	32	32
Check Valves		34	
Gate Valves	1	2	2
Flex Hose	1	10	10
Total			77

Flow		Head Loss	
SCFM	L/sec	mmHg/m of pipe	In Hg/Ft of pipe
150	70.8	0.07	0.00084
225	106	0.12	0.00144
250	118	0.14	0.00168
300	142	0.30	0.0036
375	177	0.40	0.0048
450	212	0.50	0.006

USACE Friction Loss Chart for 100 mm D pipe, but taken from Rev 100% EDR

Flow	Total Head Loss (in Hg)	Total Head Loss (in H2O)	
150	0.0647	0.880	
225	0.111	1.51	
250	**0.129**	**1.76**	**Target Flow**
300	0.277	3.77	
375	0.370	5.03	
450	0.462	6.29	

Section 5: Loss Across Rotron MS600BS Knockout

	Headloss Across Knockout Tanks and Filter at 150 scfm	**Headloss Across Knockout Tanks and Filter at 300scfm**	Headloss Across Knockout Tanks and Filter at 450 scfm	Headloss Across Knockout Tanks and Filter at 600 scfm	Headloss Across Knockout Tanks and Filter at 750 scfm
in Hg	0.04	**0.09**	0.18	0.59	0.81
in H2O	0.5	**1.25**	2.5	8	11

Total System Head Loss to the Blowers at 250 cfm
14.1 "wc

		(Kelvin)	(degrees F)	(degrees C)
Extracted Gas Temperature		308	95	35
		(Kelvin)	(degrees F)	(degrees C)
Ambient temperature in winter (T) - (Kelvin)		273	32	0
Concentration of water vapor at 95 degrees Fahrenheit [1] (kg/kg)		0.0340		
Concentration of water vapor at 30 degrees Fahrenheit [1] (kg/kg)	minus	0.0038		
Concentration of condensate (kg/kg)	equals	0.0302		

	(inches w.c.)	(feet w.c.)	Atm
Assumed vacuum at moisture separator (P)	50	4.17	0.123
Assumed absolute pressure at moisture separator (atm)			0.877
Molecular weight of air in kg/kg-mole (M)			29
Gas Constant (R) - (L-atm/mole-K)			0.0821
g-mole per kg-mole			1,000

Density of air in kg/L = PM/RT = 1.13E-03 kg/L

	SCFM	L/Sec
Flowrate	250	118

Volume of moisture accumulated = (concentration of condensate x flowrate)

Condensate Volume = 3.852 gallons/hour = 92.4 gallons/day

Conversions used in formula:

3.78 liters/gallon

3600 seconds/hour

.472 L/Sec per scfm

Notes:

1. Values from Phychrometric Chart No. 1 - Normal Temperature, SI Units; published by the American Society of Heating Refrigerating and Air-Conditioning Engineers, Inc., Copyright 1992.
2. Chart may be found in attachment of this document.
3. Equation from Section 5-7(d) of USACE EM 1110-1-4001

Calculation 4

Flow Rate Calculation in Pipe Leading to the Rotron Blower and at the Wellheads

Pasco Landfill NPL Site

Pasco, WA

$$Q = 128.8(K)(D^2)\left[\frac{(P)(\Delta P)}{(T+460)(S)}\right]^{\frac{1}{2}}$$

$$Q = 128.8(88)(3.94^2)\left[\frac{(-51 * .03613 + 14.7)(1.400)}{(88+460)(1.00)}\right]^{\frac{1}{2}}$$

$$\boxed{\mathbf{Q = 247\ scfm}}$$

Where:

Q = flow rate in scfm
K = instrument flow coefficient = 0.67 (dimensionless)
D = inside diameter of pipe in inches = 3.94 inches
P = measured static pressure in pounds per square inch absolute
(psia, ; convert in. H_2O to psia by multiplying by 0.03613 and adding 14.70 (psi per atmosphere)
ΔP = measured differential pressure in in. H_2O
T = measured gas temperature in °F
S = specific gravity of air = 1.00 (dimensionless)

