Plates

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PHOTOGRAPHIC LOG

Client Name: Port Kembla Port Corporation	**Site Location:** Port Kembla Outer Harbour	**Project No.** S3017801

Photo No. 1	**Date:** 13 July 09

Direction Photo Taken:

East

Description:

Sediment Grab and Piston Core Sampling Vessel

Photo No. 2	**Date:** 7 July 09

Direction Photo Taken:

East

Description:

Piston Core Sampling Method and Equipment

PHOTOGRAPHIC LOG

Client Name: Port Kembla Port Corporation	**Site Location:** Port Kembla Outer Harbour	**Project No.** S3017801

Photo No. 3	**Date:** 7 July 09

Direction Photo Taken:

Above

Description:

Piston Core 1

Photo No. 4	**Date:** 7 July 09

Direction Photo Taken:

Above

Description:

Piston Core 1 Sub-sample PC1_0.0-0.3

PHOTOGRAPHIC LOG

Client Name: Port Kembla Port Corporation	**Site Location:** Port Kembla Outer Harbour	**Project No.** S3017801

Photo No. 5	**Date:** 13 July 09

Direction Photo Taken:

North-east

Description:

Sediment Grab Sampling Equipment

Photo No. 6	**Date:** 6 July 09

Direction Photo Taken:

Above

Description:

Sediment Grab Sample SG3

PHOTOGRAPHIC LOG

Client Name: Port Kembla Port Corporation	**Site Location:** Port Kembla Outer Harbour	**Project No.** S3017801

Photo No. 7	**Date:** 15 July 09

Direction Photo Taken:

West

Description:

Alkira Vibro-core Sampling Barge

Photo No. 8	**Date:** 15 July 09

Direction Photo Taken:

Above

Description:

Vibro-core 12 Sub-sample VC12_0.2-0.3

PHOTOGRAPHIC LOG

Client Name: Port Kembla Port Corporation	**Site Location:** Port Kembla Outer Harbour	**Project No.** S3017801

Photo No. 9	**Date:** 15 July 09

Direction Photo Taken:

Above

Description:

Vibro-core 12 Sub-sample VC12_2.1-2.2

Photo No. 10	**Date:** 14 July 09

Direction Photo Taken:

North-west

Description:

Surrounding Industrial Land use Port Kembla Outer Harbour, NSW

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Appendix A

Data Validation

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A1 INTRODUCTION

The following sections describe the components of the Quality Assurance and Control Plan that assess the achievement of the DQOs set out in Appendix A, by consideration of the data quality indicators – DQIs (precision, accuracy, reproducibility, completeness and comparability) .

A2 DATA QUALITY INDICATORS

The project DQIs have been established to set acceptance limits on field and laboratory data collected as part of this investigation. For both field and laboratory procedures acceptance limits are set at different levels for different projects and by the laboratories.

Non-compliances with acceptance limits are to be documented and discussed in the report. The DQIs are as follows:

DQI	Field	Laboratory	Acceptability Limits
Completeness	All critical locations sampled All samples collected (from grid and depth) SOPs appropriate and complied with Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed according to SAQP Appropriate methods Appropriate PQLs Sample documentation complete Sample holding times complied with	As per NEPC (1999) < nominated criteria As per NEPC (1999)
Comparability	Sample SOPs used on each occasion Experienced sampler Climatic conditions Same types of samples collected	Same analytical methods used (including clean-up) Sample PQLs (justify/quantify if different) Same laboratories (NATA accredited) Same units	As per NEPC (1999) < nominated criteria
Representativeness	Appropriate media sampled according to SAQP All media identified in SAQP sampled	All samples analysed according to SAQP	
Precision	SOPs appropriate and complied with Collection of blind and split duplicate samples	Analysis of: Blind duplicate samples (1 in 10 samples) Split duplicate samples (1 in 20 samples) Laboratory duplicate samples Laboratory prepared trip spikes (1 per/day)	 RPD of 30 to 50% RPD of 30 to 50% RPD of 30 to 50% Recovery >90%

DQI	Field	Laboratory	Acceptability Limits
Accuracy	SOPs appropriate and complied with Collection of rinsate blanks	Analysis of: Field/trip blanks (1/day) Rinsate blanks (1/day/equipment) Method blanks Matrix spikes Matrix spike duplicates Surrogate spikes Laboratory control samples Laboratory prepared spikes Reagent blanks Reference materials	 Non-detect for CoC Non-detect for CoC Non-detect for CoC 70 to 130% RPD of <30% 70 to 130% 70 to 130 % 70 to 130% Non-detect for CoC Varies

All reporting must comply with NSW EPA (1997) *Guidelines for Consultants Reporting on Contaminated Sites*.

A3 FIELD QA/QC

A3.1 Sampling Team

Fieldworks were undertaken between 6 and 16 July 2009, by suitably qualified and experienced AECOM Environmental Scientists in accordance with the SAQP (AECOM, 2009).

A3.2 Sample Collection

Samples were collected in general accordance with the SAQP and are described in the below table.

