Appendix A

Borelogs and Bore Search Results

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ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH01

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.1 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						GM	Compacted Gravel. Contains minor silt.	
						FILL	Silty Gravel (FILL); Light grey, fine to coarse grained, loose, dry. Contains small gravels (<10 mm). Contains minor very dry low plasticity clay. No odour, staining or fibre cement material noted.	0.10
0.4		BH01_0.2-0.4 QC100 QC101						
1.5		BH01_0.5-0.6	✳					
						FILL	Silty Clayey Gravel (FILL); Dark grey to black, medium to coarse grained, loose, dry. Contains ash, piece of glass (20 mm) and orange/brown gravels (20-40 mm). No odour or fibre cement material noted.	0.80
				1				
4.6		BH01_1.0-1.1						
3.4		BH01_1.4-1.5	✳					
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	1.50

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH02

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.0 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Clayey Gravel (FILL).	0.01
						FILL	Silty Clayey Gravel (FILL); Dark grey, fine to medium grained, loose, dry to slightly moist. Contains ash and small gravels (<10 mm). No odour, staining or fibre cement material noted.	
0.3		BH02_0.2-0.3	✳					
2.5		BH02_0.5-0.6						
								0.80
						FILL	Clayey Silty Sand (FILL); Brown, grey and dark grey, medium grained, loose. Contains minor ash, pieces of slag (10-30 mm) and traces of gravels (<5%) (<10 mm). No odour or fibre cement material noted.	
				1				
4.9		BH02_1.0-1.1	✳					
2.6		BH02_1.4-1.5						
								1.50
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH03

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.2 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Gravelly Sand (FILL).	0.01
3.1		BH03_0.2-0.3	✳			FILL	Silty Gravelly Sand (FILL); Dark grey/brown, medium to coarse grained, loose, dry. Contains minor small gravels (10%) (10-20 mm). No odour, staining or fibre cement material noted.	
								0.50
4.6		BH03_0.5-0.6 QC102				FILL	Silty Gravelly Sand (FILL); Dark grey/black, fine to medium grained, loose, dry. Contains ash and small gravels (20%) (<10 mm). No odour or fibre cement material noted.	
				1				1.00
5.1		BH03_1.0-1.1	✳			FILL	Silty Sand (FILL); Brown and dark grey, fine to medium grained, loose slightly moist. Contains minor ash and trace small gravels (<5%) (<10 mm). No odour or fibre cement material noted.	
4.2		BH03_1.4-1.5						
								1.50
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH04

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.0 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sand (FILL).	0.01
						FILL	Silty Sand (FILL); Dark brown, fine to coarse grained, loose, dry. Contains ash and minor gravels (10%) (40 mm). No odour or fibre cement material noted.	
4.9		BH04_0.2-0.3	✳					
3.8		BH04_0.5-0.6						
				1			Increasing sand content with depth.	
5.1		BH04_1.0-1.1						
						FILL	Sand (FILL); Brown, medium to coarse grained, loose, dry to slightly moist. Contains trace small gravels (<5%) (<10 mm). No odour, staining or fibre cement material noted.	1.30
2.1		BH04_1.4-1.5	✳					
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	1.50

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH05

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.0 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sand (FILL).	0.01
3.1		BH05_0.2-0.3				FILL	Silty Sand (FILL); Dark grey/black, fine to medium grained, loose, dry. Contains ash and trace small gravels (5%) (<10 mm). No odour or fibre cement material noted.	
2.9		BH05_0.5-0.6	✳			FILL	Silty Gravel Sand (FILL); Dark grey/black, medium grained, loose, dry. Contains ash, small gravels (20%) (<10 mm). No odour or fibre cement material noted.	0.50
							Becomes dark grey/black with orange mottling from 0.8 m bgs.	
4.8		BH05_1.0-1.1 QC103 QC104		1		FILL	Silty Sandy Gravel (FILL); Dark grey/black, medium to coarse grained, loose, dry. Contains ash and minor gravels (10%) (10-20 mm). No odour or fibre cement material noted.	1.00
3.2		BH05_1.4-1.5	✳					1.50
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH06

