SCS ENGINEERS

Compliance Monitoring Plan

with Sampling & Analysis Plan (SAP) and Quality Assurance Plan (QAP)

Remedial Action at the Hansville Landfill

Kitsap County, WA

Presented to:

KITSAP COUNTY/
WASTE MANAGEMENT OF WASHINGTON, INC

c/o
Keli McKay-Means
Kitsap County Public Works
Solid Waste Division
614 Division Street MS-27
Port Orchard, Washington 98366
(360) 337-5665

Presented by:

SCS ENGINEERS
2405 140th Avenue NE
Bellevue, Washington 98005
(425) 289-5455

September 15, 2011
File No. 04211017.00
Version 0.0

This page intentionally blank.

Hansville Landfill

Compliance Monitoring Plan

with Sampling & Analysis Plan (SAP) and Quality Assurance Plan (QAP)

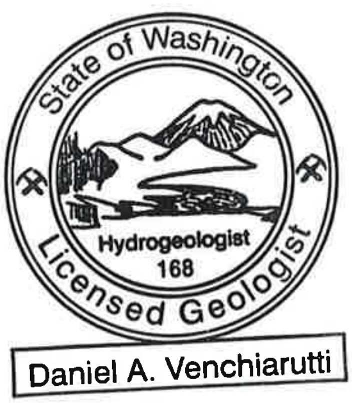
Presented To:

**KITSAP COUNTY/
WASTE MANAGEMENT OF WASHINGTON, INC**

Presented From:

SCS ENGINEERS
2405 140th Avenue NE, Ste 107
Bellevue, WA 98005

September 2011
File No. 04211017.00



Daniel A. Venchiarutti, LG, LHG
SCS ENGINEERS

Gregory D. Helland, LG, LHG
SCS ENGINEERS

Table of Contents

List of Tables

List of Figures

Appendices

REVISION HISTORY

Revision Number	Date	Changes/Additions
0.0	09/15/2011	Original plan version

ACRONYMS

bgs	below ground surface
CAP	cleanup action plan
CMP	compliance monitoring plan
COCs	contaminants of concern
County	Kitsap County
DO	dissolved oxygen
Ec	conductivity
Ecology	Washington State Department of Ecology
Eh	reduction-oxidation potential (redo)
FS	feasibility study
HDPE	high density polyethylene
KCHD	Kitsap County Health District
KCSL	Kitsap County Sanitary Landfill
KPWT	Bremerton National Airport weather station
LCL	lower confidence limit
LFG	landfill gas
LHG	licensed hydrogeologist
MDL	method detection limit
mol	mean sea level
MTCA	Model Toxics Control Act
O&M	operation and maintenance
PQL	practical quantification limit
PVC	polyvinyl chloride
QAP	quality assurance plan
QA/QC	quality assurance/quality control
RI/FS	remedial investigation/feasibility study
SAP	sampling and analysis plan
SHA	site hazard assessment
SHSP	site health and safety plan
SWL	static water level
T	temperature
TOC	total organic carbon
UCL	upper confidence limit
VOC	volatile organic compound
WAC	Washington Administrative Code
WMW	Waste Management of Washington, Inc.

This page intentionally blank.

1.0 INTRODUCTION

SCS Engineers has prepared this Compliance Monitoring Plan (CMP) on behalf of Kitsap County Public Works (the County) and Waste Management of Washington, Inc. (WMW) to guide the environmental sampling, data management and reporting for implementing the remedial actions selected under the final Cleanup Action Plan (CAP) for the Hansville Landfill. The CAP, which was finalized in June 2011, is the central component of an amended consent decree (No. 95-2-03005) that was executed on August 5th, 2011.

This CMP contains an integrated Sampling and Analysis Plan (SAP) and Quality Assurance Plan (QAP) and presents field sampling, analytical and quality assurance procedures for groundwater, surface water and landfill gas monitoring. A Site Health and Safety Plan (SHSP) has been prepared for the compliance monitoring program under a separate cover.

The Hansville Landfill is a closed landfill on a 73-acre parcel located in Kitsap County, Washington. The property is owned by the County. The landfill received municipal solid waste from the surrounding communities between approximately 1962 and 1989.

The landfill consists of three separate disposal units: a 13-acre municipal solid waste landfill; a four-acre demolition landfill that accepted construction, demolition, and land clearing wastes; and a one-third acre septage lagoon that accepted septic tank pumping waste until 1982. The landfill was closed in 1989 in accordance with Chapter 173-304 Washington Administrative Code (WAC). All three landfill units are capped with a final cover system. In addition, an active landfill gas extraction and flaring system was installed within the municipal solid waste and demolition landfill units to control the migration of landfill gas.

Individual components of this plan were developed based on the June 2011 CAP, the Model Toxics Control Act (MTCA), and specific provisions under WAC 173-340-820 and -830. This document reflects the current monitoring requirements for the landfill under the selected remedy of Natural Attenuation of Groundwater with Enhanced Monitoring and Institutional Controls and supersedes any previous monitoring plans established for the site.

1.1 PURPOSE AND SCOPE

The purpose of this document is to present the field, analytical and data reporting procedures to perform groundwater, surface water and landfill gas migration monitoring at the Hansville Landfill site, as required under the amended consent decree and the final CAP. This plan is also intended to provide the direction and guidance necessary to perform consistent, quality-assured environmental monitoring at the site.

The following sections of this plan describe the sampling procedures, analytical methods, and data evaluation techniques designed to ensure that the compliance monitoring results provide an accurate representation of the environmental conditions at the site. The plan also identifies data quality objectives for water quality monitoring, and presents data generation, assessment and validation procedures to ensure that the collected data will achieve its planned quality assurance/quality control (QA/QC) performance criteria.

2.0 SITE BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The closed Hansville Landfill is located on an approximately 73-acre parcel within the northeast quarter of Section 9, Township 27 North, Range 2 East of the Willamette Meridian, in Kitsap County, Washington. The landfill property is situated on an upland area approximately five miles south of the unincorporated community of Hansville on the northernmost reach of the Kitsap Peninsula. Port Gamble Bay is located approximately 4,000 feet west of the facility. A site location map is provided as Figure 1.

The property is bordered to the south and west by woodlands owned by the Port Gamble S'Klallam Tribe. Tribal lands in the immediately vicinity of the facility principally consist of woodland and recreational land, with scattered commercial (a tribal casino) and rural residential development further to the south and southwest. Surrounding areas to the north and east of the facility are zoned low-density residential, rural wooded, or light industrial and are sparsely developed. The area directly east of the facility has been recently cleared and is reportedly under development for light industrial use. The nearest permanent residence is located approximately 1,500 feet east of the solid waste disposal area.

The Hansville Landfill consists of three separate, inactive disposal areas. These include the following:

- 13-acre municipal solid waste disposal cell situated within the central portion of the property.
- 4-acre demolition disposal cell situated on the northeast corner of the property, which accepted construction, demolition, and land clearing wastes.
- 1/3-acre septage lagoon located immediately southwest of the demolition disposal area, which accepted residential septic tank waste until 1982. A second septage disposal area was also located near the northeast corner of the demolition disposal area.

Landfill closure activities included the final capping of the three disposal areas, installation and operation of a landfill gas extraction/flaring system, and surface water drainage controls. The active landfill gas extraction system, which was installed in 1991, includes interior landfill gas extraction wells and trenches (installed in refuse), perimeter gas extraction wells located in native soil adjacent to the solid waste disposal area, a condensate collection system, and a fenced blower/flare facility. A series of 9 landfill gas monitoring probes (with one a triple completion) are located in the vicinity of the facility borders to monitor for potential offsite methane migration. The surface water drainage control system controls stormwater flow and minimizes erosion and offsite migration of sediment-bearing water. Drainage and erosion protection improvements include hydro seeding, culverts, and drainage ditches.

2.2 TOPOGRAPHY AND CLIMATE

The site is located on a western slope near the crest of the north-south trending ridge that bisects the Kitsap Peninsula. The landfill is situated within the upper portions of several west sloping drainages with perennial creeks that ultimately discharge into Port Gamble Bay. The site topography ranges between 310 and 390 feet above mean sea level (msl). The land surface across the site generally slopes towards the west, with the highest ground elevations occurring on the southeast and east-central sections of the property.

Kitsap County's climate is characterized as maritime, with long, mild, wet winters and short, cool, dry summers. Climatically, and due to the local relief, there can be significant variations in total annual rainfall and average temperatures over short distances. Meteorological data reported for the surrounding area suggest an average annual rainfall on the order of 32 inches.

2.3 LOCAL AND REGIONAL HYDROGEOLOGY

The regional near-surface geology in the vicinity of Hansville Landfill is dominated by glacio-fluvial and glacio-lacustrine deposits associated with the Vashon glaciation. The RI (Parametrix, 2007) identifies the following main stratigraphic units at the site (from ground surface downward):

- Sand - This unit was reported in all the investigative borings from the ground surface to depths ranging from 62 to 142 feet below ground surface (bgs). The sand deposit consists primarily of poorly graded, fine- and medium-grained sand with trace amounts of silt and gravel. The material is dark yellowish brown to dark gray in color, dense to very dense, and dry to saturated. The RI references the sand unit as the upper aquifer. This unit has been interpreted as outwash associated within the Vashon Drift.

- Transition Zone - This zone was reported at three boring locations (MW-8, MW-9, and MW-14) and is approximately 15 feet thick. It consists of interbedded layers of sand, silty sand, and silt and does not appear to be areally extensive. This zone was encountered various depths ranging from approximately 150 to 200 feet bgs.

- Silt - This unit was reported in all the soil borings advanced through the upper aquifer. It occurred at elevations ranging from approximately 175 feet above msl (at MW-14) to 217 feet above msl (at MW-9). The silt is dark gray, slightly to moderately plastic, very dense, and dry. This unit has been interpreted to be the Kitsap Formation.

Groundwater in the immediate vicinity of the landfill occurs within the upper aquifer at depths ranging between 41 feet bgs (at MW-1) to 104 feet bgs (at MW-5). The water table beneath the landfill ranges between 251 and 271 feet above msl. To the west (downgradient) of the landfill, groundwater within the upper aquifer generally occurs between 7 (at MW-12I) and 45 (at MW-8) feet bgs. The corresponding water table elevations in these wells ranged from approximately 238 to 260 feet above msl.

Groundwater flow in the upper aquifer in the vicinity of the Hansville Landfill is consistently towards the west-southwest. The 2007 RI noted that groundwater from the upper aquifer discharges into the headwaters of several perennial creeks west (downgradient) of the landfill. These creeks include Little Boston Creek, Creek A, Creek B, Creek C, and Middle Creek. Within the deeper hydrologic unit, the dense silts reported for the Kitsap Formation have a relatively low hydraulic conductivity, restricting vertical movement of groundwater through the formation.

