

Order Number: CD1349
Report Number: 326303
Superseded Report:

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Order Number: CD1349
Report Number: 326303
Superseded Report:

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SDG: 150812-78
Job: H_ATKINS_LDC-440
Client Reference: MP69 pipe excavation

Location: Coed Darcy
Customer: Atkins Global Ltd
Attention: Kirsty Shorter

Order Number: CD1349
Report Number: 326303
Superseded Report:

PAH by GCMS

[illegible]



CERTIFICATE OF ANALYSIS

SDG: 150812-78
Job: H_ATKINS_LDC-440
Client Reference: MP69 pipe excavation

Location: Coed Darcy
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TPH CWG (S)

Results Legend			Customer Sample R		TPE2822_pipe1	TPE2822_pipe2	TPE2822_pipe3	TPE2822_pipe4	TPE2822_pipe5	TPE2822_pipe6
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		2.00 - 2.00	0.30 - 0.30	2.00 - 2.00	0.30 - 0.30	1.00 - 1.00	2.00 - 2.00
M	mCERTS accredited.				Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
aq	Aqueous / settled sample.				10/08/2015	10/08/2015	10/08/2015	10/08/2015	10/08/2015	10/08/2015
diss.filt	Dissolved / filtered sample.									
tot.unfilt	Total / unfiltered sample.									
*	Subcontracted test.									
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery									
(F)	Trigger breach confirmed									
1-5&\$@	Sample deviation (see appendix)									
Component	LOD/Units	Method								
GRO Surrogate % recovery**	%	TM089			87	88	94	80	89	91
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089			<176	<176	5180	<176	639	3220
					M	M	M	M	M	M
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089			<20	<20	<20	<20	<20	<20
					M	M	M	M	M	M
Benzene	<10 µg/kg	TM089			<40	<40	169	<40	<40	<40
					M	M	M	M	M	M
Toluene	<2 µg/kg	TM089			<8	<8	<8	<8	<8	<8
					M	M	M	M	M	M
Ethylbenzene	<3 µg/kg	TM089			<12	<12	<12	<12	<12	<12
					M	M	M	M	M	M
m,p-Xylene	<6 µg/kg	TM089			<24	<24	<24	<24	<24	<24
					M	M	M	M	M	M
o-Xylene	<3 µg/kg	TM089			<12	<12	<12	<12	<12	<12
					M	M	M	M	M	M
sum of detected mpo xylene by GC	<9 µg/kg	TM089			<9	<9	<9	<9	<9	<9
sum of detected BTEX by GC	<24 µg/kg	TM089			<24	<24	169	<24	<24	<24
Aliphatics >C5-C6	<10 µg/kg	TM089			<40	<40	319	<40	<40	<40
Aliphatics >C6-C8	<10 µg/kg	TM089			<40	<40	2420	<40	50.4	154
Aliphatics >C8-C10	<10 µg/kg	TM089			<40	<40	756	<40	119	660
Aliphatics >C10-C12	<10 µg/kg	TM089			<40	<40	608	<40	225	1170
Aliphatics >C12-C16	<100 µg/kg	TM173			10900	29800	44400	3730	5670	27000
Aliphatics >C16-C21	<100 µg/kg	TM173			89900	96100	154000	21200	20700	43600
Aliphatics >C21-C35	<100 µg/kg	TM173			267000	263000	446000	65600	61100	93300
Aliphatics >C35-C44	<100 µg/kg	TM173			45500	41200	88600	19100	15000	33300
Total Aliphatics >C12-C44	<100 µg/kg	TM173			413000	430000	733000	110000	103000	197000
Aromatics >EC5-EC7	<10 µg/kg	TM089			<40	<40	169	<40	<40	<40
Aromatics >EC7-EC8	<10 µg/kg	TM089			<40	<40	<40	<40	<40	<40
Aromatics >EC8-EC10	<10 µg/kg	TM089			<40	<40	503	<40	80	440
Aromatics >EC10-EC12	<10 µg/kg	TM089			<40	<40	405	<40	150	777
Aromatics >EC12-EC16	<100 µg/kg	TM173			5420	9570	12200	1960	1840	15800
Aromatics >EC16-EC21	<100 µg/kg	TM173			51200	57200	92800	10100	9810	41300
Aromatics >EC21-EC35	<100 µg/kg	TM173			223000	192000	353000	56900	50100	112000
Aromatics >EC35-EC44	<100 µg/kg	TM173			53600	39300	84100	24600	23200	56800
Aromatics >EC40-EC44	<100 µg/kg	TM173			17500	12200	28500	8990	9450	22400
Total Aromatics >EC12-EC44	<100 µg/kg	TM173			333000	298000	542000	93500	85000	226000
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173			746000	728000	1280000	203000	188000	426000



CERTIFICATE OF ANALYSIS

SDG: 150812-78
Job: H_ATKINS_LDC-440
Client Reference: MP69 pipe excavation

Location: Coed Darcy
Customer: Atkins Global Ltd
Attention: Kirsty Shorter

Order Number: CD1349
Report Number: 326303
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R		TPE2822_pipe7			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	2.50 - 2.50 Soil/Solid 10/08/2015 . 12/08/2015 150812-78 11881475				
M	mCERTS accredited.						
aq	Aqueous / settled sample.						
diss.filt	Dissolved / filtered sample.						
tot.unfilt	Total / unfiltered sample.						
*	Subcontracted test.						
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery						
(F)	Trigger breach confirmed						
1-5&*\$@	Sample deviation (see appendix)						
Component	LOD/Units	Method					
GRO Surrogate % recovery**	%	TM089	92				
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	1120	M			
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<20	M			
Benzene	<10 µg/kg	TM089	<40	M			
Toluene	<2 µg/kg	TM089	<8	M			
Ethylbenzene	<3 µg/kg	TM089	<12	M			
m,p-Xylene	<6 µg/kg	TM089	<24	M			
o-Xylene	<3 µg/kg	TM089	<12	M			
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9				
sum of detected BTEX by GC	<24 µg/kg	TM089	<24				
Aliphatics >C5-C6	<10 µg/kg	TM089	<40				
Aliphatics >C6-C8	<10 µg/kg	TM089	<40				
Aliphatics >C8-C10	<10 µg/kg	TM089	156				
Aliphatics >C10-C12	<10 µg/kg	TM089	499				
Aliphatics >C12-C16	<100 µg/kg	TM173	11500				
Aliphatics >C16-C21	<100 µg/kg	TM173	40400				
Aliphatics >C21-C35	<100 µg/kg	TM173	141000				
Aliphatics >C35-C44	<100 µg/kg	TM173	35200				
Total Aliphatics >C12-C44	<100 µg/kg	TM173	228000				
Aromatics >EC5-EC7	<10 µg/kg	TM089	<40				
Aromatics >EC7-EC8	<10 µg/kg	TM089	<40				
Aromatics >EC8-EC10	<10 µg/kg	TM089	105				
Aromatics >EC10-EC12	<10 µg/kg	TM089	334				
Aromatics >EC12-EC16	<100 µg/kg	TM173	16100				
Aromatics >EC16-EC21	<100 µg/kg	TM173	115000				
Aromatics >EC21-EC35	<100 µg/kg	TM173	401000				
Aromatics >EC35-EC44	<100 µg/kg	TM173	125000				
Aromatics >EC40-EC44	<100 µg/kg	TM173	43300				
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	658000				
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	887000				



SDG:	150812-78	Location:	Coed Darcy	Order Number:	CD1349
Job:	H_ATKINS_LDC-440	Customer:	Atkins Global Ltd	Report Number:	326303
Client Reference:	MP69 pipe excavation	Attention:	Kirsty Shorter	Superseded Report:	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
ASB_PREP				
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG:	150812-78	Location:	Coed Darcy	Order Number:	CD1349
Job:	H_ATKINS_LDC-440	Customer:	Atkins Global Ltd	Report Number:	326303
Client Reference:	MP69 pipe excavation	Attention:	Kirsty Shorter	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	11881449	11881453	11881457	11881461	11881467	11881470	11881475
Customer Sample Ref.	TPE2822_pipe1	TPE2822_pipe2	TPE2822_pipe3	TPE2822_pipe4	TPE2822_pipe5	TPE2822_pipe6	TPE2822_pipe7
AGS Ref.							
Depth	2.00 - 2.00	0.30 - 0.30	2.00 - 2.00	0.30 - 0.30	1.00 - 1.00	2.00 - 2.00	2.50 - 2.50
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
EPH CWG (Aliphatic) GC (S)	18-Aug-2015	18-Aug-2015	18-Aug-2015	18-Aug-2015	20-Aug-2015	17-Aug-2015	17-Aug-2015
EPH CWG (Aromatic) GC (S)	18-Aug-2015	18-Aug-2015	18-Aug-2015	18-Aug-2015	20-Aug-2015	17-Aug-2015	17-Aug-2015
GRO by GC-FID (S)	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015
PAH by GCMS	17-Aug-2015	18-Aug-2015	17-Aug-2015	17-Aug-2015	18-Aug-2015	16-Aug-2015	18-Aug-2015
Sample description	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015
TPH CWG GC (S)	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015	20-Aug-2015



SDG: 150812-78
Job: H_ATKINS_LDC-440
Client Reference: MP69 pipe excavation

Location: Coed Darcy
Customer: Atkins Global Ltd
Attention: Kirsty Shorter

Order Number: CD1349
Report Number: 326303
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Appendix General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill /made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than :
 - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



Atkins Global Ltd
Project Jonah site office
Llan Coed House
Suite 24
Coed Darcy
Llandarcy
SA10 6HJ

Attention: Jack Lowrie

CERTIFICATE OF ANALYSIS

Date: 19 August 2015
Customer: H_ATKINS_LDC
Sample Delivery Group (SDG): 150808-48
Your Reference: MP69
Location: Coed Darcy
Report No: 326182

