SAMPLING AND ANALYSIS PLAN

ENVIRONMENTAL EXPLORATION
PACIFIC PARK/DUMPSITE
PACIFIC, WASHINGTON

Prepared for
River and Floodplain Management Section
King County Water and Land Resources Division

Prepared by
Herrera Environmental Consultants, Inc.

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Prepared for
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King County Water and Land Resources Division
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INTRODUCTION

This sampling and analysis plan (SAP) describes field activities to be performed at the Pacific Park/Dumpsite Study Area located at 600 Third Avenue Southeast in Pacific, Washington (Figure 1). Pacific Park is composed of 21 acres located on the right (west) bank of the White River, which are part of a larger, 43-acre tax parcel that has been owned by King County since 1921 (Figure 2). The City of Pacific began leasing the 21 acres in 1969 for use as a park that opened in 1972 (S&W 2016). Before this time, it was used as an informal dumpsite and as a city dump, until it was closed to dumping in 1965. Previous investigations have identified the presence of buried municipal waste at thicknesses of 2 to 12 feet across the Study Area. Pacific Park is closed for flood control purposes from approximately October through March each year. A map of the Study Area is provided in Figure 2.

On December 1, 2017, Herrera entered into an agreement with the King County River and Floodplain Management Section of Water and Land Resources Division for Engineering Services for Pacific Right Bank Project Contract Number E00495E17. This SAP focusses on additional soil and groundwater sampling within the Study Area.

OBJECTIVES

The work is being completed to support development and evaluation of alternatives for permanent flood protection along the right (west) bank of the White River that will be evaluated in an Environmental Impact Statement (EIS). The specific objectives of the sampling described herein are as follows:

- Further refine the understanding of the lateral extent and thickness of buried municipal waste within the Study Area.
- Evaluate the presence and concentrations of chemical constituents both within the waste and in soils surrounding the waste.
- Define sufficient physical and chemical information about the dumpsite waste and surrounding soil conditions to support feasibility evaluations of potential removal, reuse, disposal and/or capping.
- Evaluate variability in seasonal groundwater fluctuations and flow direction.
- Evaluate groundwater near the buried municipal waste for the presence and concentration of chemical constituents.

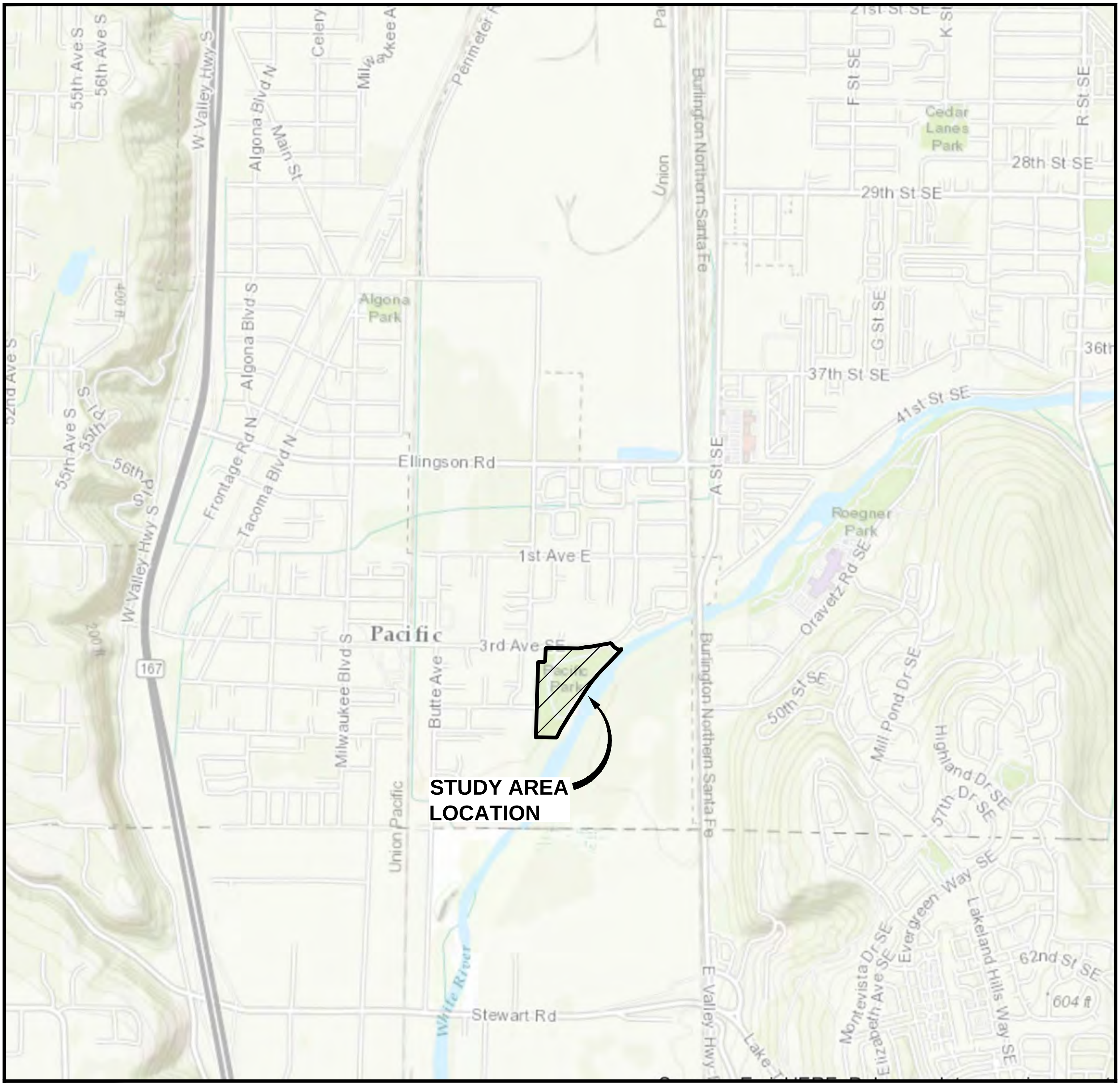

Figure 1.
Vicinity Map, Pacific Park,
Pacific, Washington.

N

0 1000 2000 4000

Scale in Feet

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LEGEND:

— — — —	Parcel boundary
▬ ▬ · ▬	Study area

Figure 2.
Study Area Map, Pacific Park, Pacific, Washington.

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SITE BACKGROUND CONDITIONS

Previous Investigations

2016 Phase II ESA

In 2016, a Phase II Environmental Site Assessment (ESA) was conducted to evaluate conditions across the Site (S&W, 2016). Soil and groundwater samples were collected from 28 push-probe borings (GP-1-15 through GP-22-15 and MW1-15 through MW6-15), and four test pits (TP1-15 through TP4-15), (Figure 3). Six of the borings were completed as groundwater monitoring wells (MW1-15 through MW6-15), (Figure 3). Sampling locations were based on historical records, including aerial photographs. The report concluded the following:

- Contaminants were revealed in soil in excess of the Model Toxics Control Act (MTCA) regulatory cleanup criteria, including the following:
    - Lube oil-range petroleum hydrocarbons were detected in two soil samples, at depths of 4.5 and 5.5 feet below ground surface (bgs), above the MTCA Method A cleanup criterion.
    - Metals were detected in soil above the MTCA Method A cleanup criteria at depths ranging from 4.5 to 12.5 feet bgs, including arsenic (three samples), cadmium (five samples), lead (seven samples) and mercury (two samples).
    - No volatile organic compounds (VOCs) were detected in soil above the MTCA Method A cleanup criteria.
    - Semi-volatile organic compounds (SVOCs), including total carcinogenic polycyclic aromatic hydrocarbons (cPAHs), calculated using the Toxicity Equivalency Factors (TEFs) to obtain a toxic equivalent concentration of benzo(a)pyrene per MTCA requirements, were detected above the MTCA Method A cleanup criterion at 18 sample locations.
    - No polychlorinated biphenyls (PCBs) were detected in soil above the MTCA cleanup criterion.