3.0 SAMPLING AND ANALYSIS PLAN

As described in Section 4.3 of the final CAP, the key elements of the Hansville Landfill compliance monitoring program for the selected remedy (natural attenuation of groundwater with enhanced monitoring and institutional controls) include:

- Groundwater Quality Monitoring
- Surface Water Quality Monitoring
- Landfill Gas Monitoring

The following SAP presents the data collection, field documentation and laboratory testing procedures that will be implemented to support groundwater, surface water and landfill gas monitoring at the landfill.

3.1 GROUNDWATER MONITORING PROGRAM

Groundwater monitoring is being conducted at the Hansville Landfill site to generate field and chemical data needed to confirm that the selected remedy continues to remain an effective remedial strategy for the site. The monitoring well network and list of analytical parameters identified in the following sections are those specified in Appendix C [Key Elements of the Compliance Monitoring Plan] of the final CAP, and have been chosen to provide adequate areal coverage and chemical testing to evaluate the natural attenuation of the landfill’s COCs.

3.1.1 Groundwater Monitoring Network

The groundwater monitoring network includes a total of six (6) well locations that will be routinely sampled under the provisions of the consent decree. The well network consists of one upgradient well (MW-5) and five downgradient wells (MW-6, MW-7, MW-12I, MW-13D and MW-14). The locations of the groundwater monitoring wells in the network are illustrated on Figure 2. A summary table showing all the water quality monitoring locations (groundwater and surface water) is provided as Table 1. Completion details for monitoring wells to be sampled are shown on Table 2.

Each of the wells designated for routine sampling is equipped with a dedicated sampling pump (Grundfos Redi-Flo2 submersible pump) suitable for low-flow purging and environmental sampling. Well completion depths range from approximately 43 feet bgs in MW-12I to 130 feet bgs in MW-5. The screen intervals in these wells range between 10 and 15 feet, with half the well screens being 10 feet in length. Construction data and lithological descriptions for the groundwater monitoring network wells are presented in the *Remedial Investigation/Feasibility Study, Remedial Investigation Report, Hansville Landfill* (Parametrix, 2007).

3.1.2 Monitoring Schedule

Groundwater monitoring will be conducted on a quarterly basis. The quarterly events will be scheduled for each of the spring, summer, fall and winter seasons in a given monitoring year. Specific dates for each quarterly event should not vary significantly between successive monitoring years. It is recommended that sampling be conducted early during each calendar quarter (during the months of January, April, July, and October every year). Key stakeholders, including the County, WMW, the Kitsap County Health District (KCHD), the Port Gamble S'Klallam Tribe and Ecology, will be notified at least seven days in advance of each water quality sampling event.

3.1.3 Parameters and Analytical Methods

The analytical parameters for the quarterly groundwater monitoring at the Hansville Landfill site include the following parameter suite:

- Field Measurements: temperature, specific conductivity, pH, dissolved oxygen, oxidation-reduction potential (Eh), and static water level (SWL).
- Dissolved Metals: arsenic (low level) and manganese.
- Geochemical Indicator Parameters: alkalinity, ammonia, bicarbonate, carbonate, chloride, nitrate, nitrite, sulfate, and total organic carbon (TOC).
- Volatile Organic Compounds: (VOCs): vinyl chloride (low level).
- Orthophosphate.

In addition, a full VOC scan (47 compounds) will be conducted for all of the groundwater samples on an annual basis. The annual VOC scan will be typically be completed during the first quarter of the calendar year.

A listing of the analytical parameters for groundwater monitoring at the Hansville Landfill facility, along with the analytical methods recommended for each specific analyte, are provided in Tables 3 and 4. Where an applicable site-specific cleanup level or groundwater standard has been developed for an analyte, this information has been included in the tables as a reference. All metals determinations will be for dissolved metals (i.e. filtration will be conducted in the field).

Laboratory methods acceptable for analysis of groundwater samples are to be among those described in EPA publication number SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods. All laboratory analyses will be completed by laboratory accredited by Ecology in accordance with Chapter 173-350 WAC, Accreditation of Environmental Laboratories. Recommended practical quantification limits (PQLs), or reporting limits, are listed in Tables 3 and 4.

3.1.4 Groundwater Monitoring Field Procedures

Field activities will consist of: describing well conditions; obtaining field measurements for SWL elevation, pH, specific conductance, temperature, dissolved oxygen and oxidation-reduction potential (redox); collecting groundwater samples for laboratory analysis; and packaging and shipping the samples to the laboratory.

The depth to the SWL will be measured in the six monitoring wells before commencing well purging and groundwater sampling. Depth to water measurements will typically be collected during the course of a single day, based on the groundwater sampling schedule. All quarterly depth to water measurements will be obtained within a two-day period, which given the lack of tidal influence or rapid water table fluctuations at the site, is anticipated to provide a representative snapshot of the seasonal groundwater flow regime.

Specific conductance, pH, dissolved oxygen, redox, and groundwater temperature measurements will be taken during well purging to ensure the collection of a representative groundwater sample. Field instruments will be calibrated in accordance with manufacturer's guidelines. An accurate record of all sampling activities, field measurements, equipment calibration, and site observations made during each quarterly monitoring event will be maintained in a field log.

The following subsections describe general procedures for the decontamination of field equipment, purging of wells, acquisition of field measurements, groundwater sampling, sample packaging and shipping, and record keeping.

Equipment Decontamination

All non-disposable equipment that is exposed to well water (specifically the water level probe) will be decontaminated between wells with a three-point wash. Decontamination of equipment must be completed before leaving each well head, therefore eliminating cross contamination. The wash will consist of:

- Non-phosphate detergent (such as Alconox) and water wash
- Tap water rinse
- Deionized water rinse

If personnel are exposed to well water (i.e. hands, face), they will wash with deionized water or when possible, wash with liquid soap and water. Disposable gloves (latex/nitrile) will be discarded after each use and prior to leaving each well head. Gloves may be discarded into regular trash. An equipment list for routine groundwater monitoring at the Hansville Landfill is presented on Table 5.

Monitoring Well Purging and Sampling Procedures

All of the groundwater monitoring wells at the Hansville Landfill that are designated for sample collection are equipped with dedicated Redi-Flo2 environmental monitoring pumps manufactured by Grundfos, Inc. Use of this type of dedicated pumping apparatus helps minimize sampling artifacts as well as the potential for cross contamination between wells, and eliminates the need for decontamination of sampling pumps. Each dedicated submersible pump is positioned with its inlet located within the screened interval of the well.

Purging and sampling of the monitoring wells at the site will be conducted using low-flow/low-volume well sampling techniques. Low-flow/low-volume methods can be used to overcome many of the limitations created by traditional fixed well volume purging (i.e. purge 3 – 5 well volumes). Low-flow sampling can control sample turbidity and minimize sample chemistry alteration by pumping at very low flow rates from the well screen zone, avoiding disturbance to the water column in the well and minimizing stress on the surrounding formation. By pumping water only from the screen zone and not drawing water from the casing above the screen (if present), the volume of water purged to achieve stable water chemistry can be reduced significantly. Samples obtained in this manner will best reflect the groundwater chemistry at each location beneath the site.

Each well's pump has been "set tested" to determine, and document, the specific well's optimum pumping rate (between 100ml/min and 500 ml/min) that would result in achieving a minimal drawdown of the initial SWL. Steady state drawdown during well purging should not exceed 0.5 feet. Once established, this flow rate will be reproduced for each subsequent sampling event. If a significant change in initial water level occurs between events, it may be necessary to reestablish the optimum flow rate at each sampling event. All water purged from the monitoring wells at the landfill will be collected and discharged to the ground surface a minimum of 25 feet away from the nearest monitoring well.

Monitoring Well Purging and Field Measurements

Prior to the initiation of purging a well, the SWL will be measured and documented. The dedicated pump at each monitoring well will be started utilizing its documented control settings and its flow rate will be confirmed by volumetric discharge measurement using a graduated container and stop watch, or by measuring the total volume discharged. If necessary, any minor modifications to the control settings to achieve the well's optimum flow rate will be documented on the field log.

When the optimum pump flow rate has been established, field measurements for pH, temperature (T), conductivity (ECY), redo (Eh), and dissolved oxygen (DO) will commence. All water chemistry field measurements will be documented on the field log. A closed, in-line, flow-through cell will be used to monitor indicator parameters.

Purging will continue until indicator parameters have stabilized. Indicator parameters will be considered stable when three consecutive readings fall within the prescribed ranges (discussed below) for the parameters of interest. Rigid numerical criteria for stabilization (as opposed to evaluating the slope of the graphs of the parameters vs. time) can be problematic as the ability of numerical criteria to identify stability is influenced by the accuracy and repeatability of field instruments, flow rate, and duration between measurements. The frequency of readings will therefore be based on the time required to purge one volume of the flow cell. For example, a 500-ml flow cell purged at a rate of 250 ml/minute will be purged in two minutes, so readings should be at least two minutes apart. If the flow rate is 100 ml/min, the readings should be at least 5 minutes apart, etc.

To account for the accuracy and repeatability of field instruments, indicator parameters and the ranges for stabilized values are as follows:

- Temperature: $\pm$ 0.5° C
- pH: $\pm$ 0.2 units
- Conductance: $\pm$ 5.0 % of reading
- Redox $\pm$ 5.0 % of reading
- Dissolved oxygen : $\pm$ 0.2 mg/L

When water quality parameters have stabilized, and there has been no change in the pumping water level (i.e. drawdown has stabilized), sample collection may begin. The final, stabilized indicator parameter values will be reported with the analytical data.

Monitoring Well Groundwater Sampling Procedure

Field staff will follow the procedures outlined below:

1. Calibrate all field instruments at the start of each day's deployment per the instrument manufacturer's instructions. Record calibration data on the "Field Instruments Calibration Documentation Form."

2. Drive to the first well scheduled to be sampled (typically the least contaminated; this practice will be continually reviewed in light of the analytical results). Make notes in the field log book describing the well condition and activity, if any, in the vicinity of the well. Decontaminate the portable water gauging probe by washing with phosphate-free detergent, rinsing with potable water and rinsing with deionized water.

3. Measure the depth to water from the surveyed reference mark on the wellhead and record the measurement on the groundwater sampling data sheet. When placing the probe in the well, take precautions to not disturb or agitate the water.

4. Attach the quick-connect cable to the Grundfos pump controller, and connect the terminal to the wellhead slot. Confirm the Grundfos controller is in the "OFF" setting before establishing any connections.

5. Start the gas-engine powered generator. Keep all electrical generator equipment (and fuel) at least 25 feet downwind of the wellhead.

6. Once the generator is operating, connect the Grundfos pump controller to the power outlet. Turn the Grundfos pump controller to the "ON" settling.