We received 4 samples on Saturday August 08, 2015 and 4 of these samples were scheduled for analysis which was completed on Wednesday August 19, 2015. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG:	150808-48	Location:	Coed Darcy	Order Number:	CD1343
Job:	H_ATKINS_LDC-433	Customer:	Atkins Global Ltd	Report Number:	326182
Client Reference:	MP69	Attention:	Jack Lowrie	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
11860385	TPE2950		3.50	07/08/2015
11860388	TPE2676 S1		1.50	07/08/2015
11860393	TPE2676 S2		1.50	07/08/2015
11860396	TPE2676 S3		1.50	07/08/2015

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

SDG:	150808-48	Location:	Coed Darcy	Order Number:	CD1343
Job:	H_ATKINS_LDC-433	Customer:	Atkins Global Ltd	Report Number:	326182
Client Reference:	MP69	Attention:	Jack Lowrie	Superseded Report:	

SOLID
Results Legend

- X

Test
- N

No Determination Possible

Lab Sample No(s)		Customer Sample Reference	AGS Reference	Depth (m)	Container						
11860385		TPE2950		3.50	250g Amber Jar (AL 60g VOC (ALE215))						
11860388		TPE2676 S1		1.50	250g Amber Jar (AL 60g VOC (ALE215))						
11860393		TPE2676 S2		1.50	250g Amber Jar (AL 60g VOC (ALE215))						
11860396		TPE2676 S3		1.50	250g Amber Jar (AL 60g VOC (ALE215))						
All	NDPs: 0 Tests: 4										
All	NDPs: 0 Tests: 4										
All	NDPs: 0 Tests: 4										
All	NDPs: 0 Tests: 4										
All	NDPs: 0 Tests: 4										
All	NDPs: 0 Tests: 4										



SDG:	150808-48	Location:	Coed Darcy	Order Number:	CD1343
Job:	H_ATKINS_LDC-433	Customer:	Atkins Global Ltd	Report Number:	326182
Client Reference:	MP69	Attention:	Jack Lowrie	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
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Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
11860385	TPE2950	3.50	Light Brown	Stone/Soil	0.1 - 2 mm	Stones	Vegetation
11860388	TPE2676 S1	1.50	Dark Brown	Silty Clay	<0.063 mm	Stones	N/A
11860393	TPE2676 S2	1.50	Dark Brown	Sandy Clay Loam	0.063 - 0.1 mm	Stones	Vegetation
11860396	TPE2676 S3	1.50	Dark Brown	Sandy Clay Loam	0.1 - 2 mm	Stones	Vegetation

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

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CERTIFICATE OF ANALYSIS

SDG: 150808-48
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Client Reference: MP69

Location: Coed Darcy
Customer: Atkins Global Ltd
Attention: Jack Lowrie

Order Number: CD1343
Report Number: 326182
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R						
#	ISO17025 accredited.		TPE2950	TPE2676 S1	TPE2676 S2	TPE2676 S3		
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	3.50	1.50	1.50	1.50		
aq	Aqueous / settled sample.		Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid		
diss.filt	Dissolved / filtered sample.		07/08/2015	07/08/2015	07/08/2015	07/08/2015		
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery		08/08/2015	08/08/2015	08/08/2015	08/08/2015		
(F)	Trigger breach confirmed		150808-48	150808-48	150808-48	150808-48		
1-5&*\$@	Sample deviation (see appendix)		11860385	11860388	11860393	11860396		
Component	LOD/Units	Method						
GRO Surrogate % recovery**	%	TM089	229	134	99	94		
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	3320000 3 #	414000 M	46500 M	5050 M		
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<100 #	<25 M	<20 M	<20 M		
Benzene	<10 µg/kg	TM089	9560 #	358 M	<40 M	<40 M		
Toluene	<2 µg/kg	TM089	<40 #	<10 M	14.3 M	<8 M		
Ethylbenzene	<3 µg/kg	TM089	32900 #	<15 M	40.7 M	<12 M		
m,p-Xylene	<6 µg/kg	TM089	56600 #	<30 M	44 M	<24 M		
o-Xylene	<3 µg/kg	TM089	<60 #	<15 M	96.7 M	<12 M		
sum of detected mpo xylene by GC	<9 µg/kg	TM089	56600	<9	141	<9		
sum of detected BTEX by GC	<24 µg/kg	TM089	99100	358	196	<24		
Aliphatics >C5-C6	<10 µg/kg	TM089	342000 3	11900	<40	<40		
Aliphatics >C6-C8	<10 µg/kg	TM089	1590000 3	93400	73.6	62.5		
Aliphatics >C8-C10	<10 µg/kg	TM089	649000 3	116000	5580	693		
Aliphatics >C10-C12	<10 µg/kg	TM089	124000 3	69000	22200	2270		
Aliphatics >C12-C16	<100 µg/kg	TM173	6820	515000	387000	67200		
Aliphatics >C16-C21	<100 µg/kg	TM173	724	647000	103000	68100		
Aliphatics >C21-C35	<100 µg/kg	TM173	25900	1740000	184000	174000		
Aliphatics >C35-C44	<100 µg/kg	TM173	13000	310000	32300	53500		
Total Aliphatics >C12-C44	<100 µg/kg	TM173	46400	3210000	706000	363000		
Aromatics >EC5-EC7	<10 µg/kg	TM089	9560 3	358	<40	<40		
Aromatics >EC7-EC8	<10 µg/kg	TM089	<200 3	<50	<40	<40		
Aromatics >EC8-EC10	<10 µg/kg	TM089	522000 3	77400	3900	487		
Aromatics >EC10-EC12	<10 µg/kg	TM089	82900 3	46000	14800	1510		
Aromatics >EC12-EC16	<100 µg/kg	TM173	<100	98200	54600	7700		
Aromatics >EC16-EC21	<100 µg/kg	TM173	<100	333000	40200	26400		
Aromatics >EC21-EC35	<100 µg/kg	TM173	12900	1220000	155000	198000		
Aromatics >EC35-EC44	<100 µg/kg	TM173	6950	258000	36000	118000		
Aromatics >EC40-EC44	<100 µg/kg	TM173	2610	79500	11600	49900		
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	19800	1910000	286000	350000		
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	3390000	5540000	1040000	718000		



SDG:	150808-48	Location:	Coed Darcy	Order Number:	CD1343
Job:	H_ATKINS_LDC-433	Customer:	Atkins Global Ltd	Report Number:	326182
Client Reference:	MP69	Attention:	Jack Lowrie	Superseded Report:	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG:	150808-48	Location:	Coed Darcy	Order Number:	CD1343
Job:	H_ATKINS_LDC-433	Customer:	Atkins Global Ltd	Report Number:	326182
Client Reference:	MP69	Attention:	Jack Lowrie	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	11860385	11860388	11860393	11860396
Customer Sample Ref.	TPE2950	TPE2676 S1	TPE2676 S2	TPE2676 S3
AGS Ref.				
Depth	3.50	1.50	1.50	1.50
Type	SOLID	SOLID	SOLID	SOLID

EPH CWG (Aliphatic) GC (S)	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015
EPH CWG (Aromatic) GC (S)	13-Aug-2015	13-Aug-2015	13-Aug-2015	13-Aug-2015
GRO by GC-FID (S)	19-Aug-2015	19-Aug-2015	19-Aug-2015	19-Aug-2015
PAH by GCMS	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015
Sample description	11-Aug-2015	11-Aug-2015	11-Aug-2015	11-Aug-2015
TPH CWG GC (S)	19-Aug-2015	19-Aug-2015	19-Aug-2015	19-Aug-2015



SDG: 150808-48
Job: H_ATKINS_LDC-433
Client Reference: MP69

Location: Coed Darcy
Customer: Atkins Global Ltd
Attention: Jack Lowrie

Order Number: CD1343
Report Number: 326182
Superseded Report:

Appendix General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill /made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than :
 - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix E. Photosheet



Photograph 1 TPE2687 – Minor free product at base of trial pit



Photograph 2 TPE2739 – Minor free product at base of trial pit



Photograph 3 TPE2740 – Excavation of largely intact barrel of free product from trial pit.



Photograph 4 TPE2742 – Minor pockets of hydrocarbon staining on weathered bedrock gravel at base of trial pit



Photograph 5 TPE2676 – Section of pipework to be removed from excavation



Photograph 6 TPE2820 – Metal and clay pipework removed from excavation



Photograph 7 TPE2999 – Section of metal pipe removed from excavation

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Coed Darcy

Validation Report
Monitor Phase 70

St Modwen Developments Limited



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Document history

Job number: 5122307			Document ref: 5041216-OSW-RPT-0001394			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
0	Draft	CRS/MM	CRS	ML	MP	May 2015
1	Draft in response to RFI	BAI	CRS	MP		Oct 2015

Client signoff

Client	St Modwen Developments Limited
Project	Coed Darcy
Document title	Validation Report Monitor Phase 70
Job no.	5122307
Copy no.	
Document reference	5041216-OSW-RPT-0001394

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Glossary of Terms

Term	Meaning / Definition
CSM	Conceptual Site Model
RBSL	Risk Based Screening Level
ACM	Asbestos Containing Material
TPH	Total Petroleum Hydrocarbons
PAH	Polycyclic aromatic Hydrocarbons
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
FFL	Finished Floor Level
mAOD	metres Above Ordnance Datum
RAP	Remedial Action Plan
VO	Visual/Olfactory Observations
BGL	Below Ground Level

1. Introduction

1.1. Background

Atkins Limited has been commissioned by St. Modwen Developments Ltd (St Modwen) to provide consultancy advice with regard to the redevelopment of the former Llandarcy Oil Refinery as Coed Darcy.

The purpose of this report is to provide data relating to Monitor Phase 70 to confirm the suitability of this area for redevelopment in line with the specific requirements of the S106 in order for St. Modwen to achieve sign off by the Monitor. For the purpose of Monitor sign off, this area is proposed as Monitor Phase 70, as shown on Drawing 5041216-REM-DWG-1951.

This document represents an updated version of an earlier report and takes into account Monitor comments in RFI0150 dated 25th June 2015 and a programme of reclamation works.

Based upon the current Masterplan, Monitor Phase 70 is shown as an area of proposed residential housing in the final development. Further to discussion with St. Modwen, however, the following assessment assumes a commercial end use within the final development, in terms of comparison with the requirements of the S106.