- Contaminants were also detected in groundwater above the MTCA regulatory cleanup criteria, including the following:
    - Total arsenic concentrations exceeded the MTCA Method A cleanup criterion at eight locations. Dissolved arsenic exceeded the MTCA Method A cleanup criterion at two locations.
    - Total lead concentrations exceeded the MTCA Method A cleanup criterion at three locations. Dissolved lead was not detected above the MTCA Method A cleanup criterion.
    - No other metals, VOCs or petroleum hydrocarbons were detected in groundwater above the MTCA Method A cleanup criteria.

LEGEND:

— – —	Parcel boundary
━ ━ · ━	Study area
■	Probe locations (Herrera, 5-2017)
⊕	Probe/well/test pit locations (Shannon & Wilson, 9-2015)
⊞	Test pit locations (Aspect, 7-2017)
◕	Monitoring well locations (Aspect, 6-2017)
○	Proposed 15' monitoring well with SPTs (Aspect)
○	Proposed 30' geotech boring (Aspect)
○	Proposed 60' geotech boring (Aspect)
□	Proposed geotech boring with environmental sampling
⊠	Proposed push probe environmental boring (Herrera)

Figure 3.
Proposed Sample Location Map,
Pacific Park, Pacific, Washington.

N

0 100 200 400

Scale in Feet

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2017 Environmental Investigation

In 2017, Herrera conducted an Environmental Investigation, including soil and groundwater sampling at the park boundary, outside of the fill area, (Figure 3) (Herrera 2017a and 2017b). The purpose of the Environmental Investigation was to determine if soil and/or groundwater contamination was present outside of the fill area and to determine the potential for offsite impacts.

Herrera sampled the six existing monitoring wells located on the Site on May 15, 2017, and collected soil and groundwater samples from nine push-probe borings (PP-1 through PP-9; Figure 3) completed at the perimeter of the Study Area on May 23 and 24. Six borings were completed along the western perimeter of the Study Area and three borings were completed along the eastern perimeter (Figure 3).

Soil samples were collected at depth intervals of 0 to 5 feet bgs and 10 to 15 feet bgs in each of the nine borings. The samples were analyzed for gasoline- and diesel-range total petroleum hydrocarbons, VOCs, SVOCs, and total and dissolved metals. Six soil samples also were analyzed for PCBs based on detection of lube oil. None of the soil sample results exceeded MTCA cleanup criteria.

Groundwater samples were collected from six existing monitoring wells and each of the nine borings. The samples were analyzed for gasoline- and diesel-range total petroleum hydrocarbons, VOCs, PAHs, and total and dissolved metals.

Benzene and other VOCs, which are components of gasoline, were detected in the groundwater sample collected from boring PP5, which also had a reported gasoline concentration. The reported benzene concentration of 6.4 µg/L slightly exceeds the MTCA Method A cleanup level of 5 µg/L. No gasoline was detected in the six monitoring wells located within the Study Area or in the three water samples collected from probes GP-12-15, GP-13-15, and GP-21-15 by S&W in 2015. The presence of benzene and gasoline at this location is likely attributable to an isolated spill not associated with the dumpsite.

No concentrations of calculated total cPAHs exceeded the MTCA Method A cleanup criterion of 0.100 µg/L in groundwater.

Arsenic was the only metal detected in groundwater (and only in MW4-15) that exceeded the MTCA Method A cleanup level of 5 µg/L. Arsenic also was reported above the MTCA cleanup level in groundwater during the October 2015 groundwater sampling event in two wells, MW2-15 and MW4-15.

SITE CONDITIONS

PHYSICAL SETTING

The Study Area is located approximately 2,000 feet north of the King/Pierce County line. The property is relatively flat. Ground surface elevation for the Study Area ranges from 80 to 87 feet (NAVD88), based on 2016 King County Water and Land Resources Division lidar and orthoimagery acquisition completed by Tetra Tech.

The Study Area is in an area that was historically occupied by the White River, prior to construction of levees in the 1910s and filling that occurred from the 1920s through the 1960s. It is subject to frequent flooding by the White River and seasonal inundation by ponded stormwater and shallow groundwater. According to historical photos and maps, flood-control measures were taken that included construction of a concrete revetment in 1919 as part of the channelization of the river, which was historically referred to as the Stuck River (S&W 2016).

A stormwater ditch drains to the south along the western edge of the Study Area. The ditch receives stormwater from residential properties located along Third Avenue Southeast, Spencer Court, and the apartments west of the ditch and also from the parking lot in the park. The water level in the ditch roughly corresponds to groundwater levels in adjacent wells, so the ditch presumably intercepts groundwater, which intermingles with surface stormwater conveyed by the ditch.

Access to the Study Area is restricted from October through March by a continuous HESCO barrier system, installed and maintained by King County for flood control purposes along the northern and western property boundary. A section of the barrier is removed from April to September to allow public access to Pacific Park at two locations on the northern portion of the property, along Third Avenue Southeast.

Geology

Regional Geology

The Puget Lowland area has been subjected to six or more major glaciations during the past 2 million years. The last ice covering the Site to a thickness estimated to be 3,000 feet, receded about 13,500 years ago, leaving a series of north-trending ridges and valleys. These deep valleys were partially or completely filled with recessional glacial deposits and recent Holocene deposits (S&W 2016).

Subsequent to the most recent glaciation, a series of lahars and mudflows associated with volcanism from Mount Rainier occurred, which contributed to the deposition of sediments in the White River valley. The most significant of these volcanic events was the Osceola mudflow that occurred 5,600 years ago, diverted the White River and initiated the deposition of the White River Alluvial fan. During the Sumerland age volcanism, approximately 2,500 years ago, the White and Green Rivers extended 20 miles north to Elliott Bay. During a large flood that occurred in 1906, the White River was re-diverted to the south and avulsed to the Stuck River.

Site Geology

The Geologic Map of Auburn 1:24,000 Quadrangle (Mullineaux 1965) maps the Study Area as artificial fill (af) with the surrounding area as alluvium (Qaw). The map indicates that the alluvium consists of mostly gravel and sand deposits of the White River and boulder cobble and pebble-cobble gravel and sand in the White River valley.

Fill material was encountered in each of the geoprobe explorations across the Study Area during the Phase II ESA (S&W 2016). Fill material was identified based on soil with a disturbed appearance and from the presence of unnatural debris such as glass shards and bottles, brick, cement, organics, wood, paper, rubber, and ceramic. Fill consisted of gravelly silt, silty sand, and sandy gravel to gravelly sand. Based on observations from the geoprobes and test pit explorations, fill is generally 2 to 12 feet thick across the Site, with fill being thicker in the central/south central portion of the Study Area.

The fill is overlain by sandy gravelly fill placed during the period after the dumpsite was closed to cover the waste and level out the Study Area for development of a park. Based on the boring and test pit logs, the thickness of this fill ranges from 1.8 to 10 feet.