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.0 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sand (FILL).	0.01
2.4		BH06_0.2-0.3	✳			FILL	Silty Sand (FILL); Brown, fine to medium grained, loose, dry. Contains trace gravels (<5%) (20-40 mm). No odour, staining or fibre cement material noted.	
5.5		BH06_0.5-0.6				FILL	Silty Sandy Gravel (FILL); Dark grey/brown, medium to coarse grained, loose, dry to slightly moist. Contains ash and gravels (40%) (10-30 mm). No odour or fibre cement material noted.	0.50
4.1		BH06_1.0-1.1	✳	1		FILL	Silty Gravelly Sand (FILL); Dark grey/black, medium grained, loose, slightly moist. Contains minor ash and gravels (20%) (10-30 mm). No odour or fibre cement material noted.	1.00
3		BH06_1.4-1.5 QC105	✳				Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	1.50

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH07

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.1 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sand (FILL).	0.01
2.1		BH07_0.2-0.3 QC106	✳			FILL	Silty Sand (FILL); Dark grey/brown, fine grained, loose, dry. Contains trace ash and trace small gravels (<5%) (<10 mm). No odour or fibre cement material noted.	
4.5		BH07_0.5-0.6				FILL	Silty Sandy Gravel (FILL); Dark grey/brown/black, fine to coarse grained, loose, dry. Contains ash and gravels (30%) (20-40 mm). No odour or fibre cement material noted.	0.50
5		BH07_1.0-1.1	✳	1		FILL	Silty Gravelly Sand (FILL); Dark grey/brown/black, medium grained	1.00
2.3		BH07_1.4-1.5					Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	1.50

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH08

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.1 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sandy Gravel (FILL).	0.01
						FILL	Silty Sandy Gravel (FILL); Dark grey, medium to coarse grained, loose, dry to slightly moist. Contains (40%) gravels (20-40mm) and ash. No odour or fibre cement material noted.	
1.1		BH08_0.2-0.3	✳					
								0.50
2.6		BH08_0.5-0.6				FILL	Silty Clayey Sand (FILL); Dark grey, brown and black, medium grained, loose to medium dense, slightly moist. Contains trace (<5%) gravels (10-20mm) and contains ash. No odour or fibre cement material noted.	
				1				1.00
4.5		BH08_1.0-1.1				FILL	Silty Sandy Clay (FILL); Brown/black, medium stiff, slightly moist to moist, low plasticity. Contains trace ash and trace (<5%) gravels (10-20mm). No odour or fibre cement material noted.	
3.2		BH08_1.4-1.5	✳					1.50
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH09

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.2 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sandy Gravel (FILL).	0.01
1.2		BH09_0.2-0.3	✳			FILL	Silty Sandy Gravel (FILL); Dark grey/brown and black, fine to coarse grained, loose, dry. Contains ash and gravels (20%) (10-30mm). No odour or fibre cement material noted.	
3.1		BH09_0.5-0.6	✳			FILL	Silty Gravelly Sand (FILL); Dark grey/brown and black, medium grained, loose, dry to slightly moist. Contains ash and trace gravels (<5%) (<10mm). No odour or fibre cement material noted.	0.50
							Borehole terminated at 0.60 m bgs - refusal on concrete. Total Depth: 0.60 m	0.60

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH10

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.0 ppm

PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Compacted Silty Sand (FILL).	0.01
1.3		BH10_0.2-0.3				FILL	Silty Sand (FILL); Dark brown, fine to medium grained, loose, dry. Contains minor gravels (<10%) (10mm) and minor ash. No odour or fibre cement material noted.	
4.2		BH10_0.5-0.6 QC107 QC108	✳ ✳ ✳			FILL	Silty Sandy Gravel (FILL); Dark brown/black, medium to coarse grained, loose, dry to slightly moist. Contains ash and gravels (30%) (10-30mm). No odour or fibre cement material noted.	0.50
5.1		BH10_1.0-1.1		1		FILL	Silty Gravelly Clay (FILL); Dark brown/black, medium stiff, slightly moist, low plasticity. Contains minor ash and gravels (10%) (10-20mm). No odour or fibre cement material noted.	1.00
3.9		BH10_1.4-1.5	✳					1.50
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