7. Connect the Flow Cell's "OUT" line and secure to drain the purge water into the purge water collection container.

8. Set the pump controller settings to the documented settings for the specific well. Confirm the flow rate is equal to the well's established optimum flow rate. Modify as necessary (documenting any required modifications).

9. Read and record water quality field measurements at appropriate time intervals until all parameters have stabilized within their allowable ranges for at least three consecutive measurements. When stabilization has been achieved, sample collection may begin.

10. Disconnect the flow cell and associated tubing from the pump discharge line before collecting samples. Decrease the pump rate to 100 milliliters per minute or less by lowering the controller's flow setting to ensure minimized sample exposure to the

ambient air. Ensure that the volatiles containers do not contain air bubbles. Place the samples in a cooler with enough ice to keep them at 4 degrees Centigrade.

11. Once samples for volatiles have been collected, re-establish pump flow rate to the original purge flow rate by inputting the documented controller settings for the well and collect remaining samples. *Note that the dissolved metals samples will be field filtered using a 0.45 um disposable filter. Filters must be pre-rinsed per manufacturer's instructions prior to filling sample bottles for filtered metals analysis.*

12. After sampling is completed, turn the Grundfos controller to the "OFF" setting, unplug the controller, and shut off the generator. Disconnect the quick-connect cable from the wellhead fitting, and restore the cover plate.

13. Record total purge volume collected. Discharge purge water on the ground surface a minimum of 25 feet away from the nearest monitoring well.

14. Remove and decontaminate the water level probe with phosphate-free detergent, rinsing with potable water and rinsing with deionized water.

15. Secure the pump's discharge line/discharge adapter in the wellhead.

16. Secure the wellhead cover with its lock. Move equipment to the next well to be sampled.

17. Clean and decontaminate field meters with phosphate-free detergent, rinsing with potable water and rinsing with deionized water

18. After leaving the site, photocopy all completed forms and keep in a separate location from the original records.

Sample Preservation and Shipment

Proper sample preservation will ensure that the chemical characteristics of the sample do not change from the time of collection to the time of analysis. The laboratory will provide the appropriate preservative directly in pre-labeled (with the type of preservative) sample containers. Care will be taken when handling acidic or caustic preservatives. Preservatives used during sample collection include:

- HCL: for VOC analysis.
- HNO_3: for dissolved metals analysis.
- H_2SO_4: for ammonia and TOC analysis.

After properly packing the samples, they should be shipped by an overnight express service, picked up by laboratory courier, or taken immediately to the laboratory to ensure they are received at the designated laboratory without potential impacts to sample integrity.

The following shipping procedures will be implemented:

1. Place samples in plastic bag and seal.

2. Put samples in a field cooler with blue ice and/or wet ice. Immediately cooling samples to 4^0C is the best sample preservation technique. Coolers and package coolants should be provided by the laboratory.

3. Pack the samples firmly with cushioning materials, such as foam blocks or bubble-wrap, to minimize the potential for breakage during shipping.

4. Chain of custody forms must be filled out and signed. Place the chain of custody in a plastic zip lock bag and place with samples. Keep a copy with the field notes.

5. Secure shipping cooler(s) for shipment with strap tape and custody seals, and coordinate shipment.

Upon receipt of the samples at the laboratory, the date and time of arrival will be noted on the chain of custody forms. The laboratory receiver will verify that the seal is intact and custody has not been broken, and make note of sample bottle condition on the forms. These forms will be retained by the laboratory and returned with the results of the analysis. Any time custody of the samples is relinquished, the chain of custody chronicles must be completed as appropriate on the chain of custody form.

Record Keeping

Sampling procedures, field measurements, and general site observations will be recorded with ink on the field log and/or chain of custody forms.

Field Logs

Field notes recorded during groundwater monitoring activities will be kept on sample collection forms. The following information should be included in the field log for each sampling event:

- Facility site name, sample point identification number, and other pertinent identifiers.
- Equipment calibration and decontamination notes.
- Depth to groundwater.
- Information regarding well purging (e.g. volumes and/or pumping rates).
- Date and elapsed time from sample start to sample finish.
- Sample location, sample number, and any field duplicates taken.
- Purging data, including time-series measurements of indicator parameters and water levels during purging.
- Type of sample and necessary treatment (e.g. filtering or preservative used).
- Field observations (e.g., weather conditions, well conditions).

- Appearance of sample (i.e., color, turbidity, sediment, odor or sheens).
- Sampler's identity and signature.

A copy of the field log forms to be used for groundwater sampling at the Hansville Landfill is provided in Appendix A. A form to document field instrument calibration is provided in Appendix B.

Chain of Custody Forms

Laboratory chain of custody form(s) must be completed for each set of groundwater samples and placed in the shipping cooler for travel with the sample shipment. These forms are provided by the analytical laboratory as a record for tracking samples from the point of collection to the laboratory. Copies of typical chain of custody forms used for the Hansville Landfill monitoring are provided in Appendix C. Upon transfer of sample possession to subsequent custodians, this form will be signed by the person taking custody of the sample container. As part of the chain of custody procedure, each sample container being delivered will be tracked by the site name, sample number, analytical testing to be performed, and other pertinent information.

Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples, including temperature, will be recorded by the receiver. The records will be reviewed in the preparation of the analytical report prepared by the laboratory, and will be considered an integral part of that report.

General Health and Safety

Proper protective chemical-resistant sampling gloves, work gloves and steel-toed boots/shoes and safety glasses are required during groundwater monitoring. When physical protection is necessary, leather work gloves will be used. If chemical protection is necessary, nitrile/latex gloves will be worn underneath work gloves or by themselves. Gloves that are torn, ripped or otherwise damaged will be immediately replaced. Safety glasses will be used when filling sample containers to avoid eye splash of well water or preservatives within sample containers. Proper lifting techniques (e.g., bending at the knees, refraining from bending or twisting the back) will be employed and heavy lifting without assistance will be avoided. Any objects that weight over 70 pounds will not be lifted without assistance.

For every work place incident, an incident report will be prepared and reported to the appropriate supervisor as soon as possible but at least within 24 hours. For minor injuries, general first aid will be applied. Advanced medical attention will be obtained if necessary. As property owner, all incidents will be reported to the County as soon as feasible.

3.2 SURFACE WATER MONITORING PROGRAM

As specified in Appendix C of the CAP, surface water sampling and analysis will be conducted quarterly at the Hansville Landfill site. The surface water monitoring focuses on several headwater areas situated immediately west (downgradient) of the landfill, where groundwater seepage is suspected to enter the drainage basins.

3.2.1 Surface Water Monitoring Locations

Water quality monitoring is conducted at four surface water sampling stations (SW-1, SW-4, SW-6 and SW-7) located within the three main drainages situated to the west-northwest of the landfill. These stations have been established approximately 1,200 to 2,400 feet downgradient of the former landfill disposal cells. Each sampling station can be accessed through a series of unimproved pathways that parallel their respective drainage channels. The locations of the four surface water monitoring stations are illustrated on Figure 2.

3.2.2 Monitoring Schedule

Surface water monitoring will be conducted on a quarterly basis, in conjunction with the scheduled groundwater sampling activities (January, April, July, and October during each reporting year). It is anticipated that the combined surface water and groundwater monitoring conducted each quarter will be completed within a two- to three-day period. As previously mentioned, the County, WMW, the KCHD, the Port Gamble S'Klallam Tribe and Ecology will be notified at least seven days in advance of each quarterly monitoring event.

3.2.3 Parameters and Analytical Methods

The surface water samples will be analyzed for the same suite of field parameters (temperature, specific conductivity, pH, dissolved oxygen and redox) and laboratory parameters (arsenic, manganese, alkalinity, ammonia, bicarbonate, carbonate, chloride, nitrate, nitrite, sulfate, TOC, orthophosphate, and VOCs [quarterly vinyl chloride, and annual full VOC scans] specified for the groundwater samples (see Section 3.1.3).

The analytical methods for each specific analyte and their respective recommended PQLs are listed on Tables 3 and 4. Laboratory methods will be those described in EPA publication SW-846, and all analyses will be performed by an Ecology-accredited laboratory.

3.2.4 Surface Water Monitoring Field Procedures

Field activities will consist of visual observations of the surface flow and water color/clarity, in-stream measurement of field parameters (temperature, specific conductance, pH, dissolved oxygen and redox), collection of water quality samples, and shipping the samples to the laboratory. Field instruments will be calibrated in accordance with manufacturer's guidelines. An accurate record of all sampling activities, field measurements, equipment calibration, and site observations made during each quarterly monitoring event will be maintained in a field log.

The following subsections describe general procedures related to the surface water monitoring program.

Sample Collection Methods

All surface water samples will consist of individual grab samples. The following sampling protocol will be used.

- All samples must be taken as close to the center of surface flow as reasonably practical and can be achieved safely.

- Samples will be obtained from mid-depth of flow directly into pre-labeled laboratory containers suitable for chemical parameters being analyzed.

- Standing downstream of the sample collection point, submerge the container into the stream of surface flow.

- Carefully seal each container before proceeding to fill subsequent sample bottles.

Field-measured parameters including temperature, specific conductivity, pH, dissolved oxygen, and redox will be measured as described in Standard Methods for the Examination of Water and Wastewater (APHA 1985). All non disposable sampling equipment (primarily the field meter probes) will be decontaminated using the previously described, triple-wash procedure before and between each surface water sampling location.

Sample Preservation, Shipment and Recordkeeping

Sample preservation, shipping and field documentation procedures for the surface water sampling are the same as those previously discussed for groundwater monitoring (see Section 3.1.4). Field information obtained during surface water sampling will be recorded on the monitoring forms provided in Appendix A. Field instrument calibration will be documented using the form provided in Appendix B.

3.3 LANDFILL GAS MIGRATION MONITORING PROGRAM

The landfill gas (LFG) migration monitoring program focuses on routinely sampling subsurface LFG concentrations around the perimeter of the closed municipal solid waste disposal cell. Nine subsurface gas probes will be monitored to document property boundary compliance. The perimeter gas probes will be sampled for major LFG constituents (methane, carbon dioxide and oxygen), temperature and pressure with portable field instruments.

In addition, field inspections, operations and maintenance (O&M), and equipment tuning will be routinely performed for the Hansville Landfill's gas collection/treatment system. These activities will be completed several times per calendar quarter, and typically cover 21 extraction well/trench ports, two blower/flare ports, and the perimeter gas probes. Data collected during these O&M activities are used to optimize the operation of the LFG management system.

3.3.1 Landfill Gas Monitoring Network

The program includes monitoring LFG at the nine gas probes (GP-1 through GP-7, including one triple-completion probe at GP-2) at the locations illustrated on Figure 2. Construction logs for LFG probes GP-6 and GP-7 (Parametrix, 2007) indicate completion depths that range between approximately 20 to 40 feet bgs. The screen intervals in these probes reportedly range between 10 and 30 feet. Construction logs/details for the remaining LFG probes were not available for review.

