

**Former Gasworks
Dock Road, Limerick**

**Quantitative Risk Assessment,
Options Appraisal and Remediation
Addendum Report**

January 2012

Report No. 1021927/R/18

Prepared by

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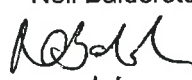
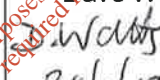
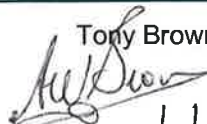
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Version	Status	Author	Check	Authorised
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Mouchel has used reasonable skill, care and diligence in the design and interpretation of the ground investigation, however, the inherent variability of ground conditions allows only definition of the actual conditions at the location and depths of exploratory holes and samples/tests therefrom, while at intermediate locations conditions can only be inferred.

New information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

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1021927/R18/OD/007	Encountered Free Phase Product
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Executive Summary

Appointment	<p>Mouchel were appointed by Bord Gais Eireann to undertake further site characterisation works following removal of the AGI infrastructure and transfer of ownership of the former Horse Pound area from Shannon Foynes Port Company to Bord Gais.</p> <p>This addendum report updates the March 2010 Quantitative Risk Assessment, Options Appraisal and Remediation Strategy report, reference 1021927/R/03 B following the drilling of an additional eleven sonic boreholes in October 2011.</p>
2011 Site Characterisation Works	<p>Works were undertaken in the two areas of the site that were not accessible during the 2009 Characterisation works. Sonic drilling was undertaken in the eleven grid cells in these two areas – A1, A2, B1, B2, C1, C2, D2, A9, A10, B9 and B10.</p>
Potential Pollutant Linkages	<p>The potential pollutant linkages with respect to human health are:-</p> <ul style="list-style-type: none"> • Ingestion/ direct contact of soil for future site occupiers • Inhalation/ ingestion/ direct contact of soil dust for future site occupiers and adjacent site occupiers, and • Inhalation of soil gas/ volatiles for future site occupiers and adjacent site occupiers. <p>The potential pollutant linkages with respect to water are:-</p> <ul style="list-style-type: none"> • Soil (including free phase hydrocarbons) leaching to groundwater impacting the River Shannon, and • Groundwater (dissolved and free phase contaminants) impacting the River Shannon.
Human Health Detailed Quantitative Risk Assessment (DQRA)	<p>The 2011 dataset has been assessed separately of the 2009 dataset. Exceedences were identified for each of the three proposed end uses. However, the maximum concentrations recorded do not exceed the 2009 maximum concentrations therefore it is considered that the Remediation Target Values (RTV's) presented in the March 2010 report are still valid. Similarly, the vapour pathway modelling has not been revised given the low concentrations of the volatile determinands recorded.</p>
Groundwater/ Surface Water Quantitative Risk assessment	<p>Quarterly ground water monitoring, sampling and testing has been undertaken since December 2009 and reported separately. As a result, there is not considered a need to update this assessment.</p>
Remediation Options Appraisal and Strategy	<p>Following assessment of the 2011 dataset, it is not considered necessary to revise the remedial options appraisal or remediation strategy presented in the March 2010 report.</p>
Recommendations	<p>The conclusions presented in the March 2010 Quantitative Risk Assessment, Options Appraisal and Remediation Strategy report. 1021927/R/03 B are unchanged following the above assessments.</p> <p>The following recommendation presented in the March 2010 Quantitative Risk Assessment, Options Appraisal and Remediation Strategy report. 1021927/R/03 B is considered to be still valid.</p> <ol style="list-style-type: none"> 1. Undertake some further preparatory works on site prior to remediation works commencing. These include demolition of the Governor House, Booster House and connecting internal walls and construction of a DRI (District Regulator Installation) together with the relocation of the ESB sub-station near the boundary with O'Curry Street. <p>The obtaining of large bulk samples of contaminated soils to undertake bench trials to allow selection of an appropriate binder for the stabilisation/ solidification works will form part of the phase 2 remediation pilot works.</p>

1 Introduction

Mouchel were appointed by Bord Gais Eireann to undertake further site characterisation works at the Limerick gasworks site following removal of the AGI infrastructure and transfer of ownership of the former Horse Pound area from Shannon Foynes Port Company to Bord Gais.

This addendum report updates the March 2010 Quantitative Risk Assessment, Options Appraisal and Remediation Strategy report, reference 1021927/R/03 B (2010 QRA report) following the drilling of an additional eleven sonic boreholes in October 2011 to complete the site characterisation. This addendum report must be read in conjunction with the 2010 QRA report and should not be read as a stand alone report.

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2 Basis of Site information

2.1 2011 Site Characterisation – Summary of site works

The 2011 Site Characterisation works were undertaken in the former AGI and the former Horse Pound that were not accessible during the 2009 Characterisation works. Sonic drilling was undertaken by IGSL Ltd in the eleven grid cells in these two areas – A1, A2, B1, B2, C1, C2, D2, A9, A10, B9 and B10.

The exploratory hole location plan is presented as Drawing 1021927/R18/OD/01.

The table below summarises the 2009 and 2011 site characterisation works.

Table 2.1: Summary of Site Activities

Activity	Dates Undertaken	Exploratory Hole Reference	Maximum Depth
Sonic drilled boreholes	4 th November – 24 th November 2009	132 locations referenced by alpha-numeric grid cell reference	12m bgl
	25 th October – 27 th October 2011	11 locations referenced by alpha-numeric grid cell reference	5.5m bgl
Window sample holes	25 th November – 27 th November 2009	13 locations (C12AWS, C12BWS, D12WS, E12WS, F9WS, F10WS, F12WS, L11WS, L12WS, L1WS, M1WS, N1WS, N2WS)	4.0m bgl
Trial pits	9 th November – 10 th November 2009	3 locations (TP1, TP2, TP3)	5.0m bgl
Soak away pits	9 th November 2009	1 location (“soakaway”)	2.1m bgl

Soil samples were selected at approximately 1m intervals, or significant strata changes, and submitted for chemical analysis.

A full record of the Site Characterisation works is presented in the Site Investigation Factual Report 1021927/R/02C dated November 2011.

The 2011 chemical test data is presented in Appendix A.

The table below summarises the drawings that have been revised following assessment of the results of the 2011 characterisation works.

Table 2.2: Summary of Updated Drawings

Drawing Number	Title	Superseded Drawing number and title
1021927/R18/OD/001	Characterisation Exploratory Hole Location Plan	Figure 2. Characterisation borehole location plan (Drawing 1021927/R03/002)
1021927/R18/004a; 004d; 004e	Cross Sections	Figure 4. Cross Sections (Drawings 1021927/R03/004a; 004d; 004e)
1021927/R18/005	Topography of Rock-Head	Figure 5. Topography of rock-head (Drawing 1021927/R03/005)
1021928/R18/007	Encountered Free Phase Product	Figure 7. Encountered Free Phase Product (Drawing 1021927/R03/007)
1021927/R18/010a-010m	Contaminant Screening Value Exceedence Plots	Figure 10. Contaminant screening value exceedence plots (Drawings 1021927/R03/010a-010m)
1021927/R18/011a-011b	Made Ground Thickness	Figure 11. Made ground depths (Drawing 1021927/R03/011a-011b)

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3 Conceptual Site Model

3.1 Conceptual Site Model

A conceptual model for the site, is presented as Figure 9 in report 1021927/R/03 dated March 2010. No amendments are proposed to the conceptual site model in light of the findings of the 2011 site characterisation works.

Site specific geology recorded during the 2011 characterisation works generally corresponds with the findings from the 2009 characterisation works. No significant NAPL was encountered during the 2011 works.

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4 Human Health Quantitative Risk Assessment

4.1 Introduction

For further information on the derivation of generic screening values, reference should be made to the 2010 QRA Report.

Due to the large dataset from the 2009 site characterisation, it was not possible to fit every sample onto one spreadsheet and previously, the data was split into two by location row ie A-G and H-L. It was not possible to add the 2011 data to the original spreadsheets and therefore the 2011 dataset was screened separately. The 95% confidence limits for the 2011 dataset were compared to the 95% confidence limits from the 2009 dataset to try and establish if the 2011 dataset is more or less contaminated.

4.2 Tier 1 – Human health screening

4.2.1 Commercial Scenario

Screening of the 2011 dataset indicates an exceedence of the 95% confidence limit for benzo(a)pyrene only. Exceedences of the screening values occur at 3 locations and these are not highlighted as statistical outliers. However, it is considered likely that these represent contamination hotspots.

Further exceedences of the screening values were recorded for aliphatic hydrocarbons C₁₂ to C₁₆ (1 location) and vinyl chloride (1 location).

Table 4.1 below compares the 95% confidence limit exceedences for the 2009 dataset with the 95% confidence limits for the 2011 dataset. 2011 screening tables are presented in Appendix B.

Table 4.1. Comparison of 2009 UCL 95 exceedences with the 2011 UCL 95 values – commercial / industrial screening

Type	Determinand	Screening Value (mg/kg)	2011 Dataset UCL95	UCL95 average – 2009
TPH	Aliphatic C ₁₂ -C ₁₆	59	22.26	397
PAH	Naphthalene	183	31.93	1447
	Acenaphthylene	212	4.73	225
	Benzo(a)pyrene	14	15.25	80
	Benzo(a)anthracene	95	16.5	103

4.2.2 Public Open Space Scenario

Screening of the 2011 dataset indicates an exceedence of the 95% confidence limit for benzo(a)pyrene only. 11 of 22 samples exceed the screening value. None are highlighted as statistical outliers.

Further exceedences of the screening values were recorded for benzo(a)anthracene (3 locations); chrysene (2 locations); benzo(b)fluoranthene (2 locations); indeno(1,2,3-c,d)pyrene (2 locations) and dibenzo(a,h)anthracene (2 locations). None are highlighted as statistical outliers.

Table 4.2 below compares the 95% confidence limit exceedences for the 2009 dataset with the 95% confidence limits for the 2011 dataset. Screening tables are presented in Appendix B.

Table 4.2. Comparison of 2009 UCL 95 exceedences with the 2011 UCL 95 values – public open space screening

Type	Determinands	Screening Value (mg/kg)	2011 Dataset UCL95	UCL95 average – 2009
PAH	Dibenzo(ah)anthracene	3.9	2.44	10.6
	Chrysene	36	12.52	79
	Benzo(a)pyrene	4.1	15.25	80
	Benzo(a)anthracene	26	16.5	103
	Benzo(b)fluoranthene	28	19.68	96.4
	Indeno(123-cd)pyrene	17	7.90	38

4.2.3 Residential Without Plant Uptake Scenario

Screening of the 2011 dataset indicates exceedences of the 95% confidence limit for aliphatic C₁₆ to C₃₅, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene and dibenzo(a,h)anthracene.

The limit of detections for PCB's, carbon tetrachloride (one result only), vinyl chloride and 1,2-dichloroethane exceed the screening values, but since all results are less than the limit of detection, no significant risk is considered to exist.

Further exceedences of the screening values were recorded for benzene (1 location); aliphatic C₈ to C₁₀ (1 location); aliphatic C₁₂ to C₁₆ (1 location); aliphatic C₃₅ to C₄₄ (3 locations); aromatic C₈ to C₁₀ (1 location); aromatic C₁₆ to C₂₁ (1 location); aromatic C₂₁ to C₃₅ (1 location) and naphthalene (3 locations). Only benzene and aromatic C₈ to C₁₀ are highlighted as statistical outliers.

Table 4.3 below compares the 95% confidence limit exceedences for the 2009 dataset with the 95% confidence limits for the 2011 dataset. Screening tables are presented in Appendix B.

Table 4.3 Comparison of 2009 UCL 95 exceedences with the 2011 UCL 95 values – residential without gardens screening

Type	Analyte	Screening Value (mg/kg)	2011 Dataset UCL95	UCL95 average – 2009
TPH	Aliphatic C12-16	59.1	22.6	397
	Aliphatic C16-35	21.2	103.26	983
	Aliphatic C35-44	21.2	10.79	62
PAH	Benzo(b)fluoranthene	7.3	19.68	96
	Benzo(k)fluoranthene	10	6.73	41
	Benzo(a)pyrene	1	15.25	80
	Benzo(a)anthracene	5.2	16.5	103
	Indeno(123-cd)pyrene	4.4	7.9	38
	Dibenzo(ah)anthracene	0.91	2.44	10.6
BTEX	Benzene	0.49	0.46	45

4.2.4 Dutch Intervention Values – Residential Scenario

Screening of the 2011 dataset indicates an exceedence of the 95% confidence limit for the sum of 10 PAH's.

Further exceedences of the screening values were recorded for copper (1 location); cyanide (1 location); benzene (1 location); xylenes (1 location) and cresol (2 locations); All are highlighted as statistical outliers.

Table 4.3 below compares the 95% confidence limit exceedences for the 2009 dataset with the 95% confidence limits for the 2011 dataset. Screening tables are presented in Appendix B.

Table 4.4 Comparison of 2009 UCL 95 exceedences with the 2011 UCL 95 values – residential (Dutch) Intervention Values

Type	Determinand	Screening Value (mg/kg)	2011 Dataset UCL95	UCL95 average – 2009
PAH	Sum of 10 PAHs	40	138.30	2852
BTEX	Benzene	1	0.46	45
	Xylenes	25	5.38	137
Inorganics	Cyanide	70	32.07	473

4.2.5 Asbestos

At least one made ground sample from each location was tested for asbestos which was identified at the following locations:-

A9 0.0m to 0.7m – chrysotile (white)

B9 1.0m to 1.8m – amosite (brown); chrysotile (white); crocidolite (blue)

B10 0.0m to 0.4m - amosite (brown); chrysotile (white);

4.2.6 Summary of Tier 1 Human Health Risk Assessment

Exceedences identified within the 2011 dataset for all land uses were also identified in the 2009 dataset, although at significantly lower concentrations.

No revision of the human health or groundwater remedial target values (RTV's) detailed in Section 4.4 of the 2010 QRA Report are considered necessary following the above assessment.

4.3 Tier 2 - Quantitative Vapour Modelling

The quantitative vapour modelling presented in the 2010 QRA Report has been reviewed but not updated. None of the contaminants of concern identified and assessed previously have been identified in the 2011 dataset at concentrations in excess of the 2009 dataset. Therefore the findings and conclusions of the vapour modelling are considered to still be valid following the 2011 characterisation works. No amendment to the RTV's are considered necessary.

5 Groundwater / Surface Water Quantitative Risk Assessment

Quarterly ground water monitoring, sampling and testing has been undertaken since December 2009 and reported separately. Therefore there is not considered a need to update this risk assessment.

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6 Remedial Options Appraisal

None of the chemical test results assessed above are significantly greater than the results recorded during the 2009 characterisation. Therefore it is not considered necessary to revise the remedial options appraisal presented in the 2010 QRA Report.

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7 Remediation Strategy

It is not considered necessary to revise the remediation strategy presented in the 2010 QRA Report.