In the absence of detailed information relating to any proposed layout and/or finished floor levels (FFL) across this area, the following assessment assumes that existing ground levels represent a depth of 1m below FFL for the purpose of comparison with the requirements of the S106.

1.2. Aims and Objectives

This report provides an overview of the site including information regarding the site setting, local geology and hydrogeology, identified contamination and discussion of remedial works undertaken.

In the long term, it is anticipated that the suitability of land quality will need to be reassessed once detailed development proposals for each area are defined. Planning Condition 44 of the Outline Planning Permission for the site (P2005/0393) requires that:

Prior to the submission of the first reserved matters application on each phase of development, notwithstanding the provisions of Condition 26, a phase specific remediation strategy focusing upon the remediation requirements of that area shall be submitted to and approved in writing by the Local Planning Authority. The submitted documents shall include the results from the site investigation and risk assessment; and using the above information a method statement shall be submitted detailing remediation measures and a detailed programme for the submission of verification reports upon completion of the remedial works confirming implementation of agreed measures, together with proposals for future monitoring and reporting. The approved details shall be fully implemented on site, in line with a schedule of works that shall form part of the details submitted to the Local Planning Authority for approval.

In line with the detailed information relating to historical and recent ground investigation and laboratory analysis for Monitor Phase 70 as provided in the following report, it is envisaged that this document would form part of any later planning submission for this part of the site in line with the requirements of Planning Condition 44.

1.3. Scope of Work

The scope of works includes:

- A review of all readily available information including geological, hydrogeological, historical site plans, Environment Agency and British Geological Society (BGS) records;
- A review of available historical maps relating to Monitor Phase 70 and adjacent areas;

- A review of historical (1998-2004) and recent (2014) ground investigation information relating to Monitor Phase 70;
- Comparison of the available ground investigation information and laboratory data against the requirements of the S106, specific to a proposed commercial end use for Monitor Phase 70.
- Details of any remedial works undertaken, and
- Details of all validation in order to confirm that the remedial works were successfully carried out and to demonstrate that this area is now suitable for use in line with the required criteria.

1.4. Soil Quality Assessment Standards

To maintain consistency of approach, the assessment standards for historical and recent data are those stated in the S106 Agreement for Coed Darcy. The visual and aesthetic classification system, as previously defined by BP within the S106, is provided as Table 1.1.

Atkins proposes to continue this system for the classification of all soils encountered aesthetic impact to aid assessment of each area in terms of the required remediation requirements. The assigned classifications for each strata are quoted on the trial pit logs for recent ground investigation by Atkins (refer to Section 5).

Table 1.1 i Scale of Aesthetic Criteria

Class	Visual	Olfactory
0	No visible staining of soil, no visible suspect ACM*.	No detectable odour on soil.
1	Occasional staining of soil, no visible suspect ACM*.	Faint odour on soil.
2	Frequent staining of soil.	Distinct but not strong odour on soil.
3	Occasional heavy staining of soil.	Strong odour on soil.
4	Heavy staining of soil.	Strong odour discernible in ambient air.
5	Visible hydrocarbon present.	Overwhelming odour.

* visible suspect ACM refers to asbestos containing material visible to the naked eye which a reasonable and prudent person used to managing asbestos may suspect to be asbestos-containing.

The S106 for the proposed development presents a series of Risk Based Screening levels (RBSLs). These levels are defined in the S106 as being the 'minimum base level standard' for redevelopment remediation works (Schedule 8, Part 2, Paragraph 2,5).

In order to update the assessment of contamination in line with current UK guidance, these RBSLs are also now supplemented by a series of Remedial Target Concentrations (RTCs) derived by Atkins (Atkins reference: 5041216-REM-REP-000476 v1). A summary of the adopted thresholds for Monitor Phase 70 are presented in Appendix A.

Details of the required frequencies of testing, as stated within the S106, are presented in Section 7.

Compliance with the redevelopment remediation requirements stated within Schedule 8 of the S106 (refer to Section 4) form the basis for obtaining the relevant sign off from the Monitor.

1.5. Information Sources

Information, reviewed as part of the following assessment, has been obtained from the following sources:

- URS BP Llandarcy Refinery Desk Study 44382742/BRRP0001, July 2007
- URS Report FR1287 Final Factual Report for Ground Investigation, August 2005

- Section 106 Deed of Planning Obligations (Dewey & LeBoeuf report GNP/NJR/13773-2), February 2008

1.6. Limitations

As previously indicated, this report has been prepared with the sole intention of providing sufficient information to enable St. Modwen to obtain Monitor sign off for Monitor Phase 70 in accordance with criteria set out in the Coed Darcy Section 106 Agreement. Whilst the report may be relevant for submission as part of a reserved matters planning application, additional reports and submissions will be required as part of any future plot development.

The investigation works undertaken and summarised within this report represent a sampling exercise to determine ground conditions, in line with the required methodology outlined within the S106. The proposed works were carried out predominantly to investigate contamination across this area and do not include a review of any geotechnical issues or constraints that may exist which would need to be taken into account as part of any proposed redevelopment.

In addition, it should be noted that ground and groundwater conditions can vary over time and between sampling points. Whilst this report provides information relating to the removal of identified pipework and below ground structures encountered during the works, unidentified pipework and/or structures may still exist in situ.

2. The Site

2.1. Location and Description

Monitor Phase 70 is an irregular shaped parcel of land within the central part of the former refinery and covering approximately 4.29ha (hectares). The location of Monitor Phase 70 is shown on Drawing 5041216-REM-DWG-1951.

Monitor Phase 70 is characterised by a sloping topography with an elevation of approximately 49 metres above ordnance datum (mAOD) in the north east and 66mAOD in the south west. A topographical survey of the area is presented as Drawing-ATK-DR-C-REM-2075. Historical infrastructure and surface hardstanding has been cleared from this area.

2.2. Historical Land Use

Construction of Llandarcy Oil refinery commenced in 1917 but was temporarily suspended during the war due to the lack of men and resources. Construction started again in 1919 with production beginning in 1921. The refinery was officially opened in 1922.

The purpose of the refinery was to produce motor spirit, kerosene, gas fuel oil, fuel residue and lubricating oil and wax from imported crude oil. Between the wars, the oil industry developed rapidly. By 1939, the refinery had little of the original plant in operation.

In the mid 1980's a number of rationalisations occurred with the closure of the refinery being formally announced in 1997.

Based upon the information in URS Report 44382742/BRRP0001, a range of infrastructure was historically located within Monitor Phase 70. Workshops associated with boiler house maintenance were partially located in the north of Monitor Phase 70 from the early-1950s to the early-1970s. Meter workshops, used for the repair, storage and maintenance of flow meters and pressure gauges, were located in the east of the Phase until the early 1970s when they demolished and replaced with a gas-fired power station.

The south eastern part of Monitor Phase 70 was formerly occupied by sump separators, used locally for process plant from the early-1950s to the end of the 1980s, an electricity substation, the No.2 Crude Distillation Unit (CDU) and the stabiliser building. The Catalytic Cracking Plant was partially located in the south of Monitor Phase 70 from the mid-1950s to the late-1980s. The western part of Monitor Phase 70 was occupied by the No.1 CDU from the early 1950s to the early 1970s, the lime water washeries and the No.2 vac unit.

Tanks and above ground infrastructure were removed from Monitor Phase 70 prior to acquisition of the refinery by St. Modwen in 2008. It is not known, therefore, what condition these were in when they were removed in terms of the potential for historical spillage and leakages within this area.

Detail relating to historical land use within Monitor Phase 70 is shown on Drawing 5041216-REM-DWG-1952.

2.3. Published Geology

A review of published geological information (BGS map 247, Swansea 1:50,000 scale) indicates Monitor Phase 70 to be underlain by:

- Till (Diamicton), a heterogeneous deposit of glacial origin; and
- Pennant Sandstone Formation, specifically the Hughes Member which is described by the BGS as *'green-grey, lithic arenites ("Pennant sandstones") with thin mudstone/siltstone and seatearth interbeds and mainly thin coals'*.

2.4. Hydrogeology and Hydrology

2.4.1. Groundwater

Environment Agency data suggests that the Till (Diamicton) underlying Monitor Phase 70 is classified as 'Unproductive Strata'. These are defined as:

'...rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.'

The underlying sandstone bedrock is classified as a 'Secondary A Aquifer'. This is defined as:

'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.'

The groundwater contours presented by URS in FR1287 indicate that the groundwater flow in drift is radial from a recharge area located within the School Plot, and to the north-north east within bedrock.

2.4.2. Surface Waters

South Site Reservoir is located approximately 340m to the north west, Crymlyn Bog is located approximately 400m to the west and the containment area lagoons are located approximately 650m to the south west of Monitor Phase 70.

2.5. Landfills and Waste Management Facilities

The Containment Area (see 2.4.2 above) has been previously used by BP for historical landfilling activities.

Atkins is currently in the process of remediating the landfill associated with the former Llandarcy Oil Refinery and are in ongoing discussion with Natural Resources Wales relating to the surrender of Environmental Permit No. EPR/AP3990LR.

2.6. Sensitive Land Uses

Crymlyn Bog is a Site of Special Scientific Interest (SSSI), located within the flood plain of the Neath river estuary and represents the most extensive area of lowland fen in Wales. The Bog lies approximately 400m to the west of Monitor Phase 70.

Crymlyn Bog SSSI is internationally important for its very wet mires often identified by an unstable 'quaking' surface. Bottle sedge and bogbean are important components of some stands, together with common cottongrass, water horsetail, star sedge, mud sedge, and in places, the nationally rare slender cottongrass. Crymlyn Bog supports the largest area of calcium-rich fen dominated by great fen sedge vegetation in south Wales. Some of these stands are dominated by great fen sedge, but other areas display a more diverse vegetation in which tufted-sedge, royal fern and a range of tall-herb fen species are prominent. Some of these stands are unique in a Welsh context. In addition there are areas of wet woodland with alder and willow being the dominant species (<http://www.ccg.gov.uk/landscape--wildlife>).

3. URS Historical Ground Investigation

3.1. Recorded Ground Conditions

3.1.1. General

Records have been reviewed for 41 historical exploratory holes reported to have been excavated by URS within Monitor Phase 70 on behalf of the previous site owner, BP. The locations of known exploratory holes are presented on Drawing 5041216-REM-DWG-1953.