The fill is underlain by alluvial overbank deposits consisting mostly of poorly graded sand with gravel to sandy gravel interbedded with backwater lacustrine deposits consisting of silt with organics and interbeds of silty sand. Alluvium and lacustrine deposits were encountered from 2 to 12 feet bgs. Large cobbles to small boulders were not observed in the borings due to sampler size limitations, but were encountered in the test pit explorations. Fill material and alluvial deposits were loose, causing caving and collapse that limited excavation depths in some of the test pits. Loose soils and refuse debris limited the recovery of the geoprobe core samples at some locations (S&W 2016).

Site Hydrogeology

Groundwater was encountered in each of the previous explorations, except for the southernmost test pit and boring that were advanced to characterize the soil mounds in the southern portion of the Study Area. Groundwater depths ranged from 4 to 9 feet bgs at the time of the Phase II investigation, in September 2015. In general, groundwater was encountered between 4 to 6 feet bgs, with deeper groundwater encountered in areas of higher relief, such as explorations located on the existing levee and in terraced fill areas in the southern portion of the Study Area (S&W 2016).

Groundwater observed in test pits was generally rapid flowing, causing caving and collapse that limited excavation. Soils with generally high-permeability were observed in the test pits, which facilitated a rapid movement of groundwater into the excavation (S&W 2016).

Groundwater levels fluctuated by approximately 4.5 feet bgs across the Study Area during the data collection period between October 2015 and May 2016, based on data loggers placed in the monitoring wells by King County. Groundwater also was measured in the nine probe borings completed by Herrera in May 2017 at depths ranging from 1.8 feet bgs to 5.7 feet bgs.

King County completed an animation of groundwater levels, based on measurements from October 2015 through October 2016. The direction of groundwater flow is typically to the southwest for most of the year. When water levels rise in winter with the river stage, the gradient increases, and flow is toward the west (Brummer 2017a).

ORGANIZATION AND SCHEDULE

Key participants are identified and listed below, followed by the schedule for implementation.

ORGANIZATION AND KEY PERSONNEL

Field sampling for the Pacific Park/Dumpsite Environmental Exploration will be performed by Herrera and Aspect Consulting (Aspect) following protocols outlined in this SAP. Key personnel involved in this effort are identified below, and their respective roles and responsibilities are provided in Table 1.

Table 1. Pacific Park/Dumpsite Environmental Exploration Personnel and Responsibilities.

Personnel	Organization	Phone	Duties
Chris Brummer	King County	206-477-4655	Client Project Manager
Mark Ewbank	Herrera	206-787-8266	Herrera Project Manager
Bruce Carpenter	Herrera	206-787-8217	Field Lead and licensed hydrogeologist. Responsible for coordinating activities with County, collection of soil and groundwater samples, and field documentation.
Jesse Favia	Aspect	206-838-5846	Field Lead responsible for geotechnical borings and monitoring well installation[a]
Michael Spillane	Herrera	206-787-8201	Herrera Principal-in-charge. Responsible for technical review of project-related reports.
Gina Catarra	Herrera	206-787-8223	Quality Assurance Officer. Responsible of conducting QA/QC review of laboratory data.
David Baumeister	OnSite Environmental	425-883-3881	Laboratory Project Manager

[a] Geotechnical Borings and Monitoring Well Installations will be performed by Aspect and is discussed in their Work Plan (Aspect 2018).

SCHEDULE

The overall schedule is provided in Table 2.

Table 2. Pacific Park/Dumpsite Environmental Exploration Schedule.

Task	Activity	Scheduled Date/Duration
SAP Preparation	Draft SAP	January 31, 2018
	Final SAP	February 12, 2018
Field Sampling	Push Probe/Geotechnical Borings and Monitoring Well Installation	February 20 to March 1, 2018
	Monitoring Wells	March, June, September, December 2018
Laboratory	Laboratory Reports	14 days after sampling date
Summary Report	Draft Report	May 1, 2018
	Final Report	May 31, 2018
EIM Data Submittal	EIM Data Submittal	May 2018

SAMPLING DESIGN

Approximately 25 push-probe borings will be completed to depths up to 20 feet bgs at locations shown in Figure 3. The boring locations have been selected to further refine the understanding of the characteristics of the dumpsite fill material. The locations may change, based on completion of a geophysical survey if appropriate to meet the investigation objectives. In addition, soil samples will be collected from 13 geotechnical/monitoring well borings for chemical laboratory analysis; the locations of these borings are shown in Figure 3. These 13 borings have been selected from the area of the park where contaminated soil removal may occur. The actual GPS coordinates of each probe boring location will be recorded.

A maximum of three soil samples will be collected for chemical analyses at each location. Sample collection intervals may vary depending on the presence or absence of refuse and the homogeneity of the subsurface material. Sample intervals will include the following:

- The first sample will be collected from the 0- to 5-foot depth interval or groundwater interface and above the refuse if present
- The second sample from the 5- to 10-foot interval or within refuse
- The third sample from the 10- to 15-foot interval, below refuse (or from the 15- to 20-foot interval at locations within clean waste deep soil grids previously established by Shannon & Wilson [2016])

Table 3 provides a summary of sample locations, sample types, sample numbers, and analytical requirements. The soil and groundwater analytical approach for the investigation is described in the following sections.

SOIL ANALYTICAL APPROACH

A maximum of 114 soil samples will be submitted for chemical analysis from the 25 environmental borings, and 13 geotechnical/monitoring well borings. The sample location depths will vary to meet the objectives of the investigation. The soil samples will be submitted for the following analyses:

- Total petroleum hydrocarbon (TPH) identification using Ecology’s NWTPH-HCID method
- Total MTCA metals (arsenic, cadmium, chromium, mercury, and lead) using EPA Methods 6010C/7471A.
- Carcinogenic PAHs using EPA Method 8270D/SIM.

Table 3. Samples To Be Collected at Pacific Park/Dumpsite.

Sampling Location	Sample Type	Maximum Number of Samples to be Collected	Analytical Requirements
Twenty-five push-probes completed throughout the park (see Figure 3)	Subsurface soil—grab	75 Three soil samples from each boring, including the 0 to 5, 5 to 10, and 10 to 15 or 15–20-foot depth intervals. Collection intervals may vary, depending upon sample homogeneity in each boring and the presence of refuse.	NWTPH-HCID, NWTPH-Gx/BTEX, NWTPH-Dx, cPAHs, total MTCA metals (potential PCBs analyses if oil-range petroleum hydrocarbons detected and potential TCLP analyses if elevated metals concentrations detected).
Thirteen geotechnical/monitoring well borings completed throughout the park (see Figure 3).	Subsurface soil—grab	39 Same collection intervals as above.	
Nine monitoring wells	Groundwater sample	36 From nine monitoring wells—quarterly for 1 year.	NWTPH-Gx/BTEX, NWTPH-Dx, cPAHs, total MTCA metals (potential PCBs analyses if oil-range petroleum hydrocarbons detected).

MTCA metals = Arsenic, cadmium, chromium, mercury, and lead

NWTPH = Northwest total petroleum hydrocarbon

NWTPH-Gx= Northwest total petroleum hydrocarbon gasoline range.