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8 Conclusions/Recommendations

8.1 Conclusions

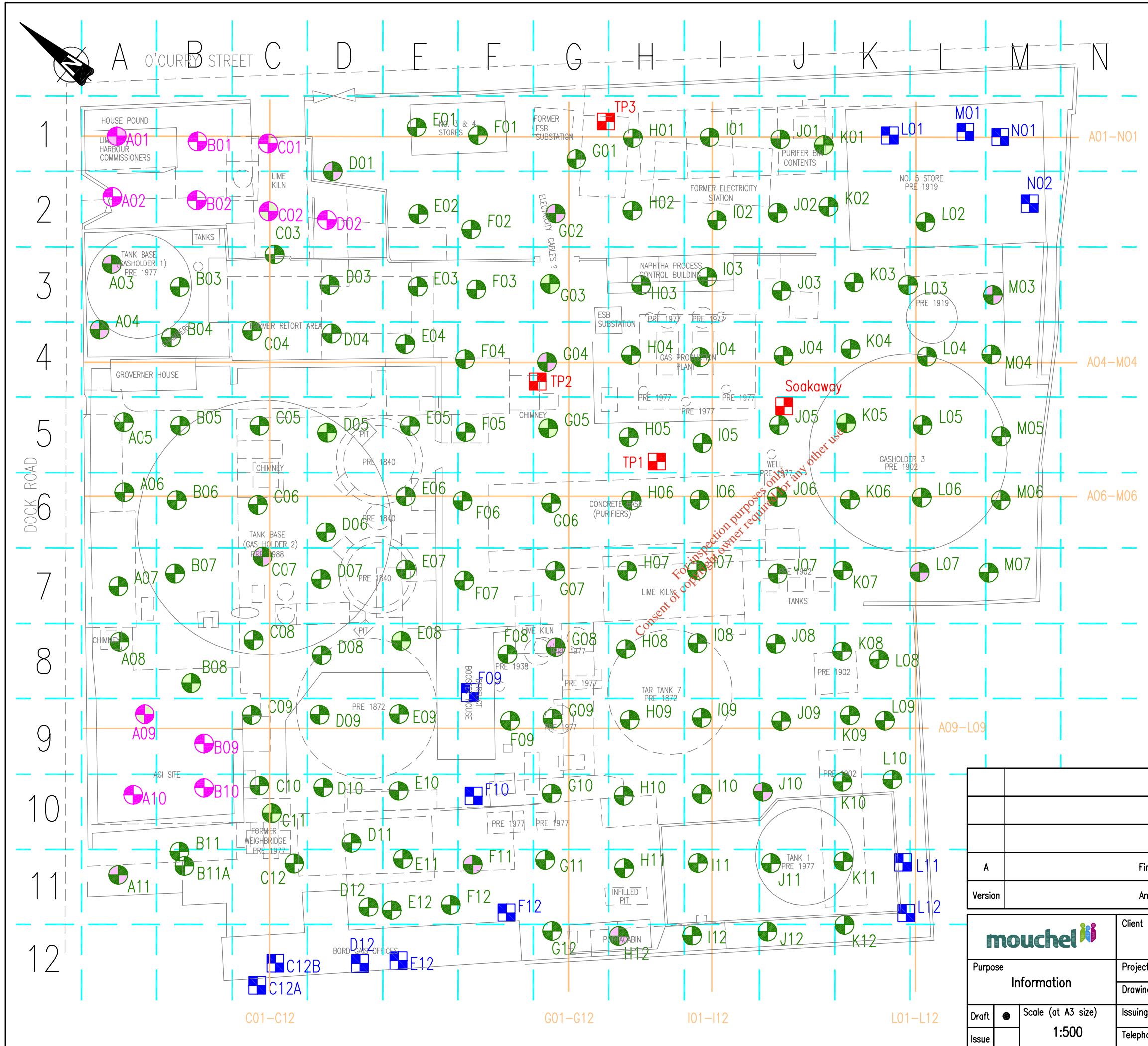
The conclusions presented in the 2010 QRA Report are unchanged following the above assessments.

8.2 Recommendations

The following recommendation presented in the 2010 QRA Report is still considered to be valid.

1. Undertake some further preparatory works on site prior to remediation works commencing. These include:-
 - Demolition of the Governor House, Booster House and connecting internal walls.
 - Construction of a DRI (District Regulator Installation) together with the relocation of the ESB sub-station near the boundary with O'Curry Street. Some preparatory works may be required at these locations.

Obtaining large bulk samples of contaminated soils to undertake bench trials to allow selection of an appropriate binder for the stabilisation/ solidification works will be undertaken as part of the Phase 2 remediation pilot works.



Key

- Approximate Location of Former Structure

2009 Site Investigation

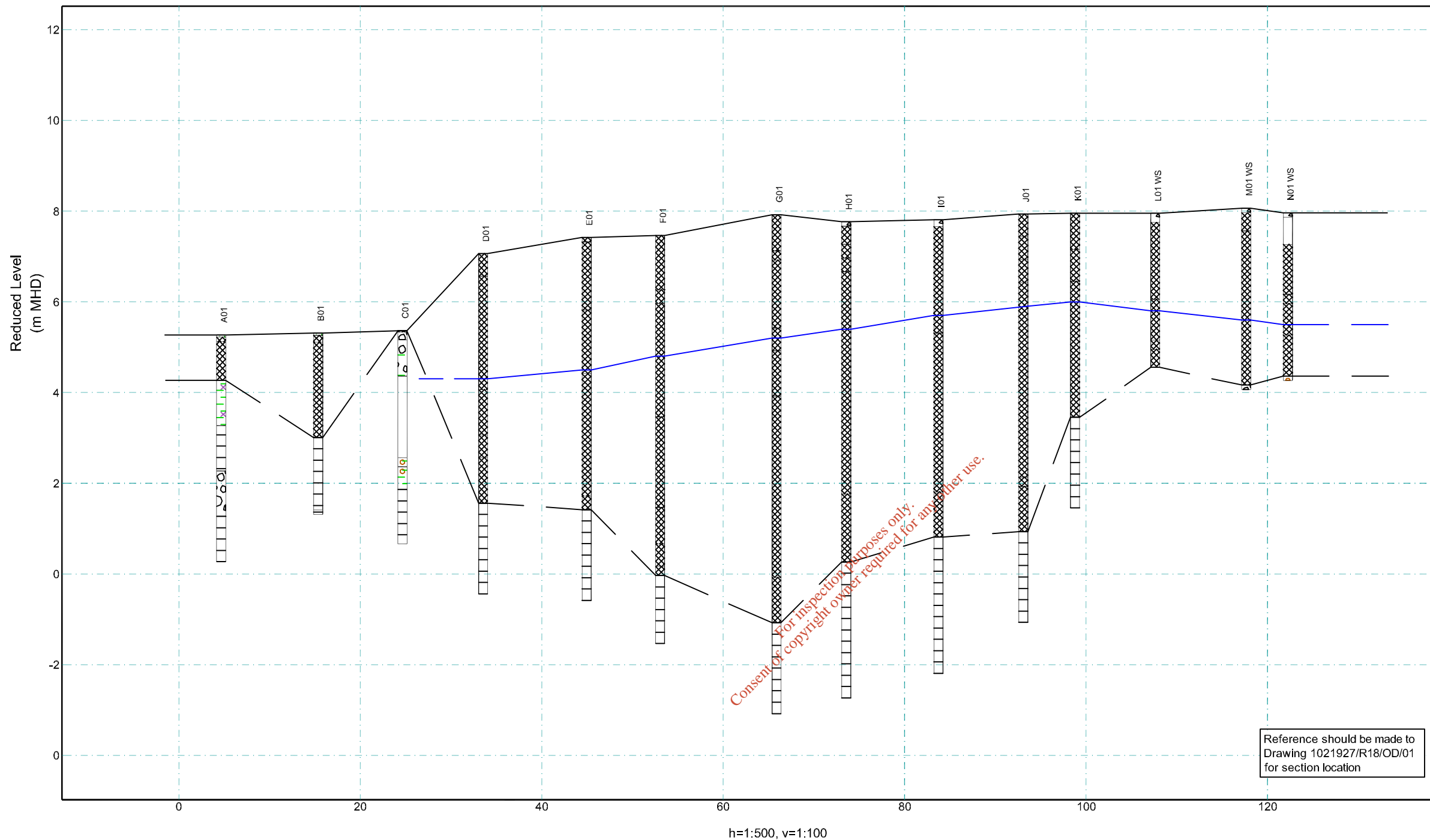
- Sonic Drilled Boreholes
- 10m Grid
- Window Sample Location
- Trial Pit
- Installation in made ground
- Installation in limestone rock

2011 Site Characterisation

- Sonic Drilled Boreholes
- Installation in made ground
- Installation in Limestone
- Cross-Sections

A	First Issue	N.Henrys 07/12/11	N.Balderstone 07/12/11	D.Watts 07/12/11
Version	Amendment	Originated by and date	Checked by and date	Approved by and date

mouchel		Client BORD GÁIS		
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		Drawing Title Characterisation Exploratory Hole Location Plan		
Draft	● Scale (at A3 size) 1:500	Issuing Office Ellesmere Port	Drawing number 1021927/R18/OD/001	Version A
Issue		Telephone 0151 356 5555		



KEY

	MADE GROUND		Ground Level
	CONCRETE		Made Ground Boundary
	Gravelly Clayey SAND		Groundwater Level
	Gravelly sandy CLAY		
	Gravelly CLAY		
	Sandy CLAY		
	Silty CLAY with rare gravel		
	Very clayey sandy GRAVEL		
	GRAVEL		
	Limestone		

REF	DATE	REVISIONS	INITIALS
B	10/01/12	ADDITION OF 2011 DATA	NH
A	15/01/12	FIRST ISSUE	NA

AMENDMENTS

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CONSULTANT

SUB CONSULTANT

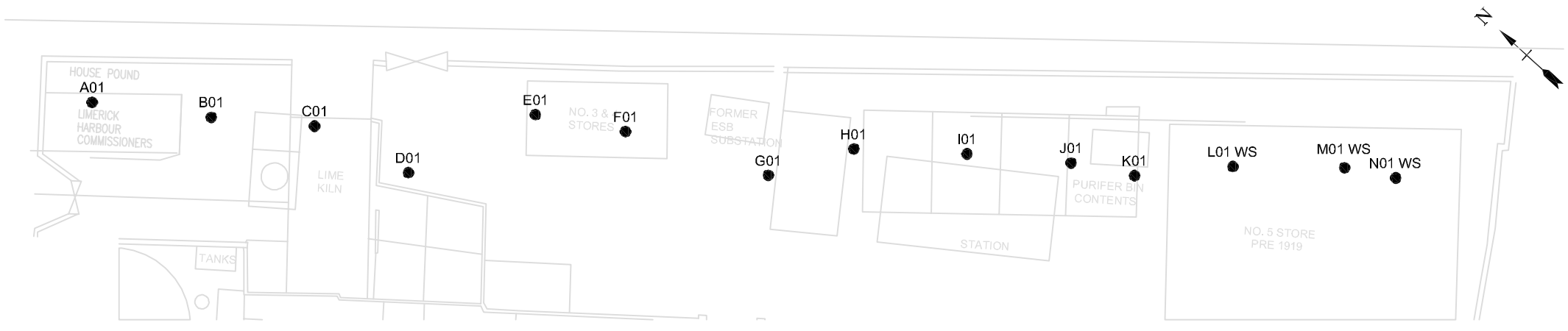
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Limerick Gasworks:

DRAWING TITLE

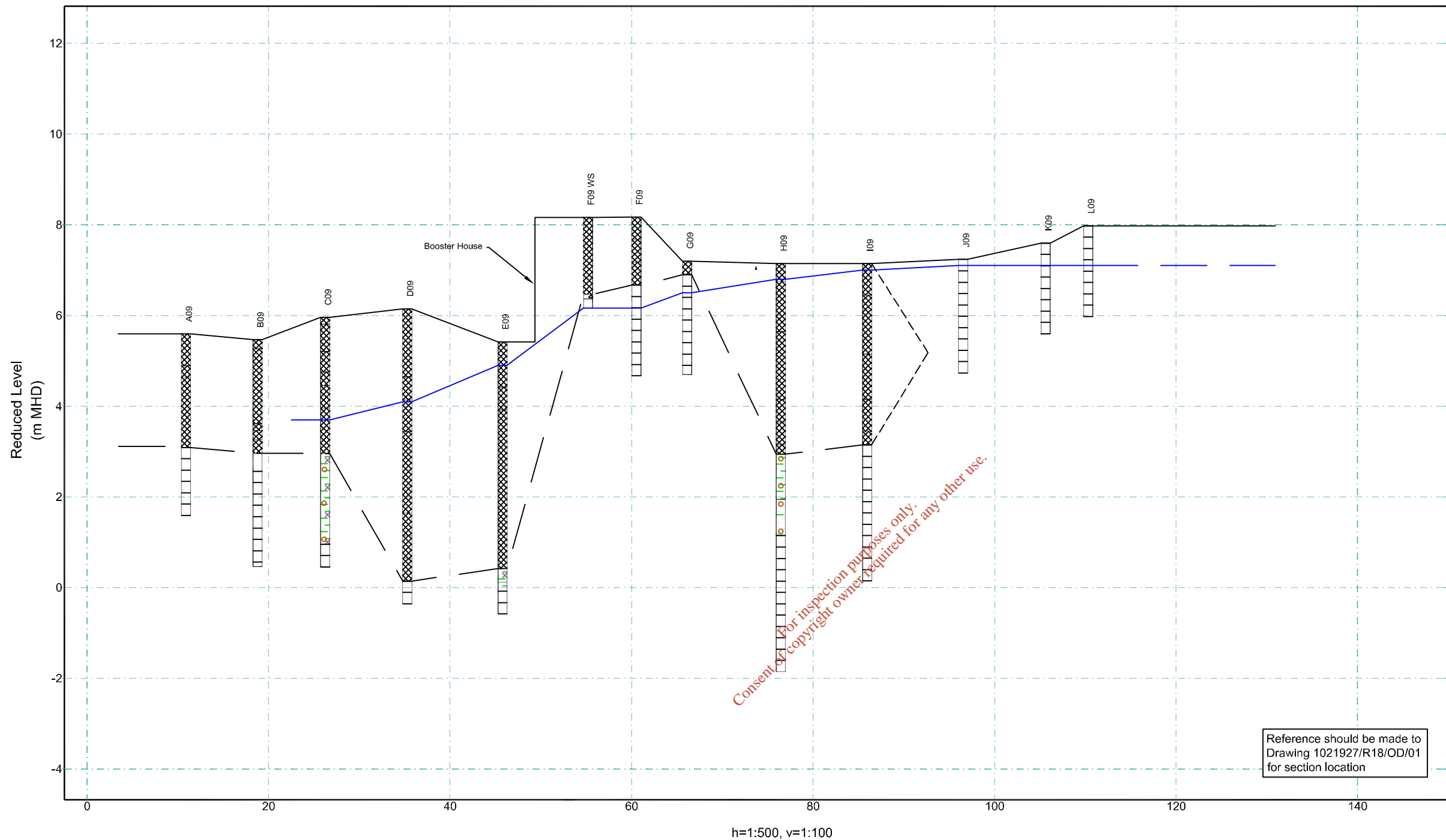
Cross Section (A01 - N01)

Design By	D. Megson	Checked By	D. Watts
Design Date	12/01/10	Checked Date	18/01/10
Drawn By	N. Appleton	Approved By	D. Watts
Drawn Date	15/01/10	Approved Date	22/01/10
	DRAFT	PRELIMINARY	TENDER
SCALE	H = 1:500 V = 1:100	DRAWING NO	1021927/R18/OD/004a
		REV	B



Reference should be made to Drawing 1021927/R18/OD/01 for section location

h=1:500, v=1:100



KEY

	MADE GROUND		Ground Level
	Clayey SAND		Made Ground Boundary
	Gravelly sandy CLAY		Groundwater Level
	Gravelly CLAY		
	CLAY		
	Silty CLAY		
	CLAY with Cobbles		
	Limestone		