Sample Type	Description of Methodology
Surface Sediment Grab Samples	Surface grab samples were collected from the top 5 cm layer of sediments using a Smith McIntyre Grab. The samples were homogenised and subsamples were placed into laboratory supplied sampling jars. Sample jars were labelled with the sample location,'SG01', sampling date and job reference number.
Piston Core Samples	Sediment cores were collected using manually-driven piston coring device with 80 mm ID polycarbonate barrels. Cores were logged and samples were collected using a decontaminated trowel or spatula and immediately placed into laboratory supplied sampling jars and were labelled with the location and sample depth range (ie. PC01_0.5-0.6), date and job reference number.

Vibrocore Samples	The vibrocore was operated from a barge and used steel barrels to penetrate the cap surface of the underwater emplacement area. Cores were typically collected within 3 m of the proposed sampling coordinate and the actual GPS location of the sample recorded.
Harbour Water Sampling	Samples were collected directly from beneath the water surface into laboratory-supplied preserved containers and decanted into appropriate laboratory-supplied preserved containers. Samples requiring field filtration were filtered through dedicated 0.45 µm disposable Stericup® filters. Samples were filled to minimise the amount of headspace in the sample containers.
Elutriate Water	Seawater was collected from the harbour in unused rinsed 20L jerry cans and submitted with each batch requiring elutriate analysis to the laboratory.

A3.3 Sample Handling and Preservation

For sediment sampling, a new pair of disposable nitrile sampling gloves was donned between each sampling location and depth. Sediment samples were placed immediately into laboratory prepared and supplied, acid washed and solvent jars with screw top Teflon-lined lids.

Sediment samples were placed either in a chilled, insulated container with ice or in a sample refrigerator between sampling and analysis. Samples were preserved for the various contaminants of concern in accordance with the requirements of NEPC (1999) as detailed in the table below:

Matrix	Analyte	Container	Preservation
Soil	All analytes	250 mL Glass screw top jar	Unpreserved, 4°C
Water	Metals	250 mL Plastic	Filtered in the field, HNO3, 4°C
	VOCs	40 mL Vial	HCl, 4°C
	SVOCs	1 L Amber glass (zero headspace)	HCl, 4°C
	Free Cyanide	250 ml White Plastic	NaOH + $Cd(NO_3)_2$, 4°C
	TSS/TDS	1L Plastic	Unpreserved, 4°C

Sample numbers, depths, preservation and analytical requirements were recorded on the chain-of-custody documentation (signed copies provided with the laboratory reports in Appendix D), which accompanied the samples to the laboratory.

A3.4 Calibration

During the field investigation calibration of the photoionisation detector (PID) was undertaken in accordance with manufacturer's instructions. The PID was calibrated prior to delivery by the supplier, and at least once daily (at the start of each sampling day) with 100 ppm of isobutylene. All calibration results were satisfactory. Details of calibration are provided in Appendix C.

A3.5 Field Blind and Split Duplicate Samples

The purpose of duplicate samples are to estimate the variability of a given characteristic or contaminant associated with a population. For this investigation, blind (intra-laboratory) duplicate soil and groundwater samples were collected in the field at a rate of at least one in ten primary samples. Split (inter-laboratory) duplicate soil and groundwater samples were collected at a rate of at least one in twenty primary samples.

The field duplicated soil samples were obtained from similar soils of an identical depth and immediately adjacent to the primary sample by placing approximately equal portions of the primary sample into two sample jars. Groundwater duplicates were collected by carefully decanting approximately equal portions of the primary sample into two sample containers.

Duplicate samples were labelled so as to conceal their relationship to the primary sample from the laboratory and the key to the duplicate samples was recorded in the field note book.

It is common that significant variation in duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity or low reported concentrations near the LOR. The overall precision of field duplicates, laboratory split samples and laboratory duplicates is generally assessed by their Relative Percent Difference (RPD), given by:

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

where D1 is the primary sample measurement

D2 is the duplicate sample measurement

RPDs for duplicate samples have been compared to criteria presented in the DQI table above and exceedences are presented below:

Sample Pair	Duplicate Type	Analytes	Exceedences
DUP01/HS-L-01 (water)	Blind	M(13)/TOC/PAH/BTEX/TPH/TSS/TDS	TSS (120%)
TRIP01/HS-L-01 (water)	Split	M(13)/TOC/PAH/BTEX/TPH/TSS/TDS	TSS (133%), Cu (67%)
DUP01/SG3	Blind	M(13)/TOC/PAH/SPOCAS	Coronene (86%), dibenzo(a)anthracene (62%)
TRIP01/SG3	Split	M(13)/TOC/PAH/BTEX/TPH	Coronene (67%)
DUP02/SG20	Blind	M(13)	Nil
DUP03/SG21	Blind	M(13)	Cd (156%), Cr (126%), Co (71%), Pb (72%), Hg (64%), Ag (77%), V (82%), Zn (139%)