NWTPH-Dx = Northwest total petroleum hydrocarbon diesel range extended (to include heavy oil)

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons (to include naphthalene)

PCBs = Polycyclic aromatic hydrocarbons

If TPH is identified in a sample, the sample will be analyzed for:

- Gasoline-range TPH and benzene, toluene, ethylbenzene and xylenes (BTEX) using Ecology's NWTPH-Gx method/EPA Method 8021B; and/or
- Diesel- and oil-range TPH using Ecology's NWTPH-Dx method; and
- PCBs using EPA Method 8082A (if oil-range TPH is detected)

If a sample contains elevated concentrations of metals, the sample may be analyzed for toxicity characteristic leaching procedure (TCLP) metals using EPA Methods 1311 and 6010C/7470A.

GROUNDWATER ANALYTICAL APPROACH

Groundwater samples will be collected from each of the six monitoring wells located within the Study Area and the three monitoring wells that are planned to be installed during the geotechnical investigation (Aspect 2018) (see Figure 3). Groundwater will be collected from monitoring wells quarterly for 1 year, for a total of four sampling events. The groundwater samples will be submitted for the following analyses:

- Gasoline-range TPH and BTEX using Ecology's NWTPH-Gx method/EPA 8021B;
- Diesel- and oil-range TPH using Ecology's NWTPH-Dx method;
- Total MTCA metals (arsenic, cadmium, chromium, mercury, and lead) using EPA Methods 6010C/200.8/7470A; and
- Carcinogenic PAHs using EPA Method 8270D/SIM.

If oil-range hydrocarbons are identified in a sample, the sample will be analyzed for PCBs using EPA Method 8280A.

FIELD PROCEDURES

PRE-DRILLING ACTIVITIES

Prior to commencing drilling activities, Utility Notification Center (UNC) will be notified of the intent to drill the probes. UNC will contact participating agencies or companies with underground utilities in the area. These utility companies will mark the locations of their utility lines and equipment along the property boundary. A private utility locate service will be retained to locate underground utilities at each proposed boring location.

SOIL SAMPLE COLLECTION

Soil borings will be advanced using a probe-drive sampler attached to driven probe rods. During drilling, discrete soil samples will be collected continuously at 5-foot intervals for soil classification, field screening, and chemical analysis. The probe-drive sampler has a 2-inch outside diameter, and each one is lined with a dedicated clear Lexan® liner. The sampler will be sealed with a piston stop pin while being pushed or driven to the desired sampling depth. The piston stop pin will be retracted into the sampler while the sampler is pushed or driven to obtain a soil sample. A split-spoon sampler without a liner will be used for soil sample collection from geotechnical/monitoring well borings.

Following retrieval, the soil-filled Lexan® liner will be removed from the sampler and cut open to expose the soil core. Soil samples collected for chemical analysis from the geotechnical/monitoring well borings will be removed directly from the sampler. Soil encountered during drilling will be visually inspected and classified in accordance with the Unified Soil Classification System (USCS; ASTM International [ASTM] D2488-09). A photoionization detector (PID) instrument (MiniRAE 3000 or similar unit) will be used to screen soil for VOCs.

Soil samples will be prepared for chemical analysis by removing soil from the liner or split-spoon sampler and placing it directly into jars provided by the analytical laboratory. Each sample will be uniquely labeled, denoting sample identification number and depth, date and time sampled, and job number. Soil samples will then be placed into a chilled cooler for storage prior to delivery to the analytical laboratory. Pre-weighed sample vials will be filled to comply with the 5035A method for sample collection for NWTPH-Gx/BTEX analyses. These samples will be collected directly from the liner.

Following soil sample collection, each boring will be backfilled from the bottom to ground surface with bentonite chips and capped at the surface with soil or cement to match surrounding surface conditions.

GROUNDWATER SAMPLE COLLECTION

The general procedures for collecting groundwater samples from the monitoring wells will be as follows:

- Remove the well monument cover and inspect the condition of the well and surrounding area. Note observations in the field notebook or on the well sampling log. Unlock and remove the well casing plug.
- Using an electronic water level indicator, measure the depth to groundwater to the nearest 0.01 foot. Record date, time, and measurements in the field notebook or on the well sampling log.
- Place dedicated 0.25-inch-diameter polyethylene tubing into the well to the midpoint of the screened zone to draw water from the formation.
- Connect the tubing to the peristaltic pump and begin purging at a low flow rate, less than 1 liter per minute. Drawdown should not exceed 0.33 foot, it should approximate the estimated well recovery rate.
- Purge one tubing volume of water from the well and then begin recording water quality indicator parameters, including pH, specific conductance, dissolved oxygen, and temperature at 5-minute intervals. The water level and flow rate should also be monitored at 5-minute intervals. Record all measurements on the well sampling log.
- When drawdown, flow rate, and the parameters have stabilized after three successive readings, the sample may be collected. Sample stabilization criteria are as follows: ±0.1 for pH, ±3 percent for specific conductance, and ±0.3 milligrams per liter for dissolved oxygen.
- If well stabilization does not occur, increase the flow rate to approximately 1 gallon per minute and purge three volumes of water from the well. Record field parameters after removing each volume of water. Sample collection may occur upon removing three volumes from the well, assuming the indicator parameters have stabilized. Sample collection may occur regardless of indicator parameter stabilization when five well volumes have been removed.
- Following purging, fill the laboratory-prepared sample containers using the peristaltic pump.
- Securely cap, label, and place sample containers into a chilled cooler for storage prior to delivery to the laboratory.
- Record the date and time of sample collection on the chain-of-custody form.
- Replace the well casing plug, lock, and well monument cover.

DECONTAMINATION PROCEDURES

Decontamination will be performed on all sampling equipment potentially exposed to contaminated soil between sampling locations. All sampling equipment will be decontaminated prior to entry in the field. Chemical-resistant gloves worn during sample collection will be changed between each location.

Decontamination of groundwater sampling equipment will not be required. Clean, dedicated, polyethylene tubing will be used during groundwater sample collection.

Decontamination of Soil Sampling Equipment

The following decontamination procedure will be used for soil sampling equipment:

- Rinse with tap water
- Scrub with water and Liquinox detergent
- Rinse with tap water
- Rinse with deionized water

SAMPLE HANDLING

All samples collected during this investigation will be handled according to the procedures described in this section.

Sample Containers and Labeling

Soil and water samples will be placed into containers supplied by the analytical laboratory and sample container labels will be completed at the time of collection using a permanent waterproof pen or marker. Sample labels will include the following information:

- Project name
- Sample identification
- Date and time of collection
- Initials of sampling personnel
- Analysis to be performed

Sample containers, preservation, and holding times are summarized in Table 4.

Table 4. Summary of Data Quality Objectives, Sample Containers, Preservation, and Holding Times for the Pacific Park/Dumpsite Environmental Evaluation.