REF	DATE	REVISIONS	INITIALS
B	10/01/12	ADDITION OF 2011 DATA	NH
A	15/01/10	FIRST ISSUE	NA

AMENDMENTS

CLIENT

CONSULTANT

SUB CONSULTANT

PROJECT TITLE

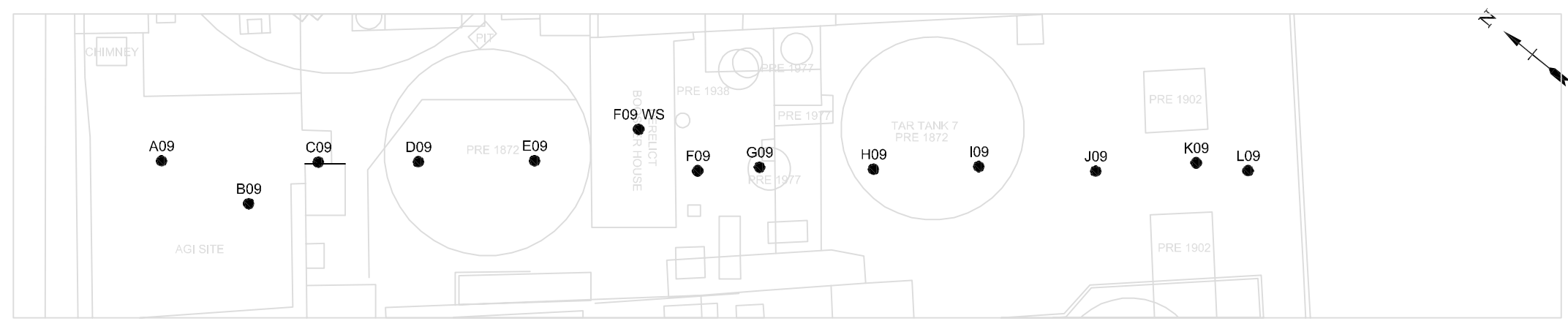
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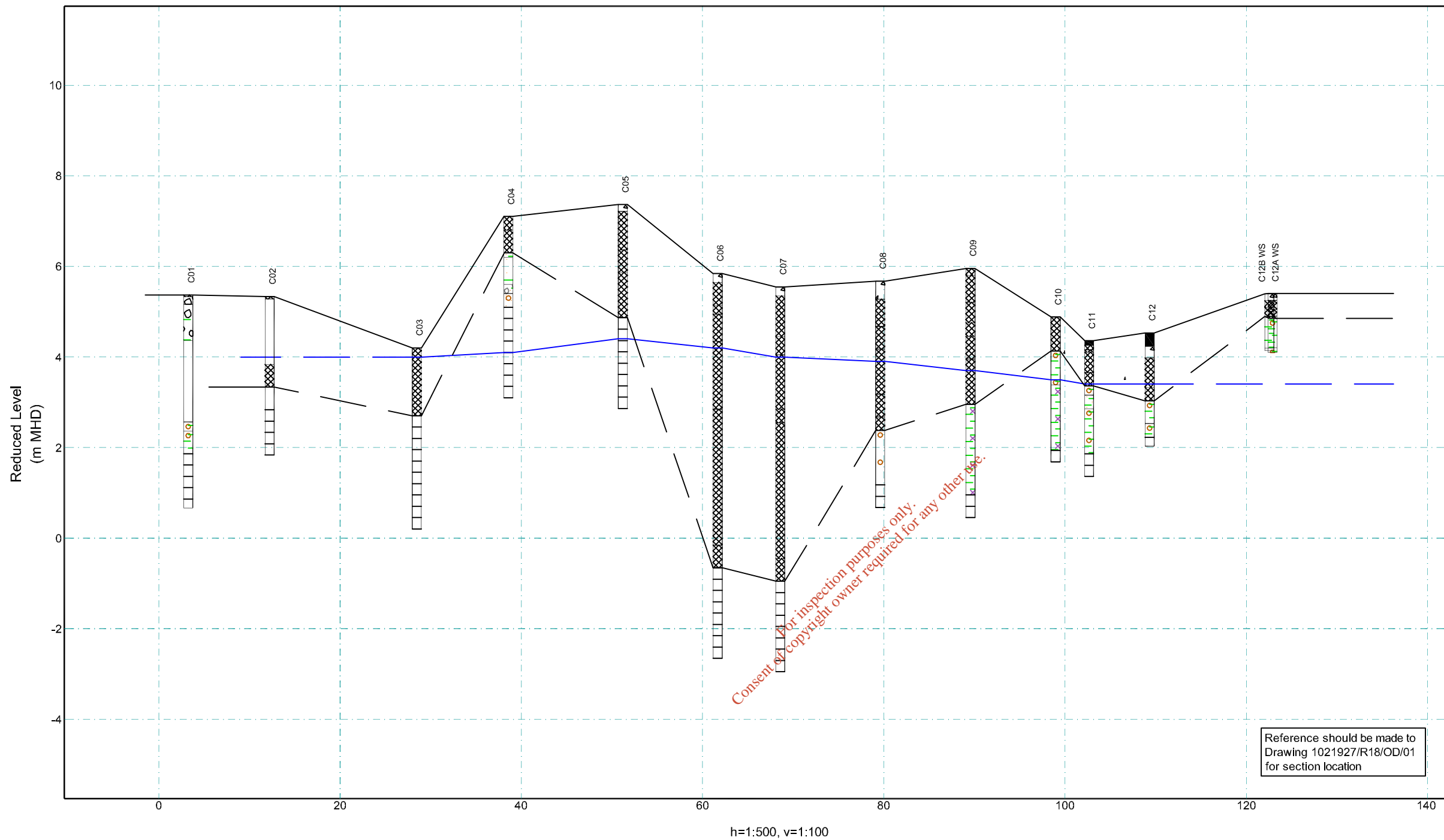
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Cross Section (A09 - L09)

Design By	D. Megson	Checked By	D. Watts
Design Date	12/01/10	Checked Date	18/01/10
Drawn By	N. Appleton	Approved By	D. Watts
Drawn Date	15/01/10	Approved Date	22/01/10

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SCALE	DRAWING NO			REV
H = 1:500 V = 1:100	1021927/R18/OD/004d			B





KEY

	MADE GROUND		Ground Level
	CONCRETE		Made Ground Boundary
	Gravelly Clayey SAND		Groundwater Level
	Gravelly sandy CLAY		
	Gravelly CLAY		
	Sandy CLAY		
	Silty CLAY with rare gravel		
	Very clayey sandy GRAVEL		
	GRAVEL		
	Limestone		

REF	DATE	REVISIONS	INITIALS
B	10/01/12	ADDITION OF 2011 DATA	NH
A	15/01/10	FIRST ISSUE	NA

AMENDMENTS

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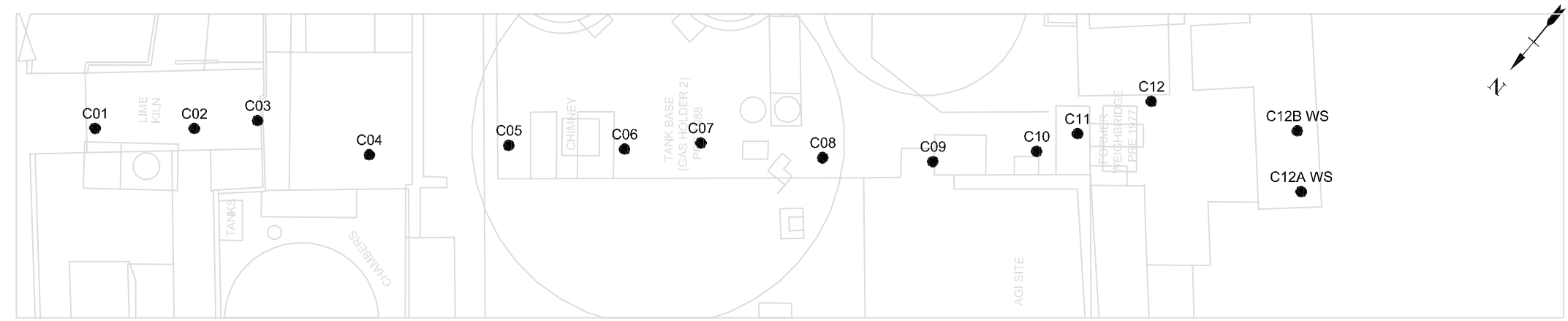
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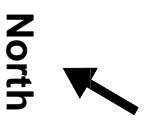
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Cross Section (C01 - C12)

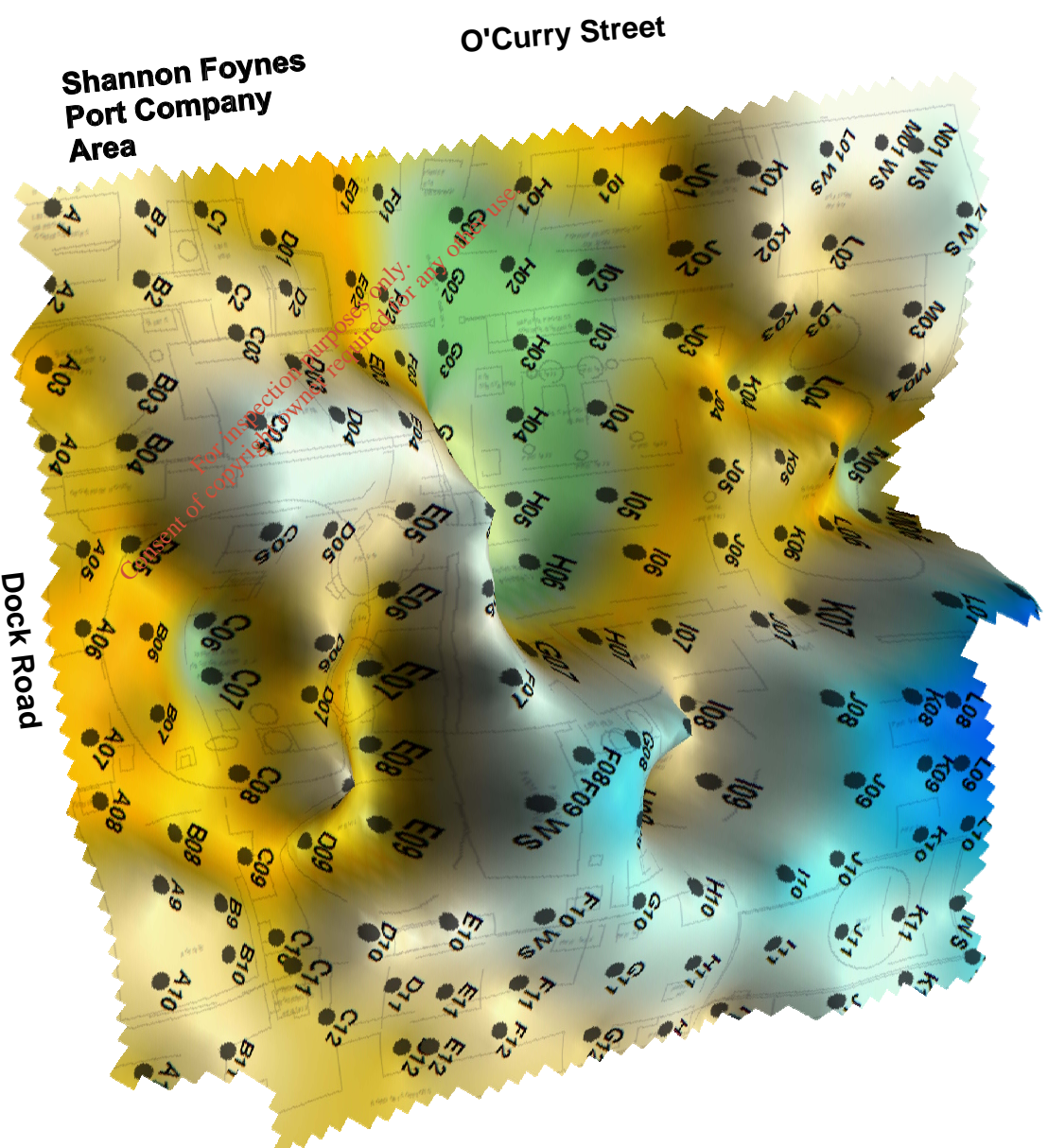
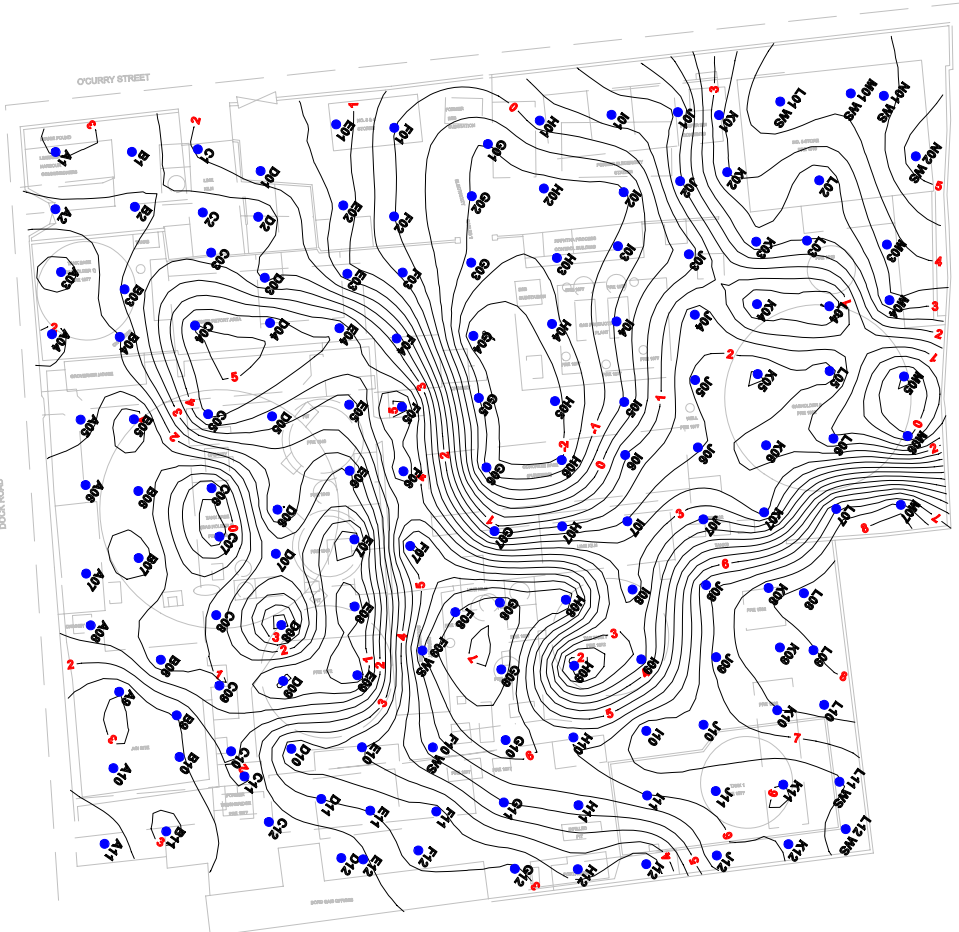
Design By	D. Megson	Checked By	D. Watts
Design Date	12/01/10	Checked Date	18/01/10
Drawn By	N. Appleton	Approved By	D. Watts
Drawn Date	15/01/10	Approved Date	22/01/10

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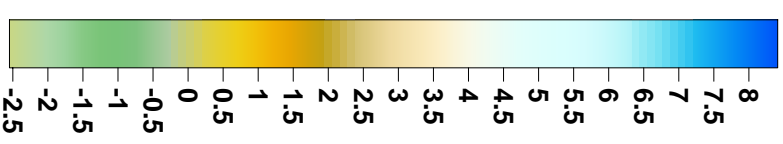




Approximate rock head contours
(m MHD)



Approximate Rock head level
(m MHD)



B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

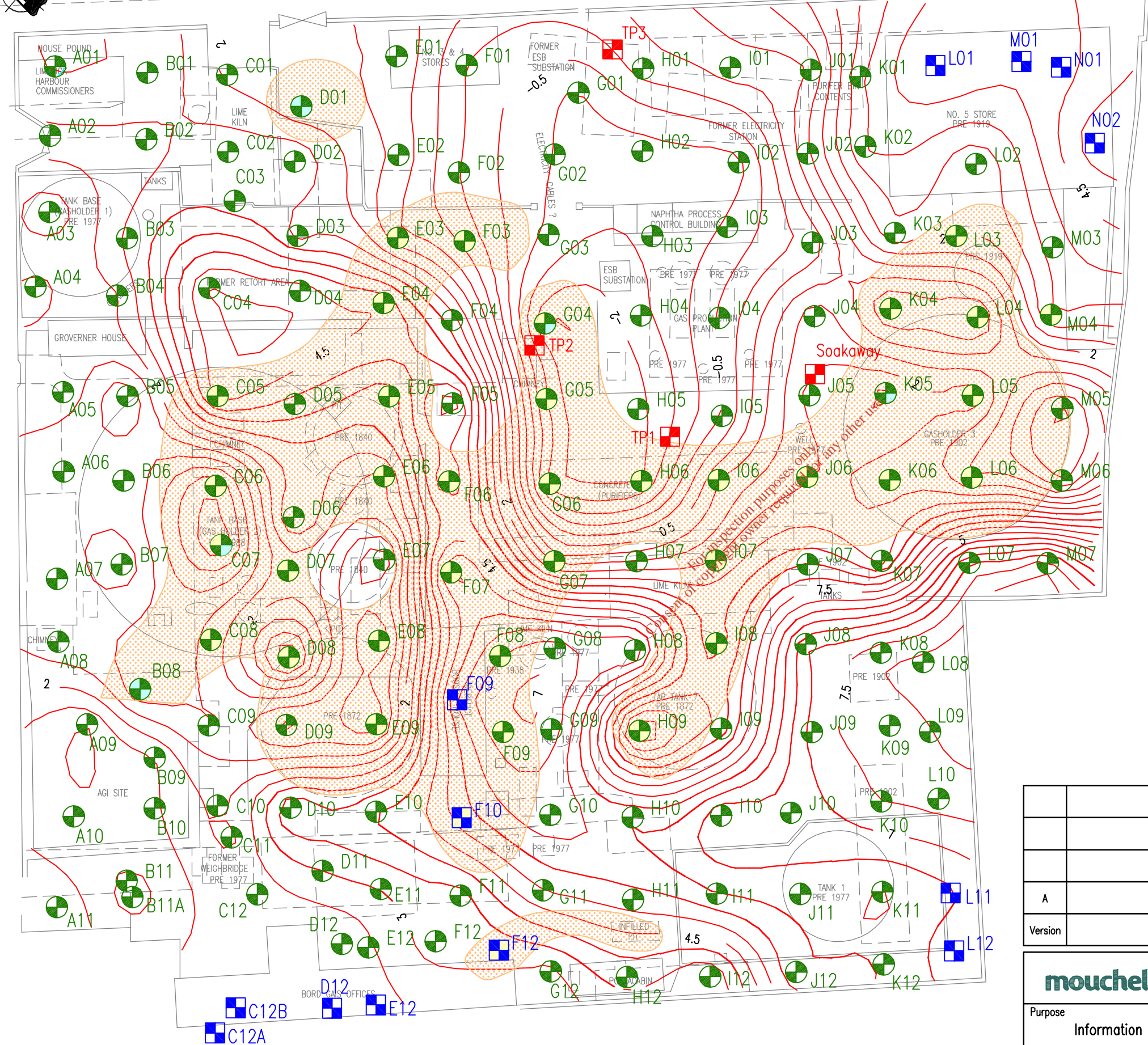
This plot was produced using data obtained from the 2009 & 2011 Site Investigations. Contours were plotted using the Kriging method based upon a 1m x 1m grid