ENSR Australia Pty Ltd. (trading as AECOM)
Level 5, 828 Pacific Highway
Gordon, NSW, 2072

BOREHOLE LOG BH11

PROJECT NUMBER S3107805 **DATE** 06 Jul 09
PROJECT NAME Port Kembla Port Corporation Road Realignment
LOCATION Port Kembla Gateway, Christy Drive, Port Kembla NSW
DRILLING METHOD Solid-Stem Auger
SAMPLING METHOD Grab

LOGGED BY K. Pigram
COMMENTS Ambient Air - 0.1 ppm

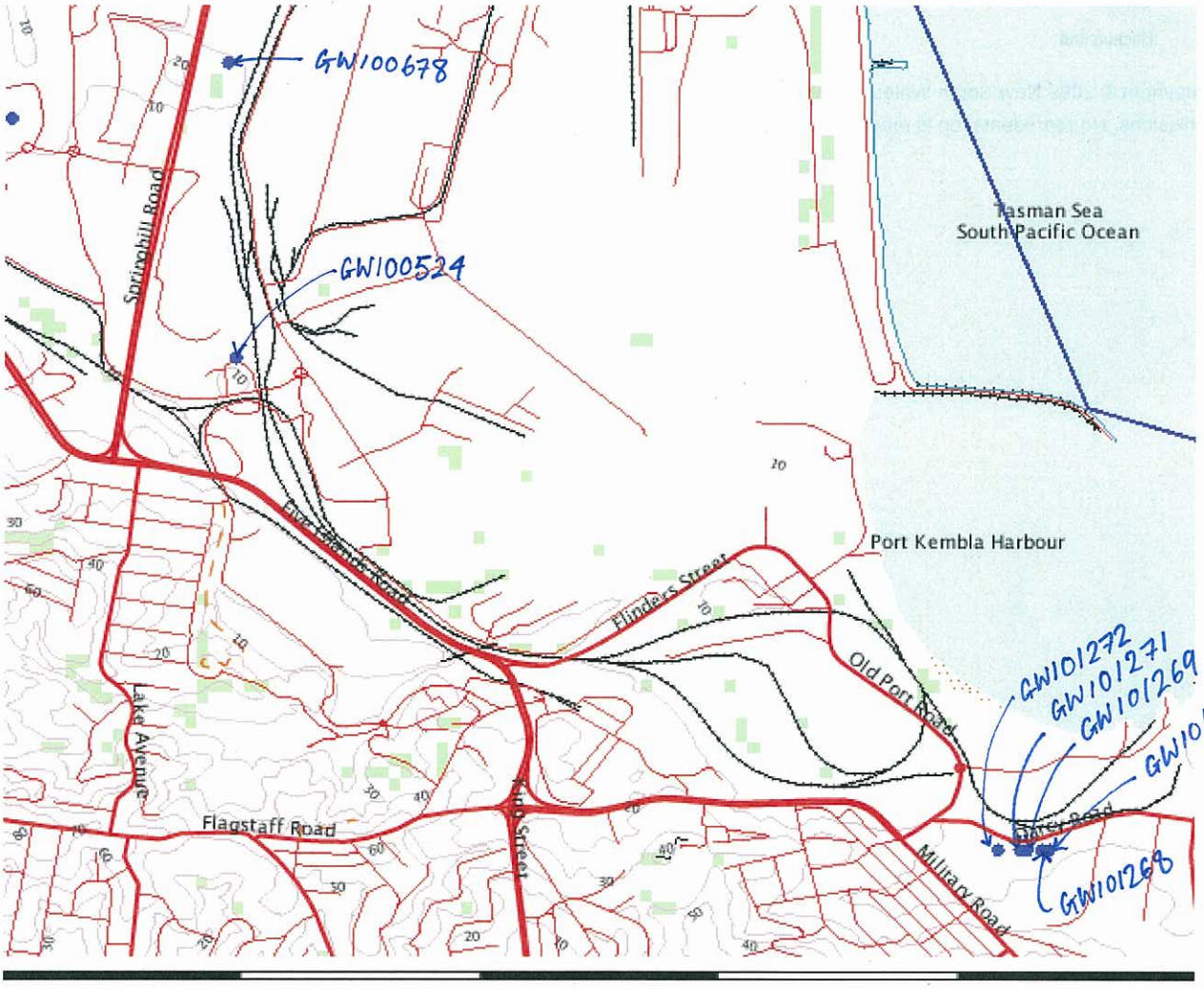
PID (ppm)	RECOVERY	SAMPLE NUMBER	ANALYSED	DEPTH (m BGS)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						FILL	Silty Clayey Sand (FILL). Disturbed surface beside road.	0.01
						FILL	Silty Clayey Sand (FILL); Dark grey/black, medium grained, medium dense, slightly moist to moist. Contains trace ash and trace gravels (<5%) (<10mm). No odour or fibre cement material noted.	
1.3		BH11_0.2-0.3						
								0.50
4.6		BH11_0.5-0.6	✳			FILL	Silty Sandy Clay (FILL); Dark grey/black, soft, moist, low plasticity. Contains ash and trace (<5%) gravels(10-20mm). No odour or fibre cement material noted.	
				1				
2.9		BH11_1.0-1.1					Refusal at 1.1 m bgs - move borehole approximately 0.5 m south.	
1.8		BH11_1.4-1.5 QC109	✳					
							Borehole terminated at 1.50 m bgs - target depth reached. Total Depth: 1.50 m	1.50

