SITE OF PROPOSED NEW FURNACE, CELSA TREMORFA, SEAWALL ROAD, TREMORFA

INTERPRETATIVE REPORT

Report No. X081206

Site of Proposed New Furnace, Celsa Steelworks, Seawall Road, Tremorfa, Cardiff CF24 5TH

Interpretative Report

Report No. X081206 September 2008

Prepared for:

James and Nicholas LLP.
Grove House,
Grove Place,
Port Talbot
SA13 1XA

Tel: (01639) 885431
Fax: (01639) 891687

Prepared by:

Quantum Geotechnical Ltd.
Ty Berwig
Bynea
Carmarthenshire
SA14 9ST

Tel: (01554) 744880
Fax: (01554) 776150

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FOREWORD

The following Conditions and Notes on Site Investigation Procedures should be read in conjunction with this report.

GENERAL

Recommendations made and opinions expressed in the report are based on the strata observed in the borings, together with the results of site and laboratory tests. No responsibility can be held for conditions which have not been revealed by the borings or which occur between borings. Whilst the report may suggest the likely configuration of strata, both between borings and below the maximum depth of investigation, this is only indicative and liability cannot be accepted for its accuracy.

Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

BORING PROCEDURES

Initially the investigation was undertaken using the 'Shell and Auger' technique for soft ground boring. All boring operations, sampling and logging of soils and in-situ testing complied with the recommendations of the British Code of Practice BS 5930 (1999), 'Site Investigations' and BS 1377: 1990, 'Methods of Test for Soils for Engineering Purposes'. Whilst the technique allowed the maximum data to be obtained in soft ground, some disturbance and variation of soft and layered soils is unavoidable. Attention is drawn to this condition whenever it is suspected.

Due to the nature of the ground conditions (very dense coarse Made Ground deposits), Rotary probing was also conducted in order to achieve penetration through the Made Ground and to progress the boreholes to completion.

ROUTINE SAMPLING

In granular soils, and where undisturbed sampling is inappropriate or impossible, large disturbed samples are collected from the boring tool and sealed in polythene bags. Smaller disturbed samples are also recovered at frequent intervals to allow a visual examination of the full strata section. Groundwater samples are also obtained where inflows of sufficient magnitude are observed.

IN-SITU TESTING

Standard Penetration Tests utilising the standard split spoon sampler and automatic trip-hammer, were conducted in the granular and cohesive soils. A summation of the number of blows for 300mm penetration, subsequent to a seating of 150 mm, is recorded on the boring records together with the blow count for each 75 mm penetration. In cases where incomplete penetration is obtained, the number of blows for the recorded value of penetration is noted.

GROUNDWATER

The depth of entry of any influx of groundwater is recorded during the course of boring/drilling operations. However, the normal rate of boring does not usually permit the recording of an equilibrium water level for any one water strike. Where possible, the daily morning groundwater levels are entered on the borehole records, together with the depth of the boring and depth cased.

Groundwater conditions observed in the borings are those appertaining to the period of investigation. It should be noted, however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions or other

causes.

RETENTION OF SAMPLES

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material is discarded.

Unless a period of retention of samples is agreed, it is our normal practice to discard all soil or rock samples **one month after submission** of our final report.

1.0. INTRODUCTION

Upon the instruction of James and Nicholas LLP., Quantum Geotechnical Limited (QGL) were commissioned to undertake a geo-environmental investigation of a site at the Celsa Steelworks, Seawall Road, Tremorfa, Cardiff. This report was required to assess the existing ground conditions and any geotechnical or environmental hazards that may be present on the site of the proposed development.

The purpose of the investigation was to provide detailed information on ground conditions beneath the site of a proposed furnace with its associated building enclosure, a recuperator structure, 60m high stack and water treatment plant. The investigation paid particular attention to stratum classification and the extent of Made Ground deposits possibly underlying the site.

