

Appendix E

Flux Emissions Sampling Methodology

E.1 General

Flux emission sampling has been recommended for the CPWE area to determine if the site is suitable for commercial/industrial development with or without management measures, e.g. a Site Management Plan. The aim of the sampling is to provide confirmation that the volatile organic compounds (VOCs) and other semi-volatile chemicals which exhibit both volatile and semi-volatile properties have been characterised, and to assess potential concentrations of VOCs at the base of excavation and potential VOCs following remediation. URS recommends that sampling be carried out to characterise and quantify levels of VOCs in the following locations;

- on the base of the excavation in the CPWE prior to reinstatement; and
- on the treated material after reinstatement in the CPWE area or other areas on site.

E.2 Methodology

Surface flux emissions samples are collected from the surface of an undisturbed¹ surface using a static Flux Chamber (Flux Hood). This methodology enables the quantification of emissions to air from the surface of the ground without the influences of ambient air. Flux emission sampling is influenced by seasonal variations and groundwater levels and rainfall. It is acknowledged that samples collected at the base of excavation will not be able to be collected over a prolonged period of time as the excavated material will be re-instated once remediation/ validation is complete.

The methodology generally follows United States Environmental Protection Agency (USEPA) "Guidance for Measurement of Gaseous Emission Rates from Land Surfaces Using an Emission Isolation Flux Chamber" (USEPA 1986 and Reinhart 1992). This method is applicable to the measurement of air emission rates at the ground surface from undisturbed sites where contaminants have been released to the surface or subsurface (USEPA 1986). The static flux hood method is listed as the preferred testing technique for the direct measurement of VOC vapour emissions by the USEPA in the "Air/Superfund Technical Guideline Series" (USEPA 1990) and it is also included by the NSW EPA (now known as the Department of Environment and Conservation, DECC) as test method OM-8 on the list of "Approved methods for the sampling and analysis of air pollutants in New South Wales" (NSW EPA 2005).

The full analytical suite identified below (**Section E.4**) requires the collection of a sample in two different sampling media. Samples at each location are to be collected onto a Summa Canister and charcoal tube (SKC 226).

The Summa Canister sample at each location is to be analysed for VOCs using the US EPA TO15 method. The Summa Canisters are to be 100% certified as clean, six litres in volume and fitted with a dedicated two hour regulator.

The charcoal tube (SKC 226) sample at each location is for the analysis of semi volatile organic compounds (SVOCs) and total petroleum hydrocarbons (TPH) listed in **Section E.4** below. Two charcoal tubes are to be collected at each location, the second tube is analysed if concentration is higher than expected in the original sample which would lead to tube saturation or an exceedence of instrument calibration. It is anticipated that the sampling rate would be approximately 2 L/min for a sixty minute period.

¹ Disturbed material maybe sampled using the flux hood when investigating emission profiles for turned or disturbed material.

E.3 Analysis

Analysis of the sample collected in the Summa Canisters should be performed using USEPA TO-15 methodology using Gas Chromatography/ Mass Spectrometry (GC/MS) by a laboratory with appropriate quality control and accreditation. URS is not aware of any laboratory within Australia that conforms to the appropriate standard and can offer the extensive list of analytes which are analysed in accordance with standard methods recommended by the USEPA. An overseas laboratory will need to be sourced to supply the Summa Canisters and perform analysis. The analysis of Summa Canister samples reports a concentration in air as $\mu\text{g}/\text{m}^3$.

It is proposed that the following chemicals will be analysed for at the base of excavation and following completion of remediation and re-instatement of validated/remediate materials:

- VOCs (USEPA TO-15)
- Volatile TPH (C6-C9 and C10-C14) this will give an indication if there are any analytes which have not been targeted by the analytical lists in T0-15 and SVOC analysis. Positive results for TPH are used as a screen for the potential for non-target analytes covered by the laboratory which may be present
- Volatile SVOC compounds (listed below in E.5). Some of the COPC identified from investigations to date exhibit both volatile and semi-volatile properties and behaviour, hence appropriate sampling methods are required to enable accurate determination.

It is recommended that carbon SKC tubes are used for the collection of TPH and SVOC compounds. The analysis should be performed by a laboratory with appropriate quality control and accreditation. Australian (Sydney) based laboratories such as LabMark Pty Ltd (LabMark) have been used by URS for such analysis. The analysis of the charcoal tubes provides a measure of the total mass of each target chemical per tube. The concentration of the target chemicals in the sampled air is calculated from known, measured parameters (e.g. sample collection time and flow rate).

The emission rate of the target chemicals (collected using Summa Canisters and charcoal tubes) from the surface of the ground to the enclosed hood area is calculated using equations from USEPA methodology.

E.4 Sampling Frequency

URS recommends that the following flux emission sample collection regime as a minimum:

- One round of sampling at ten locations on the base of the CPWE excavation prior to reinstatement. It is noted that this sampling is likely to only occur during a single event prior to reinstatement of validated/remediated material,
- One round of sampling on the remediated material following its final placement on site at the following frequency:
 - The final reinstatement surface following backfilling of validated, treated materials. The CPWE excavation is to be sampled at a nominal 5 to 10 locations.
 - Material that is placed at other locations on site is to be sampled at a minimum of 2 samples at every location.
 - It is expected that requirements for any further sampling (should they be required) would be dependant on the outcome of the initial sampling round. This needs to be discussed and confirmed with the Auditor. Similarly sample numbers may change based on the area excavated and the size of the area covered with remediated material (or as agreed with the Auditor).

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E.5 Analytical List

URS recommends the following analytical list be used as a minimum for each sample:

Volatiles -	Semi volatile Organic Compounds (SVOCs)	Total Petroleum Hydrocarbons*
<p>The full USEPA TO15 list at low level detection. The full TO15 list contains 60 compounds care needs to be taken to ensure that the low level detection (0.1 - 0.5 ppbv) is available as a minimum on the following compounds:</p> <ul style="list-style-type: none"> - vinyl chloride - 1,1-dichloroethene - methylene chloride - <i>trans</i>-1,2-dichloroethene - chloroform - carbon tetrachloride - 1,2 dichloroethane (EDC)* - trichloroethene (TCE) * - 1,1,2-trichloroethane * - tetrachloroethene (PCE) * - 1,1,2,2-tetrachloroethane - hexachlorobutadiene (HCBD) * - <i>cis</i>-1,2-dichloroethene* - cumene - 1,2-Dibromo-3-chloropropane 	<p>A low limit of detection (0.5 –1 µg/tube) is required. Analytical list should include as a minimum:</p> <ul style="list-style-type: none"> - hexachloroethane (HCE) - hexachloropropene - hexachlorobuta-1,3-diene (HCBD) * - hexachlorobuta-1,2-diene * - hexachlorocyclopentadiene - pentachlorobenzene - hexachlorobenzene (HCB) * - octachlorostyrene * - pentachlorobutadiene# * - tetrachlorobutadiene# * 	<ul style="list-style-type: none"> - C₆-C₉ Fraction - C₁₀ - C₁₄ Fraction

* Current methodology is qualitative only.# Sampling and analytical methodology to be confirmed prior to sampling

The analytical list will need to be confirmed with the Contaminated Land Auditor prior to the commencement of sampling as a change in the analytical list may require a variation in sampling methodology.

E.6 Assessment

The analytical results will be assessed with respect to land use and exposure as identified in the derivation of the risk-based concentrations (RBCs).