		Client	Bord Gais
Information		Project	Limerick Gasworks
Purpose		Drawing Title	Figure 5) Topography of rock-head
Scale		Issuing Office	Ellesmere Port
Not to scale		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/005
		Version	B



O'CURRY STREET

DOCK ROAD



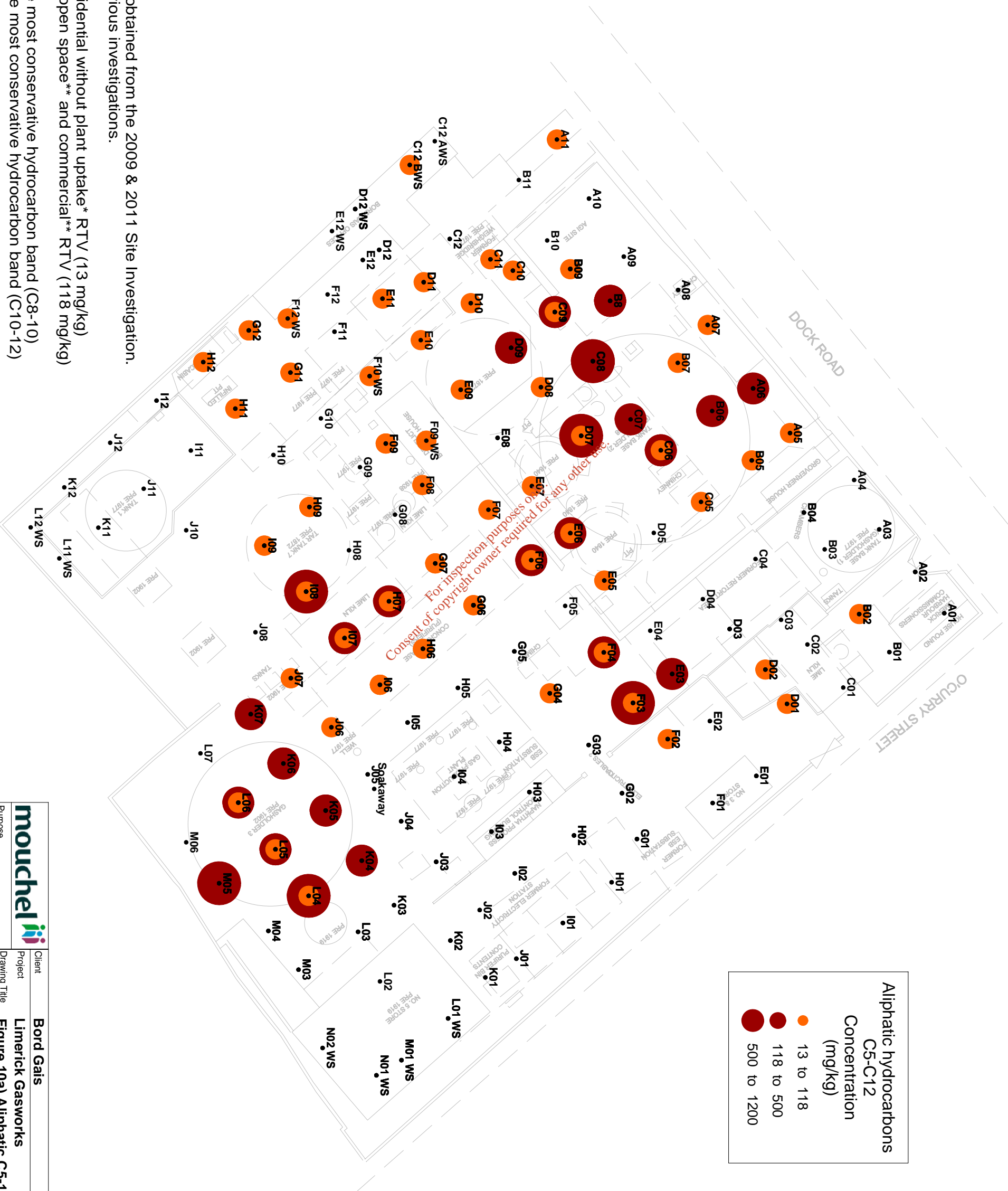
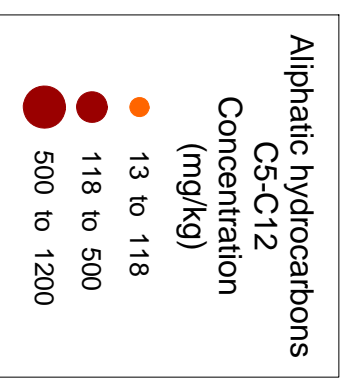
Key

- Approximate Location of Former Structure
- Site Characterisation Exploratory Holes**
- Sonic Drilled Boreholes (2009)
- Window Sample Location
- Trial Pit
- Extensive free phase observed during site works
- Free phase observed during groundwater monitoring
- Free phase observed during site works and groundwater monitoring
- Predicted extent of free phase
- Rock head contour (mMHD)

This drawing supercedes Drawing 1021927/R03/007 Vers.A Dated 26/1/10

A	First Issue	N.Henrys 07/12/11	N.Balderstone 07/12/11	D.Watts 07/12/11
Version	Amendment	Originated by and date	Checked by and date	Approved by and date

		Client		
Purpose Information		Project Limerick Gasworks		
		Drawing Title Encountered Free Phase Product		
Draft	● Scale (at A3 size) 1:500	Issuing Office Ellesmere Port	Drawing number 1021927/R18/007	Version A
Issue		Telephone 0151 356 5555		



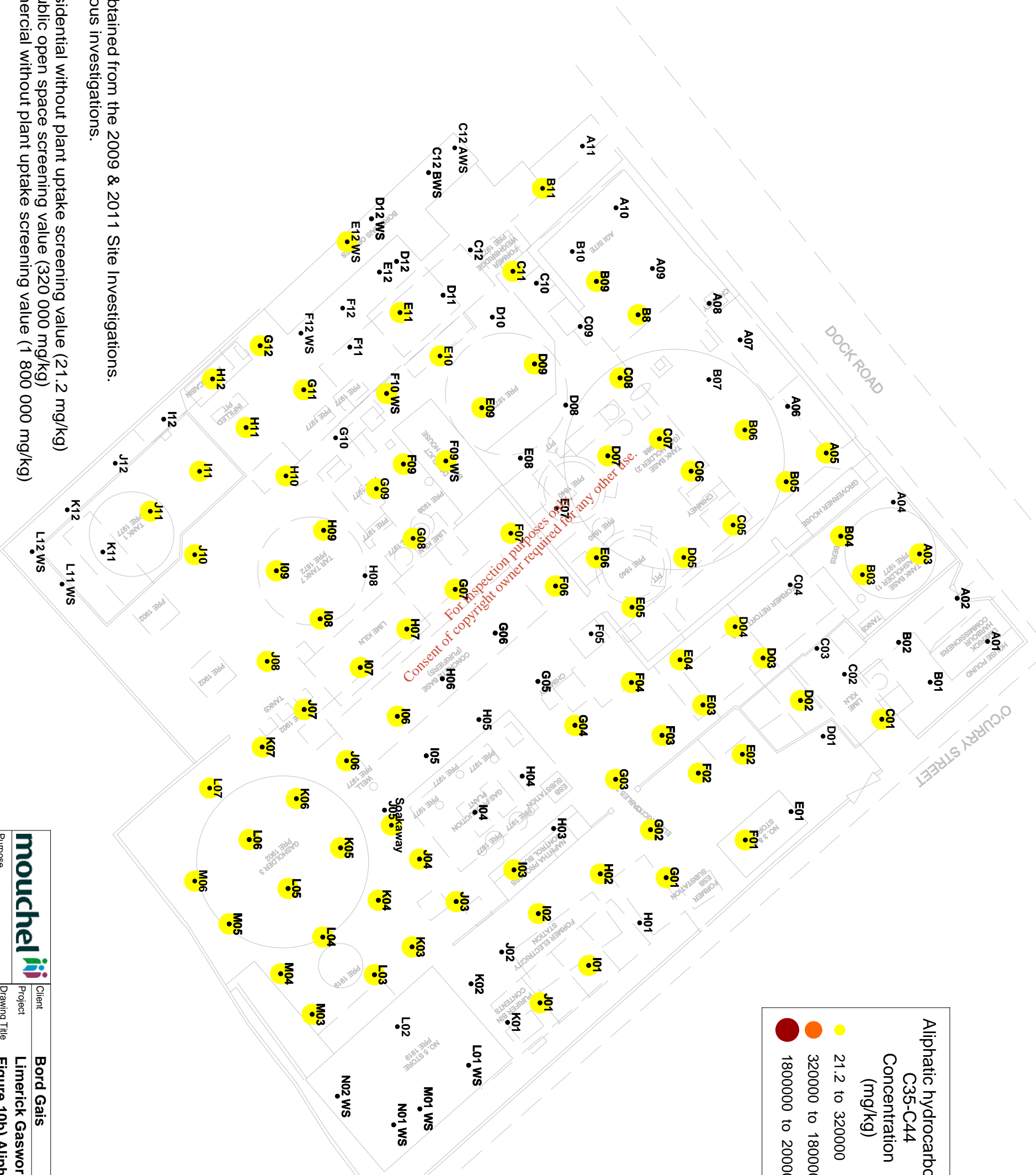
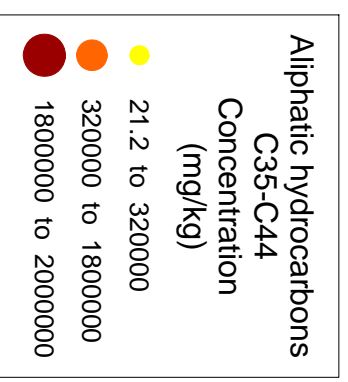
This plot was produced using data obtained from the 2009 & 2011 Site Investigation.
No data was included from the previous investigations.

Locations in orange exceed the residential without plant uptake* RTV (13 mg/kg)
Locations in red exceed the public open space** and commercial** RTV (118 mg/kg)

*Screening value is based upon the most conservative hydrocarbon band (C8-10)
**Screening value is based upon the most conservative hydrocarbon band (C10-12)

B	Addition of 2011 characterisation data	NA	DM	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

mouchel <small>ii</small>		Client	Bord Gais
Purpose Information		Project	Limerick Gasworks
Scale Not to scale		Drawing Title	Figure 10a) Aliphatic C5-12
Issuing Office Ellesmere Port		Telephone	0151 356 5555
Drawing Number 1021927/R18/OD/010a		Version	B



This plot was produced using data obtained from the 2009 & 2011 Site Investigations.
No data was included from the previous investigations.

All locations in yellow exceed the residential without plant uptake screening value (21.2 mg/kg)
All locations in orange exceed the public open space screening value (320 000 mg/kg)
All locations in red exceed the commercial without plant uptake screening value (1 800 000 mg/kg)

B	Addition of 2011 characterisation data		
A	First Issue	DM	DW
Version	Amendment	Originated	Checked

Information

Scale: **Not to scale**

Client: **Bord Gais**

Project: **Limerick Gasworks**

Drawing Title: **Figure 10b) Aliphatic C35-44**

Issuing Office: **Ellesmere Port**

Telephone: **0151 356 5555**

Drawing Number: **1021927/R18/OD/010b**

Version: **B**



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (1.0 mg/kg)

All locations in orange exceed the public open space RTV (4.1 mg/kg)

All locations in red exceed the commercial without plant uptake RTV (14 mg/kg)

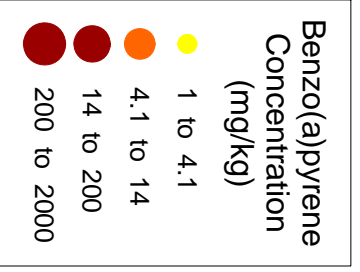
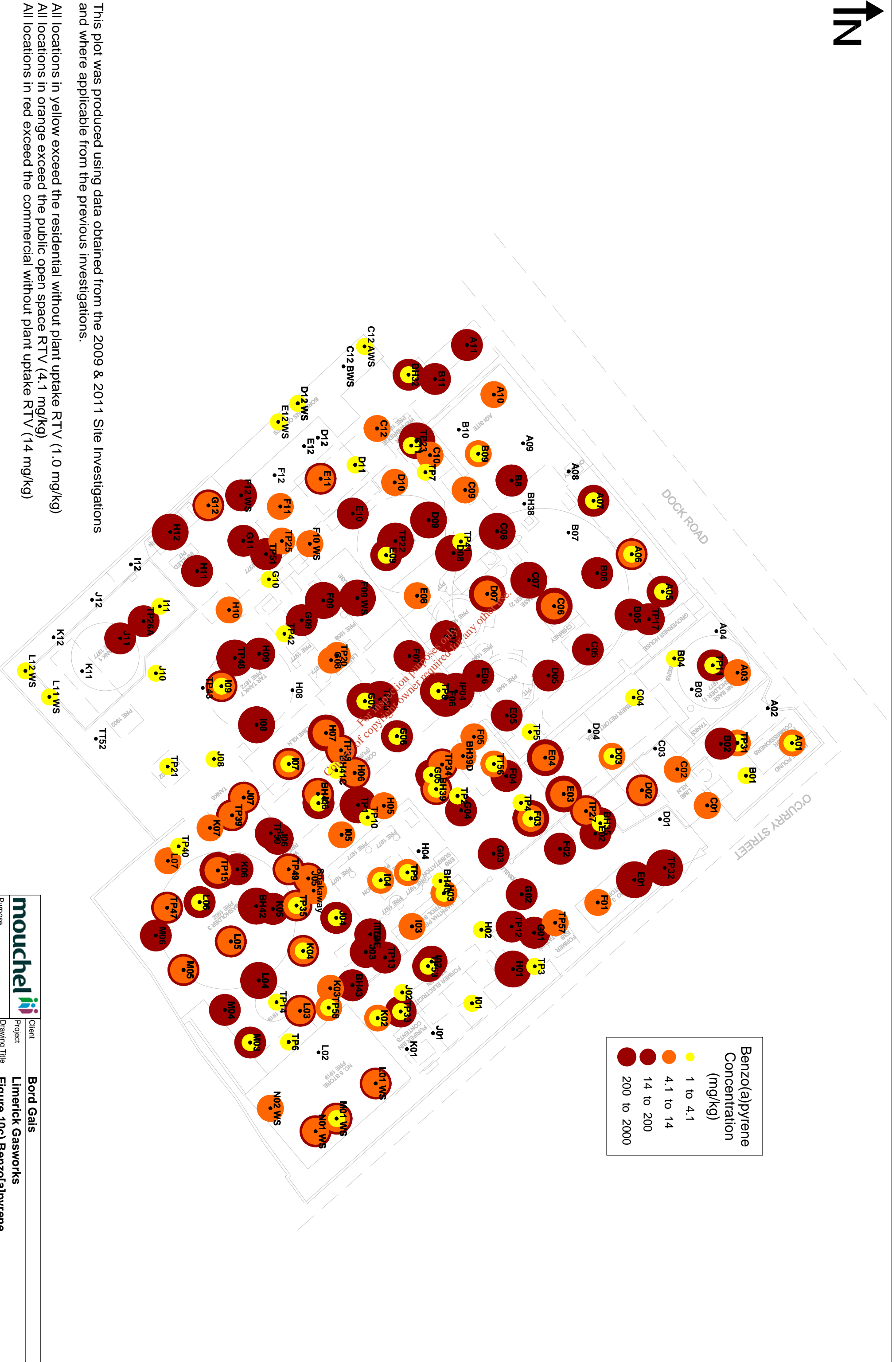
All locations in yellow exceed the residential without plant uptake RTV (1.0 mg/kg)