DUP04/PC22_0.3-0.5	Blind	M(13)/TBT/phenols/OCP/PCBs	Sb (183%), As (131%), Cd (127%), Cu (76%), Pb(164%), Ni (77%), Se (74%), Ag (127%), Zn (106%)
DUP05/PC3_0.3-0.75	Blind	M(13)/TBT/Phenols/ OCP/PCBs	Nil
DUP06/PC27_0.0-0.5	Blind	M(13)/TOC/PAH/BTEX/TPH	Nil
TRIP03/PC27_0.0-0.5	Split	M(13)/TOC/PAH/BTEX/TPH/TBT	Nil
DUP07/PC7_0.0-0.2	Blind	M(13)	Cr (58%)
DUP08/PC25_0.0-0.35	Blind	M(13)/TOC/PAH/BTEX/TPH	Cd (63%), Hg (67%)
TRIP05/PC25_0.0-0.35	Split	M(13)/TOC/PAH/BTEX/TPH/TBT/CN	Cd (51%), Cu (62%), Hg (81%)
DUP09/PC13_0.4-0.76	Blind	M(13)/CN	Cd (71%), Cr (68%), Cu (107%), Pb (55%), Hg (67%), Ag (93%)
TRIP06/PC13_0.4-0.76	Split	M(13)/CN	Cd (148%), Ag (93.3%)
DUP11/PC53_0.0-0.19	Blind	M(13)/CN/TBT	As (51%), Cu (58%)
TRIP08/PC53_0.0-0.19	Split	CN/TBT/M(13)	Nil
DUP12/PC62_0.0-0.59	Blind	M(13)/TOC/TBT/PAH/BTEX/TPH	Ag (32%)
TRIP09/PC62_0.0-0.59	Split	M(13)	Ag (82%), V
DUP13/PC42_0.0-0.5	Blind	M(13)/TBT/Phenols/PCBs/ OCPs	Nil
DUP15/PC63_0.5-1.05	Blind	M(13)/PCBs/OCP/Phenols	Nil
TRIP12/PC63_0.5-1.05	Split	M(13)/CN/Phenols/PCBs	Ag (55.3%)
DUP16/PC38_0.4-0.8	Blind	M(13)/TOC/PAH	As (60%), Cd (129%), Cu (53%), Ag (52%), Zn (52%)
DUP17/PC41_0.0-0.5	Blind	M(13)	Nil
TRIP10/PC41_0.0-0.5	Split	M(13)/Phenols/PCBs/OCPs /TBT	Cd (52%)
DUP21/VC2_0.7-0.8	Blind	M(13)/TOC/PAH	Cd (150%), Cr (75%), Cu (65%), Pb (99%), Zn (91%)
DUP25/VC5_0.5-0.6	Blind	M(13)/TOC/PAH/BTEX/TPH	Cu (70%), Ag (67%)
TRIP17/ VC5_0.5-0.6	Split	M(13)/TOC/PAH/BTEX/TPH	Cu (80.5%), Pb (51.5%), Au (67%)

DUP27/VC7_0.7-0.8	Blind	M(13)/TOC/PAH/Phenols/PCBs/OCPs	Cr (81%), Pb (142%), Zn (158%)
DUP28/VC8_0.5-0.6	Blind	M(13)/TOC/PAH	Cd (67%), Cr (61%), Pb (57%), V (102%), Zn (59%)
TRIP15_VC8_0.5-0.6	Split	M(13)/TOC/PAH	Cd (67%), Co (52%), Cu (78%), Pb (51%), Ag (67%), Zn (54%)
DUP29/VC09_0.7-0.8	Blind	M(13)/TOC/PAH	Nil
TRIP16/VC09_0.7-0.8	Split	M(13)/TOC/PAH	2-methylnapthalene (95.1%), Acenaphthylene (100%), Acenaphthylene (68%), Anthracene (79%), Benz(a)anthracene (61%), Benzo(a)pyrene (65%), Chrysene (77%), Dibenz(a,h)anthracene (124%), Fluuoranthene (61%), Indeno(1,2,3-c,d)pyrene 58%), naphthalene (62%), perylene (64%), Phenanthrene (80%), pyrene (54%), total PAHs (65%), Ag (67%), V (98%)

Notes: M(13): Metals (antimony (Sb) , arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), cobalt (Co), lead (Pb), nickel (Ni), selenium (Se), silver (Ag), vanadium (V), zinc (Zn)).TBT: Tributyltin. TOC: Total Organic Carbon. CN: Cyanide. PAH: Polycyclic Aromatic Hydrocarbons. PCBs: Polychlorinated Biphenyls. TPH: Total Petroleum Hydrocarbons. BTEX: Monocyclic Aromatic Hydrocarbons (benzene, toluene, ethylbeznzene and xylenes). OCPs: Organochlorine Pesticides. TSS: Total Suspended Solids. TDS: Total Dissolved Solids.

The majority of the exceedences listed in the above table are likely attributed to the heterogeneous nature of the sediment samples, rather than laboratory precision.

The actual blind (intra-laboratory) duplicate sample frequency for this investigation was 10% (i.e. 1 duplicate samples per 10 primary samples). The actual split (inter-laboratory) duplicate sample frequency for this investigation was 6% (i.e. 1 duplicate sample per 20 primary samples).

A3.6 Decontamination and Rinsate Blanks

The Sampling equipment (sampling trowel and sampling spoon) were cleaned in phosphate free detergent (“Decon” 90) solution, rinsed in potable water and then finally rinsed in laboratory supplied water prior to use and between each sampling location.