Parameter	Units	Detection Limits	Accuracy	Precision	Method Number[a]	Bottle/ Preservative	Maximum Holding Time
Soil							
TPH Identification	mg/kg	Gasoline – 20 Diesel – 50 Lube Oil – 100	NA	NA	NWTPH-HCID	8 oz. WMG[c]/ Cool to 4°C	14 days to extract, 40 days to analyze
TPH-Gasoline	mg/kg	5.0	NA	30%	NWTPH-Gx	1 x 40 mL GV/ Cool to 4°C	48 hours to preserve, 14 days to analyze
MTCA metals[b]	mg/kg	0.25–10	75–125%	20%	6010C/7471B	8 oz. WMG[c]/ Cool to 4°C	180 days 28 days (mercury)
TCLP metals	mg/L	0.009–0.50	75–125%	20%	1311 and 6010C/7407A		
TPH-Diesel	mg/kg	Diesel – 25 Oil – 50	58–132%	NA	NWTPH-Dx		14 days to extract, 40 days to analyze
cPAHs	mg/kg	0.0067	23–143%	34%	8270D/SIM		
PCBs	mg/kg	0.05	26–127%	22%	8082A		
Groundwater							
TPH Identification	mg/L		NA	NA	NWTPH-HCID	2 x 500 mL AG / HCl, cool to 4°C	14 days to extract, 40 days to analyze
TPH-Gasoline	µg/L	100	NA	30%	NWTPH-Gx	2 x 40 mL GV/ HCl, cool to 4°C	14 days
TPH-Diesel	mg/L	Diesel – 0.25 Oil – 0.40	58–113%	NA	NWTPH-Dx	2 x 500 mL AG/ HCl, cool to 4°C	14 days to extract, 40 days to analyze
Total MTCA metals[c]	µg/L	0.60–60	75–125%	20%	200.8/6010C/7470A	500 mL HDPE/ HNO_3, cool to 4°C	180 days 28 days (mercury)
cPAHs	µg/L	0.010–0.10	20–140%	50%	8270D/SIM	2 x 500 mL AG/ Cool to 4°C	7 days to extract, 40 days to analyze
PCBs	µg/L	0.20–5.0	65–120%	15%	8082A	2 x 500 mL AG/ Cool to 4°C	

[a] Method numbers and analytical methods are from USEPA 1986 (6010, 7470, 7471, 8082, 8270) and Ecology 1997 (NWTPH-HCID, NWTPH-Dx, NWTPH-Gx).

[b] MTCA metals include arsenic, cadmium, chromium, lead, and mercury.

[c] One 8-oz jar will be collected.

AG = amber glass bottle
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
GV = glass vial
HCl = hydrochloric acid
HDPE = high-density polyethylene
HNO_3 = nitric acid
Milligrams per kilogram (mg/kg)
Micrograms per kilogram (µg/kg)
Micrograms per liter (µg/L)
Milligrams per liter (mg/L)
PCBs = polychlorinated biphenyls
TPH = total petroleum hydrocarbons
WMG = wide-mouth glass jar
TCLP = toxicity characteristic leaching procedure
TPH = total petroleum hydrocarbons

Sample Storage

Immediately following sample collection, sample containers will be placed into a chilled cooler for storage prior to delivery to the analytical laboratory. Care shall be taken to ensure sample holding times are not exceeded during periods of storage. Sample containers may be placed into plastic bags to protect labels from moisture in the cooler, if necessary.

Sample Shipment and Delivery

Samples collected during this investigation will sent by courier to the analytical laboratory.

Chain of Custody

Following collection, sample information will be recorded on a chain-of-custody form. The purpose of this record is to account for the possession (or custody) of each sample from the time it is collected until laboratory testing and reporting is complete. The signature of each person in possession of the samples must be recorded on the chain-of-custody form. Information to be recorded on the chain-of-custody record will include the following:

- Project name and location
- Project number
- Names of project manager and sampling personnel
- Sample identification
- Date and time of collection
- Analysis requested (for each sample)
- Number of sample containers
- Signature, date, and time (for each person releasing or accepting sample custody)

Sample Documentation

Sampling activities will be documented in a dedicated field notebook. The notebook will be labeled with the project name, project identification number, dates of field activities, and the name and phone number of the field lead/project manager. All relevant activities will be recorded in the field notebook during the sample collection period. Entries into the field notebook will be made in permanent ink. Corrections will be made by placing a single line through the original entry and the initials of the person entering the correction. At a minimum, information in the field notebook will include:

- Date and atmospheric weather conditions
- Activities to be performed
- Name(s) of sampling personnel
- General condition of sampling area
- Start and stop times of work
- Any unusual events or occurrences
- Description of soil profile

DISPOSAL OF INVESTIGATION-DERIVED WASTE

Disposal of Incidental Trash

Incidental trash generated during this investigation (including discarded nitrile gloves, used Ziploc® bags, paper towels) will be placed in plastic trash bags and disposed of as solid waste.

Disposal of Soil Cuttings and Investigation-Derived Water

Soil cuttings will be placed into a 20-gallon or 55-gallon drum, depending on the volume of soil generated. Decontamination solutions, rinse water, and purge water will be placed into 55-gallon drums. Drums will be stored near the park entrance on Third Avenue, and disposal will be arranged pending analytical results.

ANALYTICAL PROCEDURES

The analytical methods listed in Table 5 will be performed by OnSite Environmental, an accredited Washington State Department of Ecology laboratory.

Table 5. Analytical Methods and Applicable Criteria for Soil and Groundwater Samples Collected for the Pacific Park/Dumpsite Environmental Evaluation.

Parameter	Method	Reporting Limit	Dangerous Waste Criterion[a]	MTCA Method A Criterion[b]
Total Petroleum Hydrocarbons				
TPH Identification	HCID (soil) HCID (Water)			
TPH Gasoline	NWTPH-Gx (soil) NWTPH-Gx (water)	5.0 mg/kg 100 µg/L	– –	100 mg/kg 800 µg/L
TPH Diesel	NWTPH-Dx (soil) NWTPH-Dx (water)	25 mg/kg 0.25 mg/L	– –	2,000 mg/kg 500 µg/L
TPH Oil	NWTPH-Dx (soil) NWTPH-Dx (water)	50 mg/kg 0.40 mg/L	– –	2,000 mg/kg 500 µg/L
Total Metals				
Total Arsenic	EPA 6010C (soil) EPA 200.7 (water)	5 mg/kg 0.5 µg/L	(20 mg/kg)[d]	20 mg/kg 5 µg/L
Total Cadmium	EPA 6010C (soil) EPA 200.7 (water)	2 mg/kg 0.5 µg/L	(20 mg/kg)[d]	2.0 mg/kg 5 µg/L
Total Chromium	EPA 6010C (soil) EPA 200.7 (water)	10 mg/kg 0.5 µg/L	(100 mg/kg)[d]	2,000 mg/kg 50 µg/L
Total Lead	EPA 6010C (soil) EPA 200.7 (water)	5 mg/kg 0.5 µg/L	(100 mg/kg)[d] –	250 mg/kg 15 µg/L
Total Mercury	EPA 7471A (soil) EPA 7470A (water)	0.25 mg/kg 0.60 µg/L	(4 mg/kg)[d]	2.0 mg/kg 2 µg/L
cPAHs				
Benzo(a)pyrene	EPA 8270D (soil) EPA 8270D (water	0.0067 mg/kg 0.010 µg/L	– –	0.1 mg/kg 0.1 µg/L
Total PAHs (TEQ)	EPA 8270D (soil) EPA 8270D (water	0.0067 mg/kg 0.010 µg/L	– –	0.1 mg/kg 0.1 µg/L
PCBs				
Total PCBs	EPA 8082 (soil) EPA 8082 (water)	0.05 mg/kg 0.05 µg/L	–	1 mg/kg

[a] Washington State Dangerous Waste Regulations (WAC 173-303).

[b] Washington State Model Toxics Control Act (WAC 173-340), Method A soil cleanup level for unrestricted land uses or Method A cleanup level for groundwater.