ATTACHMENT 2

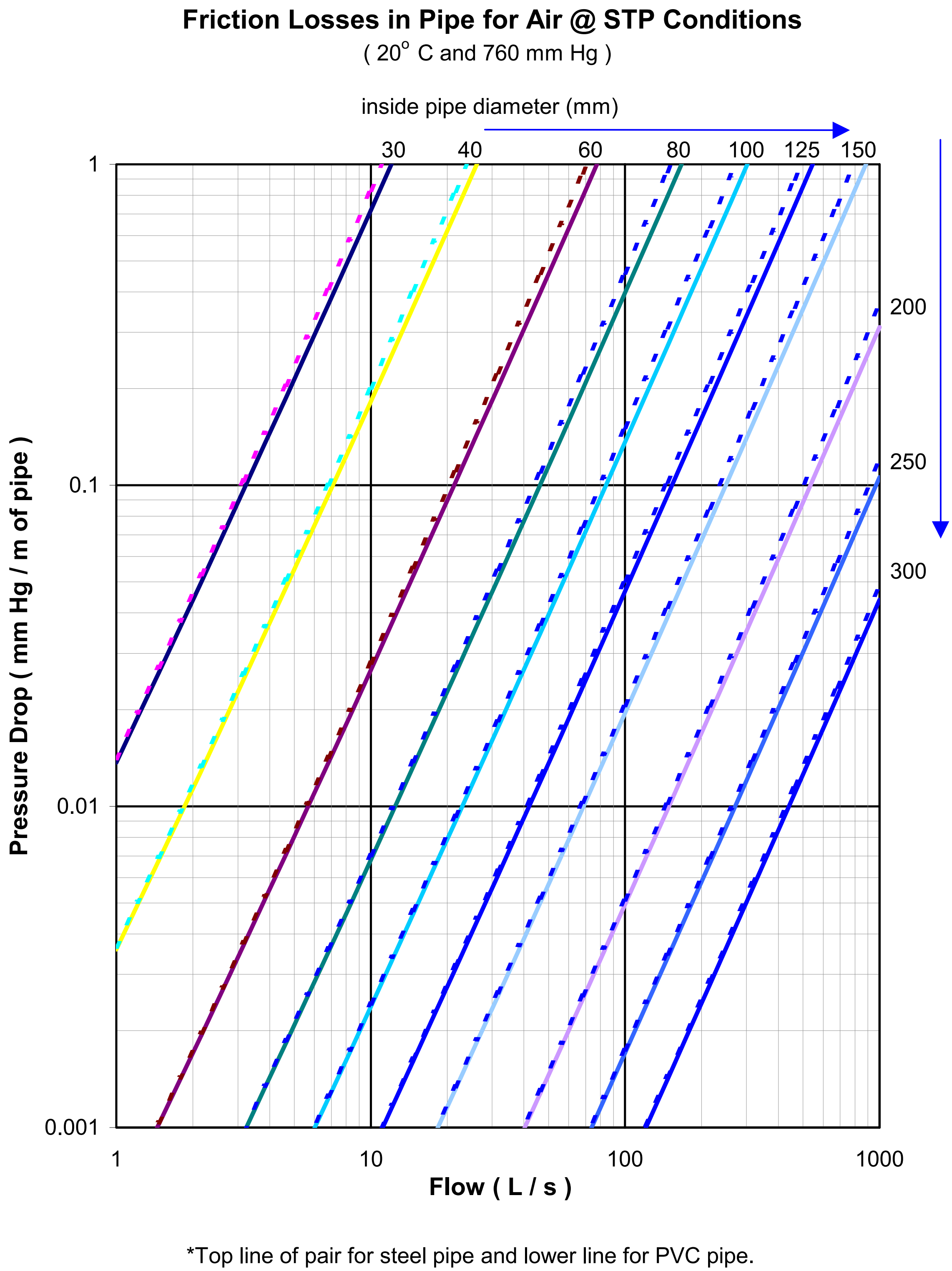
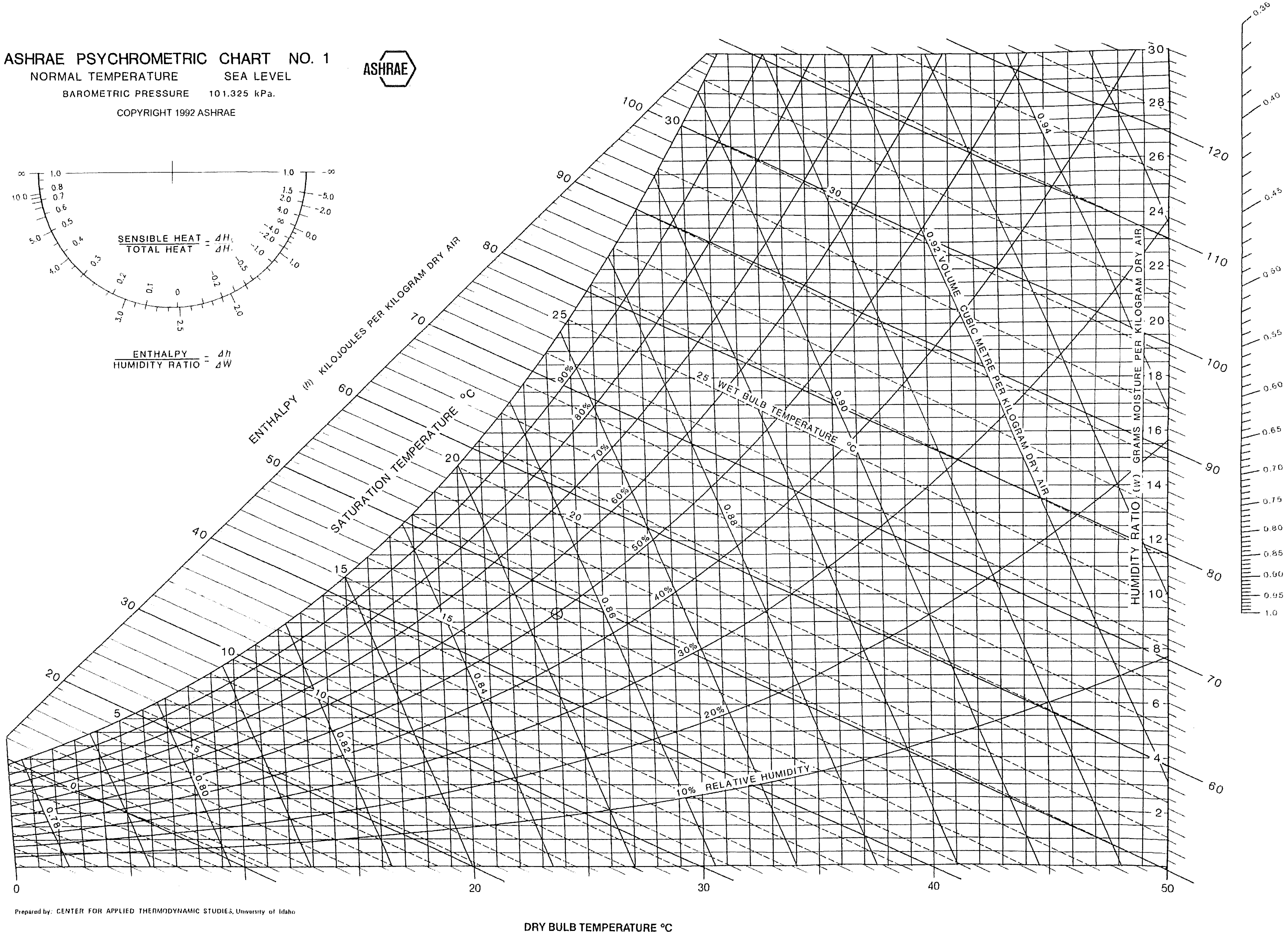


Figure 5-15. Friction Loss Chart.

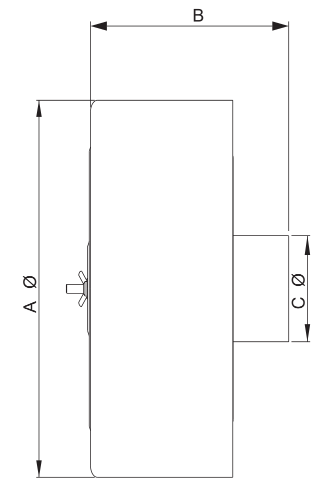


ASHRAE PSYCHROMETRIC CHART NO. 1
NORMAL TEMPERATURE SEA LEVEL
BAROMETRIC PRESSURE 101.325 kPa.
COPYRIGHT 1992 ASHRAE
ASHRAE
SENSIBLE HEAT / TOTAL HEAT = ΔHs / ΔHt
ENTHALPY / HUMIDITY RATIO = Δh / ΔW
ENTHALPY (h) KILOJOULES PER KILOGRAM DRY AIR
SATURATION TEMPERATURE °C
WET BULB TEMPERATURE °C
VOLUME CUBIC METRE PER KILOGRAM DRY AIR
HUMIDITY RATIO (W) GRAMS MOISTURE PER KILOGRAM DRY AIR
10% RELATIVE HUMIDITY
SENSIBLE HEAT / TOTAL HEAT = ΔHs / ΔHt
DRY BULB TEMPERATURE °C
Prepared by: CENTER FOR APPLIED THERMODYNAMIC STUDIES, University of Idaho

Filtration - Inlet Filter (Single Connection)

ROTRON®

Inlet Filters protect the blower and the air distribution system from dust, and other airborne particles and contaminants. Normally used in pressure systems.