S3017805_BORELOGS_8JULY09.GPJ 05/08/09

Port Kembla NSW

Map created with NSW Natural Resource Atlas - http://www.nratlas.nsw.gov.au

Tuesday, August 18, 2009



0 4 Km

Legend

Symbol	Layer	Custodian
	Cities and large towns renderImage: Cannot build image from features	
Cowra	Populated places renderImage: Cannot build image from features	
	Towns	
	Groundwater Bores	
	Catchment Management Authority boundaries	
	Major rivers	
	Topographic base map	

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW100524

Works Details (top)

GROUNDWATER NUMBER	GW100524
LIC-NUM	10BL156496
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rot. Rev. Circ. Air
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1993-10-14
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	11.21
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6184621.00
EASTING	304923.00
LATITUDE	34 27' 42"
LONGITUDE	150 52' 34"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1//606434

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1 606434

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	4.00	4.00	GREY SLAG FILL		
4.00	5.00	1.00	GREY SAND		
5.00	11.21	6.21	DARK BROWN TO GREY STIFF ESTUARINE CLAYS		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW101267

Works Details (top)

GROUNDWATER NUMBER	GW101267
LIC-NUM	10BL158181
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Other
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1997-06-12
FINAL-DEPTH (metres)	15.00
DRILLED-DEPTH (metres)	15.10
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	3000.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6182592.00
EASTING	307821.00
LATITUDE	34 28' 49"
LONGITUDE	150 54' 26"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	LOT21 DP546139

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	21 546139

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.50	200			Other
1		Hole	Hole	8.50	15.00	150			Other
1	1	Casing	P.V.C.	0.00	5.85	106	94		C: .7-2.4m; Screwed; Seated on Bottom; Cap; Casing Shoe
1	1	Casing	P.V.C.	11.65	14.55				Screwed; Seated on Bottom
1	1	Opening	Screen	5.85	11.65	106			PVC Class 12; A: .6mm; Screwed
1		Annulus	(Unknown)	2.95	14.55				Graded; GS: 1-2mm; Q: .16m³

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.50	8.50	3.00		1.72					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.50	0.50	Fill: organic, silty clay		
0.50	5.50	5.00	silty clay		
5.50	8.50	3.00	gritty, silty clay		
8.50	15.10	6.60	Latite		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW101271

Works Details (top)