The exploratory holes were excavated between 1998 and 2004 as part of a series of investigations across the former refinery (URS Report FR1287).

3.1.2. Ground Condition Summary

3.1.2.1. Made Ground

Made Ground is recorded to have been encountered in 40 of the 41 exploratory holes historically and is generally described as being both granular and cohesive, comprising a mixture of reworked glacial material. Varying quantities of clay, silt, sand and gravel matrices included different frequencies of cobbles and boulders. Rare glass fragments, ceramic tiles, cables, steel pipes and wood fragments were also encountered. The composition/provenance of gravel and cobbles included sandstone, limestone, brick, coal, clinker, concrete and tarmac. Made Ground was encountered to a maximum depth of 4.0m below ground level (m bgl) in MSMW57, located in the central east of Monitor Phase 70.

The presence of ash was noted in seven exploratory hole locations. The location of ash and the depth encountered are noted below.

- MSTP164 (0.00-0.15m bgl);
- MSTP171 (0.40-0.70m bgl);
- MSTP183 (0.02 – 0.45m bgl);
- MSMW57d (0.40-2.00m bgl);
- WSMW059 (0.75-0.95m bgl);
- WSMW061 (0.0 – 0.5m bgl); and
- WSTP089 (0.2 – 0.6m bgl).

3.1.2.2. Drift Geology

Natural soils beneath Monitor Phase 70 were found in 22 exploratory holes. Natural soils encountered were noted to be variable, comprising varying quantities of clay, silt, sand and gravel. Sand was noted to be fine to medium. Varying quantities of fine to coarse angular to rounded gravel, sub-angular cobbles and boulders were identified during excavation including sandstone.

Natural soils were encountered at a maximum thickness of 8.1m bgl in WSMW061, in which natural soils were reported between 0.5m to 8.6m bgl.

3.1.2.3. Bedrock Geology

Bedrock was encountered in five exploratory holes during historical investigation, at depths ranging between 1.5m bgl (WSTP028 in the south of Monitor Phase 70) and 13.0m bgl (MSMW57 located in the central east of Monitor Phase 70 – it is noted that this appears to be a drillers' log and weathered bedrock may have been encountered at a shallower depth than 13.0m bgl). In line with the topography, the depth to bedrock generally increases towards the north.

Where encountered, bedrock was described as weak to moderately strong light grey to grey brown fine to medium grained highly weathered sandstone.

3.1.2.4. Water Strikes

Water was encountered historically in 29 exploratory holes across Monitor Phase 70 and range from damp strata to 'rapid ingress'. The depths of the water strikes is reported to have ranged from 0.2m to 4.0m bgl. A groundwater strike was recorded in deep borehole MSMW57 in competent bedrock at 14m bgl.

Water was encountered within the Made Ground, drift and bedrock geology, inferring the presence of both perched water in addition to the true groundwater beneath Monitor Phase 70.

3.2. Soil and Groundwater Contamination

3.2.1. Introduction

A review of the historical logs and laboratory analytical data for Monitor Phase 70 has been undertaken and recorded visual and olfactory evidence of contamination and free product is summarised below.

3.2.2. Visual and Olfactory Evidence of Contamination

Visual and olfactory evidence of contamination was identified in 30 historical exploratory holes across Monitor Phase 70 and ranged from the hydrocarbon staining and sheens to free product, and slight to strong hydrocarbon odours.

3.2.3. Free Product

Free product was identified in the following historical exploratory holes, located across Monitor Phase 70:

- WSMW015 was noted to be damp with patches of black tar at approximately 0.30m bgl in Made Ground;
- WSMW017 encountered free product within superficial deposits at 3.5 and 4.0m bgl.
- WSMW030 encountered free product between 7.0 and 7.5m bgl on groundwater within bedrock.
- WSMW059 encountered free product on perched water within Made Ground at approximately 1.5m bgl.
- WSTP031 encountered free product on a water seepage within Made Ground at 0.5m bgl.
- WSTP032 observed free product on a perched water ingress at 1.8m bgl within Made Ground on a concrete obstruction.
- WSTP089 encountered free product on water at approximately 1.3m bgl in superficial deposits.

Free product was not encountered in any boreholes located in Monitor Phase 70 during subsequent groundwater monitoring.

3.2.4. Soil Contamination

From the available laboratory data for the historical exploratory holes excavated across Monitor Phase 70, heavy end hydrocarbon contamination would appear to be more prevalent than light end hydrocarbon contamination.

There were no exceedances of the Risk Based Screening Level (RBSL) for deep (>1m) soils in a commercial land use.

3.2.5. Groundwater Contamination

Laboratory data for groundwater sampling (URS Report FR1287) confirmed the prevalence of mid to heavy end hydrocarbons across this area.

There were no exceedances of the groundwater RBSL for a commercial land use in the samples taken.

3.2.6. Exclusion Areas / Special Process Areas

Based upon the findings of the previous ground investigation, there are four designated Special Process Areas within Monitor Phase 70. The Special Process Area, named as '18 – TPH Top Terrace Dissolved' is located in the south west of Monitor Phase 70, '33 – Substation 3' is located in the north of Monitor Phase 70, '37 – Separator A' is located in the east of Monitor Phase 70 and '64 – Boiler House Workshop' is located north of Monitor Phase 70. The location and extent of this is shown on Drawing 5041216-REM-DWG-1952.

Locations of historically identified free product during ground investigation correspond roughly with some of the extent of the Special Process Areas. Based on a review of the available historical exploratory hole logs, free product was located in close proximity to Special Process Areas 18, 37 and 64.

4. Requirements under the S106

4.1. Section 106 Deed of Planning Obligations Requirements

The S106 only defines remediation requirements for a single commercial classification and this is based on a **commercial end use where groundwater is in soil** scenario. Following the review of available data, this is not considered to be applicable to Monitor Phase 70 beneath which groundwater has been shown to lie within rock.

It is proposed, therefore, that the stated S106 requirements for a commercial end use where groundwater is in soil are adopted for the following assessment but that the depth of the remediation is defined by the surface of the underlying bedrock rather than being defined by the depth to seasonal groundwater.

Based upon this classification, the following remediation requirements are stated in the S106 (Schedule 8, Section 6.0) as being the minimum remediation requirements required in order to release this area for redevelopment for a commercial end use.

- *All oil saturated soils and soil containing free product other than minor sheens shall be removed to a minimum depth of 2.00m below FFL(Final Finished Level) or 0.50m below the likely lowest seasonal groundwater elevation following development of the intended Urban Village, whichever is the deeper. This depth is to be established by consideration of all available groundwater level monitoring data.*
- *All soils must meet the RBSL for TPH to at least 1m below FFL.*
- *All soils must meet in bulk, considering both dispersed fibres and pieces of ACM, the RBSL for ACM to at least 1m below FFL. Any visible ACM encountered during construction in the first 1m below FFL is to be removed.*
- *Where there is a risk of the migration in the ground of hazardous gas or contaminated liquid into remediated areas, the Developer shall take all appropriate measures to prevent this occurring. Such measures could include the installation of interception trenches and management of discharge from those. The Developer shall monitor whatever measures are put in place after their installation to continue to demonstrate their effectiveness.*
- *Where necessary, seeps, sheens and iron rich discharges from the bedrock must be controlled such that there is no visible discharge at surface and little or no odour. Acceptable methodologies for remediation may include, but are not limited to the use of land drainage via interceptors.*

Schedule 10, Paragraph 6 of the S106 states that 'Irrespective of the Intended Use of each Phase or part thereof, all existing buried services at the Property shall be removed and the routes of those services shall be backfilled with material no more permeable than the general material in the vicinity'.

As previously highlighted, in the absence of detailed information relating to finished floor levels associated with any proposed redevelopment of this area, the following assessment assumes that the current ground levels, shown on Drawing 5041216-ATK-DR-C-REM-2076, represent 1m below FFL.

5. Atkins Ground Investigation

5.1. Introduction

With the aim of supplementing and updating the historical investigation, a total of 321 machine-excavated trial pits were completed across Monitor Phase 70 by Atkins between January 2015 and March 2015.

Environmental Scientifics Group (ESG) was employed by St Modwen, to complete the exploratory holes, under direction from Atkins. Trial pits were advanced to the maximum reach of the excavator, unless terminated on bedrock or obstructions or because of water ingress or collapse. All trial pits were backfilled with arisings in reverse order to which they were excavated, then compacted with the back of the excavator bucket. Excess arisings were left in a mound above the surrounding ground surface to allow for subsequent settlement.

The locations of all recent Atkins trial pits are shown on Drawing 5041216-REM-DWG-1954. Copies of all relevant exploratory hole logs for the recent investigation works by Atkins are presented in Appendix B.

5.2. Recorded Ground Conditions

Made Ground encountered in the recent Atkins trial pits in Monitor Phase 70 was variable in composition, comprising clay, silt, sand, sandstone gravel and cobbles, locally with pockets of ash and clinker. Frequent inclusions of brick and concrete were noted, with rare to occasional inclusions of airbrick, fragments of metal and plastic, cables, slag, macadam, timber. A railway sleeper was encountered in IP3869 in the central south of Monitor Phase 70 and glass was present in IP3941 and IP3943 towards the south east of the Phase. Made Ground was encountered to a maximum depth of 5.50m in IP3943.

Pipework was encountered in situ in nineteen locations across Monitor Phase 70. In TPE3632 located in the north west of the Phase and in TPE3701 located in the west, the pipes were noted to contain free product. The pipe found in TPE3701 was removed from the trial pit before backfilling.

Superficial deposits were encountered within Monitor Phase 70, comprising sandy gravelly clay and silt, clayey, gravelly sand with sandstone cobbles and occasional sandstone boulders. Rare pockets of black fibrous peat were encountered in Monitor Phase 70 and discrete layers of dark brown pseudofibrous peat were encountered predominantly in the eastern corner.

Sandstone bedrock was encountered as a weathered zone comprising clayey angular tabular sandstone gravel, cobbles and boulders. Competent bedrock, on which excavation was terminated, was encountered at ground level in TPE3691 and TPE3692 in the south west of Monitor Phase 70.