Probe GP-2 includes multiple, vertically discrete monitoring zones within the same borehole that are separated by bentonite seals. The monitoring zones within the GP-2 probe location are designated with an “-S” for the shallow zone, “-M” for the middle zone, and “-D” for the deep zone.

3.3.2 Monitoring Schedule

Subsurface gas monitoring at the gas probes will be conducted four times a year within the following seasons:

- Once between January 1st and March 31st
- Once between April 1st and June 30th
- Once between July 1st and September 30th
- Once between October 1st and December 31st

The frequencies of sampling may be modified dependant on future monitoring results and consultation with Ecology.

Whenever possible, in order to obtain results reflective of “worst case” conditions, monitoring should be scheduled when the barometric pressure has steadily declined for a period of 18 hours or more. This typically occurs when a storm front is approaching. Sampling during falling barometric pressure will normally yield higher gas concentrations in soils, since movement (hence, concentrations) are significantly influenced by barometric pressure.

3.3.3 Parameters and Field Instrumentation

LFG parameters to be measured at each location are listed in Table 6. Methane, carbon dioxide, oxygen (depressed), gas probe temperature and pressure will be measured at all probe locations. The deepest monitoring zone at each gas probe location will be evaluated for the possible presence of water using a water level measuring tape.

Methane is the principal parameter required to be measured to demonstrate compliance with regulations. Carbon dioxide, in addition to methane, is useful to monitor since it is the other primary component of LFG. Methane is subject to bacterial consumption in soils, and therefore the presence of CO_2 may indicate a migration phenomenon in the absence of significant methane measurement.

Depressed oxygen will also be measured during sampling to identify whether air in the soil is being displaced by other gases. Like CO_2, depressed O_2 concentrations (e.g. less than 20.3 percent by volume) may indicate a migration phenomenon in the absence of significant methane measurements. Depending on the type of instrument, it may also be necessary to know oxygen concentration for proper use of instruments in measuring methane.

Relative (static) pressure measurements within the gas probes are also important, as they may be indicative of a driving force behind methane migration. In general, the presence of higher pressures (on the order of an inch of water column or more) would serve as an indicator of a possible acute migration problem.

Water level measurements are useful at gas probes with deeper sampling zones near the groundwater surface. The measurement of the water level in the segment of perforated pipe can be used to determine whether or not this monitoring zone is partially or completely submerged. This information can be used in the evaluation of gas monitoring results.

Because atmospheric pressure affects subsurface gas conditions, the barometric pressure during each LFG sampling event will be recorded, and the preceding barometric pressure trend should be noted.

Instrumentation

The parameters will be measured with portable field instruments (except for barometric pressure). The instruments are capable of measuring the appropriate range of concentrations and accuracy for each parameter shown in Table 6. The barometric pressure trend for the Hansville area will be recorded using information from the Kingston-North (KWAKINGS9) weather station.

Instrument Calibration and Care

The monitoring instruments will be routinely inspected, maintained and calibrated in accordance with manufacturer's recommendations. For all instruments, use, storage, maintenance, and calibration procedures will be performed in accordance with the instrument manufacturer's recommendations.

The portable gas instruments will be inspected and calibrated each day of use (prior to) for each specific project. If used continuously over several hours, calibration will be checked at least once during the monitoring period. The calibration of the instrument will be documented on the field log provided in Appendix E.

To avoid damage to the instrument when calibrating, gas should be supplied to the instrument at the flow and pressure recommended by the instrument manufacturer.

3.3.4 Landfill Gas Monitoring Field Procedures

This section discusses the field procedures for monitoring subsurface LFG. It specifically provides procedures for field sampling at the gas probes. This section also provides information on items to address prior to sampling.

Checklist Prior to Monitoring

Prior to conducting LFG monitoring, the weather forecast should be evaluated for conditions conducive to monitoring during optimum conditions (as described in section 3.3.3). The National Weather Service or local meteorologist can give advice on optimum times when this condition will occur. Once the time is established, monitoring activities should be planned accordingly.

The following items will be <u>conducted one day before</u> LFG monitoring:

1. Obtain necessary equipment and instrumentation for monitoring activities. These include:

- portable gas analyzer(s).
- temperature and pressure gauges.
- necessary tubing, filters, and fittings.
- field book and field log.
- keys to the gas probes.
- calibration gas.

A more comprehensive list of field items is found in Table 7.2. Make sure the battery for the portable gas analyzer has sufficient charge for the amount of monitoring to be conducted. If not, the battery should be discharged completely before recharging. The battery should then be allowed sufficient time (as recommended by the manufacturer) to fully recharge. This is necessary for nickel-cadmium batteries to maintain battery charge since nickel-cadmium batteries may develop a “memory” of reduced charge life if not fully discharged and recharged properly.

3. Make sure filters and water traps are clean and dry.

4. Make sure portable gas instrumentation is calibrated and document on Field Instrument Calibration Form (Appendix E).

Prior to beginning sampling, the field book (or field forms) with appropriate table headings and weather information should be filled out. This helps keep monitoring logs consistent and lessens field time spent on recording information.

In addition, weather conditions prior to initiating and after completing sampling will be noted and recorded. General weather conditions to be recorded include ambient temperature, barometric pressure, wind direction/speed, sky conditions (e.g. clear, cloudy, partially cloudy, high overcast, etc.), and if it is raining or snowing. If weather conditions change during sampling, these should also be recorded. The barometric pressure trend preceding sampling should be noted (i.e., rising, falling, steady or unsteady).

Precautions

Landfill gas is combustible and may contain toxic compounds. There will be no smoking near the landfill gas monitoring probes. Exposure to landfill gas will be avoided by staying up wind and/or crosswind from gas probes and exhaust port of sampling pumps.

Care will be exercised when opening any vaults and/or removing the cap from the PVC casing. Potential hazards include insects and rodents that may nest within the monuments, and elevated LFG concentrations that have accumulated within the casing (or vault).

Sampling and Analysis Procedures

For LFG monitoring at the gas probes, sampling and measurements will be conducted in the following sequence:

- After unlocking and removing the lid to the casing (or vault), check to make sure the sampling port valves are closed. Note: If valves are not closed, representative subsurface pressure readings cannot be obtained.
- Remove cap from the valve head.
- Connect pressure gauge sampling hose to valve.
- Zero pressures on pressure gauge (make sure pump is turned off if the pressure gauge is a component of the gas analyzer), then connect sampling hose to pressure gauge.
- Open valve.
- Record pressure reading (spike and steady values).
- Turn on pump to gas analyzer and observe gas readings (both spike and steady values). Care should be taken not to suck water into the instrument if water is present. Run pump long enough to obtain a steady reading (generally, two volumes of gas from the probe). This will ensure that the sample is gathered from the surrounding formation.
- Record both spike and steady readings. Record readings in the field book and/or data logger.
- Disconnect sampling hose from valve. Let pump run long enough to purge gases from instrument.
- Close valve.
- Place caps back on valve head; this keeps insects from plugging sampling ports. Make sure all valves are closed air tight.
- Place lid on steel casing and lock down.

The procedure may need to be modified slightly if other instruments are used. The pressure must be measured first before operating the sampling pump or other instruments. If separate instruments are used for each parameter, the valve should remain closed between sampling parameters. Abbreviated instructions for sampling with the GEM-2000 portable multi-gas analyzer are found in Appendix F.

Field Documentation

All monitoring results and observations for each sampling event will be recorded on the LFG field forms. Monitoring data should also be retained in the electronic memory of the portable gas analyzer for upload to the project file. At a minimum, the following information will be documented:

- Date
- Name of personnel conducting monitoring
- Time monitoring began and finished
- Instruments used (manufacturer & model number)

- Date instrument was last calibrated
- Weather conditions
- Barometric trends
- Gas probe or other location reference identifications
- Pressure measurements
- Gas concentrations (stabilized measurements and if observed, spike measurements)
- Water level (if applicable)
- Conditions of gas probe or other sampling locations
- Any abnormalities of sampling procedures

Calibration of portable instruments will be documented in the calibration logs. Maintenance of instruments will also be documented on the gas monitoring instrument maintenance log. All field sampling results and calibration logs will be retained for the quarterly data evaluation and reporting.

4.0 QUALITY ASSURANCE PLAN

The following quality assurance/quality control (QA/QC) measures will be performed on all the data obtained during water quality sampling at the Hansville Landfill facility. These measures are necessary because the monitoring program provides for analysis for constituents with standards in the low part per billion concentration range. However, site conditions at the three disposal cells at the landfill are not static. Continuing decomposition of the refuse and the associated settlement reflect processes that result in on-going changes. These conditions can present challenges to developing measurement performance criteria. In order to minimize temporal effects, similar results between consecutive monitoring events will be considered as an indication that measurement performance criteria are being satisfied.

4.1 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

4.1.1 Data Quality Objectives

All data are potentially subject to error during sampling, chemical analysis, and data reduction. Control and recognition of these errors is vital prior to data analysis and final report preparation. The establishment of appropriate levels of control of potential sources of error, and quantifying these errors when possible, will assist in assessing the impact of errors on the findings of the monitoring program.

Data quality objectives, in terms of accuracy, precision, completeness, comparability, and representativeness, have been established for each task that involves the collection of quantifiable data. Definitions of the objectives are discussed below.

Accuracy

Accuracy is a measure of the bias inherent in a system. It is the degree of agreement of a measurement (or an average of the measurements of the same item) with the accepted reference or true value. Because the exact bias of a system cannot be quantified (since the true values are not accessible), inferences are drawn from an examination of blank analyses, field-spiked sample analyses, and laboratory-spiked sample analyses. For example, trip blank analyses provide measures of the bias introduced by shipping and laboratory analyses. Method blanks and laboratory-spiked sample analyses provide measures of biases in laboratory analyses. Finally, field-spiked sample analyses provide measures of biases originating from sample matrices, shipping, and laboratory procedures. Acceptable accuracy measures depend on the sample matrices involved and the types of measurements performed.

Precision

Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Measurements of precision are made through analyses of replicate samples collected at regular intervals. Because replicate samples are anticipated to contain identical chemical characteristics, any variability in the laboratory analyses of these samples may be due to factors introduced by sampling, handling, or analytical procedures.

Completeness

Completeness is a measure of the quantity of valid data obtained from a measurement system compared to the quantity of data that could be obtained from the system under optimum conditions. Overall completeness consists of field completeness, laboratory completeness, and office completeness. Field completeness is based on the number of planned field samples or tests and the number actually collected. Laboratory completeness is based on the number of samples analyzed by the laboratory and the number of validated analyses produced. Office completeness is the quantity of data received compared to the quantity of chemical data validated. The goal for each is 100 percent.

Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. It can be related to precision and accuracy, as these quantities are measures of data reliability. To assess comparability, field sampling procedures, laboratory sample preparation procedures, analytical procedures, and reporting units must be known. Comparability of analytical data can be enhanced by use of traceable reference materials and by the performance of evaluation programs. Qualitatively, data subjected to rigorous quality assurance or quality control procedures are more comparable than other data because they are more reliable.

Representativeness

Representativeness is the degree to which a set of data accurately represents the characteristics of a population, a process condition, or an environmental condition. Data are usually considered representative if the distribution of the sample results is within statistically defined bounds. The degree to which data represent an intended characteristic will be assessed during the completion of analytical and interpretive procedures.

4.2 DATA GENERATION AND ACQUISITION

4.2.1 Field and Laboratory Control Measures

An Ecology-accredited laboratory will be used for all the groundwater and surface water sample analysis. The samples will be delivered to the laboratory one to two days after sample collection. The laboratory will perform the analysis within the appropriate holding times.

The laboratory will perform method-specific QC activities, including surrogate recoveries, matrix spike, duplicates, and blanks. The data will be considered valid if percent recoveries fall between method-specific lower and upper control limits.

Equipment Rinse Blanks

Because dedicated sampling pumps have been installed in each of the groundwater monitoring wells at the site, it should not be necessary to collect any equipment rinse blanks from the groundwater sampling equipment.

Duplicate Samples

During each quarterly sampling event, one field duplicate or one field duplicate for every ten percent of the total samples (i.e., 1 duplicate for every 10 samples), whichever is greater, will be collected and analyzed for all parameter groups in the analytical suite.

These samples will be submitted as blind duplicates (i.e. under a separate, unique sample number). The location where the duplicate samples were collected will be recorded in the field logs and documented in the monitoring report. The duplicate samples will be submitted to the same laboratory as the primary samples. The duplicate samples should be collected from wells where constituents of concern have been readily detected above PQLs. The duplicate should rotate among eligible locations between sampling events whenever possible.

Trip Blanks

The trip blank is designed to determine if the VOC vials were decontaminated properly, if the source water was contaminant-free, or if cross contamination may have occurred during storage and transport of samples as a result of VOCs possibly diffusing through the septum lids. The trip blanks will be prepared by the contracted laboratory and sent with the empty VOC sample vials. Two trip blanks (one for the cooler containing groundwater samples and one for the cooler containing surface water samples) will accompany the primary VOC samples. The receiving laboratory will analyze these trip blanks for the same compounds that are being tested for in the primary VOC samples.

4.2.2 Instrument/Equipment Testing, Maintenance and Calibration

Field Instruments

Field instruments will be used to measure the water table elevation, and to monitor groundwater quality parameters during well purging activities. All field instruments will be calibrated and tested as appropriate before any measurements are collected. Standard equipment inspection and maintenance, consistent with the manufacturer’s requirements, will be performed.

All field instruments used during the monitoring program will be calibrated according to manufacturers’ requirements. The instruments may be calibrated in the office immediately before use, or at the project site. The calibration records (Appendices B and E) will be placed in the project file.

Laboratory Instruments

Maintenance of the laboratory equipment is the responsibility of the laboratory. Routine performance checks and preventive maintenance will be performed by qualified laboratory personnel or by the instrument manufacturers. Other maintenance or repair functions will be performed by instrument manufacturers' service representatives only.

The laboratory will perform instrument calibration as specified by the analytical methods required for this monitoring program. Otherwise, calibration frequency will conform to the manufacturers' specifications.

4.3 DATA VALIDATION AND USABILITY

4.3.1 Data Review, Validation and Verification Requirements

The data collection process will be reviewed to verify that the data have been collected consistent with the program design and the quality assurance plan. Quality assurance personnel will review the progress of the data collection, starting with the monitoring and sampling and the documentation of field activities. Any deviations from the sampling protocol, the rationale for the deviations, and the expected impact on the program and the collected data will receive particular attention.

The review will follow the sample handling process from collection to delivery at the analytical laboratory. Proper chain-of-custody documentation will be evaluated and confirmed. Sample handling within the laboratory, analytical procedures used, QC activities, and the subsequent data reporting by the laboratory will be reviewed and evaluated.

Field Data Validation

The integrity of the field reportable data will be validated before it can be reported. This involves reviewing all field logs, reviewing and checking raw data entries and calculations, and verifying the custody integrity of all samples collected. Corrective actions will be performed when the precision and accuracy results fall outside of the control limits.

Water level data will be reduced by staff collecting the data and validated with an appropriate checking process performed by another staff member. Resultant reports will bear the initials of the staff member.

Laboratory Data Validation

Laboratory analytical reports will also be subjected to a data validation review, including confirming the laboratory QA/QC procedures, comparing original and duplicate sample results, and ensuring spike recoveries are within acceptable ranges. Validation will include determining if:

- Sample holding times were met.
- Duplicate sample concentrations were within acceptable limits.

- Trip blanks were analyte-free.
- Detection limits were acceptable.
- Laboratory blanks were analyte free.
- Laboratory matrix spike recoveries were within acceptable limits.
- Any analytical interferences were identified.
- Laboratory precision and accuracy were within acceptable limits.
- Obvious anomalous values were identified and addressed.

Based on these reviews, the data will be classified as valid, useable, or unusable. Data classified as valid will have met all the data quality objectives, the sample custody and field logs will be in order, the results of the analyses of the field and laboratory QC blanks will be acceptable and other laboratory performance criteria will be acceptable. Valid data can be used for all purposes.

Data classified as useable will not have met all the QA/QC criteria described above. Sample custody may have been broken, holding times may have been slightly missed, a QC blank may have been contaminated, or the detection limit may have been elevated. These are a few examples of situations that cause the analytical data to be questionable but still useable, providing that data are used with caution.

Data that has been classified as unusable are invalid and will not be used for any purpose. Unusable data may be the result of gross laboratory error, strong analytical interferences, or other major problems associated with the data.

4.3.2 Reconciliation with Data Quality Objectives

The results of the data verification and validation process will be used to determine the value, application and usefulness of the data for this monitoring project. It is possible that some or all of the data may be qualified. The qualifications, if any, and the impacts on the usefulness of the data, will be discussed in the quarterly monitoring reports.

The data, and any qualifications, will be evaluated with respect to the data quality objectives. Depending on the results, corrective action may be necessary. The corrective action could range from minor adjustments to the monitoring program, to discarding the data and repeating the specific portions of the monitoring for that particular quarter.

5.0 REPORTING AND DATA SUBMITTALS

Water quality data obtained during groundwater and surface water monitoring at the Hansville Landfill will be evaluated using the procedures specified in Appendix D [Evaluation of Monitoring Data] of the final CAP. These data evaluation procedures have been selected to determine whether the water quality data are falling within limits that show progress towards achieving the cleanup levels specified for the site.

Compliance reporting under the CAP consists of three main elements: quarterly progress reports, annual monitoring reports, and upload of quarterly water quality data to Ecology's Environmental Information Management (EIM) database.

5.1 DATA EVALUATION

Water quality data will be evaluated on a quarterly basis through:

- Comparison with applicable water quality standards;
- Tracking of natural attenuation parameters to assess the effectiveness of the selected remedy; and the
- Statistical analysis of groundwater COCs to project contaminant trends.

In addition, upper and lower confidence limits for vinyl chloride and arsenic in groundwater will be statistically derived on an annual basis for comparison with site cleanup levels

5.1.1 Chemical Methods

The following table (Table 5.2 from the final CAP) specifies the site-specific cleanup levels for the primary COCs at the Hansville Landfill. As detailed in the CAP, two of the primary COCs (vinyl chloride and arsenic) will be statistically evaluated to monitor the effectiveness of the site remedy. Manganese, also identified as a COC, has a secondary maximum contaminant level (MCL), and does not impact cleanup decisions at this site (Ecology, 2004). As a result, manganese will not be statistically evaluated.

SITE CLEANUP LEVELS – HANSVILLE LANDFILL REMEDY			
Chemical	**Media**	**Site Cleanup Level (ug/L)**	**Origin of Cleanup Level**
Vinyl chloride	Groundwater	0.025	EPA Human Health, 2004
Arsenic		5	Background
Manganese		2,240	Method B Formula Value
Vinyl chloride	Surface Water	0.025	EPA Human Health, 2004
Arsenic		5	Background

Laboratory results for vinyl chloride and arsenic will be tabulated and compared to the listed cleanup levels on a quarterly basis. If groundwater results for these parameters exceed their site-specific cleanup levels, statistical trend analysis methods (see Section 5.1.2) will be applied to these data to assess whether the current downward trends in contaminant concentrations are continuing.

In addition, water quality parameters indicative of natural attenuation that are monitored on a quarterly basis (including dissolved oxygen, redox, sulfate, nitrate/nitrite and TOC) will be evaluated to provide evidence of the biological and geochemical processes indicative of the breakdown of the site COCs. The relative magnitude and trends of these indicator parameters will provide insight into the mechanisms of natural attenuation that are occurring in groundwater at the site.

5.1.2 Statistical Methods

Statistical evaluation procedures were selected to assess whether the water quality monitoring data from the Hansville Landfill are falling within limits that show progress towards achieving the site cleanup levels specified in the CAP for the primary COCs (vinyl chloride and arsenic). The procedures outlined below generally employ a weight of evidence approach that considers the following:

- Statistically derived trend analysis which is a useful tool for identifying contaminant concentration trends;
- Statistical curve fitting which enables a projection of hypothetical clean-up time frames; and
- Confidence limit comparisons which will ultimately determine the end of the corrective action.

The application of these procedures is outlined below.

Statistical Trend Analysis and Time-Series Plots (Quarterly/Annual)

As mentioned in Section 5.1.1, vinyl chloride and arsenic groundwater results that exceed their respective site-specific cleanup levels will be statistically analyzed using Mann-Kendall and/or Sen's Slope tests. These methods will be used to test for statistically significant concentration trends that may potentially deviate from the currently established downward pattern. This evaluation will be completed for each quarter’s data set.

In addition, all the vinyl chloride and arsenic data from each downgradient monitoring well will be plotted versus time (time series graphs). Time series graphs will be plotted on a quarterly basis.

Statistical Trend Projections (Quarterly/Annual)

Vinyl chloride and arsenic results that exceed site-specific groundwater cleanup levels will also have exponential decay (or attenuation) curves fit to their data sets to qualitatively evaluate any changes that could negatively impact their convergence towards the cleanup level. The procedure will involve a least squares regression method and the resulting trend lines will be extended forward in time (several years) as far as is feasible given the data.