GROUNDWATER NUMBER	GW101271
LIC-NUM	10BL158181
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Other
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1997-06-25
FINAL-DEPTH (metres)	14.50
DRILLED-DEPTH (metres)	14.50
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	3000.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6182590.00
EASTING	307719.00
LATITUDE	34 28' 49"
LONGITUDE	150 54' 22"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	LOT21 DP546139

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	21 546139

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	5.70	200			Other
1		Hole	Hole	5.70	11.00	150			Other
1		Hole	Hole	11.00	14.50	125			Other
1	1	Casing	P.V.C.	0.00	5.70	106	94		C: .8-2.8m; Screwed; Seated on Bottom; Cap; Casing Shoe
1	1	Casing	P.V.C.	11.50	13.90				
1	1	Opening	Screen	5.70	11.50	106			PVC Class 12; A: .6mm; Screwed
1		Annulus	(Unknown)	3.30	14.50				Graded; GS: 1-2mm; Q: .16m³

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.00	7.50	2.50		1.30					3000.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT

0.00	0.20	0.20	Fill: loam
0.20	1.00	0.80	silty clay - organic
1.00	5.70	4.70	silty clay
5.70	7.50	1.80	weathered latite
7.50	14.50	7.00	latite

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW101272

Works Details (top)

GROUNDWATER NUMBER	GW101272
LIC-NUM	10BL158181
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Other
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1997-06-24
FINAL-DEPTH (metres)	14.00
DRILLED-DEPTH (metres)	14.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	3000.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6182588.00
EASTING	307642.00
LATITUDE	34 28' 49"
LONGITUDE	150 54' 19"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	LOT21 DP546139

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	21 546139

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	5.85	200			Other
1		Hole	Hole	5.85	9.00	150			Other
1		Hole	Hole	9.00	14.00	125			Other
1	1	Casing	P.V.C.	0.00	4.35	106	100		C: .5-2.8m; Screwed; Seated on Bottom; Cap; Casing Shoe
1	1	Casing	P.V.C.	10.15	12.95	106	100		
1	1	Opening	Screen	4.35	10.15	106			PVC Class 12; A: .6mm; Screwed
1		Annulus	(Unknown)	3.20	3.30				Graded; GS: 1-2mm; Q: .15m³
1		Annulus	(Unknown)	12.95	13.00				Graded

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.00	8.00	3.00		1.27					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.50	0.50	Loam		
0.50	5.40	4.90	silty clay		
5.40	5.85	0.45	gritty, silty clay		
5.85	8.60	2.75	latite - weathered		
8.60	14.00	5.40	latite - hard		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW100678

Works Details (top)

GROUNDWATER NUMBER	GW100678
LIC-NUM	10BL156580
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1995-03-22
FINAL-DEPTH (metres)	65.00
DRILLED-DEPTH (metres)	65.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	2200.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6185871.00
EASTING	304868.00
LATITUDE	34 27' 1"
LONGITUDE	150 52' 33"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1//837554

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1 837554

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	2.00				Rotary
1		Hole	Hole	2.00	65.00	140			Rotary
1	1	Casing	P.V.C.	-0.40	2.00	200			Driven into Hole

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
27.00	27.40	0.40		8.20		6.00			1030.00
45.80	46.20	0.40							1470.00
51.00	52.00	1.00							
56.80	57.20	0.40				7.50			1720.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.60	0.60	TOPSOIL		
0.60	3.80	3.20	WEATHERED BASALT		
3.80	9.00	5.20	BASALT		
9.00	16.00	7.00	INDURATED SHALE		
16.00	65.00	49.00	SANDSTONE		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW101268

Works Details (top)

GROUNDWATER NUMBER	GW101268
LIC-NUM	10BL158181
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Other
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1997-06-16
FINAL-DEPTH (metres)	14.60
DRILLED-DEPTH (metres)	15.30
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	3000.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6182591.00
EASTING	307795.00
LATITUDE	34 28' 49"
LONGITUDE	150 54' 25"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	LOT21 DP546139