In this report a factual account of the fieldwork is presented, the strata encountered and groundwater observations from the investigation are detailed, along with results of subsequent laboratory testing of samples recovered. Guidance and recommendations on contaminant issues and foundations are discussed.

The contract was awarded on the basis of a competitive tender quotation as detailed in our letter of the 4th April 2008.

Final design details regarding the various elements of the proposed furnace development were not received until 9th September 2008.

General notes on the techniques employed by QGL are described in the Foreword together with the limitations inherent in this type of work.

2.0. THE SITE AND GEOLOGY

2.1. The Site

The site of the proposed furnace development lies within the Celsa Steelworks site which is located between Seawall Road and Rover Way to the east of Cardiff City centre. The new structures will be located at the southern end of the main works complex (at the eastern end of the milling warehouse and the adjacent turning area and vehicular through fare). The existing warehouses are steel framed with brick or block-work to approximately 2.0m and then cladding. The floor of these warehouses is mixed hardcore fill and concrete. The turning area is of surfaced with tarmacadam.

The approximate National Grid Reference of the centre of the site is ST 321050 176050. The general site location is shown within Figure 1 whilst the detailed location of the site is shown in Figure 2 both of which are presented in Appendix I.

2.2. Geology

The geology of the site is shown on the British Geological Survey sheet number 263 – Cardiff, 1:50,000 solid and drift editions. This plan shows the superficial deposits directly underlying the site to be comprised of estuarine deposits (clays, silts and peat) possibly overlying river terrace gravels. The solid geology underlying the area consists of Triassic Mercia Mudstones. This sequence of strata generally consists of mudstone with occasional siltstone and sandstone bands.

There are no faults shown on the geological plot affecting the site.

Much of this area of Cardiff Docks has been reclaimed from the Severn Estuary and consequently made ground is expected to exist at or near surface.

2.3 Radon

The requirement for radon protection measures in new dwellings (housing) is assessed in the guidelines published by the Building Research Establishment (Scivyer, 2007). These guidelines relate to the construction of new dwellings (houses), however, the preliminary assessment of radon risk therein may also be applied to other developments, including commercial and industrial.

The BRE indicate that the site lies in an area where either basic radon protection should incorporated within the new building or a BR211 Radon Report (a geological assessment of the risk posed by radon) should be obtained from the British Geological Survey (BGS) which will provide definitive guidance on the potential risk from radon.

3.0. FIELDWORK

3.1. General

The fieldwork initially involved the boring of two shell and auger boreholes at the positions shown on the borehole location plan, (Fig. 3. Appendix I). However, this method of boring proved unable to penetrate the dense made ground deposits and consequently the boreholes were completed using rotary drilling techniques. The exploratory holes were drilled between 1st and 15th July 2008. On completion of boreholes monitoring standpipes were installed to enable gas and groundwater monitoring to be undertaken.

3.2. Sampling

Samples were taken at the depths indicated on the borehole records. Bulk disturbed samples were recovered from granular deposits for testing and to enable more representative descriptions of coarse-grained soils to be made. Additional small disturbed samples were taken at SPT locations for geotechnical and environmental laboratory testing.

3.3. Exploratory Hole Positions

The exploratory hole locations are shown on Figure 3, Appendix I. The exploratory holes were positioned at locations directed by James and Nicholas LLP.

4.0. LABORATORY TESTING

The laboratory testing was scheduled by QGL with the test programme comprising a variety of environmental and geotechnical testing. The environmental testing was carried out on selective samples of soil with comparisons of the results to threshold values contained within the DEFRA and EA published CLEA (2002) guidelines. The results are given in Appendix III.

4.1. Geotechnical Testing

The geotechnical testing schedule prepared included analysis to determine the following geotechnical characteristics:

- Moisture Content
- Plasticity Index
- Water Soluble Sulphate
- Plastic Limit
- Liquid Limit
- pH

4.2. Environmental Testing

Laboratory testing has been undertaken on a number of samples of soil and leachate (generated from soil samples) as indicated below. The geo-environmental analyses were carried out by a UKAS accredited testing laboratory with detection limits being generally compatible with the relevant guideline values.