Milligrams per liter (mg/L)

QUALITY CONTROL OBJECTIVES AND PROCEDURES

The overall quality assurance objective is to ensure that data of known and acceptable quality are provided. All measurements will be performed to yield consistent results that are representative of the media and conditions measured. Specific objectives and procedures for precision, accuracy, representativeness, completeness, and comparability are identified below and presented above in Table 2:

- **Precision—**Precision will be assessed using laboratory duplicates. One laboratory duplicate will be analyzed for each sample batch. Two levels of precision for duplicate analyses will be evaluated. For values that are greater than 5 times the reporting limit, the relative percent difference (RPD) of laboratory duplicates will be less than or equal to values specified in Table 4. For values that are less than or equal to 5 times the reporting limit, duplicate values will be within ±2 times the reporting limit.

- **Accuracy—**Accuracy will be assessed with analyses of laboratory preparation blanks, matrix spikes, laboratory control samples, and surrogates. The values for blanks will not exceed the reporting limit. The percent recovery of spikes will meet criteria specified in Table 4.

- **Representativeness—**Sample representativeness will be ensured by employing consistent and standard sampling procedures.

- **Completeness—**A goal of 100 percent of the samples submitted to the laboratory and analyzed will be judged valid.

- **Comparability—**Data comparability will be ensured through the application of standard sampling procedures, analytical methods, units of measurement, and detection limits. The results will be tabulated in standard spreadsheets for comparison with regulatory standards and historical data.

FIELD QUALITY CONTROL PROCEDURES

Quality control procedures that will be implemented for field activities are described in the following subsections. The frequency and type of quality control samples to be collected in the field are also summarized in Table 6.

Table 6. Quality Assurance Requirements and Anticipated Number of Samples.

Parameter	Number of Samples	Laboratory Method Blanks[a]	Laboratory Control Standard[a]	Matrix Spike[a]	Lab Duplicates[a]	Field Duplicates
Soil						
HCID	100	4			4	0
TPH-Gasoline	10	1	NA	NA	1	0
MTCA metals	100	4	4	4	4	0
TPH-Diesel	10	1	1	NA	1	0
cPAHs	100	1	1	NA	1[c]	0
PCBs	18[c]	1	1	1	1[d]	0
Groundwater						
HCID	36					0
TPH-Gasoline	12	4	NA	NA	4	0
TPH-Diesel	12	4	4	NA	4	0
Total MTCA metals	36	4	4	4	4	0
cPAHs	36	4	4	4	4[c]	0
PCBs	0	0	0	0	0	0

[a] Laboratory quality assurance samples will be analyzed with each batch of samples submitted to the laboratory for analysis. A laboratory batch will consist of no more than 20 samples.

[b] Estimated number of samples to be analyzed. PCBs will be analyzed if oil-range petroleum hydrocarbons are detected above the laboratory reporting limit in a soil or water sample. It is not anticipated the oil-range petroleum hydrocarbons will be detected in groundwater samples.

[c] A matrix spike/matrix spike duplicate or laboratory control sample/laboratory control sample duplicate may be analyzed as a laboratory duplicate.

NA = not applicable

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

MTCA = Model Toxics Control Act

PCBs = polychlorinated biphenyls

TPH = total petroleum hydrocarbons

Instrument Maintenance and Calibration

Portable electronic field instruments will be used to screen soil and to measure groundwater parameters. The instrument manufacturers give direction for the maintenance and calibration of the instruments.

Soil Screening Instruments

The recommended calibration and maintenance procedures for the PID and sensors can be found in Appendix A of this SAP.

Groundwater Monitoring Instruments

A multimeter (YSI ProDSS) will be used to make measurements of water temperature, conductivity, pH, turbidity, and DO. The recommended calibration and maintenance procedures for this instrument and sensors can be found in Appendix A of this SAP.

Field Duplicates

No field duplicates planned for this phase of sampling.

LABORATORY QUALITY CONTROL PROCEDURES

Quality control procedures that will be implemented in the laboratory are described in the following subsections. The frequency and type of quality control samples to be analyzed by the laboratory are also summarized in Table 6.

Method Blanks

Method blanks consisting of deionized and micro-filtered pure water will be analyzed with every laboratory sample batch. A laboratory sample batch will consist of no more than 20 samples and may include samples from other projects. The total number of method blanks anticipated for this study is shown in Table 6 by parameter. Blank values will be presented in each laboratory report.

Control Standards

Control standards for each parameter will be analyzed by the laboratory with every sample batch. A laboratory sample batch will consist of no more than 20 samples and may include samples from other projects. The total number of control standards anticipated for this study is shown in Table 6 by parameter. Raw values and percent recovery (see formula in the Data *Assessment Procedures and Corrective Actions* section) for the control standards will be presented in each laboratory report.

Matrix Spikes

For applicable parameters, matrix spikes will be analyzed by the laboratory with every sample batch. A laboratory sample batch will consist of no more than 20 samples and may include samples from other projects. The total number of matrix spikes anticipated for this study is shown in Table 6 by parameter. Raw values and percent recovery (see formula in the *Data Assessment Procedures and Corrective Actions* section) for the matrix spikes will be presented in each laboratory report.

Laboratory Duplicates

Laboratory duplicate samples for each parameter will be analyzed for specifically labeled quality assurance samples submitted with every sample batch. This will represent no less than 20 percent of the project submitted samples. The total number of laboratory duplicates anticipated for this study is shown in Table 6 by parameter. Raw values and relative percent difference (see formula in the *Data Assessment Procedures and Corrective Actions* section) of the duplicate results will be presented in each laboratory report.

DATA ASSESSMENT PROCEDURES AND CORRECTIVE ACTIONS

Quality control problems and corrective actions will be summarized in quality assurance worksheets. Values associated with minor quality control problems will be considered estimates and flagged with a J. Values associated with major quality control problems will be rejected and flagged with an R. Estimated values may be used for evaluation purposes, while rejected values will not be used. This section describes the data assessment procedures for the following quality control elements:

- Completeness
- Methods
- Holding times
- Detection limits
- Blanks
- Duplicates
- Matrix spikes
- Surrogates (organic compounds only)

COMPLETENESS

Completeness will be assessed by comparing valid sample data with this quality assurance plan and the chain-of-custody records. Completeness will be calculated by dividing the number of valid values by the total number of values. Samples may be reanalyzed if completeness is less than 100 percent.

METHODS

Analytical and field methods will be assessed by examination of the field notebook and laboratory reports for deviation from the quality assurance plan. Unacceptable deviations will result in rejected values.

HOLDING TIMES

The dates that analyses are performed will be reported by the laboratory. Holding times will be assessed by comparing analysis dates to sample collection dates. Values that exceed the maximum holding times allowed by the method will be flagged as estimates (J), whereas severe exceedances will result in rejected values (R).

DETECTION LIMITS

Detection limits will be reported in each laboratory report. If detection limits are elevated due to matrix interference, the laboratory will be requested to reanalyze the samples and/or revise the method, if time permits. Detection limits will be less than or equal to criteria listed in Table 3.

BLANKS

Blanks (including method, trip and filter blanks), composed of deionized distilled water prepared as a sample, will be analyzed and the results reported in each laboratory report. If a blank value exceeds the detection limit, associated sample values that are less than 5 times the blank value will be flagged as estimates (J).

DUPLICATES

Precision of laboratory duplicate results will be presented in each laboratory report and checked by the project chemist. Precision of laboratory duplicate results will be calculated according to the following equation:

$$\mathrm{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

Where: RPD = relative percent difference

C_1 = larger of two values

C_2 = smaller of two values

Laboratory duplicate results exceeding the objectives will be noted in the quality assurance worksheets and associated values will be flagged as estimates (J). If the objectives are severely exceeded (e.g., more than twice the objective), associated values will be rejected (R).

