APPENDIX B

FIELD ACTIVITIES WORK PLAN

B1. FIELD ACTIVITIES WORK PLAN

B1.1 Scope and Objectives of Field Activities

The objective of the investigation is to evaluate potential northern gas migration from the landfill towards the newly developed residential apartments. The scope is to complete a total of three gas probes at one location, KGP-200 (Figure 2) evaluating shallow, middle, and deep gas zones.

B1.1.1 Quality Assurance Project Plan Objectives

The overall data quality objective of this Gas Evaluation is to provide data of known and sufficient quality to evaluate concentration ranges of target chemicals of potential concern, namely methane, in the subsurface for determining risk to nearby properties.

B1.2 Gas Monitoring During Drilling

- Methane, hydrogen sulfide, and carbon dioxide will be monitored using a four-gas meter.
- Methane is the most dangerous of these gases due to the explosion risk.
- Work stoppage should occur if methane concentrations reach 5% BV, the LEL for methane.
- Work can resume once methane concentrations reach 3% BV, or 60% of the LEL.
- The four-gas meter will be calibrated prior to each day's use with a methane calibration gas.
- Field screening of subsurface samples will also be completed using a four-gas meter.
- Hydrogen sulfide is the most dangers for asphyxiation risk due to desensitization of the chemical compound.
- Carbon dioxide is less of a risk, but also should be monitored for worker safety.
- The site HASP will detail gas monitoring criteria related to the drilling, and when safe operations can be completed.

B1.3 Construction of Gas Probes

Following drilling of three boreholes at the KGP-200 location, shallow, middle, and deep gas probes will be constructed. Based on the anticipated sequence of stratigraphy, KGP-200 is anticipated to be constructed with a shallow gas probe with a screened interval from 5 to 15 feet Bgs, a middle gas probe with a potential screened interval approximately from 25 to 40 feet Bgs, and a deep gas probe with a potential screened interval approximately 120 to 140 feet Bgs. The screened zones will be modified based upon the field geology and methane observations. The goal will be to place the screens in unsaturated zones where gas would potentially be present to allow for proper evaluation of landfill gas. Areas where methane concentrations are evident from drilling observations will be preferred candidates for screened intervals. Table B-1, below, summarizes the proposed completion intervals.

Table B-1: New Gas Probe Completion Details

Location ID	Probe Interval	Land Elev. (feet)	Screen Interval (feet Bgs)
KGP-200-S	Shallow	270	5-15
KGP-200-M	Middle	270	25-40
KGP-200-D	Deep	270	120-140

Schedule 40 PVC casing is anticipated to be utilized for construction of the screen and blank risers for the gas probes. Pea gravel pack material will be utilized surrounding the screened intervals to allow collection of landfill gas (if present). Layers of bentonite grout and/or bentonite chips will be utilized to seal the remainder of the boreholes in accordance with WAC 173-160. The gas probes will be completed with lockable above-ground steel monuments surrounded by steel bollards with the monument and bollards encased in cement at land surface.

B1.3.1 Relevant Project Schedule

Table B-2 contains a time table for approval of the Gas Evaluation and implementation of the field work.

Table B-2: Project Timeline

Activity	Due Date
Submit Draft Gas Evaluation for Review - COMPLETED	April 2017
Revise / Finalize Gas Evaluation	November 2017
Complete Field Work (Estimated Date)	December 2017 / January 2018
Complete All Field Sampling & Reporting Activities (Estimated Date)	February 2018

B1.4 Project Organization and Responsibilities

The team organization established at EHSI for this project includes a project manager, field hydrogeologist, support staff, and a health and safety officer.

The project manager is responsible for overseeing the completion of the project and oversees coordinating the field hydrogeologist, support staff, and health and safety officer as well as construction/drilling sub-contractors for the successful implementation of the project. The field hydrogeologist is responsible for oversight of the drilling and construction of the gas probe installation, characterization, and sampling of the subsurface materials, and implementing the Health and Safety Plan (HASP) required landfill gas monitoring. The health and safety officer is responsible for designing the HASP for the project and providing details to the field and support staff as well as the sub-contractors to effectively complete the project. The support staff is responsible for assisting the field hydrogeologist, health and safety officer, and project manager in coordinating the efforts.

B1.5 Project Documentation

The following list identifies the step-by-step procedures for permanent documentation of each sample interval.

All sample intervals:

- Sample assigned a unique number; pertaining to sample interval depth below ground surface
- Photograph of sample location
- Measure gas concentrations from top of casing near land surface
- At time of sampling, information recorded in field logbook: soil descriptions, gas concentrations, etc.