Water strikes were recorded in 43 of the trial pits excavated in Monitor Phase 70. Nine of these were encountered directly overlying concrete hardstanding. In 26 locations, the strikes were recorded as perched water within granular bands of Made Ground and superficial deposits, at depths ranging from 0.3m to 5.0m. Eight water strikes were recorded on competent bedrock or within a zone of weathered sandstone gravel at depths ranging from 1.0m and 4.1m.

Concrete, tarmacadam and brick obstructions were encountered in 78 trial pit locations distributed across MP70. The depth of obstructions ranged from ground level to 3.3mbgl.

5.3. Relict Pipework

Relict pipe work was encountered in fourteen locations within Monitor Phase 70, as summarised in Table 5.1.

Table 5.1 - Summary of Pipe work Encountered in Monitor Phase 70

Location	Depth (mbgl)	Comments
IP3839	0.8m	Metal Pipe
IP3904	1.5	Metal Pipe
IP3905	1.5	Concrete Pipe
IP3914	1.1	Concrete Pipe
IP3932	1	Concrete Pipe
IP3997	0.5	Metal Pipe
IP3998	0.4	Pipe
IP4078	0.4	Metal pipe 200mm diameter
TPE3601	1.0	Metal Pipe
TPE3631	0.3	Metal pipe 500mm diameter
TPE3681	1.3	Metal Pipe 300mm diameter
TPE3701	0.8	Metal Pipe 200mm diameter (removed)
TPE3755	2.5	Metal Pipe 100mm diameter
TPE3884	2	Clay Pipe 100mm diameter

5.4. Soil and Groundwater Contamination

5.4.1. Visual and Olfactory Evidence of Contamination

A review of the logs for the 321 trial pits recently excavated within Monitor Phase 70 shows that visual and/or olfactory evidence of contamination was identified in 237 locations.

In five trial pit locations the classification of visual contamination was recorded as '5'. Four of these trial pits were located in the north west of Monitor Phase 70, and one in the south.

Observations of 'oil' and 'oily water' were made in trial pits IP4038 and TPE3601 respectively. Hydrocarbon sheens were identified in IP3926, IP4021, IP4043 and TPE3756. These trial pits were located in the south east and west of Monitor Phase 70.

These locations where the V/O classification was recorded as a '5' are summarised in the table 5.2 below.

Table 5.2- Summary of the locations where Visual and Olfactory classification was recorded as 5

Trial Pit	Depth (m bgl)	Visual and Olfactory Evidence of Contamination
TPE3626	0.3 - 1.3	VO 5,4 Black staining on clayey gravelly sand. Black seepage at 1.0mbgl
TPE3683	0.3	VO 5,5 Heavy hydrocarbon staining under concrete. Water flow at 0.3mbgl stained black.
TPE3628	0.0 - 0.4	VO 5,4 Frequently stained black sandy clayey gravel. Hydrocarbon on water inflow at 0.3mbgl

Trial Pit	Depth (m bgl)	Visual and Olfactory Evidence of Contamination
TPE3699	1.2 - 2.6	VO 5,5 Frequently stained black gravelly sandy clay.
TPE3714	1.0 -2.2	VO 5,3 No description of visual or olfactory contamination.
IP4038	3.4	Oil on water inflow at 3.4mbgl.
TPE3601	1.0	Oily Water ingress. Possibly associated with pipe.
IP3926	2.0	Hydrocarbon Sheen on groundwater
IP4021	2.6	Hydrocarbon Sheen on groundwater
IP4043	2.0	Hydrocarbon Sheen on groundwater
TPE3756	2.9	Hydrocarbon Sheen on groundwater

5.5. Laboratory Analysis

A total of 745 soil samples representing identified soils from across Monitor Phase 70 were submitted to Alcontrol Laboratories and analysed for a suite of contaminants considered appropriate for the range of historical infrastructure formerly present.

Due to the uncertainty over final floor levels, a generic suite comprising the majority of determinands listed in the RBSLs, was scheduled on all soil samples collected during the ground investigation.

Once determined, should final floor levels be proposed to lie at or below the current ground levels, the availability of this additional data will enable a reassessment of the relevant data without the need for further investigation and/or additional sampling.

The analytical suite comprised:

- Metals - arsenic, cadmium, chromium, copper, lead, nickel, mercury, selenium, vanadium, zinc (all samples);
- pH (all samples);
- Polycyclic Aromatic Hydrocarbons (all samples);
- Speciated Total Petroleum Hydrocarbons plus BTEX hydrocarbons (all samples);
- Soil Organic Matter (selected samples);
- Asbestos screen and identification (samples within top 1m of existing ground level only, assuming that current levels represent 1m below FFL and the asbestos RBSL does not apply at depths greater than 2m below FFL in any land use scenario).

The achieved frequency of testing, based on the recent trial pitting, is discussed in Section 7.

Trial pits IP3927, IP3928 and IP3929 were situated within the footprint of a historic substation (No.3) (see Historical layout plan – 5041216-REM-DWG-1952). A total of 14 samples were taken from these locations and scheduled for PCBs.

5.5.1. Comparison with Risk Based Screening Levels

There were no recorded exceedances of the Risk Based Screening Levels (RBSL) for deep soils in a commercial land use recorded in MP70.

The results from the 14 samples scheduled for PCB analysis reported no detects for any of the 12 PCB congeners analysed. A total of 264 samples underwent laboratory analysis for asbestos and loose asbestos fibres were detected in 169 samples taken from trial pits in Monitor Phase 70.

As previously highlighted, the following assessment is based upon the assumption that existing ground levels across Monitor Phase 70 represent 1m below FFL for the purpose of comparison with the requirements of the S106. Based on this assumption, existing soils across this area would lie at depths greater than 1m within the final development.

In line with the adopted scenario of a 'commercial end use where groundwater is in soil' (refer to section 4), there are no permitted thresholds for asbestos at depths >1m below FFL and soils are thus considered suitable for retention.

Drawing 5041216-REM-DWG-2109 presents the trial pit locations of obstructions, '5' VO classifications, hydrocarbon sheens and free product, and relict pipe work recorded within Monitor Phase 70.

Of the 169 samples that were found to contain asbestos fibres in the initial screen, three were found in excess of 1% (TPE3595, TPE3706 and TPE3880). In addition localised surface deposits of visible asbestos was noted. Although there are no specific asbestos limits for a commercial end-use >1m FFL these results were used to safely manage the reclamation works described below (Section 6).

6. Reclamation and Remediation Works

6.1. Post Investigations Actions in Accordance with Section 106

Recent trial pitting works across Monitor Phase 70 identified the following issues requiring further investigation and/or removal in order to meet with the requirements of the S106, as summarised in Section 4.

- The presence of obstructions preventing the investigation of underlying material;
- The presence of free product;
- Elevated aesthetic criteria scores; and
- The presence of pipework identified in situ during the trial pitting.

In the absence of a full 'turnover' of soils across all of Monitor Phase 70, the potential for remaining concrete/brickwork within this area exists. The removal of relict below ground structures from across this area does not form a requirement of the S106 and is, therefore, outside of the scope of these works.

Issues that have been identified as requiring further investigation and/or removal are shown on Drawing 5041216-REM-DWG-2109.

6.2. Site Reclamation

Since the ground investigation was completed in early 2015, Monitor Phase 70 has undergone significant re-profiling works in order to achieve the proposed planning levels of the major roads surrounding the plot.

This re-profiling has largely consisted of the bulk removal of approximately 62,000m³ of material from across Monitor Phase 70 to reach levels of approximately 1m below FFL. The required remedial works identified in this section were undertaken alongside the re-profiling exercise across Monitor Phase 70. As such there is a much higher level of assurance that pipework and historic structures, together with materials deemed unsuitable for a proposed commercial end use have been removed. In particular, the majority of the identified concrete and other structural remnants have been broken out and removed.

The spreadsheet presented in Appendix F shows the depth of recorded obstructions, relict pipework and exceedances of the aesthetic criteria compared with the re-profiled level.

Pre and post reclamation levels are provided as drawings 5041215-ATK-DR-C-REM-2075 and 2076 respectively. A cut and fill isopachyte is shown on drawing 5041216-ATK-DR-C-2128.

6.2.1. Removal of Relict Pipework

Relict pipework was encountered in fourteen locations during the ground investigation. In thirteen of these locations the pipes were removed as part of the phase-wide re-profiling work. In the location of IP3997, the scope of the re-profiling work did not extend to a sufficient depth to remove the pipework. Additional excavation was carried out at this location. Photographs of this excavation are included in Appendix E.

Table 7.2 Summary of pipes removed from MP70

Location	Depth Of Pipe (m bgl)	Original Ground Level (mAOD)	Elevation of Pipe (mAOD)	Current ground level (mAOD) (1m below FFL)	Validation
IP3839	0.80	62.139	61.339	59.477	Pipework removed during re-profiling.
IP3904	1.50	57.435	55.935	53.035	Pipework removed during re-profiling.

Location	Depth Of Pipe (m bgl)	Original Ground Level (mAOD)	Elevation of Pipe (mAOD)	Current ground level (mAOD) (1m below FFL)	Validation
IP3905	1.50	57.179	55.679	52.979	Pipework removed during re-profiling.
IP3914	1.10	57.952	56.852	55.168	Pipework removed during re-profiling.
IP3932	1.00	57.224	56.224	54.624	Pipework removed during re-profiling.
IP3997*	0.50	49.657	49.057	49.657	Additional excavation required – pipework encountered at 0.20m depth and removed. No samples taken. No further action proposed.
IP3998	0.40	49.885	49.485	49.285	Pipework removed during re-profiling.
IP4078	0.40	53.045	52.645	47.833	Pipework removed during re-profiling.
TPE3601	1.00	62.759	61.759	60.959	Pipework removed during re-profiling.
TPE3631	0.30	59.392	59.092	55.392	Pipework removed during re-profiling.
TPE3681	1.30	59.186	57.886	57.786	Pipework removed during re-profiling.
TPE3755	2.50	59.128	56.628	54.528	Pipework removed during re-profiling.
TPE3884	2.00	51.296	49.296	48.496	Pipework removed during re-profiling.