SPECIFICATIONS:

HOUSING – Steel
MEDIA – Polyester
EFFICIENCY – 97-98% (8 to 10 micron particle size)
FILTER ELEMENT – Replaceable (see filter elements) NOTE: “Z” MEDIA (1 to 3 micron particle size) available

		Part/Model Number								
Specification	Units	477411	516466	515122	515123	515124	515125	515145	515151	516511
Filter Element	-	A	B	C, D	E	E	F	G	H	H
Ref Blower Model	-	271078	515132	515132	515133	515134	515134	515134	515135	516515
Outlet Connection	-	2.00 SO	1.00 NPT	1.50 NPT	2.00 NPT	2.00 NPT	2.50 NPT	3.00 NPT	4.00 NPT	6.00 NPT
Dimension A	Inches	4.56	6.00	6.00	7.75	10.00	10.00	10.00	10.00	16.00
	mm	115.8	152.4	152.4	196.9	254	254	254	254	406.4
Dimension B	Inches	6.12	6.50	6.50	7.25	12.25	12.50	13.00	14.00	15.00
	mm	155.4	165.1	165.1	184.2	311.2	317.5	330.2	355.6	381
Dimension C	Inches	2.00	1.00	1.5	2.00	2.00	2.50	3.00	4.00	6.00
	mm	50.8	25.4	38.1	50.8	50.8	63.5	76.2	101.6	152.4
Z Media Filter PN	-		517865	517866	517867	517868	517869	517870	517871	517872

A = SPIRAL	E = DR/EN/CP 656, 6, 633, S7
B = DR/EN/CP 068, 083, 101, 202	F = DR/EN/CP 757, 808, 858, S9, P9 (Inlet Only)
C = DR/EN/CP 303, 312, 313, 353	G = DR/EN/CP 833, S13, P13 (Inlet Only)
D = DR/EN/CP 404, 454, 513, 505, 555, 523	H = DR/EN/CP 909, 979, 1233, 14, S15, P15 (Inlet Only)

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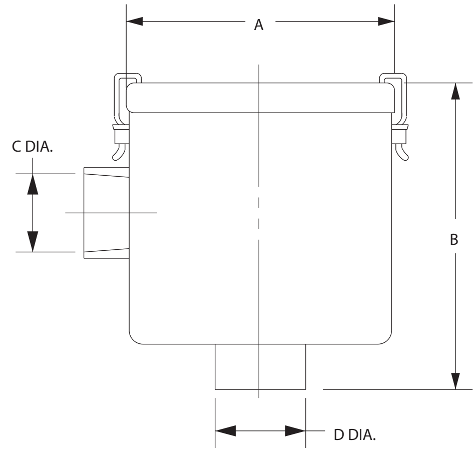
1258 Customer Service Fax: +1 215.256.1338
www.ametekdfs.com

Filtration - Inline Filter (Dual Connection)

ROTRON®

Inline Filters protect the blower from harmful dust and other particles that may be drawn into the blower through the air distribution system. Normally used in vacuum systems.



SPECIFICATIONS:

Inline filter PN 271200 is a straight through design
Inlet is directly opposite of outlet

HOUSING – Steel
MEDIA – Polyester
EFFICIENCY – 97-98% (8 to 10 micron particle size)
FILTER ELEMENT – Replaceable (see filter elements) NOTE: “Z” MEDIA (1 to 3 micron particle size) available
Feature 1/4" threaded tap for gauge connection on inlet and outlet

		Part/Model Number							
Specification	**Units**	**271200**	**516461**	**515254**	**515255**	**515256**	**516463***	**516465***	**517611***
Filter Element	-	271078	516434	516434	516435	516435	515135	515135	516515
Ref Blower Model	-	A	B	C, D	E	F	G	H	H
Inlet Connection	-	1.75 SO	1.00 NPSC-F	1.50 NPSC-F	2.00 NPSC-F	2.50 NPSC-F	3.00 NPT-M	4.00 NPT-M	6.00 NPT-M
Outlet Connection	-	2.00 SO	1.00 NPSC-F	1.50 NPSC-F	2.00 NPSC-F	2.50 NPSC-F	3.00 NPT-M	4.00 NPT-M	6.00 NPT-M
Dimension A	Inches	5.25	7.25	7.00	8.00	8.00	14.00	14.00	18.00
	mm	133.4	184.2	177.8	203.2	203.2	355.6	355.6	457.2
Dimension B	Inches	8.31	6.50	6.50	10.25	10.25	26.50	27.00	28.00
	mm	211.1	165.1	165.1	260.4	260.4	673.1	685.8	711.2
Dimension C	Inches	2.00	1.00	1.50	2.00	2.50	3.00	4.00	6.00
	mm	50.8	25.4	38.1	50.8	63.5	76.2	101.6	152.4
Dimension D	Inches	1.75	1.00	1.50	2.00	2.50	3.00	4.00	6.00
	mm	44.5	25.4	38.1	50.8	63.5	76.2	101.6	152.4
Z Media Filter PN	-		517886	517887	517888	517889	517890	517891	517892

A = SPIRAL	**E = DR/EN/CP 656, 6, 633, S7**
B = DR/EN/CP 068, 083, 101, 202	**F = DR/EN/CP 757, 808, 858, S9, P9 (Inlet Only)**
C = DR/EN/CP 303, 312, 313, 353	**G = DR/EN/CP 833, S13, P13 (Inlet Only)**
D = DR/EN/CP 404, 454, 513, 505, 555, 523	**H = DR/EN/CP 909, 979, 1233, 14, S15, P15 (Inlet Only)**

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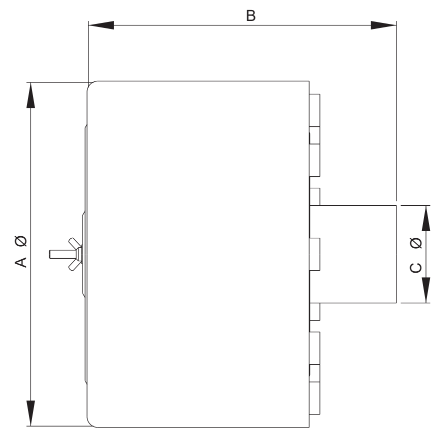
AMETEK®
PRECISION MOTION CONTROL
DYNAMIC FLUID SOLUTIONS

ROTRON®

Filter/Silencers reduce noise levels while ensuring clean air is provided to the blower and the air distribution system. Normally used in pressure applications.