All locations in orange exceed the public open space RTV (4.1 mg/kg)

All locations in red exceed the commercial without plant uptake RTV (14 mg/kg)

B	Addition of 2011 characterisation data		
A	First Issue	DM	DW
Version	Amendment	Originated	Checked

NA	NB	DW
DM	DM	DW
Originated	Checked	Approved



mouchel **ii**

Information

Scale: **Not to scale**

Client: **Bord Gais**

Project: **Limerick Gasworks**

Drawing Title: **Figure 10(c) Benzol[a]pyrene**

Issuing Office: **Ellesmere Port**

Telephone: **0151 356 5555**

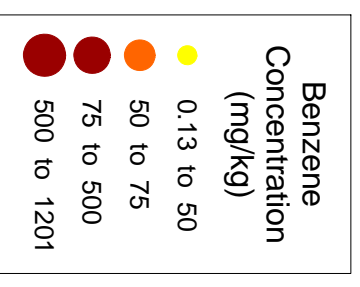
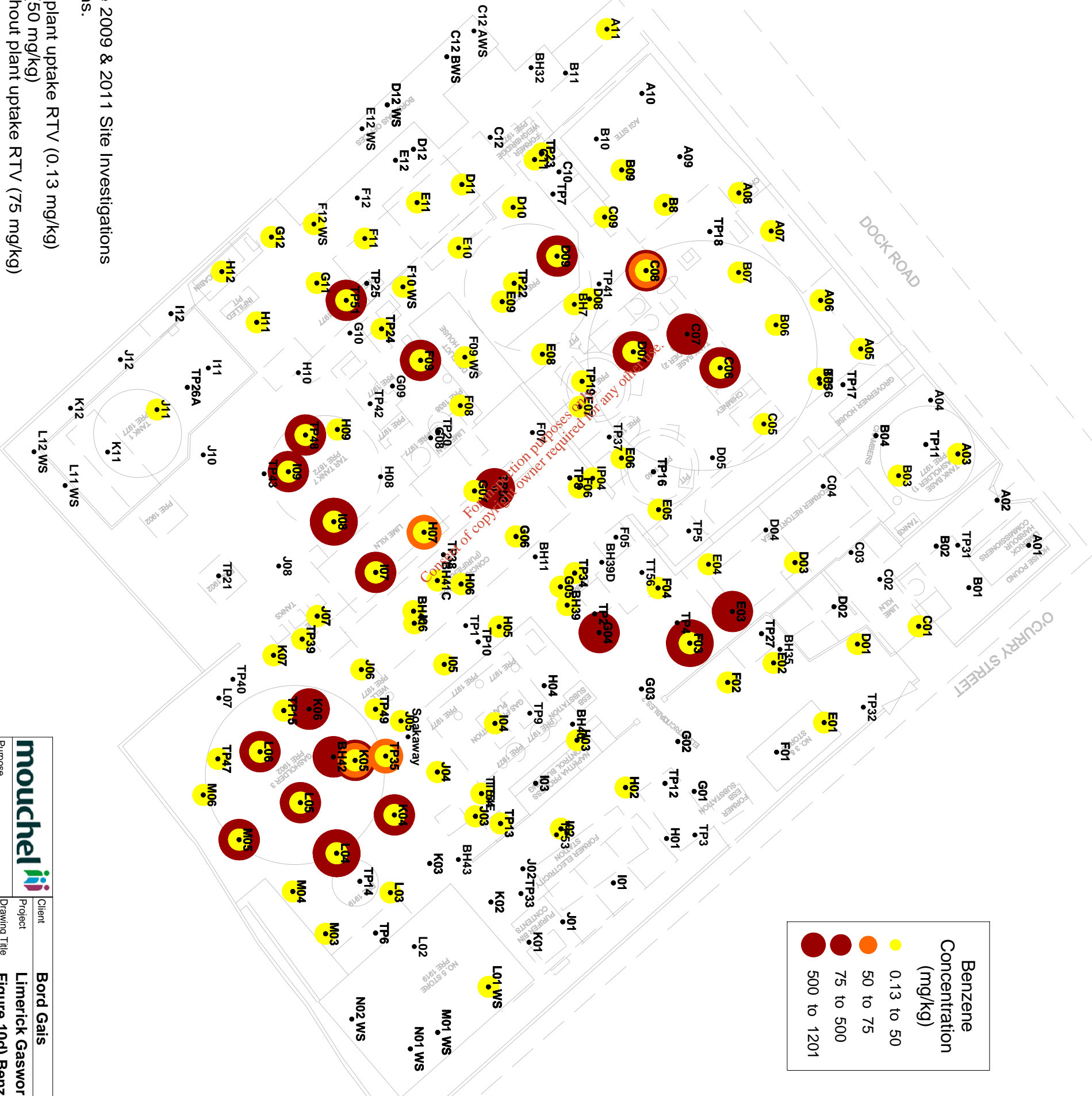
Drawing Number: **1021927/R18OD/010c**

Version: **B**



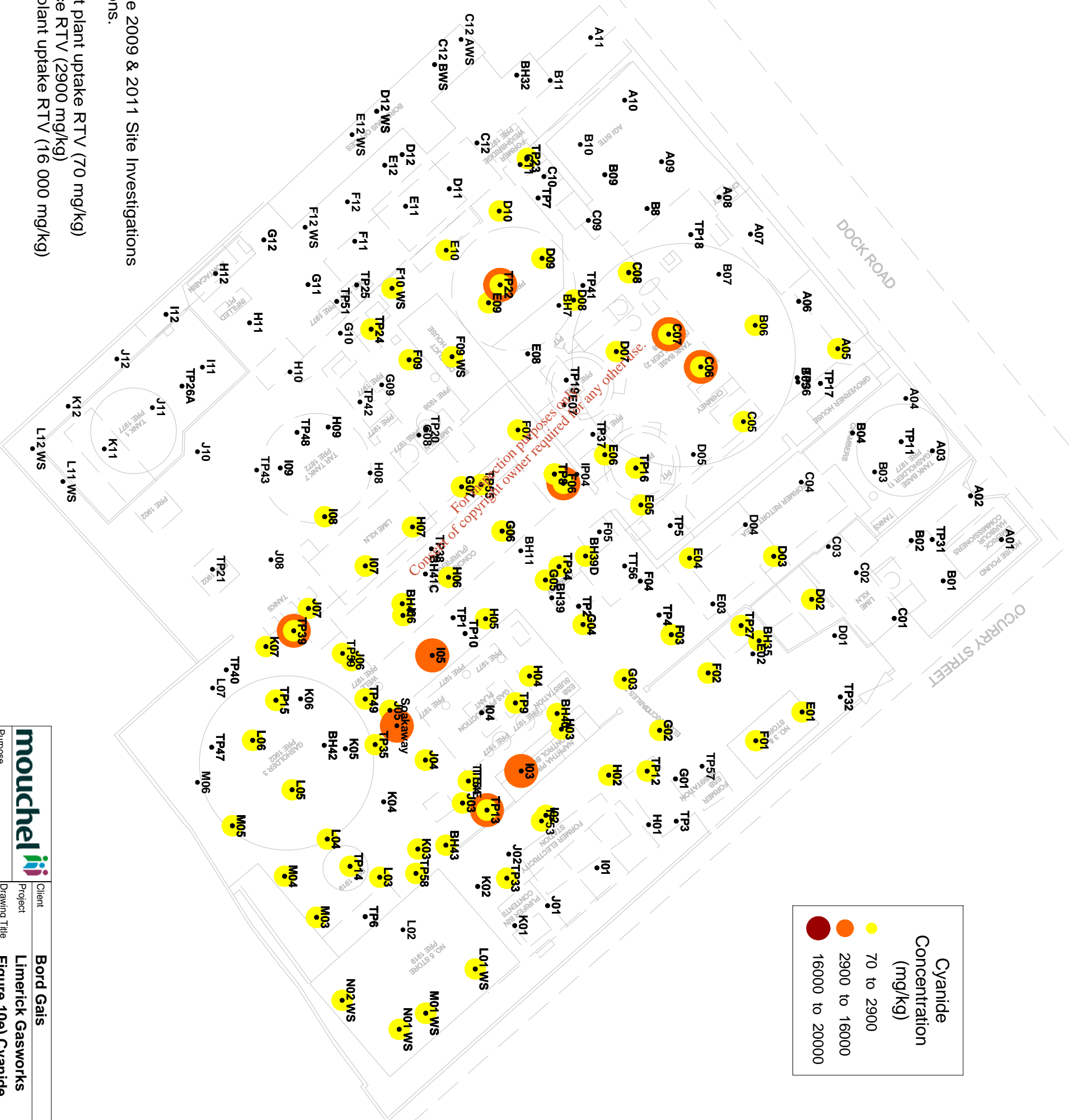
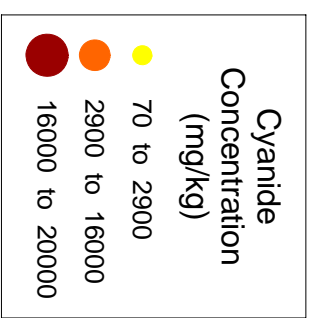
This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (0.13 mg/kg)
 All locations in orange exceed the commercial RTV (50 mg/kg)
 All locations in red exceed the public open space without plant uptake RTV (75 mg/kg)



B	Addition of 2011 characterisation data		
A	First Issue	DM	DM
Version	Amendment	Originated	Checked
		Approved	DW

mouchel		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Figure 10(d) Benzene
Scale	Not to scale	Issuing Office	Ellesmere Port
		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/010d
		Version	B



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (70 mg/kg)
 All locations in orange exceed the public open space RTV (2900 mg/kg)
 All locations in red exceed the commercial without plant uptake RTV (16 000 mg/kg)

B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

Information

Scale: **Not to scale**

Client: **Bord Gais**

Project: **Limerick Gasworks**

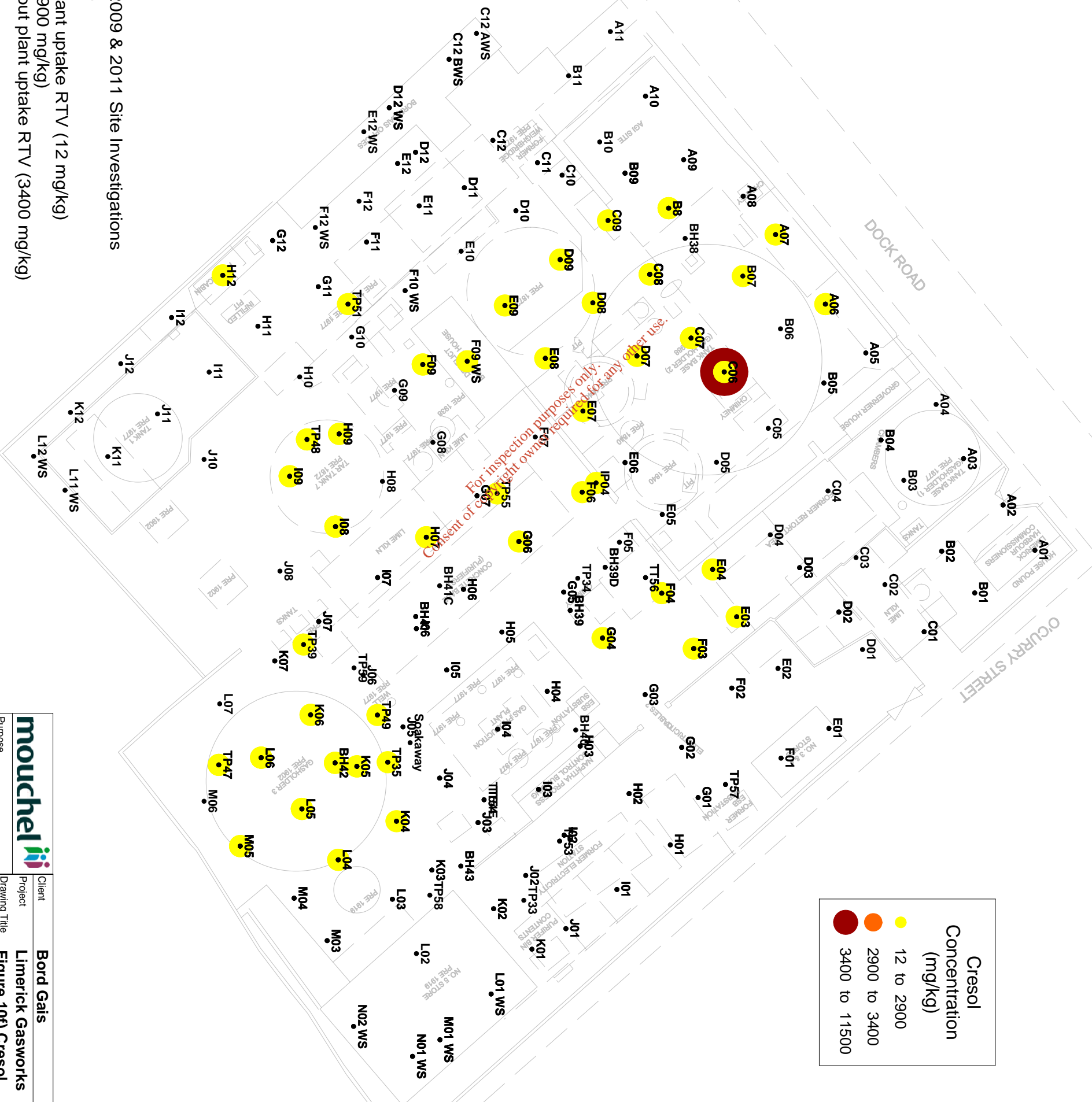
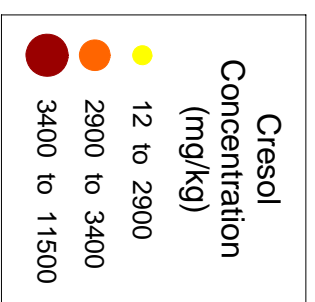
Drawing Title: **Figure 10e) Cyanide**

Issuing Office: **Ellesmere Port**

Telephone: **0151 356 5555**

Drawing Number: **1021927/R18/OD/010e**

Version: **B**



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (12 mg/kg)
 All locations in orange exceed the commercial RTV (2900 mg/kg)
 All locations in red exceed the public open space without plant uptake RTV (3400 mg/kg)