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	21 546139

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.50	200			Other
1		Hole	Hole	8.50	14.60	150			Other
1	1	Casing	P.V.C.	0.00	6.15	106	94		C: .7-3m; Screwed; Seated on Bottom; Cap; Casing Shoe
1	1	Opening	Screen	6.15	11.95	106			PVC Class 12; A: .6mm; Screwed
1		Annulus	(Unknown)	3.40	14.45				Graded; GS: 1-2mm; Q: .16m³

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
7.00	9.00	2.00		1.72					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.50	0.50	Fill: sand and clay		
0.50	3.80	3.30	silty clay		

3.80	9.00	5.20	gritty, silty clay
9.00	11.00	2.00	weathered latite
11.00	15.30	4.30	latite

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, August 18, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW101269

Works Details (top)

GROUNDWATER NUMBER	GW101269
LIC-NUM	10BL158181
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Other
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1997-06-20
FINAL-DEPTH (metres)	14.45
DRILLED-DEPTH (metres)	14.45
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	3000.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6182590.00
EASTING	307744.00
LATITUDE	34 28' 49"
LONGITUDE	150 54' 23"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	LOT21 DP546139

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	21 546139

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.50	200			Other
1		Hole	Hole	8.50	10.00	150			Other
1		Hole	Hole	10.00	13.30	125			Other
1	1	Casing	P.V.C.	0.00	3.65	106	94		C: .6-2m; Screwed; Seated on Bottom; Cap; Casing Shoe
1	1	Opening	Screen	3.65	9.45	106			PVC Class 12; A: .6mm; Screwed
1		Annulus	(Unknown)	2.70	12.30				(Unknown); GS: 1-2mm; Q: .16m³

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.00	8.50	3.50		2.09					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	Fill: loam and gravel		
1.00	8.00	7.00	silty clay		
8.00	9.00	1.00	weathered latite		

9.00	14.45	5.45	latite

Appendix B

Data Validation

B1 INTRODUCTION

The following sections describe the components of the Quality Assurance and Control process used to demonstrate achievement of the project objectives. The QA/QC process is based on consideration of the data quality indicators (DQIs) precision, accuracy, reproducibility, completeness and comparability.

B2 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 different laboratories.

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

Table 1: DQIs

DQI	Field	Laboratory	Acceptability Limits
Completeness	All critical locations sampled All samples collected (from grid and depth) Standard Operating Procedures (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 Recording off 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	

DQI	Field	Laboratory	Acceptability Limits
Precision	SOPs appropriate and complied with Collection of intra-laboratory duplicate samples	Analysis of: Intra-laboratory duplicate samples (1 in 10 samples) Laboratory duplicate samples Laboratory prepared trip spikes (1 per/day)	 RPD of 30 to 50% RPD of 30 to 50% Recovery >90%
Accuracy	SOPs appropriate and complied with	Analysis of: Inter-laboratory duplicate samples (1in 20 samples) 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	 <LOR for CoC <LOR for CoC <LOR for CoC 70 to 130% RPD of <30% 70 to 130% 70 to 130 % 70 to 130% <LOR for CoC Varies

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

B3 FIELD QA/QC

B3.1 Sampling Team

Soil samples were collected on 6 July 2009 by Kate Pigram, a suitably qualified and experienced AECOM Environmental Scientist, in accordance with AECOM's written Standard Operating Procedures for each task that comprised the field program.

B3.2 Sample Collection

Soil samples were collected directly by hand from the solid flight augers on a Bobcat mounted drill rig.

Surface grab samples were collected by stainless steel hand trowel. Samples were generally collected at the surface, 0.5 m, 1.0 m and every metre to the end of the borehole and at significant stratigraphic changes.

B3.3 Sample Handling and Preservation

A new pair of disposable nitrile sampling gloves was donned between each soil sampling location and depth. Soil samples were placed immediately into laboratory prepared and supplied jars with screw top Teflon-lined lids. Sample jars were filled so that no headspace remained (where practical). Sub-samples were placed in separate zip lock plastic bags for asbestos analysis and PID field screening, respectively.