SPECIFICATIONS:

HOUSING – Steel
MEDIA – Polyester
EFFICIENCY – 97-98% (8 to 10 micron size)
FILTER ELEMENT – Replaceable (see filter elements)

		Part/Model Number							
Specification	Units	516487	516489	516491	516493	516495	516497	516499	516513
Filter Element	-	**B**	**C, D**	**E**	**E**	**F**	**G**	**H**	**H**
Ref Blower Model	-	**515132**	**515132**	**515133**	**515134**	**515134**	**515134**	**515135**	**516515**
Outlet Connection	-	**1.00 NPT**	**1.50 NPT**	**2.00 NPT**	**2.00 NPT**	**2.50 NPT**	**3.00 NPT**	**4.00 NPT**	**6.00 NPT**
Dimension A	**Inches**	**6.00**	**6.00**	**10.00**	**10.00**	**10.00**	**10.00**	**16.00**	**16.00**
	mm	**152.4**	**152.4**	**254**	**254**	**254**	**254**	**406.4**	**406.4**
Dimension B	**Inches**	**6.50**	**6.50**	**7.25**	**12.25**	**12.50**	**12.50**	**14.00**	**15.00**
	mm	**165.1**	**165.1**	**184.2**	**311.2**	**317.5**	**317.5**	**355.6**	**381**
Z Media Filter PN	-	**1.00**	**1.50**	**2.00**	**2.00**	**2.50**	**3.00**	**4.00**	**6.00**
Dimension C	**Inches**	**517878**	**517879**	**517880**	**517881**	**517882**	**517883**	**517884**	**517885**
	mm	**13154101.2**	**13154126.6**	**13154152**	**13154177.4**	**13154202.8**	**13154228.2**	**13154253.6**	**13154279**

A = SPIRAL	**E = DR/EN/CP 656, 6, 633, S7**
B = DR/EN/CP 068, 083, 101, 202	**F = DR/EN/CP 757, 808, 858, S9, P9 (Inlet Only)**
C = DR/EN/CP 303, 312, 313, 353	**G = DR/EN/CP 833, S13, P13 (Inlet Only)**
D = DR/EN/CP 404, 454, 513, 505, 555, 523	**H = DR/EN/CP 909, 979, 1233, 14, S15, P15 (Inlet Only)**

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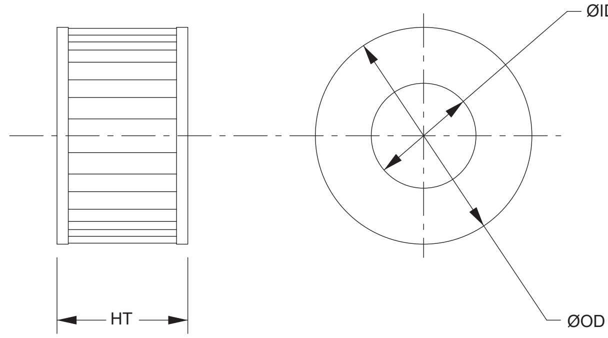
ROTRON®

All ROTRON Air Filters and Filter/Silencers have replaceable filter elements. The filter media is polyester designed for high efficiency over a wide spectrum of industrial applications. See ÿlter element cross reference table. Filter elements supplied with foam pre-filter.

Standard Replacement Filter Element Cross Reference Table

Filter	Element	Filter	Element	Filter	Element
271200	271078	515158	515134	516489	515132
477411	271078	515254	516434	516491	515133
515122	515132	515255	516435	516493	515134
515123	515133	515256	516435	516495	515134
515124	515134	516461	516434	516497	515134
515125	515134	516463	515135	516499	515135
515145	515134	516465	515135	516511	516515
515151	515135	516466	515132	516513	516515
515157	515133	516487	515132	517611	516515



For DR Blower Models

		Part/Model Number						
Specification	Units	515132	515133	515134	515135	516434	516435	516515
Z Media Filter PN	-	517873	517874	517875	517876	517893	517894	517877
Dimension ID	Inches	3.00	3.63	3.5	4.75	2.56	3.50	8.00
	mm	76.2	92.2	88.9	120.7	65	88.9	203.2
Dimension OD	Inches	4.38	5.88	5.88	7.88	5.00	5.88	11.75
	mm	111.3	149.4	149.4	200.2	127	149.4	298.5
Area	Sq/Ft	4.75	4.75	9.50	9.63	4.75	8.75	9.63
	Sq/M	0	0	1	1	0	1	1
Dimension HT	Inches	1.5	2.3	4.5	8.3	2.0	4.5	19.0
	mm	38.1	58.4	114.3	210.8	50.8	114.3	482.6

ROTRON®

All ROTRON Air Filters and Filter/Silencers have replaceable filter elements. The filter media is polyester designed for high efficiency over a wide spectrum of industrial applications. See ÿlter element cross reference table. Filter elements supplied with foam pre-filter.

Standard Replacement Filter Element Cross Reference Table

Filter	Element	Filter	Element	Filter	Element
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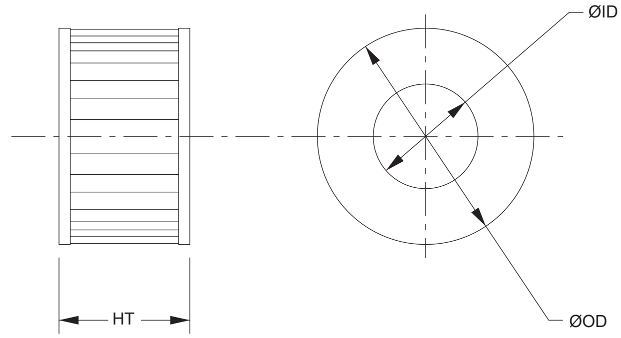
477411	271078	515254	516434	516491	515133
515122	515132	515255	516435	516493	515134
515123	515133	515256	516435	516495	515134
515124	515134	516461	516434	516497	515134
515125	515134	516463	515135	516499	515135
515145	515134	516465	515135	516511	516515
515151	515135	516466	515132	516513	516515
515157	515133	516487	515132	517611	516515