B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

mouchel **Client: Bord Gais**

Information **Project: Limerick Gasworks**

Scale: Not to scale **Drawing Title: Figure 10f) Cresol**

Issuing Office: Ellesmere Port **Telephone: 0151 356 5555**

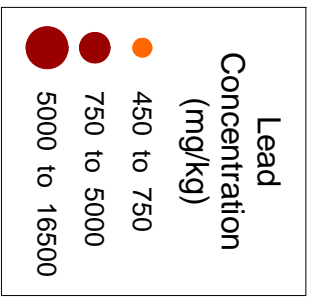
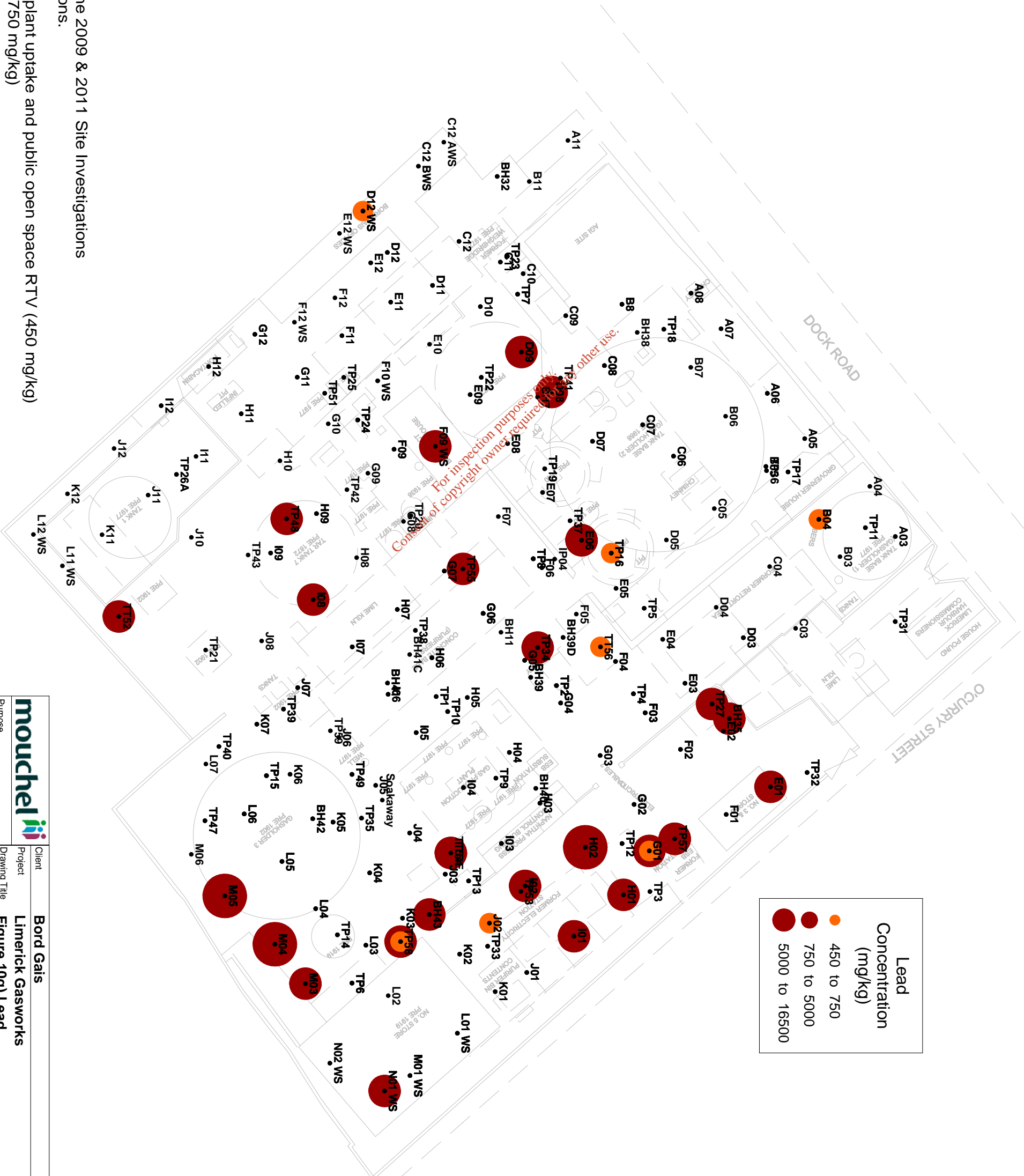
Drawing Number: 1021927/R18/OD/010f

Version: B



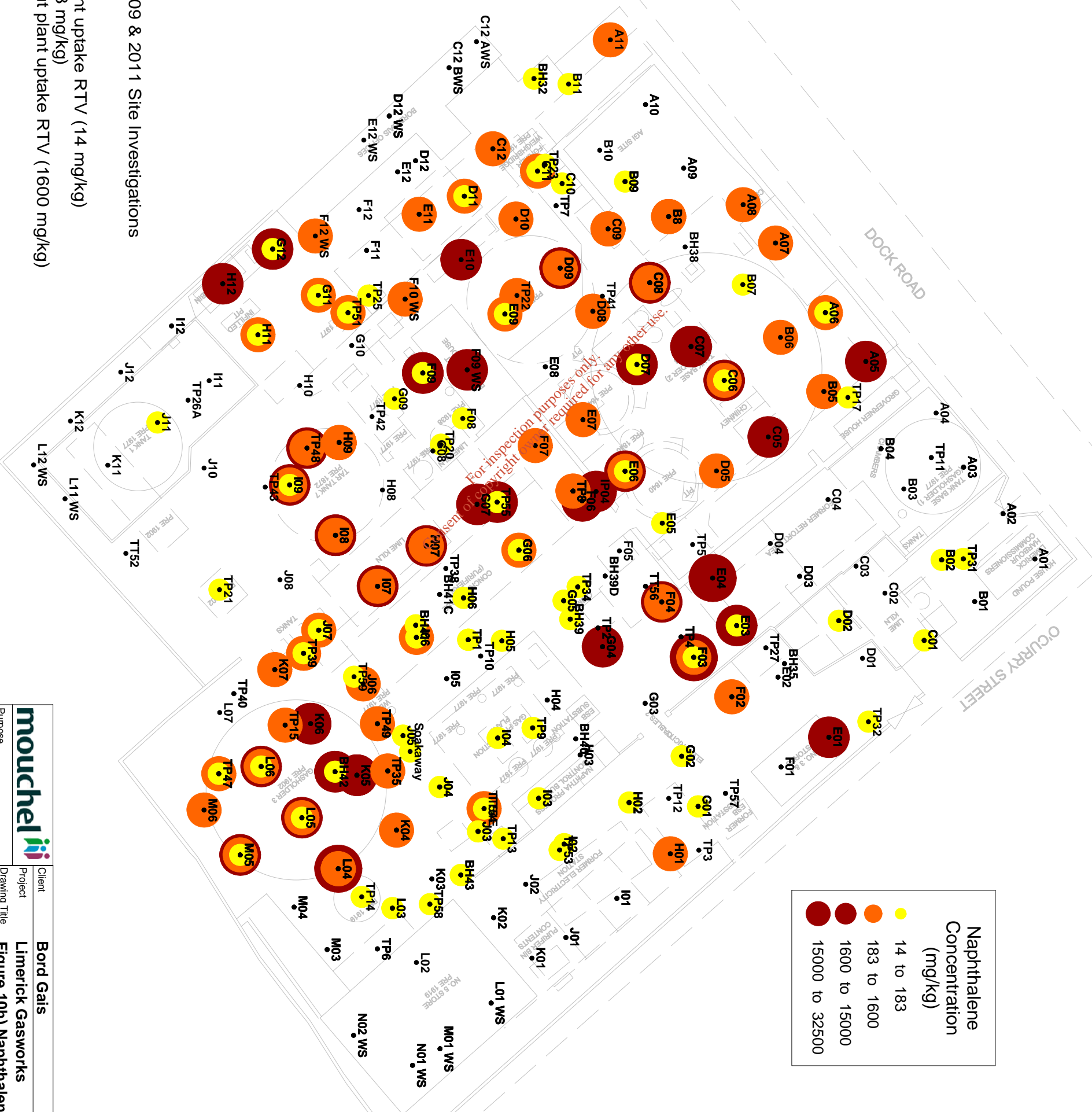
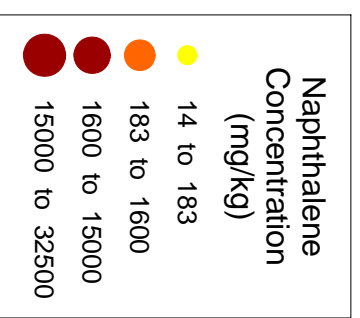
This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

Locations in orange exceed the residential without plant uptake and public open space RTV (450 mg/kg)
Locations in red exceed the and commercial RTV (750 mg/kg)



B	Addition of 2011 characterisation data		
A	First Issue	DM	DM
Version	Amendment	Originated	Checked
		Approved	

mouchel <small>ii</small>		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Figure 10g) Lead
Scale	Not to scale	Issuing Office	Ellesmere Port
Telephone	0151 356 5555	Drawing Number	1021927/R18/OD/0100G
Version	A		



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (14 mg/kg)
 All locations in orange exceed the commercial RTV (183 mg/kg)
 All locations in red exceed the public open space without plant uptake RTV (1600 mg/kg)

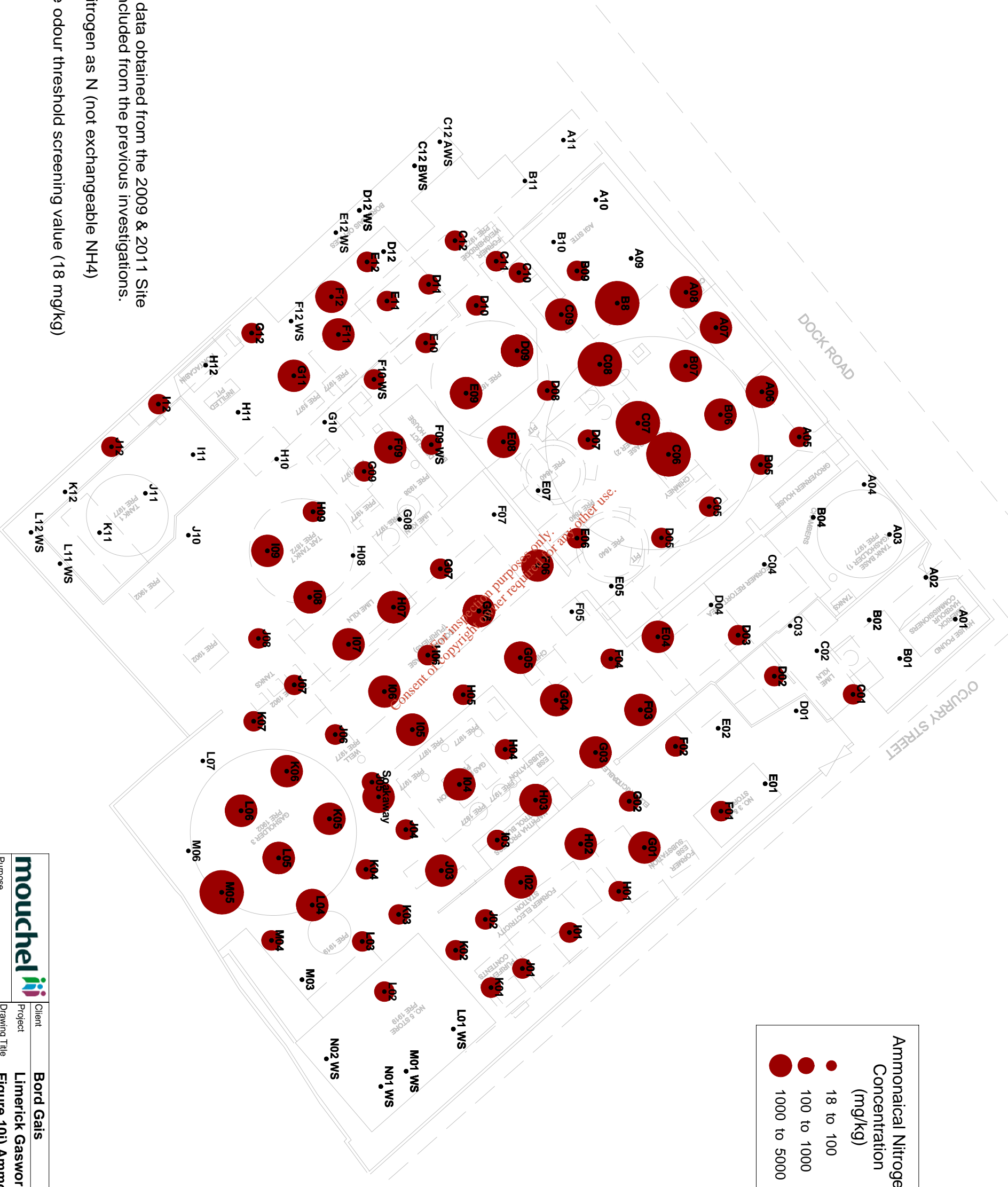
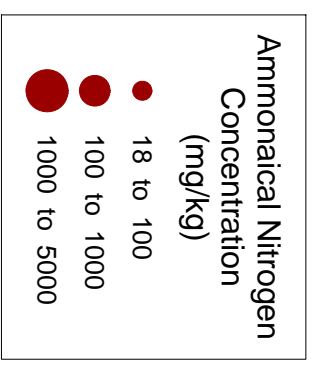
B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

mouchel **ii**

Information


Scale: **Not to scale**

Client	Bord Gais
Project	Limerick Gasworks
Drawing Title	Figure 10h) Naphthalene
Issuing Office	Ellesmere Port
Telephone	0151 356 5555
Drawing Number	1021927/R18/OD/010h
Version	B



This plot was produced using data obtained from the 2009 & 2011 Site Investigations. No data was included from the previous investigations. Results are for ammoniacal nitrogen as N (not exchangeable NH4) All locations in red exceed the odour threshold screening value (18 mg/kg)

B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved



Information

Scale **Not to scale**

Client **Bord Gais**

Project **Limerick Gasworks**

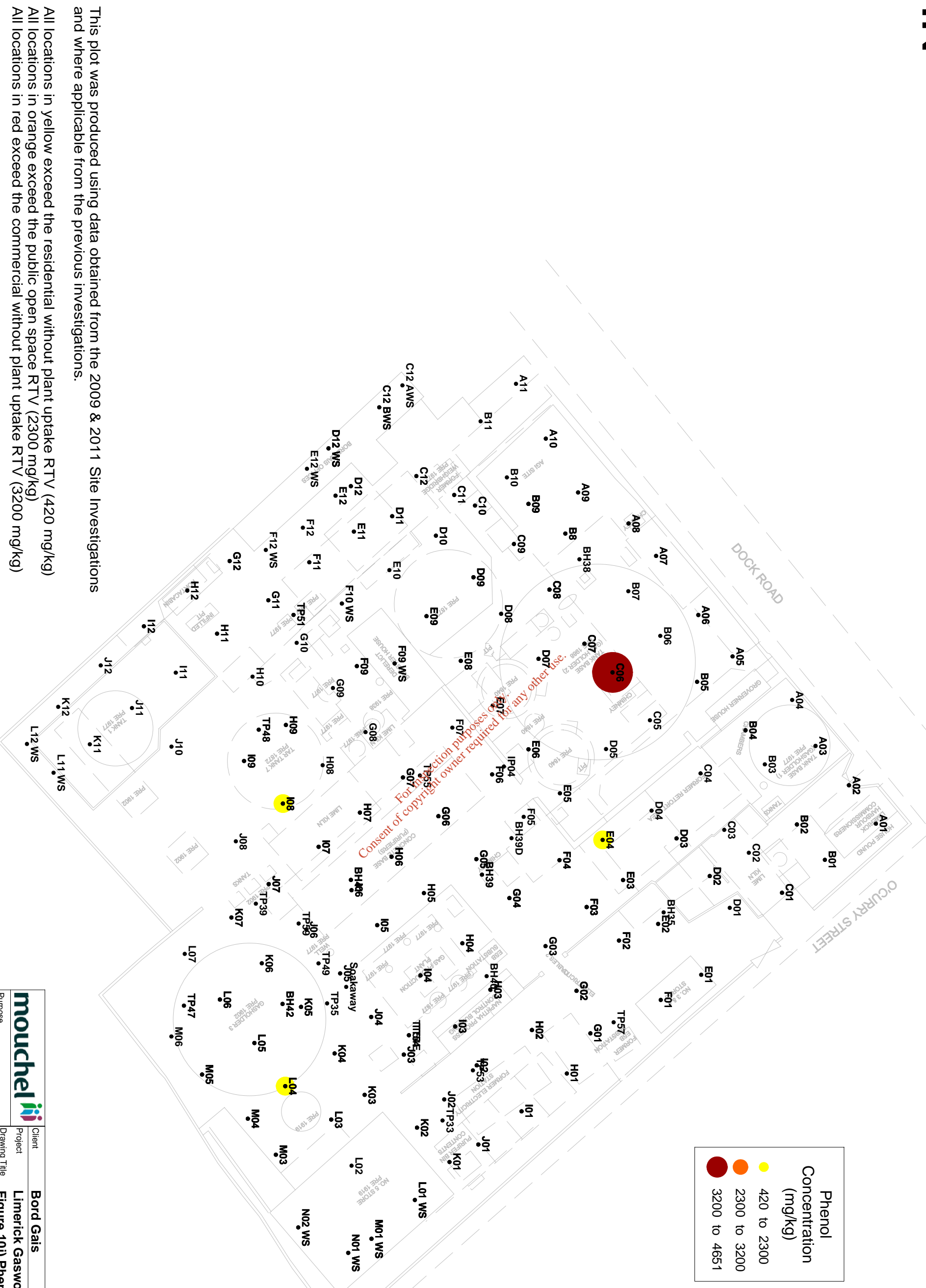
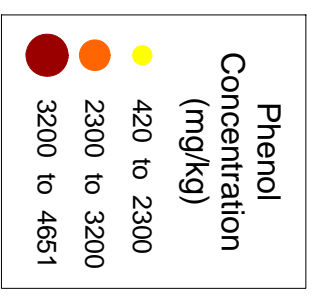
Drawing Title **Figure 10j) Ammoniacal Nitrogen**

Issuing Office **Ellesmere Port**

Telephone **0151 356 5555**

Drawing Number **10219277/R18/OD/010i**

Version **B**



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations.