Rinsate blanks are collected from the final rinse water off equipment that has been field cleaned. During the sampling program, a new pair of disposable nitrile gloves was used for the collection of discrete samples to reduce potential for transfer of contaminants between samples.

Seven rinsate blank samples were collected using laboratory supplied rinse water, which was run over a decontaminated piece of sampling equipment at the end of each day of fieldwork. These samples were used to evaluate whether contaminants were likely to have been introduced by contact of the sample medium with sampling equipment.

The following equipment blank samples were collected and analysed:

Rinsate Sample	Date	Equipment	QC Description	Results
RB01	6/07/09	Sampling trowel	Collected by pouring laboratory supplied D.I. water over decontaminated sampling trowel into sample bottles	All <LOR
RB02	7/07/09	Sampling trowel	Collected by pouring laboratory supplied D.I. water over decontaminated sampling trowel into sample bottles	All <LOR
RB01	13/07/09	Sampling spoon	Collected by pouring laboratory supplied D.I. water over decontaminated sampling spoon meter/dipper into sample bottles	All <LOR
RB02	14/07/09	Sampling spoon	Collected by pouring laboratory supplied D.I. water over decontaminated sampling spoon meter/dipper into sample bottles	All <LOR
RB03	15/07/09	Sampling spoon	Collected by pouring laboratory supplied D.I. water over decontaminated sampling spoon meter/dipper into sample bottles	All <LOR
RB04	16/07/09	Sampling spoon	Collected by pouring laboratory supplied D.I. water over decontaminated sampling spoon meter/dipper into sample bottles	All <LOR
RB05	10/07/09	Sampling trowel	Collected by pouring laboratory supplied D.I. water over decontaminated sampling spoon meter/dipper into sample bottles	All <LOR

Analytes were not detected at concentrations greater than the LOR indicating that decontamination procedures used were adequate.

A3.7 Trip Blanks and Trip Spikes

A trip blank assesses the potential for cross contamination between during transit from the investigation site to the laboratory. Samples are typically analysed for the same contaminants targeted as part of the investigation.

A trip spike assesses for the potential of loss of volatile constituents from both soil and groundwater samples whilst in transit from the investigation site to the laboratory. The spike sample is prepared by the laboratory, transported to the investigation site under COC protocol and returned to the laboratory with the primary samples being submitted for analysis. Trip blank and trip spike samples were not utilised for this investigation.

A4 LABORATORY QA/QC

A4.1 Analytical Laboratory

Samples were submitted to the following laboratories:

- ALS in Smithfield, NSW (primary laboratory);and
- ALS in Stafford, QLD (secondary laboratory);

The ALS NATA accreditation number is 825, and its analytical procedures are based on established internationally-recognised procedures such as those published by the US EPA, APHA, AS and NEPM (1999). In house procedures are employed by ALS in the absence of documented standards.

A4.2 Analytical Methods

The laboratory analysis methods are provided on the laboratory certificates in Appendix G and summarised below:

Sediment Analysis

Analysis	Reference method	Limit of Reporting for Sediments (mg/kg)	Assessment Criteria (mg/kg)
ICP/MS: Total Metals Sb, Cd, Cr, Cu, Pb, Ni, Ag, Zn, Co, V, Se, As (incl. digest)	USEPA 6020	Ag, Cd, Se – 0.1 Co, Sb - 0.5 V - 2, Mn – 10 Al, Fe – 50 Others - 1	1 – 600 000
Mercury - total recoverable (incl. digest)	APHA 3112 Hg-B CV/FIMS/ICPMS	0.1	0.15-75
TOC (Leco)	ALS In-house/Leco	0.02%	-
PAHs – ***Ultra trace*** - *(24 analytes):*	USEPA 3640/8270 GC/MS-SIM	0.01-0.1 (10-100 µg/kg)	0.044 - 100
TPH(C6-C36)/BTEX	GC/FID, P&T-GC/MS	10-100/0.2-0.5	65/1-14
SPOCAS Suite – *Complete*	AS4969	Various	-
Cyanide - Total	APHA 4500-CN^- C&N	1	25-2 500
Organo Tins (TBT)	*In-House* GC/MS	0.5 µg Sn/kg	5.0-70 µg Sn/kg
Phenols *(12 analytes)*	GC/MS - SIM	0.5-2	42 500
OC Pesticides – ***Ultra trace*** (21 analytes)	USEPA 3640/3620 USEPA8081/8082 GPC/Florisil/GCµECD	0.0005 (0.5 µg/kg)	20-250
PCBs Total – ***Ultra trace***	USEPA 3640/3620 USEPA8081/8082 GPC/Florisil/GCµECD	0.005 (5 µg/kg)	0.023-50
TCLP Analysis Non volatiles			

Analysis	Reference method	Limit of Reporting for Sediments (mg/kg)	Assessment Criteria (mg/kg)
PAHs – ***Ultra trace*** - *(24 analytes):*	USEPA 3640/8270 GC/MS-SIM	0.05-0.1 mg/L	0.04 – 0.16 mg/L
ICP/AES: Total Metals Sb, Cd, Cr, Cu, Pb, Ni, Ag, Zn, Co, V, Se, As (incl. digest)	USEPA 6010 ICP/AES	0.05-0.1 mg/L	1-20 mg/L
Mercury - total recoverable (incl. digest)	APHA 3112 Hg-B CV/FIMS/ICPMS	0.001 mg/L	0.2-0.8 mg/L