For DR Blower Models

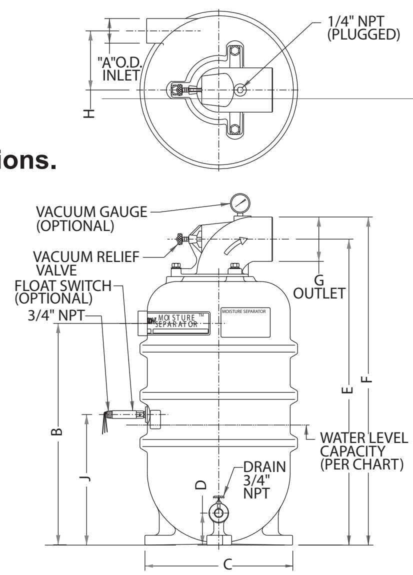
		Part/Model Number						
Specification	**Units**	**515132**	**515133**	**515134**	**515135**	**516434**	**516435**	**516515**
Z Media Filter PN	-	517873	517874	517875	517876	517893	517894	517877
Dimension ID	Inches	3.00	3.63	3.5	4.75	2.56	3.50	8.00
	mm	76.2	92.2	88.9	120.7	65	88.9	203.2
Dimension OD	Inches	4.38	5.88	5.88	7.88	5.00	5.88	11.75
	mm	111.3	149.4	149.4	200.2	127	149.4	298.5
Area	Sq/Ft	4.75	4.75	9.50	9.63	4.75	8.75	9.63
	Sq/M	0	0	1	1	0	1	1
Dimension HT	Inches	1.5	2.3	4.5	8.3	2.0	4.5	19.0
	mm	38.1	58.4	114.3	210.8	50.8	114.3	482.6

ROTRON®

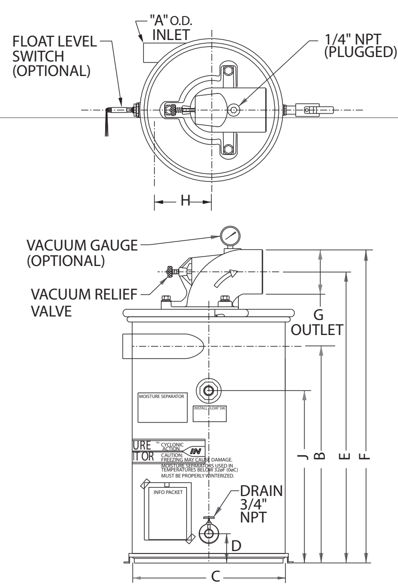
By separating and containing entrained liquids, ROTRON'S™ moisture separator helps protect our regenerative blowers and the end treatment system from corrosion and mineralization damage. Recommended for all soil vacuum extraction Applications.

SPECIFICATIONS:
SEPARATION METHOD – High Effciency Cyclonic
RELIEF VALVE MATERIAL – Brass & Stainless Steel
FLOAT MATERIAL – Copper
FLOAT SWITCH – SPDT, Explosion-proof NEMA 7&9, 5 Amp max.

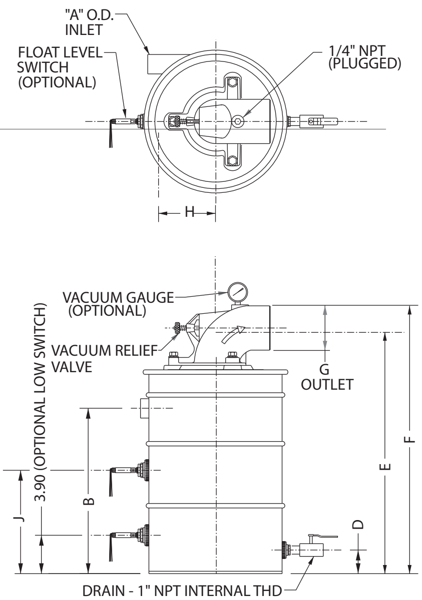
applications.



PLASTIC "P" DESIGN



METAL "D" DESIGN



METAL "B" DESIGN

		Part/Model Number					
		MS200PS	MS300PS	MS350BS	MS500BS	MS600BS	MS1000BS
Specification	Units	038519	038520	038357	080660	080659	038914
Dimension A	Inches	2.38	2.88	3.25	3.25	4.00	6.00
	mm	60.5	73.2	82.6	82.6	101.6	152.4
CFM Max.	CFM	200	300	350	500	600	1000
	m3/hr	340	510	595	850	1020	1700
Dimension B	Inches	22.46	22.46	28.00	28.00	27.00	31.00
	mm	570.5	570.5	711.2	711.2	685.8	787.4
Dimension C	Inches	16.00	16.00	23.00	23.00	23.00	27.00
	mm	406.4	406.4	584.2	584.2	584.2	685.8
Dimension D	Inches	3.25	3.25	4.00	4.00	4.00	4.00
	mm	82.6	82.6	101.6	101.6	101.6	101.6
Dimension E	Inches	31.05	31.05	37.25	37.37	37.37	47.32
	mm	788.7	788.7	946.2	949.2	949.2	1201.9
Dimension F	Inches	33.30	33.30	39.50	54.50	54.50	51.70
	mm	845.8	845.8	1003.3	1384.3	1384.3	1313.2
Dimension H	Inches	6	6.00	9.75	9.75	9.25	10.00
	mm	152.4	152.4	247.7	247.7	235	254
Dimension G	Inches	4.50 OD	4.50 D	4.50 OD	6.63 ID	6.63 ID	8.62 OD
	mm	114.3	114.3	114.3	168.4	168.4	218.9
Dimension J	Inches	13.25	13.25	17.50	17.50	17.50	19.88
	mm	336.6	336.6	444.5	444.5	444.5	505
Drain Internal Thd	-	3/4	3/4	1	1	1	1
Shipping Weight	Lbs	42	42	82	95	96	150
	Kg	19.1	19.1	37.2	43.1	43.5	68

This document is for informational purposes only and should not be considered as a binding description of the products or their performance in all applications. The performance data on this page depicts typical performance under controlled laboratory conditions. AMETEK is not responsible for blowers driven beyond factory specified speed, temperature, pressure, flow or without proper alignment. Actual performance will vary depending on the operating environment and application. AMETEK products are not designed for and should not be used in medical life support applications. AMETEK reserves the right to revise its products without notification. The above characteristics represent standard products. For product designed to meet specific applications, contact AMETEK Technical & Industrial Products Sales department.

AMETEK DYNAMIC FLUID SOLUTIONS
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www.ametekdfs.com

AMETEK®
PRECISION MOTION CONTROL
DYNAMIC FLUID SOLUTIONS

2.0 Moisture Separator™ Specifications

2.1 Duty

The moisture separator shall be designed for use in a soil vapor extraction system capable of continuous operation with a pressure drop of less than six inches of water at the rated flow of _____ SCFM. The separator shall be capable of operation under various inlet conditions randing from a fine mist to slugs of water with high efficiency.