All locations in yellow exceed the residential without plant uptake RTV (420 mg/kg)
 All locations in orange exceed the public open space RTV (2300 mg/kg)
 All locations in red exceed the commercial without plant uptake RTV (3200 mg/kg)

B	Addition of 2011 characterisation data		
A	First Issue	DM	DM
Version	Amendment	Originated	Checked
		Approved	DW

Information

Scale: **Not to scale**

Client: **Bord Gais**

Project: **Limerick Gasworks**

Drawing Title: **Figure 10j) Phenol**

Issuing Office: **Ellesmere Port**

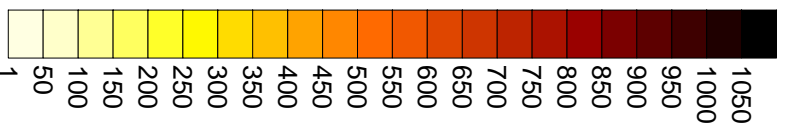
Telephone: **0151 356 5555**

Drawing Number: **1021927/R18/OD/010j**

Version: **B**

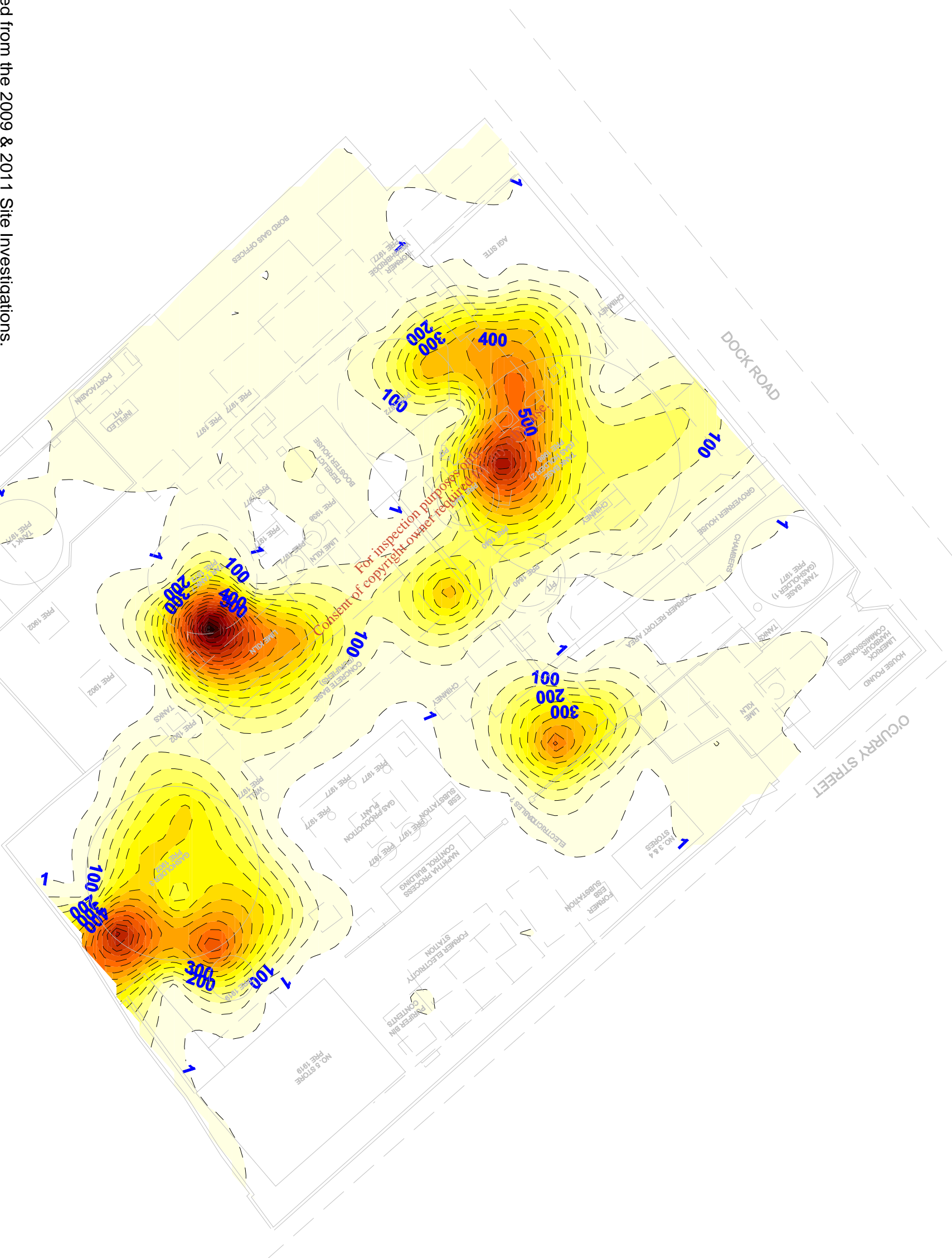


Aliphatic C5-C12 Concentration (mg/kg)



This plot was produced using data obtained from the 2009 & 2011 Site Investigations. No data was included from the previous investigations. Where more than one sample was obtained from a hole the highest concentration for that location was used to produce the plot

Contours were plotted using the Kriging method based upon a 1m x 1m grid

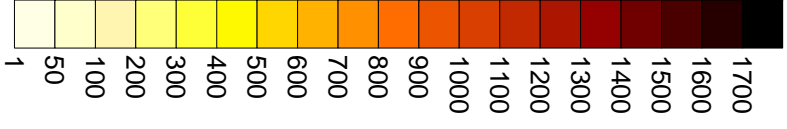


B	Addition of 2011 characteristic data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

mouchel		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Figure 10(k) Aliphatic C5 - C12 contour plot
Scale	Not to scale	Issuing Office	Ellesmere Port
		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/010k
		Version	A

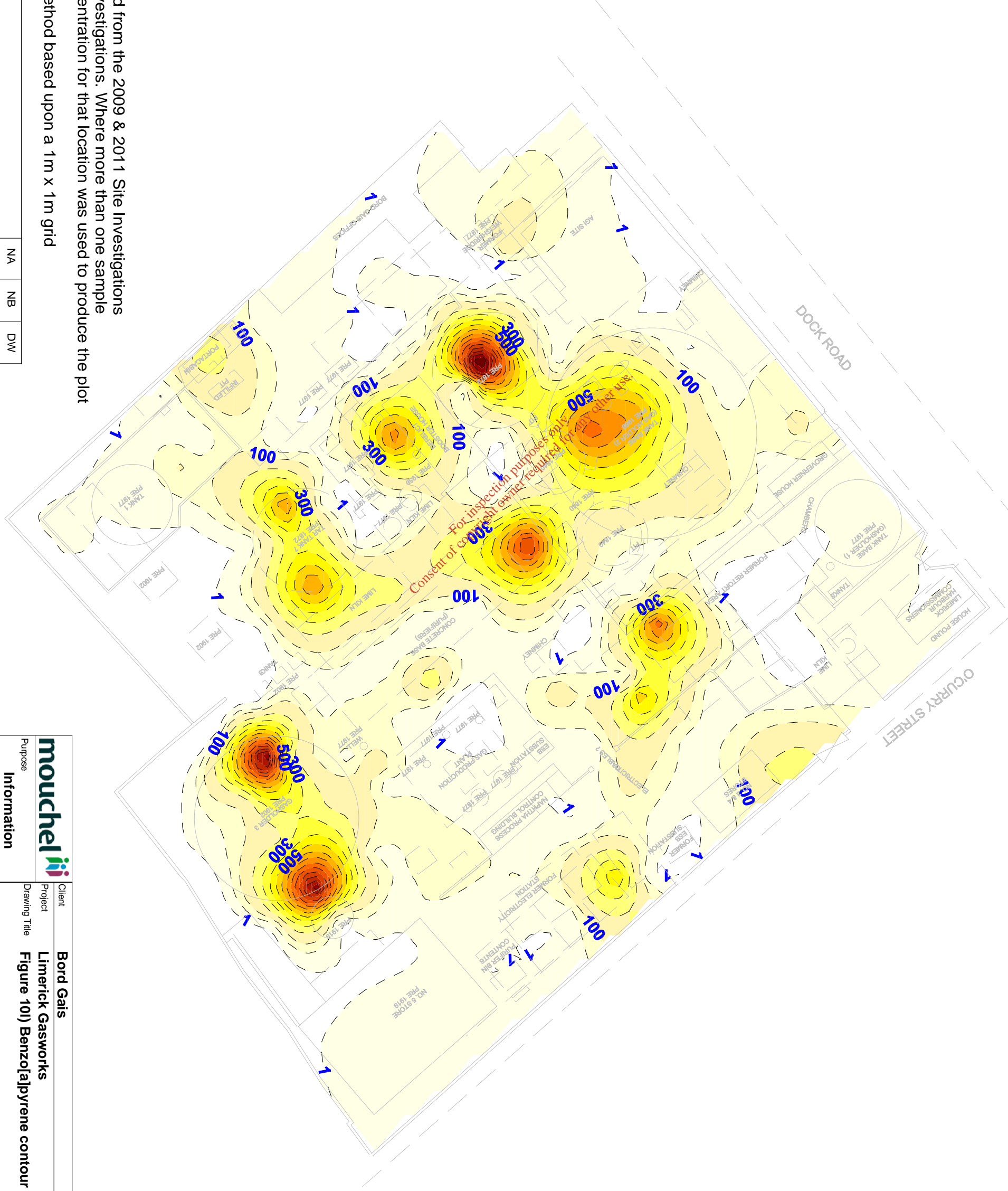


Benzol[a]pyrene Concentration (mg/kg)



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations. Where more than one sample was obtained from a hole the highest concentration for that location was used to produce the plot

Contours were plotted using the Kriging method based upon a 1m x 1m grid

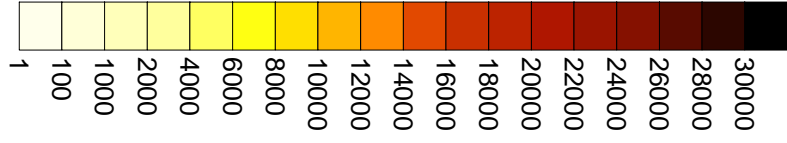


Version	Amendment	Originated	Checked	Approved
A	First Issue	DM	DM	DW
A	Addition of 2011 characterisation data	NA	NB	DW

mouchel <small>ii</small>		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Figure 10(i) Benzol[a]pyrene contour plot
Scale	Not to scale	Issuing Office	Ellesmere Port
		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/0101
		Version	A

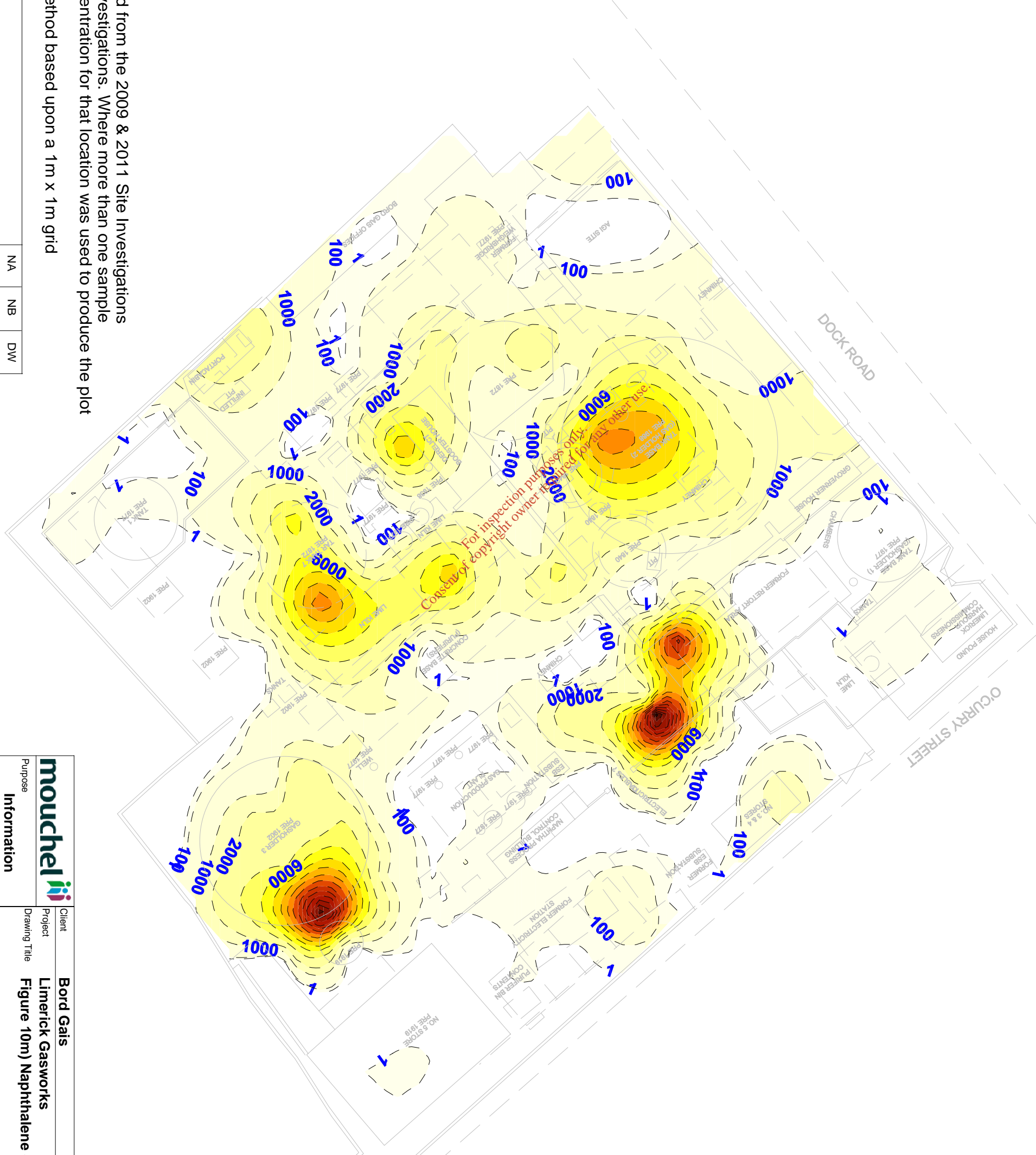


Naphthalene Concentration (mg/kg)



This plot was produced using data obtained from the 2009 & 2011 Site Investigations and where applicable from the previous investigations. Where more than one sample was obtained from a hole the highest concentration for that location was used to produce the plot