Elutriate Analysis

Analysis	Reference method	Limit of Reporting (mg/L) (or as indicated)	Assessment Criteria
Preparation of elutriates from marine sediment – PAH and Metals	Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Guide, 1991, EPA-503/8-91/001, USEPA and US Army Corps of Engineers. National Ocean Disposal Guidelines for Dredged Material, 2002. (NODG)	N/A	N/A
PAHs – *Ultra trace* - *(24 analytes)*	USEPA 3640/8270 GC/MS-SIM	0.00005 -0.1	0.0004-0.07
Total Metals by ORC-ICPMS (Ag, Cd, Se, Co, Sb, Cu, Pb, Zn, Cr, Ni, As, V)	USEPA 6020 Mod. ORC-ICPMS	0.0001 – 0.01	0.001-0.27
Mercury - total recoverable (incl. digest)	APHA 3112 Hg-B CV/FIMS/ICPMS	0.0001	0.0004

Harbour Water Analysis

Analysis	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Assessment Criteria
Solids: Suspended (TSS) – Low level	APHA 2540 D	1	-
Solids - Total Dissolved (TDS) – Low level	APHA 2540 C	1	-
Cyanide – Free	APHA 4500-CN^- C&N	0.004	-

Analysis	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Assessment Criteria
OC Pesticides – ***Ultra trace*** (21 analytes)	USEPA 3640/3620 USEPA8081/8082 GPC/Florisil/GCμECD	0.005-0.01	0.008 -0.01 µg/L
PAHs – ***Super Ultra trace -*** *(16 analytes):*	USEPA 3640/8270 GC/MS-SIM	0.005-0.1	0.0002-0.07
Phenols – ***Ultra trace -*** *(16 analytes)*	USEPA 3640/8270 GPC-GC/MS-SIM	0.05-1	0.4
PCB - Total - Standard level	USEPA 3510/8270 GC/ECD/ECD/ MS	1	-
Ultra trace ORC: Total Metals in Saline Water Sb, Cd, Cr, Cu, Pb, Ni, Ag, Zn, Co, V, Se, As (incl. digest)	ORC/ICP/MS Octopole Reaction Cell (APHA 3125B)	Ag, Be, Bi, Mo, Th, Tl, U (0.1); Cd, Co & Pb (0.2); As, Cr, Mn, Ni, Sb, Te, V (0.5); Ba, Cu, Li(1); Se(2); Fe, Sn, Ti, Zn(5); Al, Sr (10); B (100)	0.001-0.27
Mercury - total recoverable (incl. digest)	APHA 3112 Hg-B CV/FIMS/ICPMS	0.0001	0.0004

A4.3 Laboratory (Method) Blanks

Laboratory or control blanks consist of reagents specific to each individual analytical method and are prepared and analysed by laboratories in the same manner as regular samples. The preparation and analysis of laboratory blanks enables the measurement of contamination within the laboratory.

Laboratory blanks are typically analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

Review of the laboratory QA/QC reports indicated that the results for all method blanks were below the laboratory detection limit, with the exception of lab sample 1202139-001, which reported a concentration of 0.1 mg/kg of silver in ALS Sydney Batch ES0910562.

As the detection of silver in the method blank was very low (equal to the LOR) it is not considered to significantly affect the quality of the data.

A4.4 Laboratory Duplicates

Laboratory duplicate samples are prepared in the laboratory by splitting a field sample and analysing it as two independent samples. The analysis of laboratory duplicate samples provides an indication of analytical precision and may be influenced by sample heterogeneity. The laboratory duplicate RPDs are used to assess laboratory precision.

Laboratory duplicates are typically analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

Review of the laboratory QA/QC reports indicated that the RPDs for all laboratory duplicate samples ranged from 0% to 114 % and were within the acceptance criteria, with the exception of the following samples listed below.

Soil Matrix

- Laboratory batch ES0909938: Lab sample ES0909938-001 (SG1) reported an RPD of 40% for PAH compound Coronene
- Laboratory batch ES0910122: Lab sample ES0910122-001 (PC20_0.0-0.17) reported an RPD of 114% for tributyltin (TBT)
- Laboratory batch ES0910203: Lab sample ES0910203-001 (PC63_0.0-0.5) reported elevated RPDs for nickel (71%), vanadium (64.6%), 2-Methylnapthalene (45.1%) and naphthalene (40%)
- Laboratory batch ES0910122: lab sample ES0910122-001(PC20_0.0-0.17) reported an RPD for Tributyltin of 114%
- Laboratory batch ES0910405: lab sample ES0910562-049 reported an RPD of 73.1% for vanadium and lab sample ES0910405-004 (SG12_0.0-0.04) reported elevated RPDs for benz(a)anthracene (37.4%), benzo(b)fluoranthene (41.8%), benz(a)anthracene (37.4%), benzo(b)fluoranthene (41.8%), benzo(e)pyrene (31.3%), benzo(g.h.i)perylene (32.1%), coronene (35%), chrysene (37.8%), fluoranthene (34.1%), indeno(1.2.3.cd)pyrene (65.8%), pyrene (32.6%)
- Laboratory batch ES0910562: Lab sample ES0910562-001 (VC1) reported an RPD of 34.2% for copper, lab sample ES0910562-011 (VC3) reported an RPD of cadmium of 45.2% and lab sample ES0910562-049 (DUP28) reported an RPD for vanadium of 73.1

The above RPD exceedences in the soil laboratory duplicate samples are likely to be attributed to sample heterogeneity rather than laboratory precision.