Calculation of Upper and Lower Confidence Limits (Annual)

On an annual basis, the quarterly vinyl chloride and arsenic groundwater data obtained during the reporting year will be statistically evaluated in accordance with ASTM D7048 - 04, Standard Guide for Applying Statistical Methods for Assessment and Corrective Action Environmental Monitoring Programs (ASTM, 2004). The purpose of this analysis is to quantitatively verify that current downward trends in contaminant concentrations are continuing. The steps in this process are those summarized in Appendix D of the CAP, and are as follows:

- Sample size (N) decision - Since the number of samples (N) will be less than 7 (the last year of data will be used, so N = 4), compute the 95% Normal Upper Confidence Limits (UCLs) and Lower Confidence Limits (LCLs).
- Adjustment for non-detections - Set non-detects to one-half the minimum detection limit (MDL).
- Compute means, UCLs, and LCLs - Calculate the mean, 95% UCL and LCL from the reporting year's (4 quarters) sampling data.
- Compare to Site Cleanup Levels - The UCL and LCL will then be compared to the site-specific cleanup levels to determine the position of the UCL and LCL relative to these criteria (above or below) and whether the confidence limits are still converging and approaching the cleanup level. If a downward trend in the groundwater data is present, the mean, UCL and LCL should trend downward.

5.2 REPORTING

5.2.1 Quarterly Progress Reports

Quarterly progress reports will be prepared for the first, second, and third quarter monitoring events of each calendar year. Fourth quarter results (see Section 5.2.2) will be presented in an annual monitoring report that will document the site activities and monitoring results for the entire reporting year. All reports will be prepared under the direction and seal of a current Washington State licensed hydrogeologist (LHG).

The quarterly reports will include the following information:

- A list of on-site activities that have taken place during the quarter, along with a discussion of any deviations from the CAP or required tasks not otherwise documented in project plans. If deviations occur, a plan will be included for recovering lost time and maintaining compliance with the project schedule.
- Determination of groundwater flow direction and gradient for the monitoring quarter, including a water table elevation contour map.
- The results of all sampling, laboratory reports, and/or test results generated for the quarterly water quality monitoring event, including all raw data and laboratory analyses.
- The quarterly landfill gas monitoring results.

- Summary tables of all monitoring data and results highlighting any exceedances of the water quality cleanup levels established in the CAP.
- Results of the groundwater statistical evaluation, including a summary of the statistical analysis procedures, any deviations, and statistical conclusions.

Draft quarterly reports will be prepared and submitted to the County and WMW for review within 30 days after the end of the respective quarter. Upon receipt of comments to the draft documents, electronic and hard copies of the final quarterly reports will be provided to Ecology within 60 days after the end of the quarter in which monitoring and sampling was conducted. Copies of the final quarterly reports will also be provided to the KCHD and the Port Gamble S'Klallam Tribe.

5.2.2 Annual Reports

An annual monitoring report will be prepared upon the conclusion of the fourth quarterly monitoring event. The annual report will include all of the information required in the quarterly progress reports for the fourth quarter's monitoring results, as well as a summary of the preceding three quarters of compliance monitoring. The annual report will also include comparison of the statistically derived UCLs and LCLs for groundwater with their respective site-specific cleanup levels. In addition, the annual report will provide recommendations, as appropriate, for optimizing the existing landfill monitoring and control systems.

A draft annual report will be submitted to the County and WMW for review within 30 days after the end of the calendar year. After receipt of comments to the draft document, electronic and hard copies of the final annual report will be provided to Ecology by March 1st of the following year. Copies of the final reports will also be provided to the KCHD and the Port Gamble S'Klallam Tribe.

5.3 EIM SUBMITTAL

After the quarterly progress and annual monitoring reports have been finalized, water quality data obtained during each quarterly monitoring event at the Hansville Landfill will be complied and submitted to Ecology's EIM database. The EIM data uploads are anticipated to be completed within 30 days of issuance of each final quarterly/annual report.

5.4 RECORDS RETENTION

Consistent with the requirements of the Amended Consent Decree, project specific records generated from the Hansville Landfill monitoring program will be retained for a minimum of 10 years. Records retention will include field and laboratory reports, quarterly and annual monitoring reports, subcontractor records, and O&M records. The majority of these monitoring records may be preserved in an electronic format.

6.0 REFERENCES

American Society for Testing and Materials. *Standard Guide for Applying Statistical Methods for Assessment and Corrective Action Environmental Monitoring Programs.* ASTM International. 2004

American Public Health Association, American Water Works Association, Water Environment Federation *Standard Methods for the Examination of Water and Wastewater (APHA 1985).*

Parametrix. *Remedial Investigation/Feasibility Study, Remedial Investigation Report, Hansville Landfill.* July 2007.

Parametrix. *Final Feasibility Study Report, Remedial Investigation/Feasibility Study Report, Hansville Landfill.* June 2009.

Parametrix. *Environmental Monitoring Report – 2010 Annual Report, Hansville Landfill.* March 2011.

Parametrix. *Transmittal of First Quarter 2011 Environmental Monitoring Data, Hansville Landfill*. April 2011.

SCS Engineers. *Transmittal of Second Quarter 2011 Environmental Monitoring Data, Hansville Landfill, Kitsap County, WA.* July 2011.

U.S. Environmental Protection Agency. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. EPA Publication No. 530-09-007. March 2009.

Washington Department of Ecology, *Preparing for Termination of Post-Closure Activities at Landfills Closed under Chapter 173-304 WAC*. Publication No. 11-07-006. February 2011.

Washington Department of Ecology. *Draft Consent Decree, Draft Cleanup Action Plan (CAP), and State Environmental Policy Act (SEPA) Checklist and Mitigated Determination of Non-significance Available for Public Comment*. May 2011.

Washington Department of Ecology. *Final Consent Decree, Final Cleanup Action Plan (CAP), and State Environmental Policy Act (SEPA) Checklist and Mitigated Determination of Non-significance Available for Public Comment*. August 2011.

Washington Department of Ecology. *Cleanup Action Plan, Hansville Landfill, Kitsap County, Washington*. June 2011.

Washington Department of Ecology. *Amended Consent Decree No. 95-2-03005-1 between State of Washington Department of Ecology and Kitsap County and Waste Management of Washington, Inc*. August 2011.

This page intentionally blank.

TABLES AND FIGURES

This page intentionally blank.

Table 1. Compliance Monitoring Network – Groundwater, Surface Water and Landfill Gas Sampling Locations

Sampling Location	Function	Frequency	Description
Groundwater Monitoring Well Network			
MW-5	Upgradient	Quarterly	Adjacent to the recycling area
MW-6	Downgradient	Quarterly	Adjacent to landfill
MW-7	Downgradient	Quarterly	Adjacent to septage area
MW-12I	Downgradient	Quarterly	On Tribal property
MW-13D	Downgradient	Quarterly	On Tribal property
MW-14	Downgradient	Quarterly	Adjacent to landfill
Surface Water Monitoring Network			
SW-1	Downgradient	Quarterly	On Tribal property
SW-4	Downgradient	Quarterly	On Tribal property
SW-6	Downgradient	Quarterly	On Tribal property
SW-7	Downgradient	Quarterly	On Tribal property
Perimeter LFG Monitoring Probe Network			
GP-1	East perimeter	Quarterly	Adjacent to demolition fill area
GP-2S	Southwest perimeter	Quarterly	Shallow perimeter probe adjacent to landfill
GP-2M		Quarterly	Mid-depth perimeter probe adjacent to landfill
GP-2D		Quarterly	Deep perimeter probe adjacent to landfill
GP-3	South perimeter	Quarterly	Adjacent to landfill
GP-4	West perimeter	Quarterly	Adjacent to landfill
GP-5	North perimeter	Quarterly	Adjacent to septage area
GP-6	Northeast perimeter	Quarterly	Adjacent to landfill
GP-7	Far West	Quarterly	On Tribal property

Table 2. Data for Compliance Monitoring Groundwater Wells

Well ID	Northing	Easting	Reference Elevation (ft)*	Total Depth (ft)**	Top of Screen (ft)*	Bottom of Screen (ft)*	Screen Length (ft)
MW-5	314597.60	1220051.15	366.9	130	244	234	10
MW-6	314126.79	1218646.59	372.7	86	260	245	15
MW-7	315213.81	1218952.19	346.0	100	259	244	15
MW-12I	313367.61	1217449.67	248.1	43	217	207	10
MW-13D	314232.80	1217617.30	260.4	63	205	195	10
MW-14	313746.75	1218815.88	341.1	92	262	247	15

* Elevation referenced to MSL in feet.
** Below ground surface.

Table 3. Inorganic Parameter Standards & Analytical Methods for Groundwater and Surface Water

Constituent	Groundwater Standards and Site Cleanup Levels (mg/L)[1]	Analytical Method	Recommended PQL (mg/L)[1]
Field Parameters			
pH	6.5-8.5	Field Instrument	NA
Specific conductance	700 umhos/cm	Field Instrument	NA
Temperature	NSE	Field Instrument	NA
Redox	NSE	Field Instrument	NA
Dissolved Oxygen	NSE	Field Instrument	0.2
Static water level	NA	Field Instrument	0.01 feet
Laboratory Parameters			
Arsenic (As -dissolved)	0.005 *	SW-846 200.8	0.004
Manganese (Mn -dissolved))	2.24 *	SW-846 6020	1
Chloride (Cl)	250	SW-846 9251	1
Ammonia (NH_3, -N)	10	EPA 350.1	0.03
Nitrate -N	10	EPA 300.0	0.5
Nitrite -N	1	EPA 300.0	0.5
Bicarbonate	NSE	SW-846 2320B	5
Carbonate	NSE	SW-846 2320B	5
Alkalinity (as $CaCO_3$)	NSE	SW-846 2320B	5
Sulfate (SO_4)	250	EPA 300.0	1
Orthophosphate -P	NSE	EPA 300.0	0.5
Total Organic Carbon (TOC)	NSE	SW-846 5310B	1

1 Implementation Guidance for the Groundwater Standards, WA Department of Ecology 2005.
* Site Specific Cleanup Levels from the CAP.
NSE No Standard Established.
PQL Practical Quantification Limit
NA Not applicable

Table 4. Organic Parameter Standards & Analytical Methods for Groundwater and Surface Water