2.2 Principle of Operation

The moisture separator shall incorporate cyclonic separation to remove entrained water. The separator must protect against an overflow by fail safe mechanical means. An electrical switch or contact(s) alone is not an acceptable means of protection against overflow, but is a good backup.

2.3 Construction

The body of the moisture separator shall be constructed of heavy wall plastic or heavy gauge cold rolled steel. The steel interior and exterior shall be epoxy (powder) coated to resist abrasion, corrosion, and chipping that might expose the surface. The inlet shall be tangentially located and welded to the body. The outlet port shall be constructed of PVC or cast aluminum alloy, flanged and sealed to the center of the top of the separator. The separator shall incorporate a non-sparking copper float ball and an adjustable relief valve to protect against overflow and overheating the blower.

<table>
<tr><th>For DR/EN/CP Blower Model</th><th>Selector Moisture Separator Model</th><th>Liquid-holding Capacity (gallons)</th><th>Inlet (OD)</th><th>Outlet</th><th>Max Vacuum Allow (IHG)</th></tr>
<tr><td>404
454
505
513
523
555
633
833</td><td>MS200PS</td><td>7</td><td>2.38</td><td rowspan="3">4.5 OD</td><td rowspan="2">12</td></tr>
<tr><td>656
6
757</td><td>MS300PS</td><td>7</td><td>2.88</td></tr>
<tr><td>808</td><td>MS350BS</td><td rowspan="3">40</td><td rowspan="2">3.25</td><td rowspan="4">22</td></tr>
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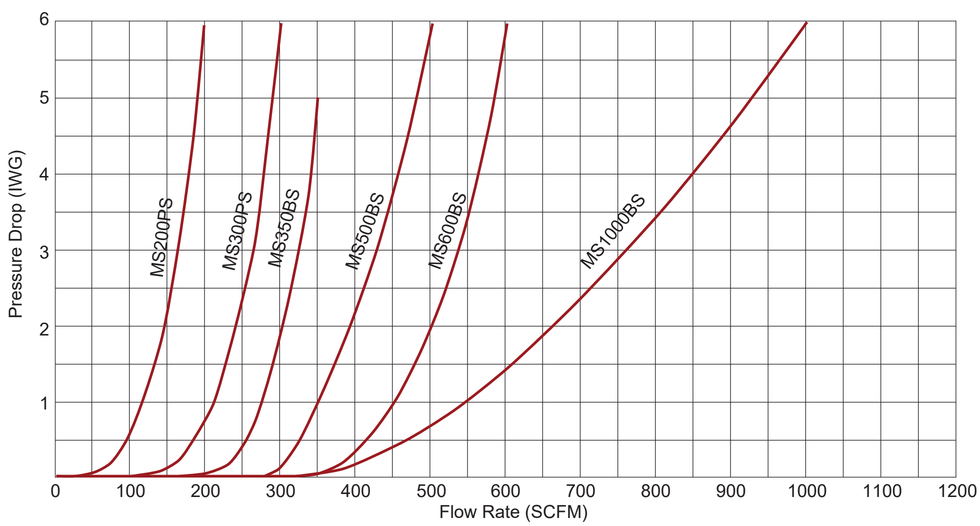
1233</td><td>MS500BS</td><td rowspan="2">6.63 ID</td></tr>
<tr><td>909</td><td>MS600BS</td><td>4.0</td></tr>
<tr><td>979
14</td><td>MS1000BS</td><td>65</td><td>6.0</td><td>8.62 OD</td></tr>
</table>

2.4 Capacity and Dimension

The moisture separator must have a liquid capacity of _____ gallons. The inlet shall be _____ inch OD slip-on type. The outlet shall be _____ inch OD slip-on type.

2.5 Pressure Drop



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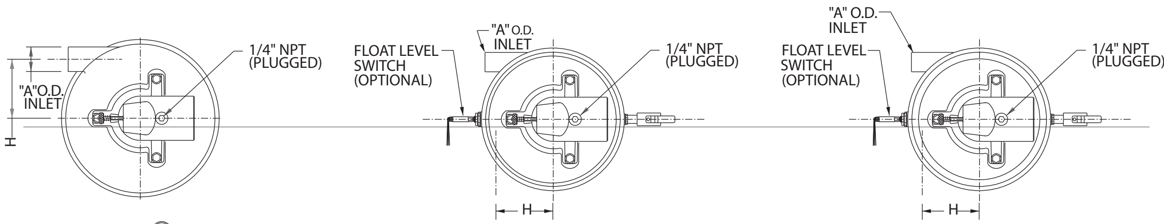
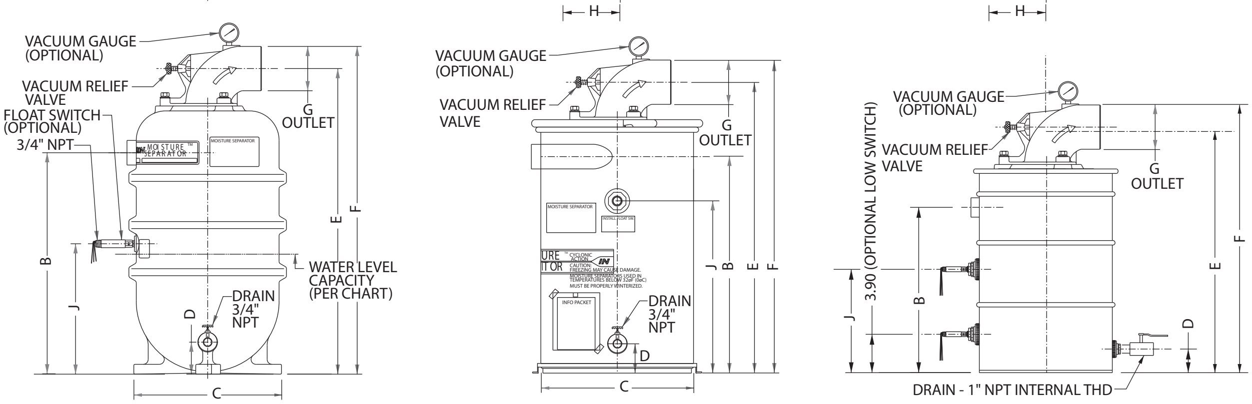
ROTRON®

By separating and containing entrained liquids, ROTRON'S™ moisture separator helps protect our regenerative blowers and the end treatment system from corrosion and mineralization damage. Recommended for all soil vacuum extraction Applications.

SPECIFICATIONS:
SEPARATION METHOD – High Effciency Cyclonic
RELIEF VALVE MATERIAL – Brass & Stainless Steel
FLOAT MATERIAL – Copper
FLOAT SWITCH – SPDT, Explosion-proof NEMA 7&9, 5 Amp max.



applications.