Elutriate Matrix

- Laboratory batch ES0910405: Lab sample ES0910408-004 (SG28_0.0-0.01) reported an RPD of 51.8% for lead.

The RPD exceedance in the above water sample was not significantly greater than upper acceptance RPD limit of 50% (results less than 10 times the LOR) and is likely attributed to low concentrations of the analyte (0.7 and 0.4 µg/L).

A4.5 Laboratory Control Samples

Laboratory control samples (LCS) or Quality Control check samples are prepared within the laboratory by spiking an aliquot of an appropriate clean matrix reagent with known concentrations of specific analytes. The LCS sample is then analysed and the results are used to assess the laboratory performance on sample preparation and analysis procedure. Certified reference material may also be used to assess analytical accuracy independent of the investigations. Accuracy is assessed by calculation of percent recovery.

LCSs are typically analysed at a frequency of 1 in 20, with a minimum of one analysed per analytical batch.

Review of the laboratory QA/QC reports indicated that the percent recoveries for laboratory control samples ranged from 18.2% to 138%and were within the DQI acceptance criteria of 70-130% or the laboratory analyte specific acceptance criteria, with the exception of the following:

Soil Matrix

- Laboratory batch ES0909939: LCS recoveries for PAH compounds benzo(g,h,i)perylene (55.8%), dibenzo(a,h)anthracene (61.3%) and indeno(1,2,3.cd)pyrene (51.3%) were less than the lower recovery limit in water sample 1187927-002
- Laboratory batch ES0909954: LCS recovery for PAH compound N-2-Fluorenyl Acetamide (43.4%) was less than the lower recovery limit in soil sample 1187927-002
- Laboratory batch ES0910203: LCS recovery for PAH compound N-2-Fluorenyl Acetamide (47.5%) was less than the lower recovery limit in soil sample 1193014-002
- Laboratory batch ES0910405: LCS recovery for Total PCBs (135%), 2-Nitrophenol (27.1%) and 4-Nitrophenol (32.3%) were outside the LCS acceptable recovery limits in water sample 1202049-002
- Laboratory batch ES0910408: LCS recovery for PAH compound N-2-Fluorenyl Acetamide (46.5%) in elutriate lab sample 1205006-002 was below the lower recovery limit

Laboratory control sample recovery for exceedences were infrequent, with five samples reporting poor recoveries for either PAH or PCBs out of 238 LCS samples analysed for PAH and PCBs by the primary laboratory. Therefore the very low rate of DQI exceedences (<2%) indicate that the laboratory sample preparation and analysis procedure was considered acceptable.

A4.6 Matrix Spikes

Matrix spikes are samples prepared within the laboratory by dividing a field sample into two aliquots, then spiking each with identical concentrations of the analytes. The matrix spike and matrix spike duplicate are then analysed separately and the results compared to determine the effects of the sample matrix on the accuracy and precision of the analytes. Accuracy is assessed by the calculation of the percent recovery.

Review of the laboratory QA/QC reports indicated that the percent recoveries for matrix spike samples ranged from 5.3% to 146% and were either within the DQI acceptance criteria of 70 to 130% or within the laboratory analyte specific acceptance criteria, with the exception of the following listed below.

Soil Matrix Exceedences

- Laboratory batch ES0909938: Matrix spike recovery for PAH compound benzo(e)pyrene (136%) in lab sample ES0909938_001 (SG1) exceeded the upper control limit
- Laboratory batch ES0909950: Matrix spike recovery for PAH compound pyrene (131%) in sample (PC30_0.3-0.68) exceeded the upper control limit
- Laboratory batch ES0909954: numerous PAH and OCP compounds matrix spike recoveries could not be determined due to matrix interference. This was confirmed by re-extraction and re-analysis by the analysing laboratory. Zinc and lead matrix spike recoveries could also not be determined due to significant background concentrations in the sample.
- Laboratory batch ES0909955: Matrix spike recoveries for PAH compounds Coronene (29%) and Dibenz(a,h)anthracene (19.1%) in lab sample ES0909955_024 (anonymous) were less than the lower recovery limit.
- Laboratory batch ES0910203: Matrix spike recoveries for anthracene (146%), benzo(k)fluorathene (36.7%) and dibenz(a.h)anthracene (30.4%) were outside the recovery limits in sample ES0910203-001 (PC63_0.0-0.5). Another 15 compounds in sample could not be determined due to matrix interference.
- Laboratory batch ES0910203: Matrix spike recoveries for 2-chlorophenol (5.3%) and 4-Chloro-3-Methylphenol (34.9%) were less than the lower control limits in sample ES0910110-001 (anonymous). Matrix spikes for Phenol, 2-Nitrophenol and Pentachlorophenol in the same sample could not be determined due to matrix interference. This was confirmed by re-extraction and re-analysis by the laboratory.
- Laboratory batch ES0910405: Matrix spike recovery for anthracene (131%) was greater than the upper control limit. Several other PAH compounds recoveries were not determined due to matrix interference
- Laboratory batch ES0910562: Matrix spike recoveries for chrysene (54.4%), fluoranthene (37.9%) and pyrene (45%) in sample ES0910562-046 (DUP25) were below the lower recovery limit
- Laboratory batch EB0910858: Matrix spike recoveries for anthracene (25.7%), benzo(e)pyrene (38.4%), benzo(k)fluoranthene (34.1%), fluorene (39.4%), indeno(1.2.3.cd)pyrene (24.7%) and perylene (36%) were below the lower recovery limit in sample EB0910858-001 (TRIP01)