Appendix I Organic Constituent [1]	Groundwater Standards and Site Cleanup Levels [2] (ug/L)	Analytical Method	Recommended PQL (ug/L)
Acetone	NSE	SW-846 8260	10.0
Acrylonitrile	0.07	SW-846 8260	30.0
Benzene	1	SW-846 8260	1.0
Bromochloromethane	NSE	SW-846 8260	1.0
Bromodichloromethane	0.3	SW-846 8260	1.0
Bromoform	5	SW-846 8260	1.0
Carbon Disulfide	NSE	SW-846 8260	2.0
Carbon Tetrachloride	0.3	SW-846 8260	1.0
Chlorobenzene	100	SW-846 8260	1.0
Chloroethane	NSE	SW-846 8260	2.0
Chloroform	7	SW-846 8260	1.0
Dibromochloromethane	0.5	SW-846 8260	1.0
1,2-Dibromo-3-chloropropane	0.2	SW-846 8260	2.0
1,2-Dibromoethane	0.001	SW-846 8260	1.0
1,2-Dichlorobenzene	600	SW-846 8260	1.0
1,4-Dichlorobenzene	4	SW-846 8260	1.0
trans-1,4-Dichloro-2-butene	NSE	SW-846 8260	3.0
1,1-Dichloroethane	1	SW-846 8260	1.0
1,2-Dichloroethane	0.5	SW-846 8260	1.0
1,1-Dichloroethene	7	SW-846 8260	1.0
cis-1,2-Dichloroethene	70	SW-846 8260	1.0
trans-1,2-Dichloroethene	100	SW-846 8260	1.0
1,2-Dichloropropane	0.6	SW-846 8260	1.0
cis-1,3-Dichloropropene	NSE	SW-846 8260	1.0
trans-1,3-Dichlorpropene	NSE	SW-846 8260	1.0
Ethylbenzene	700	SW-846 8260	1.0
2-Hexanone	NSE	SW-846 8260	5.0
Bromomethane	NSE	SW-846 8260	2.0
Chloromethane	NSE	SW-846 8260	2.0
Dibromomethane	NSE	SW-846 8260	1.0
Methylene Chloride	5	SW-846 8260	5.0
2-Butanone	NSE	SW-846 8260	5.0
Methyl iodide	NSE	SW-846 8260	5.0
4-Methyle-2-Pentanone	NSE	SW-846 8260	1.0
Styrene	100	SW-846 8260	1.0
1,1,1,2-Tetrachloroethane	NSE	SW-846 8260	1.0
1,1,2,2-Tetrachloroethane	NSE	SW-846 8260	1.0
Tetrachloroethene	0.8	SW-846 8260	1.0
Toluene	1,000	SW-846 8260	1.0
1,1,1-Trichloroethane	200	SW-846 8260	1.0
1,1,2-Trichloroethane	NSE	SW-846 8260	1.0
Trichloroethene	3	SW-846 8260	1.0
Trichlorofluoromethane	NSE	SW-846 8260	2.0
1,2,3-Trichloropropane	NSE	SW-846 8260	2.5
Vinyl Acetate	NSE	SW-846 8260	3.0
Vinyl Chloride	0.025 [3]	SW-846 8260 SIM	0.02
Xylenes, Total	10,000	SW-846 8260	2.0

1 Appendix I VOC list from WAC 173-351
2 Implementation Guidance for the Groundwater Standards, WA Department of Ecology 2005.
3 Site Specific Cleanup Level from the CAP.
NSE No Standard Established.
PQL Practical Quantification Limit

Table 5. List of Groundwater Monitoring Equipment

General Equipment & Tools	
☐ Well/Gate Keys ☐ Site Location Map ☐ Site Map ☐ Water Level Meter (at least one small diameter probe) ☐ Flow Cell ☐ Grundfos Pump Controller ☐ Generator and power cords ☐ Graduated Cylinder ☐ Clipboard	☐ Knife ☐ Health and Safety Plan ☐ Tool Box including: - 11/16 socket - bolt cutters - set of wrenches ☐ Manhole Hook ☐ Machete and Pruning Shears ☐ Purge Bucket ☐ Cell Phone
Safety Equipment ☐ First Aid Kit ☐ Fire Extinguisher ☐ Hat ☐ Leather Gloves	☐ Raingear ☐ Carhartts ☐ Steel-Toed Leather or Rubber Boots ☐ Whistle ☐ Orange Safety Vest
Supplies	
☐ Fuel for Generator ☐ Spare Fittings for Pump Connections ☐ 0.45 Micron Filters ☐ Hose Clamps ☐ Clearing Machete ☐ Masterflex Tubing ☐ Batteries ☐ Surveyor's Tape	☐ Calibration Supplies (pH buffers, conductivity stds.) ☐ Sample Coolers, Bottles, Ice ☐ Packing Material (bubble wrap, tape, custody seals, stickers, labels, etc.) ☐ Ziplock Bags ☐ Business Cards ☐ Insect Repellent ☐ Permanent Markers
Safety Supplies ☐ Thick Nitrile Gloves ☐ Thin Nitrile Gloves	*Decon Supplies* ☐ Alconox Detergent ☐ Garbage Bags ☐ Paper Towels ☐ DI Water (decon) ☐ Tap Water
Forms, Etc.	
☐ TA FedEx Forms (enough for one per day) and blank FedEx Forms ☐ Field Information Forms (blank and from previous event) ☐ Chain of Custody Forms	☐ Sample Container Forms ☐ Calibration Forms ☐ Unified Monitoring Field Report ☐ Water Level Measurement Form ☐ Project Contact List

Table 6. Landfill Gas Portable Monitoring Instrument Detection Methods, Range and Accuracy

Parameter	Detection Method (1)	Response Time (sec)	Units	Range	Accuracy	Resolution	Detection Limit
Methane (CH_4)	Catalytic Oxidation (2) or infrared	< 20	% Vol.	0 – 5	+ 0.5 %	+ 0.1	+ 0.1
	Thermal Conductivity or infrared	< 20	% Vol.	0 – 100	+ 3.0 %	+ 0.1	+ 0.1
Carbon Dioxide (CO_2)	Chemical Absorption or infrared	< 20	% Vol.	0 – 5	+ 0.5 %	+ 0.1	+ 0.1
	Chemical Absorption or infrared	< 20	% Vol.	0 – 60	+ 3.0 %	+ 0.1	+ 0.1
Oxygen (O_2)	Chemical absorption or electro-chemical cell or galvanic cell	< 20	% Vol.	0 – 5	+ 1.0 %	+ 0.1	+ 0.1
	Chemical absorption or galvanic cell	< 20	% Vol.	0 – 25	+ 1.0 %	+ 0.1	+ 0.1
Relative (Static) Pressure	Magnetic Linkage or Transducer	N.A.	in. of W.C.	+ 250 mbar	+ 1.0 %	+ 0.01	+ 0.01

Equivalent methods may be used, but must be documented on the field log and in the monitoring report.
Catalytic Oxidation must have at least 10 percent oxygen to function accurately.
NA Not Applicable.

Table 7. List of Field Items for Landfill Gas Monitoring

Documents

Compliance Monitoring Plan (including map and gas probe information)
Site Safety Plan
Instrument Calibration Log
Field Book or Forms*

Instruments

Portable Gas Analyzer (GEM 2000)
Camera *
Measuring Tape *

Equipment

Battery Charger

Tools

Keys to: Gates, Casing / Vault Lids, etc.
Tool to open lids to Vaults / Manholes. etc.
Socket Wrench with Sockets for Vault Lids
Stick (to remove insect/spider webs)
Pencil / Pen *
Black Permanent Marker *
Screw Driver (Flat Head and Phillips) *
Hammer *
Bolt Cutters *
Channel Lock Pliers *
Crescent Wrench *
Pipe Cutter *
Scissors or Knife *
Flash Light *

Supplies

Calibration Gas Kit
Particle Filter
Hydrophobic Filter
Hose & Fittings
Compressed Air
Silicon or WD-40 Lubricant Spray
Insect Spray *
Batteries*
Electrical Tape *
Teflon Tape *

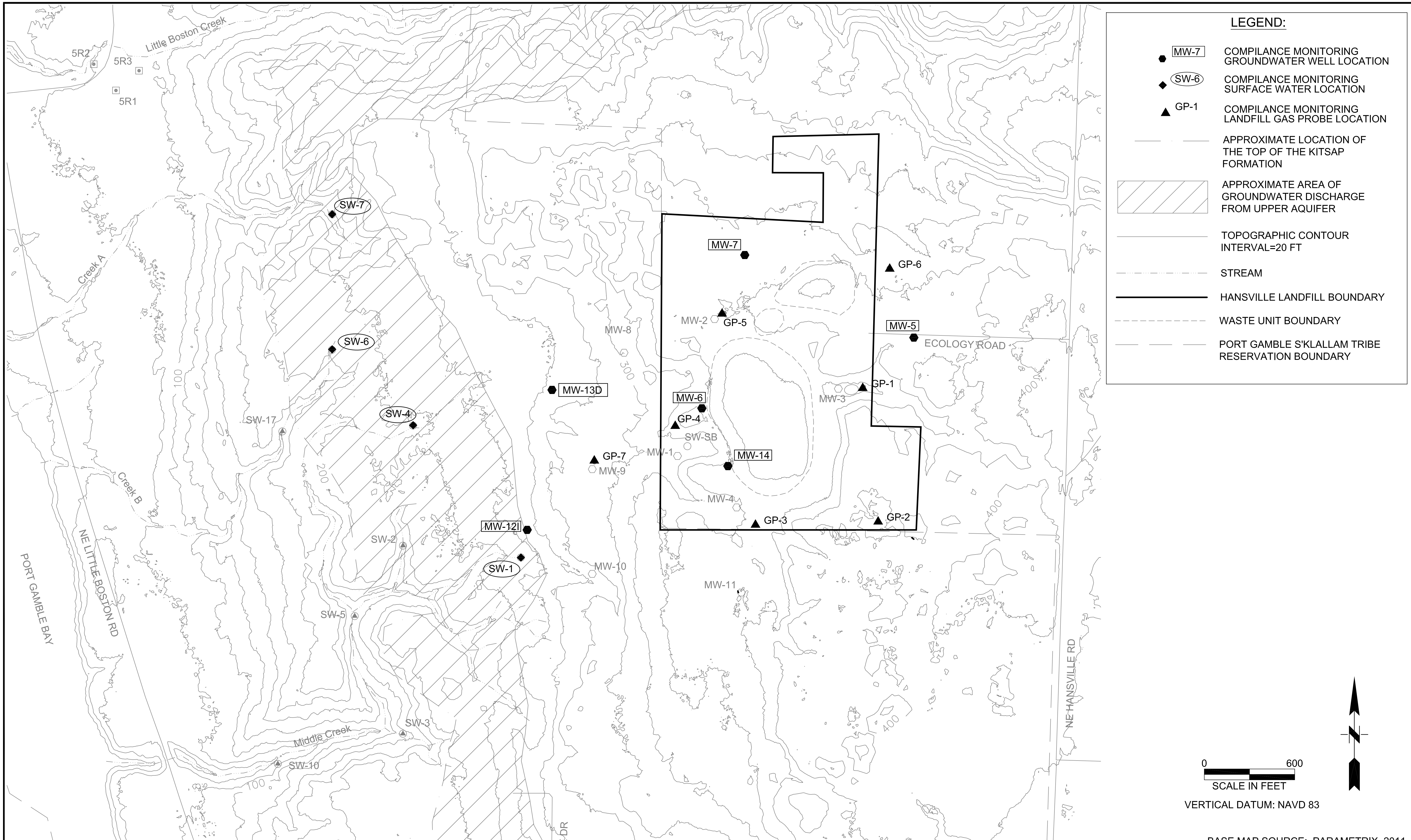
* Not required, but may be needed for unanticipated conditions.