B1.5.1 Field Logbook

All field notes will be maintained in a bound book, which is assigned to a specific person who is responsible for entry and information into the logbook. All information pertinent to the sampling effort will be recorded in a field logbook. Each page/form will be consecutively numbered. All entries will be made in indelible ink and all corrections will consist of lined-out deletions that are initialed and dated by the person making the corrections. Each page of the logbook should be signed and dated by the personnel responsible for observations. As a minimum, the applicable items for the entry into the logbook are listed below.

GENERAL INFORMATION:

- Date
- Start and finish times of work
- Weather conditions
- Name and signature of person making entry
- Names of personnel present
- Names of visitors

SAMPLING INFORMATION:

- Date and time of sample intervals / measurements
- Geologic descriptions: color, grain size, odor, moisture/wetness
- Photograph identification
- Any unusual observations
- Gas concentrations and measurements

The original field notes will be submitted as part of a final summary report.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory.

B1.5.2 Sample Numbering System

A permanent record for each sample core will be documented in the field logbook including:

- Site name
- Project number
- Sample number / depth
- Sample core description / water content / hardness / gas concentrations
- Date/time and other notes

B1.5.3 Corrections to Documentation

The project manager is responsible for ensuring that the requisite Quality Control (QC) records are generated and controlled. The project manager will verify that these controls are implemented as follows:

- Measurements and observations are recorded at the time they are made.
- Documentation is orderly, legible, and traceable to relevant items/conditions.
- Documentation includes sufficient information to be readily interpreted by staff other than those responsible for its generation.

- Changes or revisions to a record are made in a manner that preserves the original data, such as by drawing a single line through a hard copy entry or maintaining historical records of electronic entries/files.
- Changes to records are signed (or initialed) and dated.
- As a minimum standard, changes to a record are subject to the same review and approval protocols as the original entry.
- Records adequately document digressions from specified procedures, Quality Assurance (QA) plan, or work plan and identify authorization for the digression.
- Project documents and records, including photographic and electronic records, are protected from loss, damage, misuse, or deterioration.

B1.5.4 Reporting

All data generated by the study will be reviewed, summarized, and presented with figures and tables in the overall project report. The goal of the report will be to provide the City with target specific subsurface information that can be used for analysis of the potential gas migration.

The report summarizing the field investigation will be submitted and stamped by a licensed geologist and/or hydrogeologist. Figures, diagrams, and photographs derived from the investigation will be submitted with the written analysis of the subsurface conditions. The licensed geologist/hydrogeologist will issue an opinion regarding the result findings and any recommendations for whether additional analysis is needed. A draft of the final project report will be submitted for review and comment prior to issuance of the final report.

B1.6 Drilling Protocols

The following drilling procedures will be followed.

- Site Safety – No drilling will be done if dangerous conditions exist in the sample site area. See the project HASP for more details on site safety conditions.
- Field Measurement Procedures and Criteria – Field measurements will consist of recording the location and depth of samples.
- Sample intervals will be verified by drilling rod position and driller confirmation.
- Blow counts / hardness will be verified separately by driller observations.
- Drilling water levels will be verified by manual measurements using a water level sounder.

Field QC Sampling Procedures.

The following QA procedures apply to collection of field investigation samples:

- All data must be documented on field logs or sample data sheets.
- Calibration of gas monitoring equipment prior to measurements (daily).
- Decontamination Procedures – All drilling rods and casing to be used at the site will be pre-cleaned with a pressure washer prior to use. All drilling rods and casing to be used will be decontaminated using a pressure washer and wash trailer at the site between probe locations to prevent cross-contamination. If samples are collected using a split-spoon sampler, samplers will be decontaminated between sample intervals using an alconox-water solution (or comparable) followed by a water rinse.

B1.6.1 Investigative Derived Waste

All investigation derived waste (IDW), or drill cuttings, for this project will be assumed non-hazardous based upon previous environmental delineation of the landfill and spread out on-site. The IDW for this project is anticipated to be primarily soil cuttings with variable water content. Detergent solution and water used for the decontamination of equipment will be contained in steel drums and disposed of appropriately. Used nitrile gloves and other disposable personal protective gear, and disposable sampling equipment will be placed in a garbage bag and disposed of as solid waste in a garbage dumpster.

B1.7 Field Analyses

Gas vapors will be measured following the analysis presented in Table B-3.

Table B-3: Field Monitoring of Gases

Gas	Analytical Method	Interval/Procedures
Methane	Four-gas meter	Following drilling of each 5-foot sample interval
Methane	Four-gas meter	Field screening of recovered sample cores for landfill gas
Hydrogen Sulfide	Four-gas meter	Following drilling of each 5-foot sample interval
Hydrogen Sulfide	Four-gas meter	Field screening of recovered sample cores for landfill gas
Carbon Dioxide	Four-gas meter	Following drilling of each 5-foot sample interval