PLASTIC "P" DESIGN — METAL "D" DESIGN — METAL "B" DESIGN

		Part/Model Number					
		MS200PS	MS300PS	MS350BS	MS500BS	MS600BS	MS1000BS
Specification	Units	038519	038520	038357	080660	080659	038914
Dimension A	Inches	2.38	2.88	3.25	3.25	4.00	6.00
	mm	60.5	73.2	82.6	82.6	101.6	152.4
CFM Max.	CFM	200	300	350	500	600	1000
	m3/hr	340	510	595	850	1020	1700
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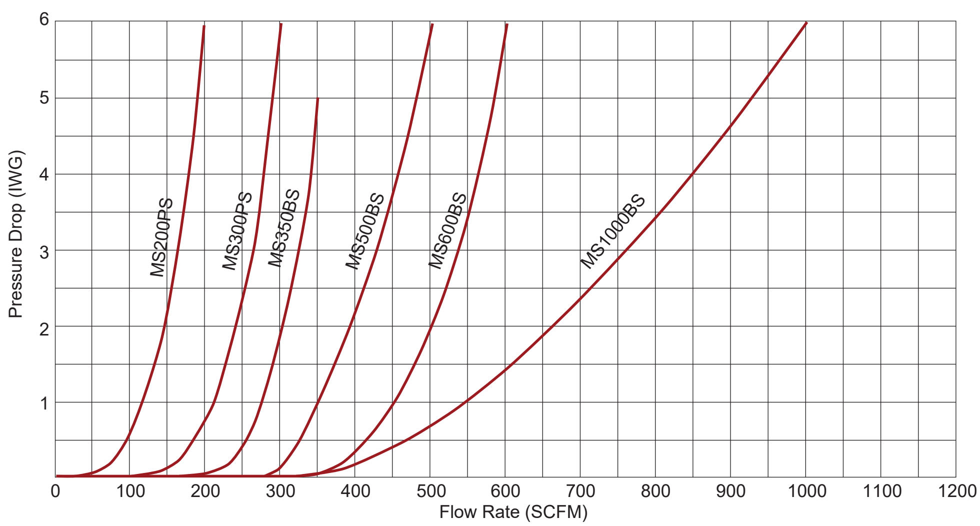

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ATTACHMENT 3

BIO-BORE DRILLING FLUID SDS

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **BIO-BORE™**

Revision Date: 13-Apr-2015 **Revision Number:** 14

1. Identification

1.1. Product Identifier

Product Trade Name:	BIO-BORE™
Synonyms:	None
Chemical Family:	Carbohydrate
Internal ID Code	HM003574

1.2 Recommended use and restrictions on use

Application:	Fluid Loss Additive
Uses Advised Against	No information available

1.3 Manufacturer's Name and Contact Details

Manufacturer/Supplier

Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By

Chemical Stewardship
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

1.4. Emergency telephone number

Emergency Telephone Number (281) 575-5000

2. Hazard(s) Identification

2.1 Classification in accordance with paragraph (d) of §1910.1200

Combustible dust	Combustible dust

2.2. Label Elements

Hazard Pictograms

Signal Word Warning

Hazard Statements

May form combustible dust concentrations in air.

Precautionary Statements

Prevention None

Response None

Storage None

Disposal None

Contains

Substances	CAS Number
Complex carbohydrate	Proprietary

2.3 Hazards not otherwise classified
None known

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - US
Complex carbohydrate	Proprietary	60 - 100%	Combustible Dust

The specific chemical identity of the composition has been withheld as proprietary. The exact percentage (concentration) of the composition has been withheld as proprietary.

4. First-Aid Measures

4.1. Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

4.2 Most important symptoms/effects, acute and delayed
No significant hazards expected.

4.3. Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically.

5. Fire-fighting measures

5.1. Extinguishing media
Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

5.2 Specific hazards arising from the substance or mixture
Special Exposure Hazards

Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential. Decomposition in fire may produce toxic gases.

5.3 Special protective equipment and precautions for fire-fighters
Special Protective Equipment for Fire-Fighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.
See Section 8 for additional information

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Scoop up and remove.

7. Handling and storage

7.1. Precautions for Safe Handling

Handling Precautions
Avoid creating or inhaling dust. Avoid contact with eyes, skin, or clothing. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment. Slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information
Store away from oxidizers. Store in a cool, dry location.

8. Exposure Controls/Personal Protection

8.1 Occupational Exposure Limits

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA
Complex carbohydrate	Proprietary	15 mg/M3	TWA: 10 mg/m^3

8.2 Appropriate engineering controls

Engineering Controls Use in a well ventilated area.

8.3 Individual protection measures, such as personal protective equipment

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (N95, P2/P3)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Solid **Color:** Off white

Odor:	Starch	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	4.5-7
Freezing Point/Range	No information available.
Melting Point/Range	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Flammability (solid, gas)	No data available
upper flammability limit	No data available
lower flammability limit	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.5
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	380 °C
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

Molecular Weight	1000000
VOC Content (%)	No data available
Bulk Density	32-41 lbs/ft3

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.

10.2. Chemical Stability
Stable

10.3. Possibility of Hazardous Reactions
Will Not Occur

10.4. Conditions to Avoid
None anticipated

10.5. Incompatible Materials
Strong oxidizers.

10.6. Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. Toxicological Information

11.1 Information on likely routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics

Acute Toxicity

Inhalation	May impede respiration.
Eye Contact	May cause mechanical irritation to eye.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

11.3 Toxicity data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Complex carbohydrate	Proprietary	No data available	No data available	No data available

Substances	CAS Number	Skin corrosion/irritation
Complex carbohydrate		Not a dermal irritant

Substances	CAS Number	Eye damage/irritation
Complex carbohydrate		Non-irritating to the eye

Substances	CAS Number	Skin Sensitization
Complex carbohydrate		Not regarded as a sensitizer.