MATRIX SPIKES

Matrix spike results will be presented in the laboratory reports and checked by the project chemist. The percent recoveries for matrix spikes will be calculated using the following equation:

$$\%R = \frac{(S - U)}{C_{sa}} \times 100\%$$

Where: %R = Percent recovery

S = Measured concentration in spike sample

U = Measured concentration in unspiked sample

Csa = Actual concentration of spike added

If the analyte is not detected in the unspiked sample, then a value of zero will be used in the equation.

REPORTING

Herrera will prepare a report, including sample location map, summary of sampling results compared to appropriate regulatory criteria to meet the investigation objectives, and a quality assurance review of the analytical results.

Any problems and associated corrective actions taken will be reported. Specific quality assurance information that will be noted in the report includes:

- Changes in the sampling and quality assurance plan
- Significant quality assurance problems and recommended solutions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and detection limits
- Discussion of whether the quality assurance objectives were met and the resulting impact on decision-making
- Limitations on use of the measurement data

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Ecology. 2013. Model Toxics Control Act Regulation and Statute —Model Toxics Control Act, Chapter 70.105D RCW; Uniform Environmental Covenants Act, Chapter 64.70 RCW; and MTCA Cleanup Regulation, Chapter 173-340 WAC. Washington State Department of Ecology, Toxics Cleanup Program. Publication Number 94-06.

Herrera. 2017a. Sampling and Analysis Plan, Pacific Park/Dumpsite, Environmental and Economic Assessment, Pacific, Washington. Prepared for River and Floodplain Management Section, King County Water and Land Resources Division by Herrera Environmental Consultants, Inc., Seattle, Washington. April 20.

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Mullineaux, D.R. 1965. Geologic Map of the Auburn Quadrangle, King and Pierce Counties, Washington. US Geological Survey, Geologic Quadrangle Map GQ406, scale 1:24,000.

S&W. 2016. Pacific Park Phase II Environmental Site Assessment for the Pacific Right Bank Levee, Pacific, Washington. Prepared by Shannon and Wilson, Seattle, Washington, for King County River and Floodplain Management Section, Water and Land Resources Division. May 2016.

APPENDIX A

Instrumentation Calibration and Maintenance Documentation

MiniRAE 3000
ppbRAE 3000

Basic Operation
Pocket Reference

PN: 059-4030-000-D
Rev. B August 2010

Read Before Operating

This Pocket Reference is intended as a quick guide to basic use and calibration of your instrument. It does not cover advanced features. Information on advanced features and other operation modes is included in the User's Guide.

The User's Guide must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the instrument cover. Disconnect the battery before removing sensor module for service. Never operate the instrument when the cover is removed. Remove instrument cover and sensor module only in an area known to be non-hazardous.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

WARNINGS

STATIC HAZARD: Clean only with damp cloth.
For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand the User’s Guide completely before operating or servicing.

Use only RAE Systems battery packs, part numbers 059-3051-000, 059-3052-000, and 059-3054-000. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

Do not mix old and new batteries or batteries from different manufacturers.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

For maximum safety, the accuracy of the instrument should be checked by exposing it to a known concentration calibration gas before each day’s use.

Do not use USB/PC communication in hazardous locations.

Intrinsic Safety: US and Canada: Class I, Division 1,
Groups A,B, C, D
Europe: ATEX (0575 Ex II 2G Ex ia
IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009,
EN60079-11:2007
IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb
Complies with IEC 60079-0:2007,
IEC 60079-11:2006
(IIC: 059-3051-000 Li-ion bat pack or
059-3054-000 NiMH bat pack;
IIB: 059-3052-000 alkaline bat pack)

Special Notes

⚠ When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

⚠ The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to the User Guide’s section on battery charging for more information on battery charging and replacement.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Contents

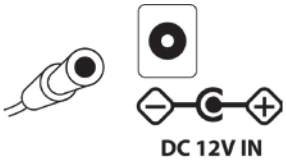
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glow

The instrument begins charging automatically. The "Primary" LED in the cradle blinks green to indicate charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown. The cradle's LED glows continuously green.

Note: If you see the "Battery Charging Error" icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been set into the cradle properly. If you still receive the message, check the Troubleshooting section of this guide.

Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The charging cradle is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor’s cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. Turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Pump Status

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

During duty cycling (PID lamp cleaning), the display shows these icons in alternation:

If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section in the User's Guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

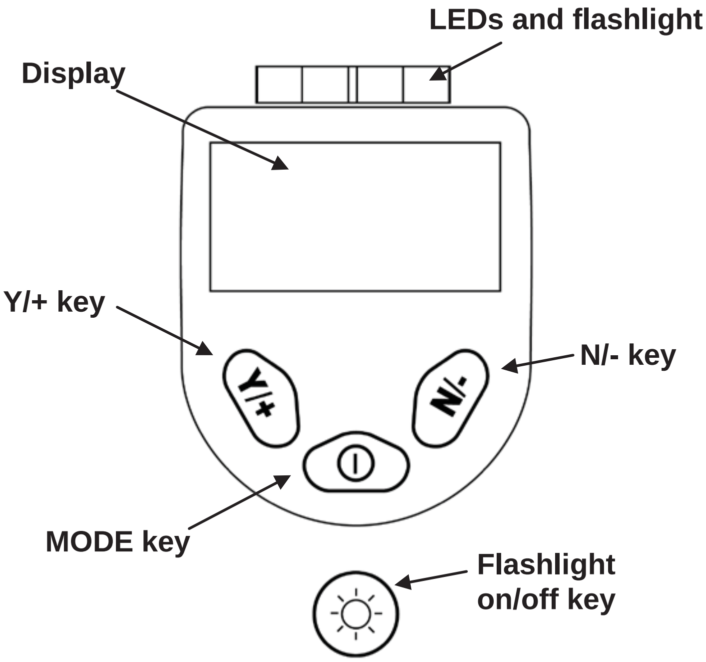
User Interface

The instrument’s user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

Y/+
MODE
N/-
Flashlight on/off

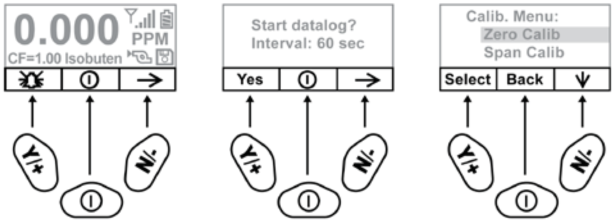
The LCD display provides visual feedback that includes time, battery condition, and other functions.

In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as “soft keys” that control different parameters and make different selections within the instrument’s menus. From menu to menu, each key controls a different parameter or makes a different selection.


LEDs and flashlight
Display
Y/+ key
N/- key
Y/+
N/-
MODE key
Flashlight on/off key

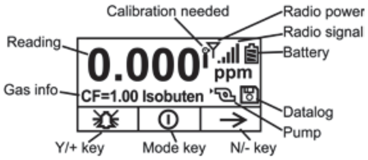
Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:

RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



Display

The display shows the following information:



Graph	Graphic representation of concentration plotted over time
Gas info*	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured
Calibration needed	Indicates that calibration should be performed
Radio power	Indicates whether radio connection is on or off
Radio signal	Indicates signal strength in 5-bar bargraph
Battery	Indicates battery level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key’s function for this screen
MODE	MODE key’s function for this screen
N/-	N/- key’s function for this screen

Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.