This page intentionally blank.

SOURCE: USGS

SCS ENGINEERS
Environmental Consultants and Contractors
2405 140th Avenue NE, Suite 107
Bellevue, Washington 98005
(425) 746-4600 FAX: (425) 746-6747

PROJECT NO.	DES BY		DATE
04211017.00	L.L.	SITE LOCATION MAP	SEP 2011
SCALE: NA	CHK BY: D.V.	HANSVILLE LANDFILL SITE	FIGURE
CAD FILE: FIGURE 1	APP BY: G.H.	KISTAP COUNTY, WASHINGTON	1



BASE MAP SOURCE: PARAMETRIX, 2011

SCS ENGINEERS
Environmental Consultants and Contractors
2405 140th Avenue NE, Suite 107
Bellevue, Washington 98005
(425) 746-4600 FAX: (425) 746-6747

PROJECT NO. 042110017.00	DES BY L.L.	COMPLIANCE MONITORING LOCATIONS	DATE SEPT 2011
SCALE AS SHOWN	CHK BY D.V.	HANSVILLE LANDFILL KITSAP COUNTY, WASHINGTON	FIGURE 2
CAD FILE FIGURE 2	APP BY G.H.		

Appendix A

Example Water Quality Monitoring
Field Data Collection Forms

SCS ENGINEERS 2405
140th ave NE #107 Bellevue Wa
98005
(425)746-4600

Groundwater Sampling Data Sheet

Project #: ____________________

Site ____________________

Well ID: ____________________

Sample ID: ____________________

Date: ____________________

Weather: ____________________

____________ DTW

____________ TOS

____________ Intake

____________ BOS

____________ Total Depth

CONTROL SETTINGS:

Refill ____________

Discharge ____________

Pressure ____________

Sampling Method: ____________________

Notes:

Filtered? Y N

Locked? Y N

Water in Protector? Y N

Damage? Y N

Sample Containers:

1000 ml Poly	500 ml Poly	250 ml Poly	125 ml Poly
500 ml HNO3	500 ml H2SO4	40 ml VOA	1000 ml Amber
125 ml NaOH			

TIME	DTW	Temp.	Sp.Cond.	DO	pH	Eh	Turbidity	Q / Vol.

Observations (color, odor, anomalies, etc)

Stabilization Parameters: pH/DO ± 0.2, SpC ± 10%, Temp ± 5°C, Turb. ± 10% or ≤ 5

SAMPLER: ____________________ ____________________

Printed Name Signature

SCS ENGINEERS 2405
140th ave NE #107 Bellevue Wa
98005
(425)746-4600

Surface Water Sampling Data Sheet

Project #: ______________________

Site ______________________

Sample ID: ______________________

Date: ______________________

Weather: ______________________

____

Sampling Method: Grab

Stream Flow Level: ___High ___Normal ___Low

Sample Containers:

1000 ml Poly	500 ml Poly	250 ml Poly	125 ml Poly
500 ml HNO3	500 ml H2SO4	40 ml VOA	1000 ml Amber
125 ml NaOH			

Notes:

TIME	Temp.	Sp.Cond.	DO	pH	Eh	Turbidity		

Observations (color, odor, anomalies, etc)

Stabilization Parameters: pH/DO ± 0.2, SpC ± 10%, Temp ± 5°C, Turb. ± 10% or ≤ 5

SAMPLER: ______________________ ______________________
Printed Name Signature

Appendix B
Example Water Quality Monitoring
Field Equipment Calibration Forms

This page intentionally blank.

SCS ENGINEERS

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION DOCUMENTATION FORM

	Conductivity	pH 7	pH4	DO	Turbidity	Comments/Exceptions
Date						
Time						
Weather (sky or precip, temp)						
Barometric Pressure (*)						
Type of Calibration	Standard	Standard	Standard	Standard	Standard	
Standard Value	0.445	7	4.01	100% or ~8.5	800, 100, 20, <0.1	
Pre-Cal Reading						
Post Cal Reading						
Descrepancy						
Calib. Successful?						
Calibration by						
Instrument Type, ID	MP20	MP20	MP20	MP20	HACH 2100P	
Calibration Location						

* If Direct Reading is Unavailable, Assume pressure = 760 mm - 2.5 (altitude in ft/100)

Appendix C
Example Chain of Custody Forms

This page intentionally blank.

Chain of Custody Record

TAL-4124-280 (0508)

Sampler ID ______

Temperature on Receipt ______

Drinking Water? Yes ☐ No ☐

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Client	Project Manager	Date	Chain of Custody Number 122520
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page ______ of ______
City / State / Zip Code	Site Contact / Lab Contact		
Project Name and Location (State)	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH		Analysis (Attach list if more space is needed)												Special Instructions/ Conditions of Receipt

Possible Hazard Identification

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other ______

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Appendix D

Example Landfill Gas Monitoring Field Data Collection Forms

This page intentionally blank.

Results of Landfill Gas Monitoring

SCS Engineers

Landfill Gas Monitoring Network

Facility ______________________________

PROJECT NO. ____________________

DATE: ____________________

Date:

Monitored by:

Instruments:

Calibration Date:

Weather Conditions

Sky Cover:

Wind / Rain / Snow:

Temperature:

Preceding 24 hr Baro. Trend:

(i.e., rising / falling / steady / unsteady)

Location ID Designation	Time	Relative Pressure (in. H_2O)	Baro. Pressure (in. Hg)	Temp. (^{o} F)	Pump Run Time (sec.)	CH_4 (% vol.)	CO_2 (% vol.)	O_2 (% vol.)	Comments

Notes:

Appendix E

Example Landfill Gas Monitoring Field Instrument Calibration and Maintenance Forms

This page intentionally blank.

Calibration Log for Portable Landfill Gas Instruments

							Tank # 1 (or ambient air)			Tank # 2									Ambient Air		
							Methane Low End Concentration (% vol)			Methane High End Concentration (% vol)			Carbon Dioxide High End Concentration (% vol)			Oxygen Low End Concentration (% vol)			Oxygen High End Concentration (% vol)		
Date	Instrument mfr & model #	Calibrated by	Date filter replaced	Date battery discharged / recharged	Pump vacuum (in. H_2O)	Pump flow (scfh)	Initial	Final [A]	Cal. Gas	Initial	Final [A]	Cal. Gas	Initial	Final [A]	Cal. Gas	Initial	Final [A]	Cal. Gas	Initial	Final [A]	Cal. Gas
	Landtec, GEM 2000	TAM			>100, <5 sec	1.0	0.0	-	0.0	49.4	50.0	50.0	34.8	-	35.0	0.1	-	0.0	20.6	-	20.8

[A] If no adjustment is made, then indicate with " - " symbol.

			@		@		@		@		@	
Instrument accuracy	Gas	0 to 5 %vol	5	5 to 15 %vol	15	15 to FS %vol	TR		FS		FS	
for GEM 2000	CH_4	+/- 0.5%	0.03	+/- 1%	0.15	+/- 3%	1.5	50	1.8	60	3	100
TR = typical range	CO_2	+/- 0.5%	0.03	+/- 1%	0.15	+/- 3%	1.1	35	1.2	40	1.8	60
FS = full scale	O_2	+/- 1%	0.05	+/- 1%	0.15	+/- 1%	0.2	21	0.2	21	0.3	25

Appendix F

Sampling and Analysis Procedures for Gas Probes Using GEM 2000

This page intentionally blank.

Sampling and Analysis Procedures
for Gas Probes using the "GA" mode of the
GEM-2000 portable multi-gas analyzer

For landfill gas monitoring at the gas probes, sampling and measurements will be conducted in the following sequence:

1. Depress the red "on" button to turn on the gas analyzer.

   Wait for self test and purge cycle (pump running) to stop < 20 seconds.

   Wait for "gas read" menu to be displayed.

2. Connect sampling hoses to instrument. If temperature is being measured connect temperature probe to instrument and sampling hose pipe.

3. Depress the "[1]" button for Menu.

   Scroll to select "Mode of Operation", then depress the "enter" button.

   Scroll to select "Landfill Gas Analyzer", then depress the "enter" button.

   The "gas read" menu will be displayed.

4. Depress the "[3]" button for Next ID.

   Scroll to select the "ID Number ####", then depress the "enter" button.

   The "clean air purge" menu will be displayed.

   Depress the "enter" button to start purge cycle.

   After the purge cycle has ended (<30 seconds), a note will be displayed stating: "Please connect hoses to device."

   Depress the "[1]" button to continue.

   The "gas read" menu will be displayed.

5. Make sure the relative pressure has stabilized to zero (+/- 0.01) before connecting hose to sampling port.

   Note: The pressure must be measured first before operating the sampling pump or other instruments. If separate instruments are used for each parameter, the valve should remain closed between sampling parameters.

   If the pressure does not stabilize to zero, then zero the transducer. Press "[1]" and scroll to select "zero transducer(s)", then press "enter". The "zero relative pressure transducer" menu will be displayed. Press "enter" to zero transducer. The transducer will be zeroed and the "gas read" menu will be displayed.

6. Unlock and remove the lid to the casing (or vault) and check to make sure the sampling port valves are closed (¼-inch ball valves).

   Note: If valves are not closed, representative subsurface pressure readings can not be obtained (Skip step 10).

7. Remove cap from ¼-inch valve head.

   Note: If there is moisture present in the barbed connection of the ¼-inch valves, then blow out moisture with compressed air.

8. Connect sampling hose to ¼-inch valve.

9. Open ¼-inch valve.

10. Make sure relative pressure has stabilized, then depress the "pump on" button.

    This will automatically record the pressure reading at the moment the pump is turned on.

11. Observe the display (gas read menu) for gas concentrations and temperature as the pump is running and note any spike readings.

    Care should be taken not to suck water into the instrument (if water is present).

    Run the pump for the prescribed time interval (a minimum of one volume of gas from the probe).

    This will ensure that the sample is gathered from the surrounding formation.

12. Depress the "enter" button to record measurements.

    This will automatically record the gas concentrations and temperature (if temperature probe is connected to analyzer).

13. Disconnect sampling hose from valve.

14. Close ¼-inch valve.

15. Place caps back on valve head.

    Note: This keeps insects from plugging sampling ports. Make sure all valves are closed air tight.

16. Place lid on steel casing (or vault) and lock down.

Go to step 4 and repeat process for next gas probe.