6.2.2. Visual and Olfactory Evidence of Contamination

In nine locations the visual and olfactory classification for material was recorded to be a '5' and therefore potentially indicative of the presence of free phase and oil soaked soil in excess of those acceptable for a commercial end use. At the majority of these locations the impacted material was removed as part of the phase-wide re-profiling work. In two locations, further investigation was required. The works carried out are summarised below in Table 7.3 and photographs are included in Appendix E.

Table 7.3 Summary of the removal of unacceptable material

Trial Pit	Visual and Olfactory Evidence of Contamination	Depth (m bgl)	Original Ground Level (mAOD)	Elevation of V/O failure (mAOD)	Re-profiled Ground level (mAOD)	Validation
TPE3626	5/4 Black staining on clayey gravelly sand. Black seepage at 1.0mbgl	0.30-1.30	60.879	59.579	57.644	Impacted soils removed as part of the re-profiling. New ground level visually inspected, No free product or oil-saturated soils present. Soils suitable for retention.
TPE3683	5/5 Heavy hydrocarbon staining under concrete. Water flow at 0.3mbgl stained black.	0.30	60.771	60.471	58.971	Impacted soils removed as part of the re-profiling. New ground level visually inspected, No free product or oil-saturated soils

						present. Soils suitable for retention.
TPE3628	5/4 Frequently stained black sandy clayey gravel. Hydrocarbon on water inflow at 0.3mbgl	0.00 - 0.40	60.577	57.377	55.391	Impacted soils removed as part of the re-profiling. New ground level visually inspected, No free product or oil-saturated soils present. Soils suitable for retention.
TPE3699	5/5 Frequently stained black gravelly sandy clay.	1.20 - 2.60	62.251	59.651	58.912	Impacted soils removed as part of the re-profiling. New ground level visually inspected, No free product or oil-saturated soils present. Soils suitable for retention.
TPE3714*	5/3 No visual or olfactory description of contamination.	1.00 - 2.20	53.104	50.904	51.87	Additional investigation undertaken. Maximum assigned VO score of 3,3. Soils suitable for retention.
IP4038*	Oil on water inflow at 3.4mbgl.	3.40	49.128	45.628	54.182	Additional investigation undertaken. Maximum assigned VO score of 3,3. Soils suitable for retention.
TPE3601	Oily water ingress. Possibly associated with pipe.	1.00	62.759	61.759	60.959	Pipe and adjacent impacted soils removed as part of re-profiling. No free product or oil-saturated soils present. Soils suitable for retention.
IP3926	Hydrocarbon sheen on groundwater	2.00	55.966	53.966	53.166	No free product or oil-saturated soils present. Soils suitable for retention.
TPE3756	Hydrocarbon sheen on groundwater	2.90	59.789	56.889	55.389	No free product or oil-saturated soils present. Soils suitable for retention.

6.2.3. South West Corner i Observations and Actions

6.2.3.1. Observations

V/O failures were observed within IP4141, IP4128, IP4129 during the ground investigation of the adjacent Monitor Phase33. On exposure during reclamation the area of impact appeared more extensive and extended westwards over the boundary into Monitor Phase 70. Exposed soils were noted to display strong pungent odours with a characteristic burnt chicken/sewage odour. The soils, although appearing natural and undisturbed, appeared wet on excavation with a grey brown colour and exhibited a 'tarry' texture which flowed under gravity.

Chemical analysis during the investigation and following exposure during reclamation indicated a mix of refinery related hydrocarbons and some additional compounds which were measured as tentatively identified compounds (TICS) during analysis. These compounds were:

- 2-methylphenol,

- 4-methylphenol
- 2-Methylnaphthalene
- Dimethyl disulphide,
- Methyl ethyl disulphide
- Diethyl disulphide.

The disulphide compounds especially could be linked to the characteristic odours. Their occurrence on the site could be linked to refinery operations and more precisely to historical process plant located immediately north-west of the site.

No screening values existed for these compounds and Atkins were commissioned to derive site specific screening criteria. Atkins report 5041216/REM/RPT/1455 provides information on the derivation of screening values. This report has been submitted to the Coed Darcy Monitor previously.

6.2.3.2. Remediation

Removal of this material was considered appropriate on account of its unusual physical characteristics and its strong odours. Removal was commenced on a visual basis and was undertaken as part of the general reclamation works.

An approximate area of removal is indicated on drawing 5041216-ATK-DR-C-REM-DWG-2118. Excavations proceeded to levels where impacted material was no longer evident and the V/O score was 2/2 or better. Although predominantly across Phase 33 excavation was also undertaken across the Monitor Phase 70/Monitor Phase 33 boundary, which provided confidence that the likelihood of cross boundary recontamination would be minimised.

Excavated materials were taken off Monitor Phase 70 and 33 to a segregated area on the Coed Darcy treatment pad to await additional testing prior to treatment.

6.2.3.3. Validation

Validation across the previously impacted south west area was undertaken on a V/O basis and by chemical testing.

Visual and Olfactory

A walkover survey was undertaken by Atkins on 15th September 2015. The V/O score across the reclaimed Monitor Phase 70 profile on completion was 2/2 or better. The odours present were largely mild petroleum hydrocarbon odours rather than the pungent odours noted above.

Chemical Testing

Given that there were no specific failures during the investigation, a post excavation sampling exercise was undertaken across a wide area of plausible impact, including the area specifically targeted for excavation. Thirty soil samples (SL001 – SL0030) were recovered by shallow excavation in exposed soil including at ten locations within the area of highest impact before excavation. The sampling locations are shown on drawing 5041216-ATK-DR-C-REM-DWG-2118. The screened chemical test results are presented in Appendix D.

No exceedances of the original RBSLs (>1m below FFL commercial criteria) were recorded. It is noted that screening against the >1m below FFL residential criteria also only registered one modest failure, for benzene at locations SL0025 and SL00026 both of which are not located within Phase 70.

In relation to the previously identified compounds there were no detections of these compounds at any of the sampling locations.

6.2.4. Obstructions

Concrete, tarmac and brick obstructions were encountered in 78 trial pit locations. The location, depth and type of the obstruction are listed in Appendix F.

Where obstructions were encountered in clusters, further investigation has been carried out through or beneath obstructions, as summarised in Table 7.4. Investigation was carried out in areas referred to as A, B, C, G, H and I. as shown on Drawing 5041216-ATK-DR-C-REM-2111.

A total of eleven additional trial pits were excavated following removal of obstructions and a total of 35 samples of underlying material were obtained for laboratory analysis.

Review of the results of laboratory analysis of these samples identified no RBSL failures for deep soils in a commercial end use.

Table 7.4 Summary of Additional Investigation beneath obstructions

Group ID	Brief Description	No. of additional pits	Investigative/Remedial Work	Testing /Validation
A	Concentrated cluster of trial pits terminated on obstructions in the south east part of MP70. Indicative of a structure base.	3	Structure has been removed as part of the re-profiling work. Prior to its removal, a concrete breaker was used to excavate through the structure to obtain samples of the underlying material.	Testing results from 3 trial pits excavated through the structure found no exceedances of the adopted RBSLs. The visual V/O classification of the underlying material was recorded no higher than 3. Results of this testing are provided in appendix D.
B	Large area of concrete obstructions, but not continuous. Trial pits between obstructed pits were able to obtain samples from depth.	N/A	Concrete structures were removed in June 2014. Heavily impacted material with a high VO score underlying the structures was removed.	The area was validated by a VO inspection following the removal of the structures. The remaining material has been V/O classified as 2/2 or lower.
C	Concentrated cluster of trial pits terminated on obstructions in the south east part of MP70. Indicative of a structure base.	2	Structure has been removed as part of the re-profiling work. Prior to its removal, a concrete breaker was used to excavate through the structure to obtain samples of the underlying material.	Testing results from 2 trial pits excavated through the structure are provided in appendix D. There were no exceedances of the adopted RBSL thresholds. The Highest V/O classification assigned to this material was 4/4,
G	Linear cluster of trial pits terminated on obstructions in the south east part of MP70. Indicative of a former road.	2	Structure has been removed as part of the re-profiling work. Prior to its removal, a concrete breaker was used to excavate through the structure to obtain samples of the underlying material.	Testing results from 2 trial pits excavated through the structure are provided in appendix D. There were no exceedances of the adopted RBSL thresholds. The visual V/O classification of the underlying material was recorded no higher than 3.
H	Concentrated but discontinuous cluster of trial pits terminated on obstructions in the south east part of MP70. Indicative of structures.	2	Structures have largely been removed as part of re-profiling works	Testing results from 2 trial pits excavated through the structure are provided in appendix D. There were no exceedances of the adopted RBSL thresholds. The visual V/O classification of the underlying material was recorded no higher than 4.
I	Concentrated cluster of trial pits terminated on obstructions in the south east part of MP70. Indicative of structures	2	Structure has been largely removed as part of the re-profiling works. Prior to removal concrete breaker was used to obtain samples of the underlying material .	Testing results from 2 trial pits excavated through the structure found no exceedances of the adopted RBSLs. Results of this

Group ID	Brief Description	No. of additional pits	Investigative/Remedial Work	Testing /Validation
				testing are provided in appendix D
Isolated	28 No. isolated locations of concrete obstructions	N/A	Because of the isolated nature of these obstructions they are not considered to be indicative of significant structures. Due to surrounding trial pits there is a reasonable understanding of the surrounding ground conditions and no large areas of uncertainty associated with these obstructions.	Most structures removed as part of the reclamation process.

6.3. Asbestos Assessment

Of the 169 samples that were found to contain asbestos fibres, three were found in excess of 1% (TPE3595, TPE3706 and TPE3880) with some local observances of ACM at the surface. These results although not requiring specific remediation for the proposed end-use scenario were used to safely manage the reclamation works. These areas were fenced off prior to the re-profiling exercise as part of a process of controlled excavation. At the time of writing, these isolated areas are awaiting treatment by a licenced contractor before those areas will be reduced to the required levels.

The isolation of these areas has not prevented the removal of known pipework or unacceptable material identified during the ground investigation.

