APPENDIX D

SOIL AND GROUNDWATER SAMPLING PROTOCOLS

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by Environmental Investigation Services. The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

SOIL SAMPLING

(i) prepare a test pit/borehole log.

(ii) Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill/rig excavator such that the drill rig/excavator can operate in a safe manner.

(iii) Ensure all sampling equipment has been decontaminated prior to use.

(iv) Remove any surface debris from the immediate area of the sampling location.

(v) Collect samples and place in a glass jar with a Teflon sea. This should be undertaken as quickly as possibly to prevent the loss of volatiles. If possible, fill the glass jars completely.

(vi) Label the jar with the EIS job number, sample location (eg. TP1), sampling interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).

(vii) Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled glass jars. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.

(viii) Record the lithology of the sample and sample depth on the borehole/test pit log in accordance with AS1726-1993.

(ix) Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab.

(x) Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.

(xi) Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

DECONTAMINATION PROCEDURES FOR SOIL SAMPLING EQUIPMENT

(i) All of the equipment associated with the soil sampling procedure should be decontaminated between every sampling location.

(ii) The following equipment and materials are required for the decontamination procedure:

- Phosphate free detergent (Extran 100)
- Tap water
- Two buckets
- Stiff brushes
- Plastic sheets

(iii) Ensure the decontamination materials are clean prior to proceeding with the decontamination.

(iv) Fill both buckets with clean tap water and add phosphate free detergent to one bucket.

(v) In the bucket containing the detergent scrub the sampling equipment until all the material attached to the equipment has been removed.

(vi) Rinse sampling equipment in the bucket containing tap water.

(vii) Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure, high-pressure water cleaning is recommended. If any equipment is not completely decontaminated by both these processes that equipment should not be used until it has been thoroughly cleaned.

GROUNDWATER SAMPLING

Groundwater samples are more sensitive to contamination than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations details in AS2306.1 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed piezometers.

(i) After piezometer installation, at least four bore volumes should be pumped from the piezometers to remove any water introduced during the drilling process. Piezometers should then be left to recharge for at least five days before purging and sampling. Prior to purging or sampling the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.

(ii) Take the groundwater level from the collar of the piezometer using an electronic dipmeter. The collar level should be taken during the site visit using a dumpy level and staff.

(iii) Purging and sampling of piezometers should generally be done on the same site visit. Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:

- New disposable polyethylene bailer and sufficient cord OR submersible pump.
- Micropore filtration system (for heavy metals samples).
- Filter paper (glass fibre and 0.45(m).
- Buckets with volume increments.
- Sample containers – at least 1 x Teflon bottle with 1ml nitric acid, 1 x 75mL glass vial and 2 x 1L amber glass bottles for each piezometer.
- pH/Cond/Eh/T meters.
- Glass jars for purged samples.
- Esky and ice.
- Latex gloves.
- Distilled water (for cleaning).
- Electronic dipmeter.
- Groundwater sampling forms and notebook.
- Aluminium foil and labels.

(iv) Clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.

(v) Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.

(vi) Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.

(vii) Purge at least four bore volumes from the well. Take pH, conductivity, redox potential, and temperature measurements of the purged groundwater at regular intervals during purging. (Say, every 5-10 litres if abundant groundwater and every 1 litre if only limited groundwater is encountered). Groundwater condition measurements should be taken from a sample in a clean glass jar which has been taken directly from the sampling equipment (either pump or bailer). Electrodes should be placed in the sample after the electrodes have been rinsed with distilled water. Purged volumes and groundwater measurements should be recorded on the field sampling sheet. An assessment of the turbidity of the sample should also be made based on three categories: silty, opaque and clear.

(viii) Prepare all sample bottles. Label bottles with EIS job number, borehole number and date of collection.

(ix) Fill amber sample bottles and BTEX vial directly from pump or bailer. Ensure sampling equipment does not touch sample containers. Sample bottles and vials must be filled to the brim, so that a reverse meniscus is formed, seal with aluminium foil and then cap. Check that no air has entered the sample invert and check for bubbles.

(x) Fill vacuum filtration system and turn on filter pump.

(xi) Undertake pH/Cond/Eh/T of a sample taken in a clean glass jar used only for groundwater condition measurements. Turn the meters on and insert the electrodes into the sample. Record the measurements when the instruments have stabilized, then discard the sample. Clean the electrodes with distilled water between measurements.

(xii) When the sample filtering is complete (note: at least 50mL of filtered sample is required for heavy metal analysis), decant the filtered sample into a Teflon bottle containing nitric acid. Check label of sample bottle to ensure container has been treated with nitric acid and not sulfuric acid. Clean the filtration system with distilled water and replace the filters ready for the next sample.

(xiii) Photoionisation detector (PID) screening of volatile organic compounds (VOC) should be undertaken on groundwater samples using the sample headspace method during fieldwork. VOC data is obtained from partly filled glass jar samples following equilibration of the headspace gases. The PID headspace data should be included on the chain of custody forms and borehole logs.

(xiv) Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab.

(xv) Record the sample on the appropriate log in accordance with AS1726-1993. At the end of each water sampling complete a chain of custody form.

DECONTAMINATION PROCEDURE FOR GROUNDWATER SAMPLING EQUIPMENT

(i) All of the equipment associated with the groundwater sampling procedure should be decontaminated between every sampling location.

(ii) The following equipment and materials are required for the decontamination procedure:

- Phosphate free detergent (Extran 100).
- Tap water.
- Distilled water.
- Two buckets.
- Plastic sheets.

(iii) Fill one bucket with clean tap water and phosphate free detergent, and one bucket with distilled water.

(iv) Flush tap water and detergent through pump. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.

(v) Flush pump with distilled water.

(vi) Change water and detergent solution after each sampling location.

(vii) Rinse sampling equipment in the bucket containing distilled water.

(viii) Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned.

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with current US EPA SW-846 (1994) methods and those described in Environmental Sampling and Analysis, A Practical Guide, (H. Keith 1991).

Practical Quantitation Limit (PQL), Limit of Reporting (LOR) and Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection limit (MDL) for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations.
"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit", Keith (1991).

Accuracy

The proximity of an averaged result to the true value, where all random errors have been statistically removed. Accuracy is measured by percent recovery. Acceptable limits for accuracy generally lie between 70% to 130% recoveries. Certain laboratory methods may allow for values that lie outside these limits.

Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD). Acceptable targets for precision in this report will be less than 50% RPD for concentrations greater than ten times the PQL, less than 75% RPD for concentrations between five and ten times the PQL and less than 100% RPD for concentrations that are less than five times the PQL.

Blanks

The purpose of laboratory and field blanks is to check for artifacts and interferences that may arise during sampling and analysis.

Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples

may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula;

$$\frac{(\text{spiked sample result} - \text{sample result})}{\text{concentration of spike added}} \times 100$$

Acceptable recovery limits are 70% to 130%.

Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula:

$$\frac{|\ D1 - D2\ |}{|\ (D1 + D2)/2\ |} \times 100$$

where D1 is the sample concentration and D2 is the duplicate sample concentration.