Substances	CAS Number	Respiratory Sensitization
Complex carbohydrate		No information available

Substances	CAS Number	Mutagenic Effects
Complex carbohydrate		No information available

Substances	CAS Number	Carcinogenic Effects
Complex carbohydrate		Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Complex carbohydrate		Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Complex carbohydrate		No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Complex carbohydrate		No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Complex carbohydrate		Not applicable

12. Ecological Information

12.1. Toxicity

Ecotoxicity Effects

Product Ecotoxicity Data

No data available

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Complex carbohydrate	Proprietary	No information available	Mortality (96h) 5000 mg/L (Bairdiella chrysoura) Mortality (96h) 5000 mg/L (Lagodon rhomboids)	No information available	TLM (96h) > 1,000,000 ppm (Mysidopsis bahia) Mortality (96h) 1000 mg/L (Crassostrea virginica) Mortality (96h) 1000 mg/L (Crassostrea virginica)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Complex carbohydrate	Proprietary	Readily biodegradable

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Complex carbohydrate	Proprietary	No information available

12.4. Mobility in soil

Substances	Mobility
Complex carbohydrate	No information available

12.5 Other adverse effects

No information available

13. Disposal Considerations

13.1. Waste treatment methods

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. Transport Information

US DOT

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

US DOT Bulk

DOT (Bulk) Not applicable

Canadian TDG

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number: Not restricted

UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IATA/ICAO
UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable
Special Precautions for User: None

15. Regulatory Information

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.

16. Other information

Preparation Information
Prepared By
Chemical Stewardship
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

Revision Date: 13-Apr-2015

Reason for Revision Update to Format SECTION: 2 3 4 6 7 8 10 11 12 16

Additional information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
ErC50 – Effective Concentration growth rate 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NIOSH – National Institute for Occupational Safety and Health
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
UN – United Nations
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/

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This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

LEB-CD ENZYME SDS

SAFETY DATA SHEET

1. Identification

Product identifier **LEB-CD™**

Other means of identification None.

Recommended use Not available.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name CETCO, an MTI Company

Address 2870 Forbs Avenue
Hoffman Estates, IL 60192
United States

Telephone General Information 800 527-9948

Website http://www.cetco.com/

E-mail safetydata@mineralstech.com

Emergency phone number Emergency 1.866.519.4752/1 760 476 3962

Americas 1.866.519.4752 (US, Canada, Mexico) 1 760 476 3962

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Sensitization, respiratory Category 1

Environmental hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statement

Prevention Avoid breathing mist/vapor. In case of inadequate ventilation wear respiratory protection.

Response If inhaled: If breathing is difficult, remove person to fresh air and keep comfortable for breathing. If experiencing respiratory symptoms: Call a poison center/doctor.

Storage Store away from incompatible materials.

Disposal Dispose of contents/container to .

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information 46% of the mixture consists of component(s) of unknown acute oral toxicity. 46% of the mixture consists of component(s) of unknown acute dermal toxicity. 46% of the mixture consists of component(s) of unknown acute hazards to the aquatic environment. 46% of the mixture consists of component(s) of unknown long-term hazards to the aquatic environment.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Cellulase		9012-54-8	1 - < 3
Other components below reportable levels			90 - 100

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

Composition comments This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

4. First-aid measures

Inhalation	If gas/fume/vapor/dust/mist from the material is inhaled, remove the affected person immediately to fresh air. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If experiencing respiratory symptoms: Call a poison center or doctor/physician.
Skin contact	Get medical attention if irritation develops and persists. Wash affected area with mild soap and water.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. If ingestion of a large amount does occur, seek medical attention. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Difficulty in breathing.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Dry chemical, CO2, water spray or regular foam. Use any media suitable for the surrounding fires.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Not a fire hazard. No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Avoid breathing mist/vapor. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Stop leak if you can do so without risk. Large Spills: Dike the spilled material, where this is possible. Following product recovery, flush area with water. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground. Do not flush into surface water or sanitary sewer system.

7. Handling and storage

Precautions for safe handling	Avoid prolonged or repeated skin contact with this material. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Avoid breathing vapors or mists of this product.
Conditions for safe storage, including any incompatibilities	Keep containers tightly closed in a dry, cool and well-ventilated place. Keep out of the reach of children. Store away from incompatible materials (see Section 10 of the SDS). Do not allow material to completely dry.

8. Exposure controls/personal protection

Occupational exposure limits	This mixture has no ingredients that have PEL, TLV, or other recommended exposure limit.

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Ensure adequate ventilation, especially in confined areas. Ventilation should effectively remove and prevent buildup of any vapor/mist/fume/dust generated from the handling of this product.

Individual protection measures, such as personal protective equipment

Eye/face protection	Chemical respirator with organic vapor cartridge and full facepiece. Applicable for industrial settings only.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Applicable for industrial settings only.
Other	Normal work clothing (long sleeved shirts and long pants) is recommended. Applicable for industrial settings only. Recommended gloves include rubber, neoprene, nitrile or viton.
Respiratory protection	No personal respiratory protective equipment normally required. Chemical respirator with organic vapor cartridge and full facepiece. Applicable for industrial settings only. If airborne concentrations are above the applicable exposure limits, use NIOSH approved respiratory protection.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Use good industrial hygiene practices in handling this material. Eye wash fountain and emergency showers are recommended.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Color	Light brown.
Odor	Glycol.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	< 32 °F (< 0 °C)
Initial boiling point and boiling range	220 °F (104.44 °C)
Flash point	> 220.0 °F (> 104.4 °C)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

Other information

Explosive properties	Not explosive.
Flammability class	Combustible IIIB estimated
Flash point class	Combustible IIIB
Oxidizing properties	Not oxidizing.
VOC	CARB

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Will not occur.
Conditions to avoid	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. High temperatures. Contact with incompatible materials.
Incompatible materials	Strong acids, alkalies and oxidizing agents.
Hazardous decomposition products	Thermal decomposition can lead to release of irritating gases and vapors.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Difficulty in breathing.

Information on toxicological effects

Acute toxicity	Not known.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
Skin sensitization	Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1052)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.

12. Ecological information

Ecotoxicity	This product is not expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.

Product		Species	Test Results
LEB-CD™			
Aquatic			
Algae	IC50	Algae	100, 72 Hours
Crustacea	EC50	Daphnia	212, 48 Hours
Fish	LC50	Fish	357, 96 Hours

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not established.

15. Regulatory information

US federal regulations OSHA Process Safety Standard: This material is not known to be hazardous by the OSHA Highly Hazardous Process Safety Standard, 29 CFR 1910.119.
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1052)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No (Exempt)

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Cellulase (CAS 9012-54-8)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 04-December-2014

Revision date 14-August-2018

Version # 07

Further information This safety datasheet only contains information relating to safety and does not replace any product information or product specification.

HMIS® ratings Health: 0*
Flammability: 0
Physical hazard: 0

NFPA ratings Health: 2
Flammability: 0
Instability: 0

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The manufacturer expressly does not make any representations, warranties, or guarantees as to its accuracy, reliability or completeness nor assumes any liability, for its use. It is the user's responsibility to verify the suitability and completeness of such information for each particular use.

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Revision information

This document has undergone significant changes and should be reviewed in its entirety.