6.4. Previously Backfilled areas

Drawing No: 5041216-Atk-DR-C REM-2112 highlights two areas of MP70 that have been excavated to bedrock and backfilled with clean validated material. The dust suppression lagoon and south east margin were both excavated during the remediation of the adjacent Monitor Phase 31.

Both of these areas have been backfilled with validated stockpiles of site won material. The validation of the backfill materials used is discussed below.

6.4.1. Dust Suppression Lagoon

The dust suppression lagoon excavation was approximately 4m deep with an area of approximately 1100m². The volume of this excavation is approximately 4800m³. The base of excavation topographic survey is shown on Drawing No: 5041216-Atk-DR-C REM-2112. This excavation was backfilled with material from the following pre-validated stockpiles:

- Stockpile 66- 2,531m³ – 51 Samples taken with a validation frequency of 1 per 50m³.
- Stockpile 107- 6,250m³– 67 Samples taken with a validation frequency of 1 per 93m³. A single exceedance of the asbestos RBSL dictated that this material was placed at the base of the excavation with stockpile 66 used for the top 1m (Final floor level will be made up with a metre of clean imported material prior to development).

The testing results for these stockpiles is provided in Appendix D.

6.4.2. South East Margin

The south east margin of MP70 was excavated to bedrock approximately 3.5m below current ground level. The area shown on Drawing No: 5041216-Atk-DR-C REM-2112 is approximately 2,900m². The volume of this excavation is approximately 10,400m³. A Stockpile of site won material that had been treated ex-situ and homogenised was used to backfill the excavation.

The total volume of the stockpile used was approximately 10,500m³. 90 Samples were taken at a validation frequency of 1 per 117m³. There were no RBSL exceedances in the stockpile for a commercial end use at a depth in excess of 1m.

The testing results for this material is provided in Appendix D.

7. Validation Summary

7.1. Requirements of the S106

The S106 (Schedule 8, Part 3, Section 8) sets out the requirements for validation testing which need to be complied with to enable Monitor sign off as part of the ongoing redevelopment of the former Llandarcy Oil Refinery.

Details of relevant frequencies relating to Monitor Phase 70 are presented in Table 7.1.

Table 7.1 - Minimum Validation Testing Frequencies - Commercial End Use

Testing for the Validation Suite ¹ at the following frequency:	Deeper Soils (Commercial >1m below FFL)
Imported quarried material	1 per 1000m ³ ex situ, composite of 5 regular sub-samples.
Imported soil from verified greenfield site	1 per 500m ³ ex situ, composite of 5 regular sub-samples.
Imported soil from characterised brownfield site ¹	1 per 100m ³ ex situ, composite of 5 regular sub-samples.
0.5-1m below FFL in-situ	Regular grid of 1 per 400m ² , sample over 0.5m depth.
>1m below FFL in-situ	Regular grid of 1 per 400m ² , sample over 0.5m depth.
Stockpiled excavated site materials for re-use	1 per 400m ³ ex situ, composite of 5 sub-samples.
Face of remedial excavations <1m deep	1 per 15m ² , minimum of 1 per face, worst case VO sample.
Face of remedial excavations >1m deep	1 per 15m ² , minimum of 1 per face, worst case VO sample.
Along redundant service excavations	1 per 20m of trench, worst case VO sample.
Soil treated ex-situ and homogenised	1 per 500m ³ ex situ, composite of 5 regular sub-samples.

¹ Validation suite to reflect prior use of the originating brownfield site and the design and purpose of the relevant area of Coed Darcy.

VO = visual/olfactory (i.e. aesthetic) observation

As previously stated, the re-profiled ground level within MP 70 (Drawing 5041216-ATK-DR-C-REM-DWG-2076) represents a level of 1m below FFL for the purpose of comparison with the S106.

7.2. Sampling Frequencies

7.2.1. Ground Investigation

The locations of all exploratory holes are shown on Drawing 5041216-REM-DWG-1954. Relevant exploratory logs are presented in Appendix B.

A total of 321 no. trial pits were undertaken by ESG within Monitor Phase 70 between January 2015 and May 2015 as part of the ground investigation.

A total of 745 no. environmental samples from Monitor Phase 70 have been subject to laboratory analysis as part of the recent works (refer to Appendix C).

Based on an approximate area of 42,880 m², 321 trial pits equates to an approximate frequency of 134m² which meets with the required frequency of 1 per 400m² for proposed commercial land use. A total of 745 samples equates to an approximate sample validation frequency of 1 test per 58m².

As part of the investigation of the concrete obstructions a further 35 samples were taken to remove the uncertainty of materials beneath significant structures. The inclusion of these samples in the overall data set equates to an approximate sample validation frequency of 1 test per 55m².

12 samples were recovered as a precautionary check across the base of excavation in the area adjacent Monitor Phase 33 were gross V/O contamination was removed.

All of these validation frequencies are compliant with the adopted thresholds and S106 frequency (refer to Table 7.1).

7.3. Summary

A summary of the status of Monitor Phase 70, in line with the requirements of the S106 is presented in Table 7.5 below:

Table 7.5 i Validation Summary

Requirement	Status	Comment
Chemical quality of soils in situ	Complete	Trial pitting and sampling has been undertaken in Monitor Phase 70 to the S106 frequency for validation of soils in situ (refer to Section 7.2.1). Additional coverage has been provided across areas not accessible as part of the main investigation.
VO quality of soils in situ	Complete	A maximum recorded VO of 4 was recorded for retained soils in Monitor Phase 70. This is acceptable in line with the requirements of the S106 for 'deep' use (>1m below FFL) within a commercial area. An area of impact with tarry material across the boundary with Phase 33 was removed and validated at the reclaimed base.
Observations of groundwater for the presence of free phase product	Complete	In general groundwater was not encountered during the works except for what were considered localised perched bodies. Material recorded during the ground investigation as containing free product (TPE3628 & TPE3699) has been removed as part of the re-profiling work. Where the record of free product was noted to be deeper than the re-profiling (TPE 3714) an additional exploratory hole was excavated at this location and recorded no groundwater seepages.
Chemical and VO quality of imported material	Complete	Material used in the backfill of the south east margin and the dust lagoon have been validated for a commercial end use at a depth greater than 1m below FFL. Chemical testing results for this material is provided in Appendix D.
Compliance with adopted thresholds	Complete	A re-profiling exercise has been undertaken across MP 70, as part of this work, material has been removed from locations where exceedances of the adopted thresholds were recorded (refer to Section 7.5). Remaining soils within Monitor Phase 70 have been shown to be suitable for retention.
Removal of oil saturated soils	N/A	No oil-saturated soils were encountered in Monitor Phase 70.
Asbestos Assessment	Complete	A high fibre content (>0.1%) was found in three samples and there were local ACM observations at the surface, the locations of these samples have been fenced off awaiting removal by a licenced contractor. Notwithstanding, the assessment which has been carried out assumes a depth >1m below FFL and the site is considered compliant with the requirements of the S106.
Control of seeps, sheens and iron staining from bedrock	Complete	Minor oil seepages and sheen were initially noted emanating from the exposed bedrock in the west of MP70. Over the course of the works these seepages have been monitored (3 months) and noted to have stopped and therefore do not to require control measures to prevent discharge at the surface.

8. Conclusion

Atkins has been commissioned by St Modwen Developments Ltd to undertake an assessment of an area of the former refinery with a view to enabling Monitor sign-off for this area in terms of a proposed commercial end use. For the purpose of Monitor Sign off, this area shall be referred to as Monitor Phase 70.

Based upon the findings of recent investigation and in line with the scope of recent remedial works undertaken, this area has been validated in accordance with the S106 and Monitor Phase 70 has been deemed to be suitable for commercial end use >1m bgl in line with the requirements of the S106.

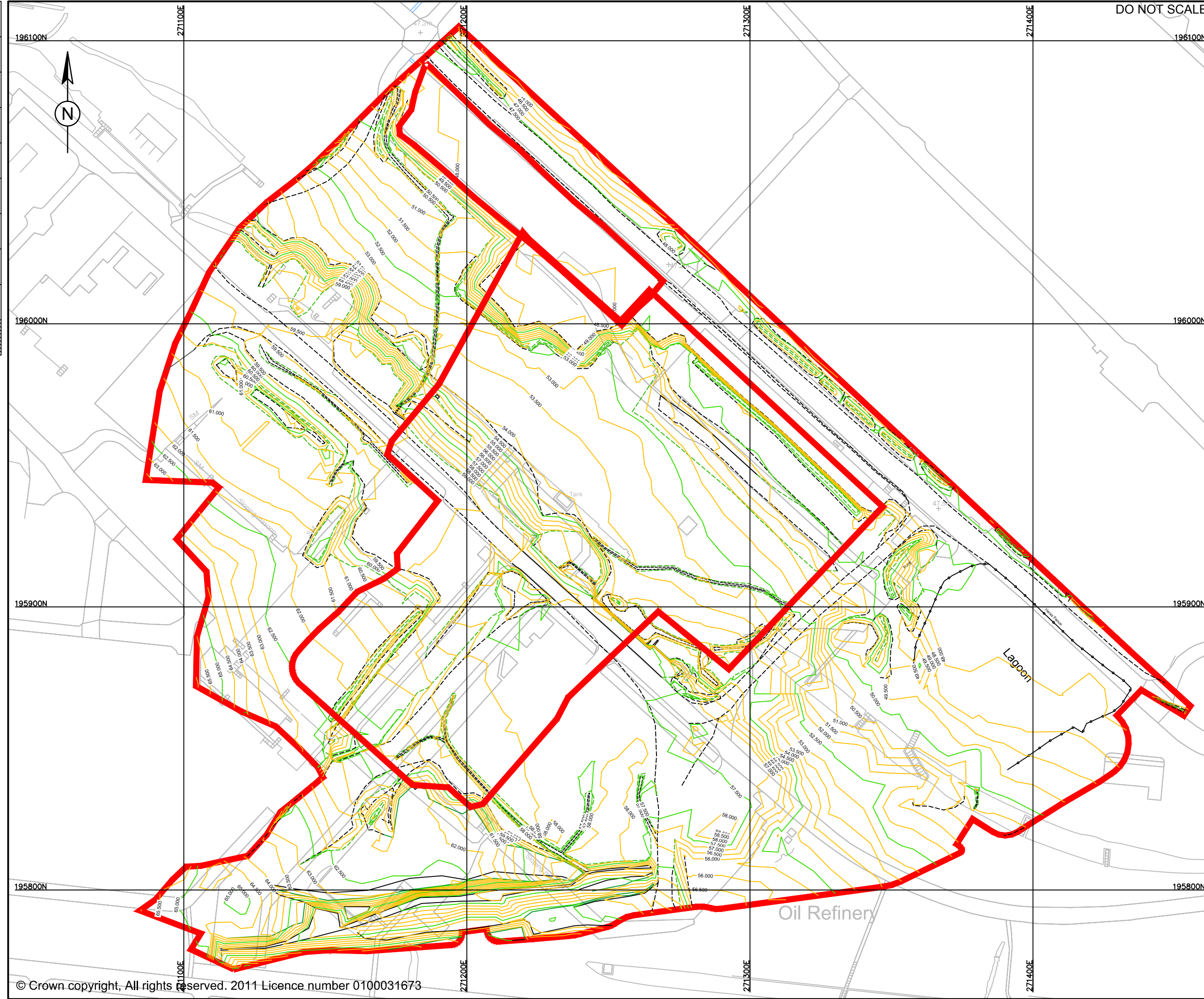
It should be noted that recent ground investigation works focussed predominantly on contamination across this area and further assessment to assess potential geotechnical constraints within this Phase should be carried out prior to any proposed development.