- Laboratory batch EB0911461: Matrix spike recoveries for vanadium and zinc could not be determined due to significant background concentrations in sample EB0911461-002 (PC53)
- Laboratory batch EB09111142: Matrix spike recoveries were outside the recovery limits in the following samples:
  - EB09111142-002 (TRIP10): TPH C_6-C_9 fraction (49%) recovery was below the lower recovery limit due to matrix interference caused by high moisture content;
  - EB09111142-005: delta-BHC (21.1%), trans-Chlordane (38.7%) and aroclor 1254 (37.7%) recovery was below the lower recovery limit;
  - EB09111142-003 (TRIP05): Chrysene (37.4%), coronene (5.3%), perylene (22.9%) and 4-Bromofluorobenzene (60.9%) recoveries were below the lower recovery limits
  - EB09111142-004 (TRIP03): Recovery of 4-Bromofluorobenzene (62.4%) was below the lower recovery limit

Water and Elutriate Matrix Exceedences

- Laboratory batch ES090910121: Matrix Spike recovery for PAH compound 2-Methylnapthalene (133%) in sample elutriate ES0910121-007 (PC9_0.8-1.12) was greater than the upper control limit
- Laboratory batch ES0910405: Matrix Spike recoveries for fluoranthene (69.1%), benz(a)anthracene (62.8%), benzo(a)pyrene (66.5%), indeno(1.2.3.cd)pyrene (65.5%), dibenz(a.h)anthracene (62%) and benzo(g.h.i)perylene (68%) in water sample ES0910405-022 (HS-L-02) were below the lower control limit

The above exceedences indicate that matrix interference and significant background concentrations were resulting in poor recovery of PAH compounds in some samples, rather than poor laboratory accuracy. Laboratory accuracy was considered acceptable based on the LCS recovery results discussed in section E4.5.

A4.7 Surrogates

Surrogates are compounds which are similar to the organic analytes of interest in chemical composition, extraction, and chromatographic behaviour, but which are not normally found in field samples. Surrogates are generally spiked into all sample aliquots prior to preparation and analysis by chromatogaphic methods. Percent recoveries are calculated for each surrogate, providing an indication of analytical accuracy. US EPA methodology (SW – 846) requires that surrogate testing be performed whenever analysing by Gas Chromatography or HPLC.

Review of the laboratory reports indicated that the percent recoveries for surrogated ranged from 10.4% to 152% and were either within the DQI acceptance criteria of 70 to 130% or within the laboratory analyte specific acceptance criteria, with the exception of the following listed below.

- Laboratory report ES0909940: TBT surrogate recovery for tripropyltin in sample SG2 (26.1%) was below the lower recovery limit due to matrix interference. Confirmed by re-extraction and re-analysis
- Laboratory report ES0909946: TBT surrogate tripropyltin recovery in samples PC2_0.0-0.3 (30%), PC3_0.0-0.3 (31%), PC4_0.0-0.33 (27.4%), PC7_0.0-0.2 (21.8%), PC32_0.0-0.23 (23.8%), PC17_0.0-0.7 (25.1%) and

PC30_0.0-0.3 (27%) was below the lower control limit due to matrix interference (was confirmed by re-extraction and re-analysis)

- Laboratory report ES0909947: TBT surrogate tripropyltin recovery in sample PC33_0.0-0.2 (31.7%) was below the lower control limit
- Laboratory report ES0909954: OCP and PCB surrogates not determined due to matrix interference
- Laboratory report ES0910122: TBT surrogate tripropyltin recoveries in samples PC29_0.0-0.45 (25.1%), DUP06 (30.80%), PC26_0.0-0.5 (28.7%), PC8_0.0-0.35 (28%), PC9_0.0-0.4 (26.3%), PC36_0.0-0.16 (29%), PC36_0.0-0.37 (19.1%), PC38_0.0-0.4 (33.5%), PC40_0.0-0.5 (29.9%), PC25_0.0-0.35 (33.40%), PC24_0-0.23 (28.30%), PC55_0.0-0.3 (22.3%), PC45_0.0-0.5 (23.0%), PC43_0-0.35 (17.4%), DUP13 (16.2%) and PC14_0.0-0.36 (14.9%) were below the lower control limit. Matrix interference was confirmed by re extraction & re analysis.
- Laboratory report ES0910204: TBT surrogate tripropyltin recovery in samples PC54_0.0-0.3 (12.6%), PC56_0.0-0.42 (26.7%), PC62_0.0-0.59 (23.8%), DUP12 (10%) and PC64_0.0-0.25 (25.6%) was below the lower recovery. Matrix interference was confirmed by re extraction & re analysis
- Laboratory report ES0910405: Base/Neutral extractable surrogate 2-Fluorobiphenyl (25.4%) recovery was below the lower recovery limit