Soil 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	Metals, PAHs, Phenols, TPH, BTEX, OPP, OCP, PCB, TCLP (Metals and PAH)	250 mL Glass screw top jar	Unpreserved, 4°C
	Asbestos	Zip lock plastic bag	Unpreserved

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.

All samples were received chilled and intact by the laboratory.

B3.4 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 isobutylene. All calibration results were satisfactory.

Details of calibration are provided in **Appendix C**.

B3.5 Inter and Intra-laboratory Field 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 intra-laboratory duplicate soil samples were collected in the field at a rate of at least one in 10 primary samples. Inter-laboratory duplicate soil samples were collected at a rate of at least one in 20 primary samples.

The field duplicate 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.

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

The intra-laboratory duplicate sample frequency acheived for this investigation was 11% (i.e. 2 duplicate samples per 22 primary samples). The achieved inter-laboratory duplicate sample frequency achieved for this investigation was 4.5% (i.e. 1 duplicate samples per 22 primary samples).

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
QC107/BH10_1.0-1.1	Intra-laboratory	Metals/TPH/BTEX/PAHs/Phenols/ OCP/OPP	Hg (67%)
QC108/ BH10_1.0-1.1	Inter-laboratory	Metals/TPH/BTEX/PAHs/Phenols/ OCP/OPP	Hg (127%), Zn (52%), As (32%)

All duplicate samples collected and analysed contained fill material and therefore are likely to be heterogeneous samples. The above RPD exceedences are therefore likely attributed to the heterogeneous distribution of metals within the fill materials sampled.

B3.6 Decontamination and Rinsate Blanks

Excess soil and materials were removed from the solid stem augers and visually inspected between sampling locations. 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.

Rinsate blanks are typically collected from the final rinse water off equipment that has been field cleaned.

Rinsate blank samples were not considered a necessary requirement for the investigation and there exclusion is not considered to significantly affect the reliability of the data for the purposes of this investigation.

B3.7 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 considered a necessary requirement of the investigation and there exclusion is not considered to significantly affect the reliability of the data for the purposes of this investigation.

B4 LABORATORY QA/QC

B4.1 Analytical Laboratory

Samples were submitted to the following laboratories:

- ALS in Smithfield, NSW (primary laboratory); and
- LabMark in Asquith, NSW (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.

The Labmark NATA accreditation number is 13542, and its analytical procedures are based on methods referenced from NEPC, ASTM, modified USEPA / APHA.

B4.2 Analytical Methods

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

Analyte	Matrix	Reference Method	Limit of Reporting (LOR)	Assessment Criteria
Metals (8)	Soil	USEPA SW846, 6020	0.05 – 2.0 mg/kg	75 – 600 000 mg/kg
TPH C6-C9	Soil	USEPA SW 846-8260B	10 mg/kg	65 mg/kg
TPH C10-C36	Soil	USEPA SW 846-8015A	50-100 mg/kg	1000 mg/kg
BTEX	Soil	USEPA SW 846-8260B	0.2-0.5 mg/kg	1-130 mg/kg
PAHs	Soil	USEPA SW 846-8270B	5.0-100 mg/kg	5- 42 500 mg/kg
OCPs/PCBs	Soil	USEPA 3640,3620,8081/8082	0.5-5.0 mg/kg	50 -1000 mg/kg
Asbestos	Soil	AS 4964-2004	0.1 g/kg	No detection
TCLP Metals (8)	Water	USEPA SW846-3005	1.0 - 50 µg/L	0.2 –20 µg/L
TCLP PAHs	Water	USEPA SW846-1311, ALS QWI-EN/33	0.5-1.0 µg/L	0.16-1600 µg/L

Notes: The LORs were less than the corresponding assessment criteria for all analytes.

B4.3 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.

B4.4 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.

Four laboratory duplicate samples were analysed in the primary sample batch. This was equivalent to one lab duplicate for nine soil samples analysed, and one lab duplicate for five TCLP samples analysed, thereby fulfilling the QA/QC requirements.