The following assessment assumes a proposed Commercial end use for this part of the former refinery. Where a change in proposed end use is proposed, reassessment of the data will be required in order to confirm the need for additional investigation and/or further remediation.

Drawings

Millimetres

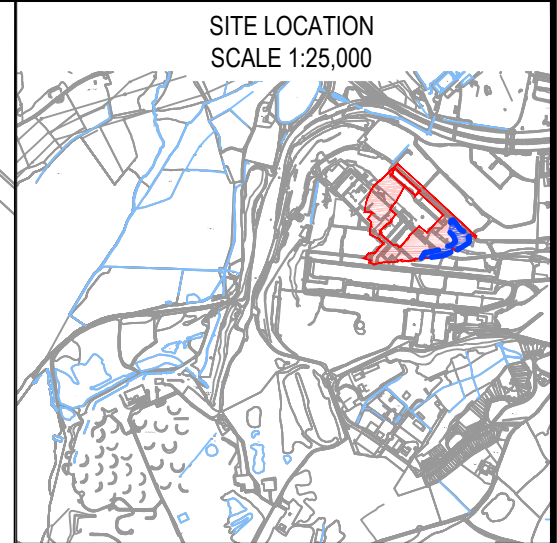
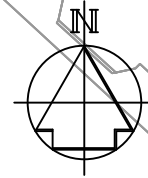
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DO NOT SCALE

- KEY:
- MONITOR PHASE BOUNDARY
 - MAJOR CONTOUR
 - MINOR CONTOUR

P1		13/10/15	FIRST ISSUE	MJ	MM	ML
Rev.	Date	Description		By	Chkd	App'd
Drawing Status					Suitability	
FOR INFORMATION					S2	
ATKINS		The Axis 10 Holliday Street Birmingham B1 1TF				
Copyright © Atkins Limited (2015)		Tel: +44 (0)1214 835000 Fax: +44 (0)1214 835252 www.atkinsglobal.com				
Client						
ST.MODWEN						
Project Title						
COED DARCY						
Drawing Title						
MONITOR PHASE 70 PRE-WORKS TOPOGRAPHIC SURVEY						
Scale	Designed	Drawn	Checked	Authorised		
1:1250		MJ	BI	MP		
Original Size	Date	Date	Date	Date		
A3	13/10/15	13/10/15	13/10/15	13/10/15		
Drawing Number						Revision
5041216-ATK-DR-C-REM-DWG-2075						P 1



SITE LOCATION
SCALE 1:25,000

KEY

MONITOR BOUNDARY PHASE 70

REVISIONS

Drawn By	Checked By	Date

PURPOSE OF ISSUE

Rev.	Authorised for issue	Date

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PROJECT

COED DARCY

DRAWING TITLE

MONITOR BOUNDARY PHASE 70
RECENT EXPLORATORY HOLE LOCATION PLAN

SCALES

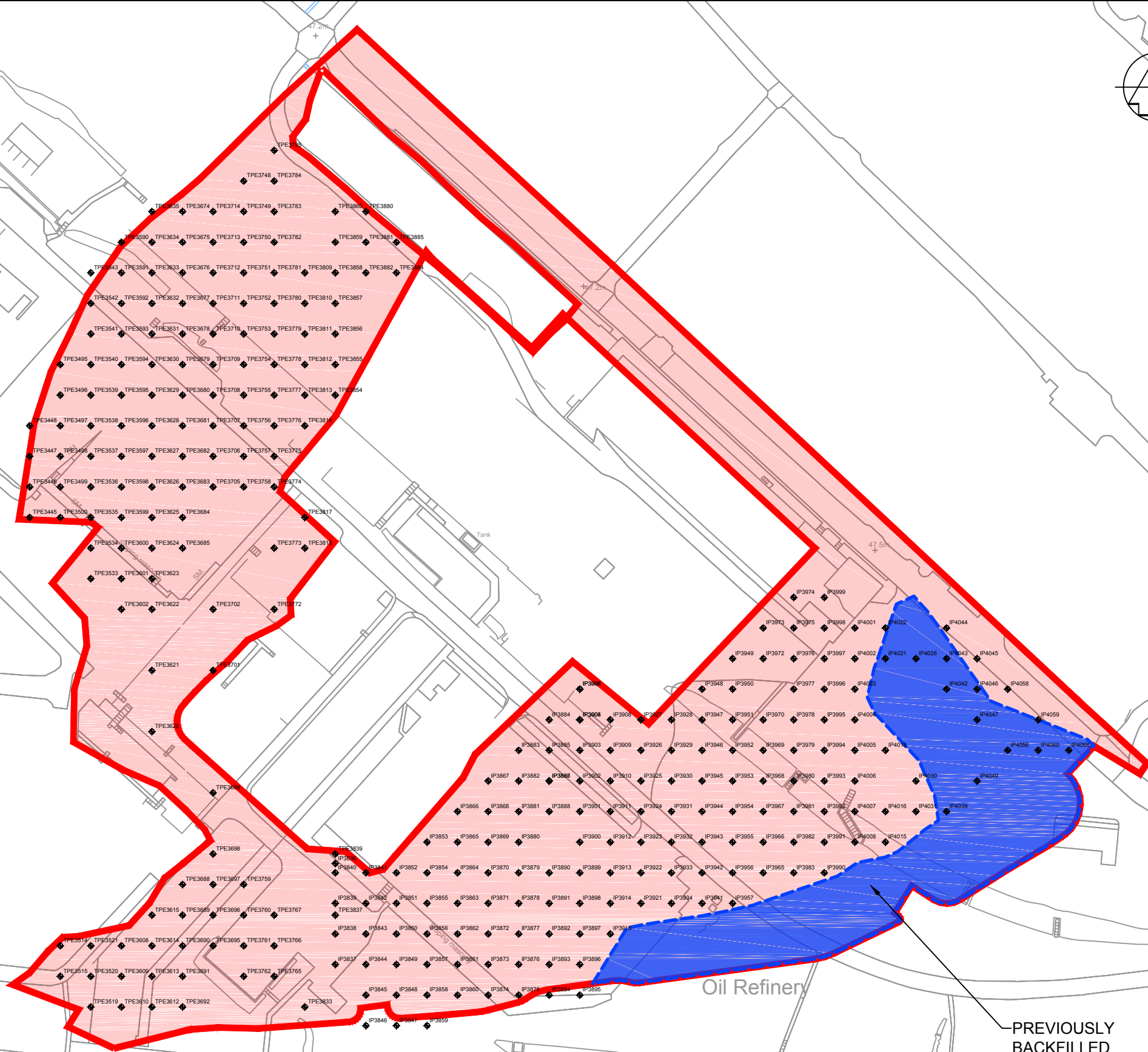
N.T.S.	DRAWN JSD	CHECKED CS	CO-ORD CHECK
	DATE 06.05.15	DATE 06.05.15	DATE

0	SHEET A3	PLOT DATE 30.10.15
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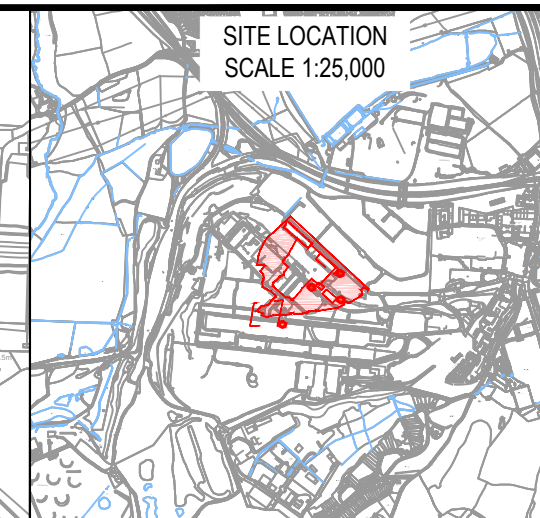
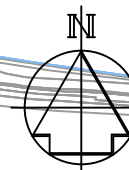
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5041216-REM-DWG-1954

REV -



PREVIOUSLY
BACKFILLED
AREA



SITE LOCATION
SCALE 1:25,000

KEY

MONITOR BOUNDARY PHASE 70

REVISIONS	Drawn By	Checked By	Date

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DRAWING TITLE

MONITOR BOUNDARY PHASE 70
HISTORICAL EXPLORATORY HOLE LOCATIONS

SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:2500	JSD	CS	
	DATE	DATE	DATE
	05.05.15	05.05.15	

DRAWING NO 5041216-REM-DWG-1953

SHEET A3

PLOT DATE 30.10.15

REV -

Special Process Area Key

- ① TPH Top Terrace
- ② Separator A
- ③ Substation
- ④ Boiler House Workshop