The majority of surrogate exceedences were for tripropyltin which is a surrogate for TBT. Since there were no corresponding exceedences for TBT in LCS samples the poor tripropyltin recoveries are attributed to matrix interference and was confirmed by the laboratory by re extraction & re analysis of the samples.

All other exceedences are not considered to affect the quality of the data.

A4.8 Holding Times

NEPC (1999), APHA 20th Edition and AS2031.1-1986 present recommended holding times for various analyses (under specified conditions, for example below 4°C in an airtight container), which must be met in order to consider the results valid. The holding times may vary slightly depending on the document referenced.

Review of the chain-of-custody documentation and the laboratory reports indicated that the holding time have been met for all analyses as per the table below:

Analyte	Matrix	Recommended Maximum Holding Time	Compliance
Metals (13)	Soil / Water	6 months	Yes
Mercury	Soil / Water	28 days	Yes
TPH C6-C9	Soil / Water	14 days / 7 days	Yes
BTEX	Soil / Water	14 days / 14 days (with HCl)	Yes
SVOCs (PAHs,TPH C10-C36,OCPs,OPP,PCBs,TBT)	Soil / Water	14 days / 7 days	Yes
SPOCAS	Soil	24hr (4°C)/6 months (frozen)	Yes

Analyte	Matrix	Recommended Maximum Holding Time	Compliance
Asbestos	Soil	NA	NA

Notes:

A5 DATA VALIDATION

The overall assessment of the quality of the data obtained during this investigation is discussed below in terms of the data quality indicators provided above.

Non-compliances are to be documented and discussed in the report. The DQIs are as follows:

DQI	Description	Compliance
Completeness	Completeness is a measure of the amount of usable data (expressed as %) from a data collection activity.	The completeness of data is defined as the percentage of analytical results that are considered valid. Valid chemical data are values that have been identified as acceptable or acceptable as qualified during the data validation process. The completeness is a comparison of the total number of samples accepted against the total number of samples, calculated as a percentage. The project goal for completeness is 95%. Completeness also includes checking that all entries in the data tables are correct, properly entered, and that any typographical errors are corrected and the data are re-entered properly, as required. All samples collected and analysed complied with the DQOs and DQIs, as such the data obtained is considered to be sufficiently quantitative and complete for the purposes of this investigation (i.e. >95%)
Comparability	Comparability is the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.	Comparability expresses the confidence with which one data set can be compared with another. In order to assess comparability, field sampling procedures, laboratory sample preparation procedures, analytical procedures, and reporting units must be known and similar to established protocols, as was the case during this investigation. Qualitatively, data subjected to strict QA/QC procedures will be deemed more reliable, and therefore more comparable, than other data. The sampling was conducted by an AECOM environmental scientist in accordance with the sampling and analysis procedures described in the SAP. Each analyte was analysed by the same analytical laboratory using identical methods, and laboratory LORs were consistent over each laboratory batch. Additionally, a check laboratory was used to assess variability between laboratories. Based on the above, the data obtained throughout the investigation is considered to be suitably comparable.

DQI	Description	Compliance
Representativeness	Representativeness is the confidence (expressed qualitatively) that data are representative of each media present on the site.	Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of parameter variations at sampling points or environmental conditions. Sample representativeness is controlled through selecting sampling locations that exemplify site conditions and obtaining suitable samples from these sites. Sample selection and analysis was conducted in order to meet the specific objectives of the project. Analysis for the contaminants of concern was selectively conducted on soil and water samples as indicated in analytical tables. Based on the sampling and analytical regime undertaken by AECOM, the results obtained are considered to be sufficiently representative of the subsurface conditions at the locations tested.
Precision	Precision is a quantitative measure of the variability (or reproducibility) of data.	All work was conducted in accordance with AECOM's documented SOPs. Precision or variability of the data was assessed by determining RPDs between the original and duplicate samples analysed. Based on results discussed above, AECOM considers that the precision of the data is sufficient for the purposes of this investigation.
Accuracy	Accuracy is a quantitative measure of the closeness of reported data to the true value.	All work was conducted in accordance with AECOM's documented SOPs. Accuracy of the data was mainly assessed through review of the laboratory QA/QC results, though the rinsate blanks also contributed to the assessment of accuracy. Based on results discussed above, AECOM considers that the accuracy of the data is sufficient for the purposes of this investigation.

Based on an assessment of field and laboratory QA/QC data, the reported analytical results are considered, by achievement of the DQIs, to be reliable and representative of concentrations of the compounds analysed at the locations sampled.