Contours were plotted using the Kriging method based upon a 1m x 1m grid

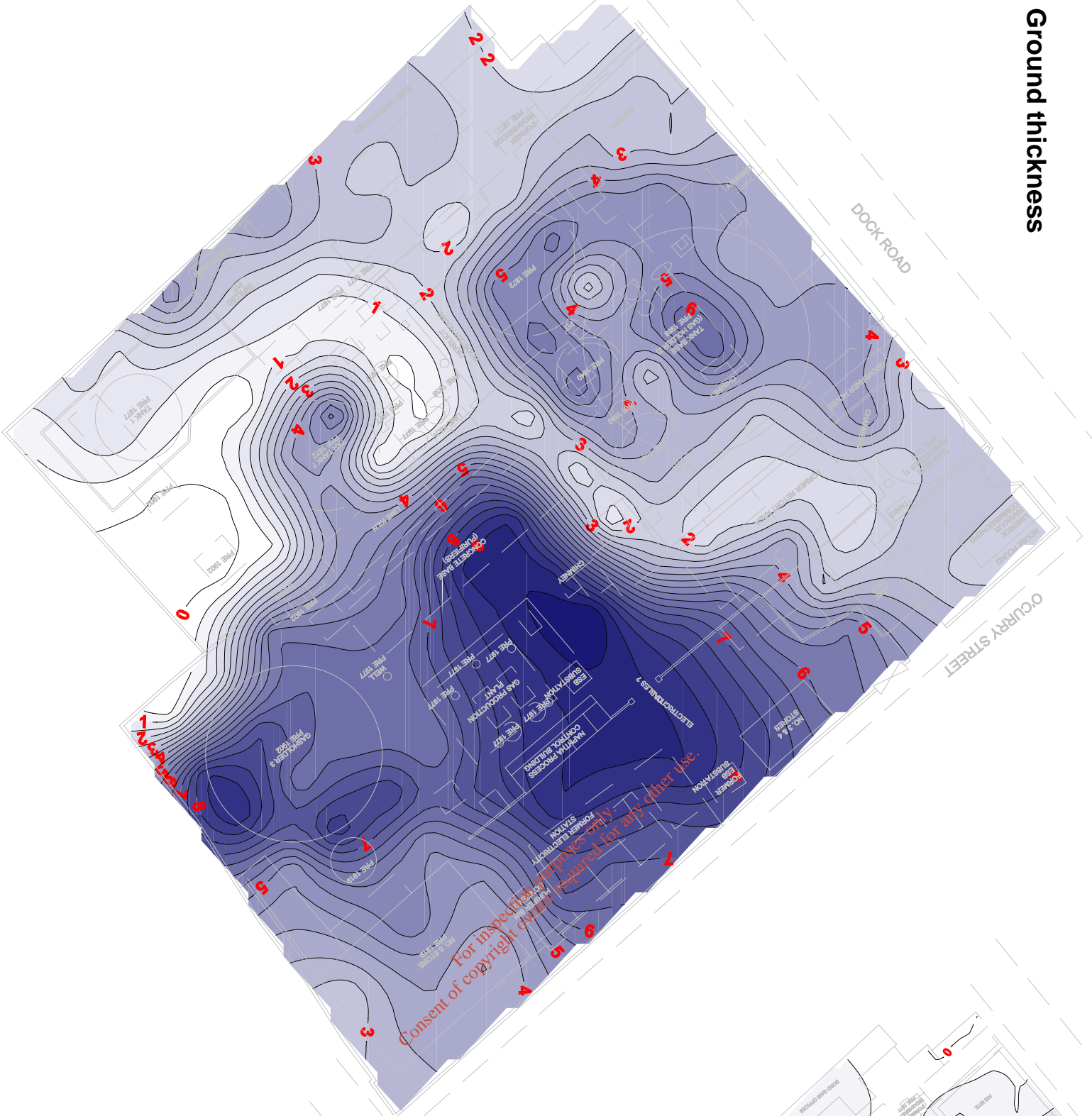
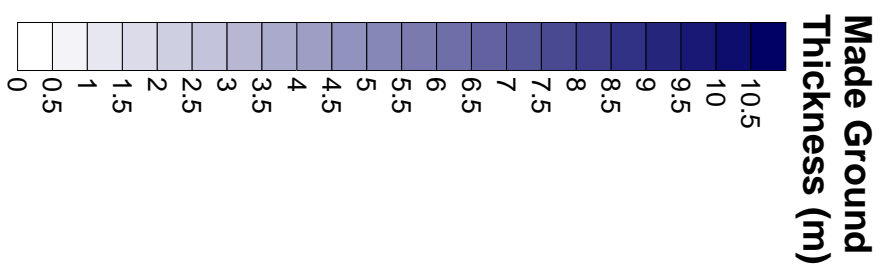


B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

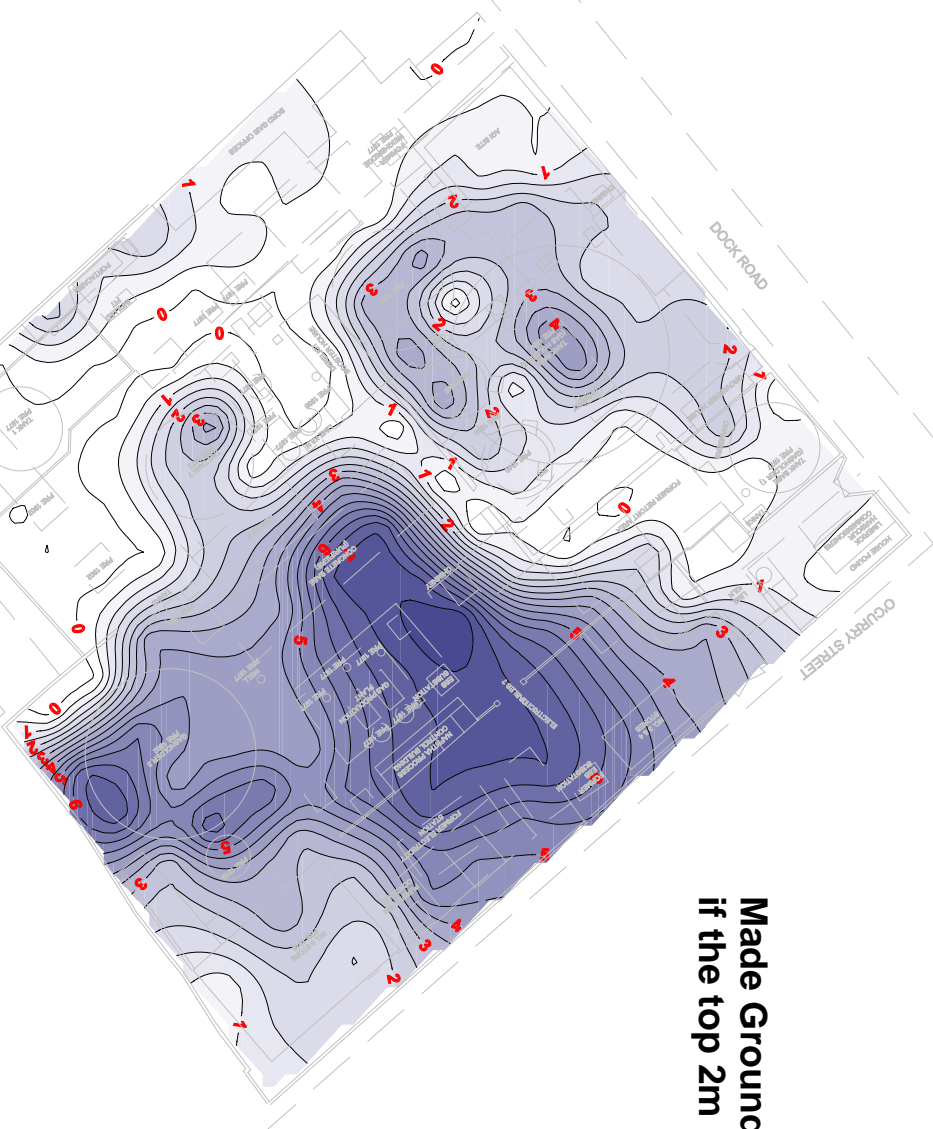
mouchel		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Figure 10(m) Naphthalene contour plot
Scale	Not to scale	Issuing Office	Ellesmere Port
		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/010m
		Version	B



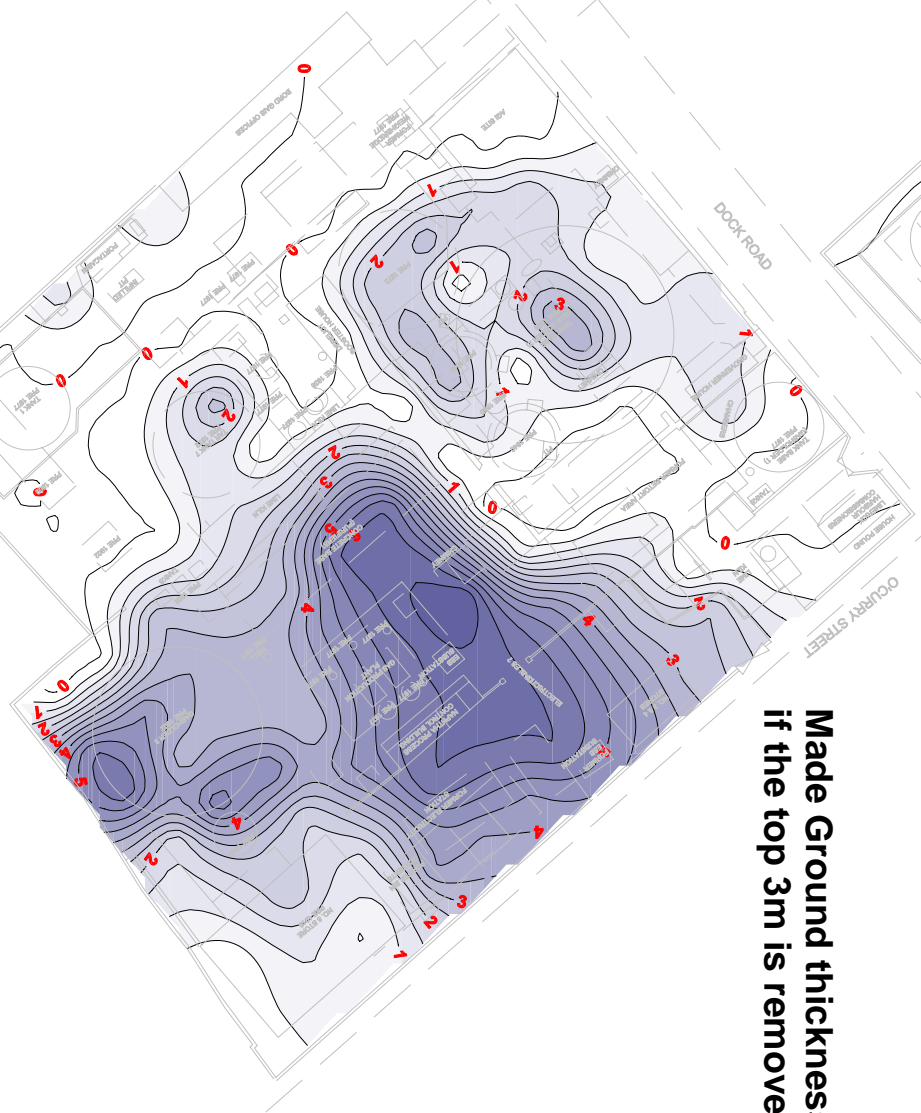
Made Ground thickness



Made Ground thickness if the top 2m is removed



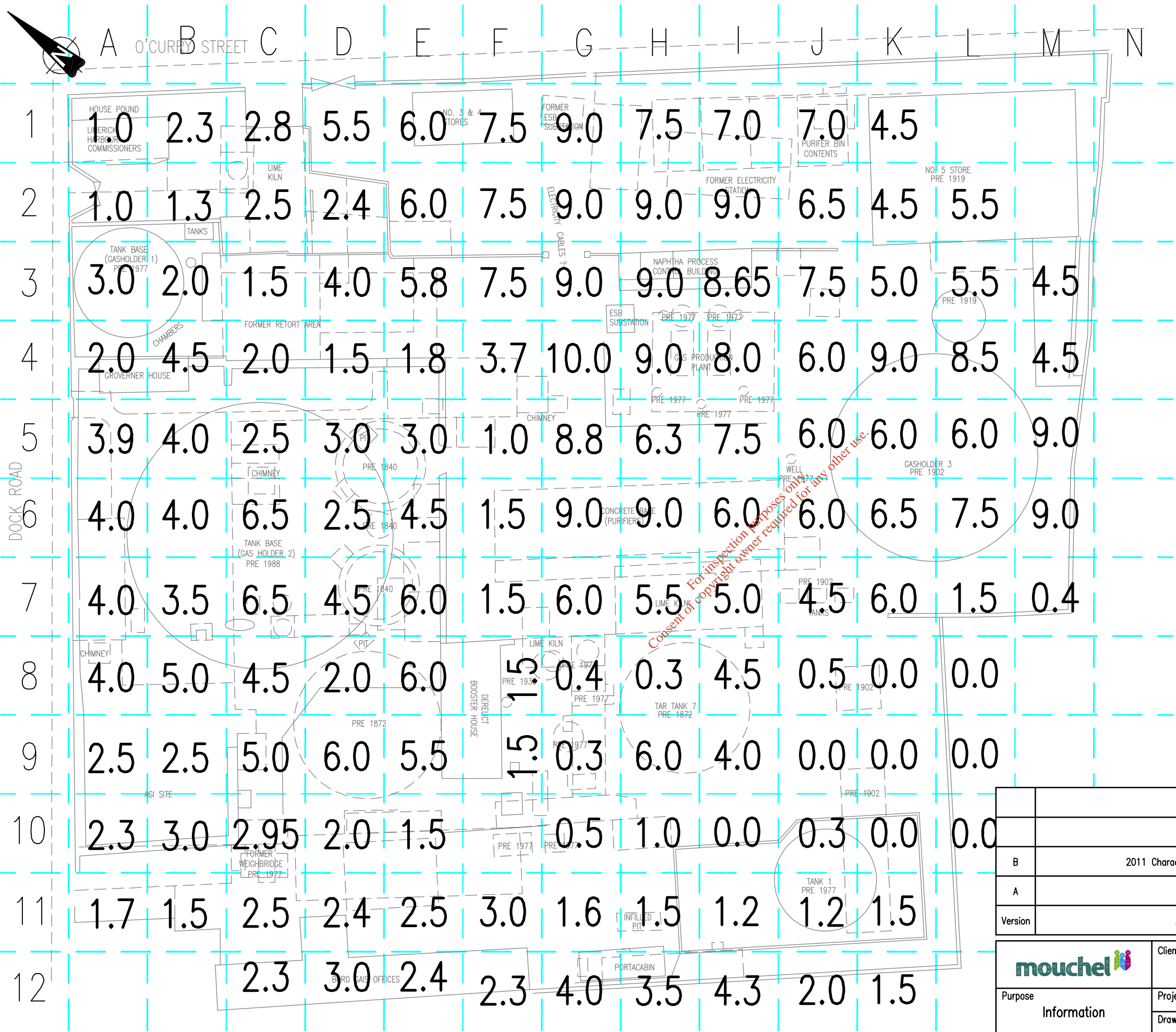
Made Ground thickness if the top 3m is removed



B	Addition of 2011 characterisation data	NA	NB	DW
A	First Issue	DM	DM	DW
Version	Amendment	Originated	Checked	Approved

This plot was produced using data obtained from the 2009 & 2011 Site Investigations. Contours were plotted using the Kriging method based upon a 1m x 1m grid

mouchel		Client	Bord Gais
Purpose		Project	Limerick Gasworks
Information		Drawing Title	Made ground thickness contour plot
Scale	Not to scale	Issuing Office	Ellesmere Port
		Telephone	0151 356 5555
		Drawing Number	1021927/R18/OD/011a
		Version	B



Key
 Approximate Location of Former Structure
 10m Grid

Note
 All depths are meters below ground level.

B	2011 Characterisation Data Added	N.Henrys 07/12/11	N.Balderstone 07/12/11	D.Watts 07/12/11
A	First Issue	K.Hodgkinson 13/01/10	D.Megson 13/01/10	D.Watts 21/01/10
Version	Amendment	Originated by and date	Checked by and date	Approved by and date
Purpose Information		Project Limerick Gasworks Drawing Title Figure 11b Depth of Made Ground		
Draft	● Scale (at A3 size) 1:500	Issuing Office Ellesmere Port	Drawing number 1021927/R18/11b	Version B
Issue		Telephone 0151 356 5555		