The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of the User’s Guide.

Note: In Basic User/Hygiene Mode (the default setting), the instrument stops after self-testing, and asks whether to perform a zero air (fresh air) calibration. You can start this calibration, quit, or abort the calibration while the instrument is undergoing calibration. When the zero calibration is done, you see screen telling you that the zero calibration is complete, along with its value. After calibration (or after you abort the calibration), the instrument then shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

Note: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

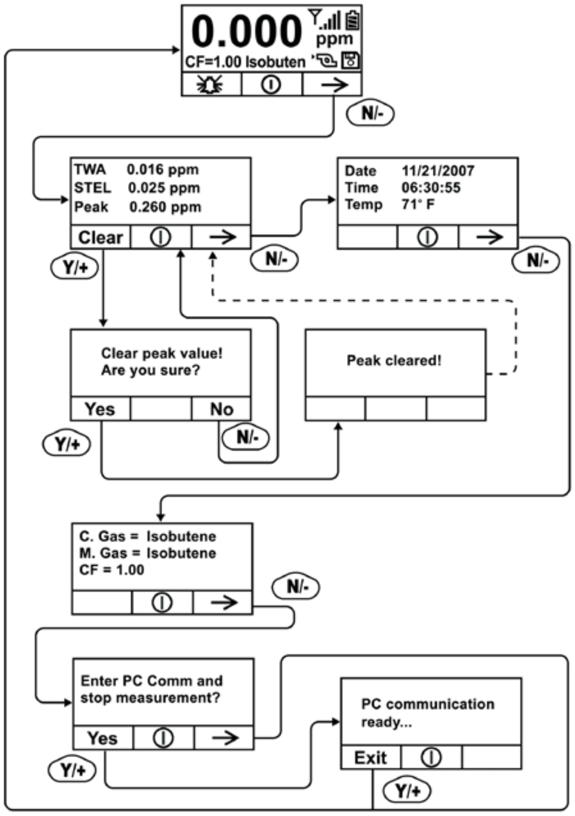
Basic User Mode/Hygiene Mode (Default Settings)

The instrument is programmed to operate in Basic User Mode/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

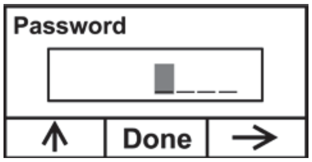
Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].

Note: Whenever you see the alarm icon in the lower left pane, you can press [Y/+] to test the alarms.


0.000
ppm
CF=1.00 Isobuten
N/-
TWA 0.016 ppm
STEL 0.025 ppm
Peak 0.260 ppm
Clear
N/-
Date 11/21/2007
Time 06:30:55
Temp 71° F
N/-
Y/+
Clear peak value!
Are you sure?
Yes
No
Y/+
N/-
Peak cleared!
C. Gas = Isobutene
M. Gas = Isobutene
CF = 1.00
N/-
Enter PC Comm and
stop measurement?
Yes
Y/+
PC communication
ready...
Exit
Y/+

Entering Calibration

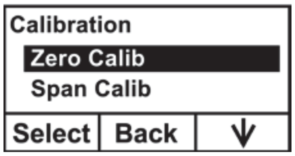
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Mode, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

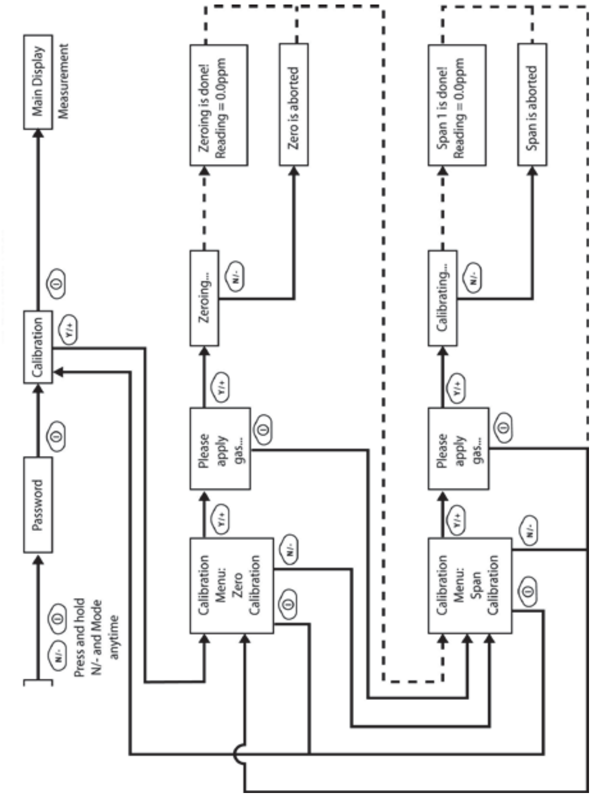
- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

Standard Two-Point Calibration (Zero & Span)

The following diagram shows the instrument's calibrations in Basic/Hygiene mode.

Note: In the diagram, a dashed line indicates automatic change to another screen.

MiniRAE 3000/ppbRAE 3000 Pocket Reference



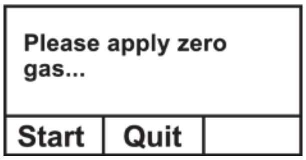
Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



Please apply zero gas...

1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts and displays this message:

   Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any actions on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says “Zero is aborted!” and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

> Zeroing is done!
> Reading = 0.000 ppm

The instrument will then show the Calibration menu on its display, with Span Calib hightlighted.

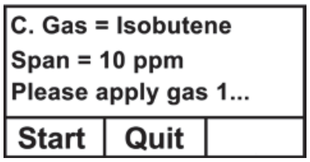
Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube. At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:


C. Gas = Isobutene
Span = 10 ppm
Please apply gas 1...

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

   Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

    Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see this message:

> Span 1 is done!
> Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with “Back” on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Alarm Signal Summary

If the measured gas concentration exceeds any of the preset limits, the buzzer and red flashing LED are activated immediately to warn you of the alarm condition. The instrument also alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

Message	**Condition**	**Alarm Signal**
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*

STEL	Gas exceeds “STEL” limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus “Lamp” message on display
Battery icon flashes	Low battery	1 flash per minute, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas.

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	**Cal Span**	**unit**	**Low**	**High**	**TWA**	**STEL**
ppbRAE 3000	10	ppm	10	25	10	25
MiniRAE 3000	100	ppm	50	100	10	25

Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

If the pump is not working properly, refer the instrument to qualified service personnel for further testing and, if necessary, pump repair or replacement.

Ordering Replacement Parts

If you need replacement parts, contact your local RAE Systems distributor. A list is available online:

http://www.raesystems.com

In the U.S., you can order sensors, replacement batteries, and other accessories online at:

http://istore.raesystems.com/

Special Servicing Note

If the instrument needs to be serviced, contact either:

1. The RAE Systems distributor from whom the instrument was purchased; they will return the instrument on your behalf.
2. The RAE Systems Technical Service Department. Before returning the instrument for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the instrument is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

Troubleshooting

Refer to the User's Guide for troubleshooting details.

RAE Systems by Honeywell
3775 N. First St.
San Jose, CA 95134-1708 USA

Web: www.raesystems.com

Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time

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Phone: +1 408-952-8461
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PN: 059-4030-000-D
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