Review of the laboratory QA/QC reports indicated that the RPDs for all laboratory duplicate samples were within the acceptance criteria, with the exception of the following:

- ALS batch ES0909983: Lab duplicate sample ES0909796-001 (sample not from the Site) reported an RPD of 43.2% for zinc (results > 10 x LOR); and
- ALS batch ES0909983: Lab duplicate sample ES0909983-024 (QC107) reported an RPD of 30.2% for lead (results > 10 x LOR).

The above exceedences may be attributed to sample heterogeneity rather than laboratory precision.

It is noted that laboratory duplicate samples were not analysed for the inter-laboratory duplicate sample batch.

C4.5 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.

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Review of the laboratory QA/QC reports indicated that the percent recoveries for laboratory control samples and certified reference material ranged from 50.6% to 130% and were either within the DQI acceptance criteria of 70 to 130% or within the laboratory analyte specific acceptance criteria.

B4.6 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 50.1% to 127% and were either within the DQI acceptance criteria of 70 to 130% or within the laboratory analyte specific acceptance criteria.

B4.7 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 chromatographic 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 QA/QC reports indicated that the percent recoveries for surrogates ranged from 28.9% to 129% and were either within the DQI acceptance criteria of 70 to 130% or within the laboratory analyte specific acceptance criteria.

B4.8 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 maximum holding times were achieved for all analyses as per the table below:

Analyte	Matrix	Recommended Maximum Holding Time	Compliance
Metals (7)	Soil	6 months	Yes
Mercury	Soil	28 days	Yes
TPH C6-C9	Soil	14 days	Yes
TPH C10-C36	Soil	14 days	Yes
BTEX	Soil	14 days	Yes
PAHs	Soil	14 days	Yes
OCPs/PCBs	Soil	14 days	Yes
TCLP Metals	Soil	6 months	Yes

Analyte	Matrix	Recommended Maximum Holding Time	Compliance
TCLP PAHs	Soil	14 days	Yes
Asbestos	Soil	NA	NA

Notes: TCLP – Toxicity Characteristic Leaching Procedure

B5 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 collected/analysed, 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 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 SAQP. 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 laboratory analysis accuracy 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 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. 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.

Appendix C

Calibration Records

ENVIROEQUIP RENTALS

Your Friend in the Field

Equipment Report - MINIRAE 2000 PID

This PID has been performance checked / calibrated* as follows:

Calibration	Actual Value	Reading	Pass?		
Zero – fresh air	0.0 ppm	0.0 ppm	☑		
Span – Isobutylene	103 ppm	103 ppm	☑		
Operations Check					
☑ Performance Check (pump, lamp, sensor & battery voltage check)					
☑ Battery Charged	☑ Filters Check	☑ Spare battery Voltage (5.5v minimum) 6 V			

* Calibration gas traceability information is available upon request.

Date: 06/07/2009 Checked by: MILENKO

Signed:

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
☑	☐	☐	MiniRae 2000 PID / Operational Check, plus Battery Voltage @ 5.7 V
☑	☐	☐	Lamp Voltage: 10.6eV C/factor: 1
			Compound Set to: ISOBUTYLENE
☑	☐	☐	Protective yellow rubber boot
☑	☐	☐	Inlet probe (attached to PID)
☑	☐	☐	Spare water trap filter(s) Qty 2
☑	☐	☐	Charger 240V to 12V 500mA
☑	☐	☐	Instruction Manual behind foam on the lid of case "
☑	☐	☐	Quick Guide Sheet behind foam on the lid of case "
☑	☐	☐	Spare Alkaline Battery Compartment with batteries
☑	☐	☐	Inline Moisture trap Filter Guide Laminated
☐	☐	☐	Calibration regulator & tubing (**optional**)
☑	☐	☐	Carry Case
☐	☐	☐	

Processors Signature/ Initials

EE Quote Reference	15294	Condition on return
Customer Ref	282789	
Equipment ID	PIDMINSW	
Equipment serial no.	110008698	
Return Date	09/07/09	
Return Time		

Melbourne **Sydney** **Brisbane** **Perth** **Auckland** **Kuala Lumpur**

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