Table 1: Metals and Semi Metals

- Arsenic
- Barium
- Cadmium
- Lead
- Nickel
- Vanadium
- Beryllium
- Chromium
- Copper
- Mercury
- Selenium
- Zinc

Table 2: Inorganic Chemicals/Others

- Cyanide (Total)
- Sulphate
- Sulphur
- Acidity/Alkalinity (pH)
- Cyanide (Free)
- Sulphide
- Nitrate

Table 3: Organic Chemicals

- Total Petroleum Hydrocarbons (TPH)
- Phenols
- Poly Aromatic Hydrocarbons (PAH)

4.3. WAC Testing

Waste Acceptance Criteria testing was conducted on one sample.

Laboratory test certificates are provided in Appendix III.

5.0. GROUND CONDITIONS

5.1. General

The general sequence of deposits encountered on the site was as follows;

- Dense to very dense Made Ground
- Very soft to soft Estuarine silt / clay with peat,
- Mercia Mudstone Group .

5.2. Ground Conditions

5.2.1. Made Ground

Made ground was encountered in both of the exploratory holes extending to a maximum depth of 6.25m (BH2R). The Made Ground deposits occurred as loose to very dense sandy gravel and cobbles of slag and clinker with occasional inclusions of metal.

Initially the boreholes were commenced using the shell and auger technique but due to the density of the Made Ground this technique had to be abandoned and rotary open-hole drilling was utilised to enable full penetration of the Made Ground and underlying deposits to be achieved.

Standard penetration tests undertaken in both the Shell and Auger and rotary open-hole boreholes gave N values ranging from N=8 to N=>50 indicating that these deposits range from loose to very dense in character.

5.2.2. Estuarine (Fine Grained) Deposits

Underlying the Made Ground horizon a deposit of silt/clay with thin organic ‘peaty’ layers was encountered. With depth the clay deposit in BH1R became slightly more gravely with medium rounded gravel being encountered. This fine grained deposit extended to a depth of 14m in BHR1m and 13.5m in BH2R.

Standard penetration tests undertaken in the rotary open-hole boreholes gave N values ranging from N=4 to N= 10 indicating that these deposits range from very soft to stiff in character.

The laboratory tests undertaken on samples of these deposits recorded typical natural moisture contents of the silt/ clay to be variable with results between 18% and 70%. The results of Atterberg Tests recorded the clay soils to be intermediate-plasticity silt / clays with one sample being of low plasticity clay. The Plasticity Indexes for these deposits ranged from 7 to 19% indicating that these soils are of low volume change potential

5.2.2. Mercia Mudstone

Below the sequence of Estuarine deposits a completely/highly weathered to partially weathered red mudstone marl was encountered which extended to termination depth of the boreholes at 19.5m below ground level.

Standard penetration tests undertaken in the weathered marls generally gave values of N in excess of 50 indicating that these deposits are very weak to weak in character.

Full descriptions of these deposits are given within the Engineers’ Borehole logs which are provided in Appendix II.

5.3. Groundwater

Ground water seepage was encountered in both boreholes at approximately 4.0m below ground level. During drilling water was standing at approximately 10.0m at the beginning of shifts.

Subsequent monitoring found ground water to be standing at depths of approximately 4.36m.

Table 4: Water levels (m)

Round/Borehole	BH1R	BH2R
24/07/08	4.36m	4.36m
30/07/08	4.38m	4.35m
06/08/08	4.36m	4.36m
13/08/08	4.27	4.26

5.4 Gas Monitoring

Four rounds of gas monitoring were undertaken over the period 24th July to 13th August 2008. During this period atmospheric pressure was seen to vary from 1000mb to 1014mb. The results of the monitoring exercise are summarised as follows:

BH Nos.	Methane CH_4 %		Carbon Dioxide CO_2%		Oxygen O_2%		Hydrogen Sulphide H_2S%	
	Min.	Max	Min.	Max	Min.	Max	Min.	Max
BHR1	0.0	0.2	0.0	0.0	20.4	20.7	0	0
BHR2	0.0	0.2	0.0	0.0	20.4	20.6	0	0

6.0. ENVIRONMENTAL APPRAISAL

6.1 Results Of Contaminant Testing – General

The Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency published a series of reports in 2002 that provide a scientifically based framework for the assessment of risks to human health from land contamination. By providing a consistent approach to risk assessment, the framework facilitates the rapid identification of sites that pose a significant risk to human health and help avoid blight on other sites. This framework does not consider risks to other receptors such as plants and animals, buildings and controlled waters.

The new Soil Guideline Values are a tool that can be used to assess the risks posed to human health from exposure to soil contamination resulting from land use. They represent 'intervention values', which indicate to an assessor that soil concentrations above this level could pose an unacceptable risk to the health of site users and that further investigation and/or remediation is required. Soil Guideline Values combine both authoritative science and policy judgements.

Soil Guideline Values have been derived using the CLEA (Contaminated Land Exposure Assessment) model according to three typical land uses:

- residential (with and without vegetable growing)
- allotments
- commercial / industrial

In respect of the proposed development only the commercial/industrial model has been taken into consideration.

Commercial/industrial

There are many different kinds of workplace and work-related activities. This land-use assumes that work takes place in a permanent single-story building, factory, or warehouse where employees spend most time indoors involved in office-based or relatively light physical work. This land-use is not designed to consider those sites involving 100% hard cover (such as car parks) where the risks to the site-user are from ingestion or skin contact because of the implausibility of such exposures arising while the constructed surface remains intact.

Where applied appropriately, exceeding a Soil Guideline Value suggests the need for either further investigation and/or remediation. Soil Guideline Values can be used in connection with the formal requirements of Part IIA of the Environmental Protection Act 1990 ("the contaminated land regime"). However, they will also be relevant to many situations where the effect of land contamination on human health is an issue such as in planning applications when judging the need for action to ensure that a new use of land does not pose unacceptable risks to health. Soil Guideline Values have superseded ICRCL values in respect of assessing risks to human health. The ICRCL guidance note 59/83 (2nd Edition) was withdrawn by DEFRA in December 2002. However, where guidelines are not given in the CLEA document the previously referenced ICRCL guidelines are still referenced in this report as to devise CLEA figures would require a site-specific toxicological analysis.

Section 6.2 details the results of the laboratory testing on selected soil samples and discusses their implications.

6.2. Soil Contamination Assessment

A total of 3 soil samples were dispatched for environmental testing. Table 5 below outlines the range of contaminant results recorded from the laboratory testing as well as the current guideline thresholds used. A full set of laboratory test certificates is provided within Appendix III.

Table 5: Summary of Soil Contamination Analysis

Determinants	CLEA (2002) & LQM/CIEH (2007) Soil Guideline Values & Generic Assessment Criteria (mg/kg)		
	Site Results (mg/kg)		Commercial/ Industrial
	Minimum	Maximum	
Potential Inorganic Contaminants			
Barium	39	150	
Beryllium	*<1*	*<1*	***1,950***
Cadmium	1.1	1.5	**1,400**
Chromium (Total)	330	850	**5,000**
Copper	*30*	*69*	***45,700***
Lead	6	120	**750**
Mercury	<0.1	0.6	**480**
Nickel	5	13	**5,000**
Vanadium	440	1200	***4,250***
Zinc	*13*	*190*	***188,000***
Arsenic	3	12	**500**
Boron (Water Soluble)	1.6	2.7	
Selenium	4.8	11	**8,000**
Sulphur	3.6	340	
Cyanide (Complex)	<0.2	<0.2	
Cyanide (Free)	<0.1	<0.1	
Sulphate	0.02	0.72	
Sulphide	44	1200	
pH	8.8	12.3	
Potential Organic Contaminants			
Petroleum Hydrocarbons[4]	*35*	*270*	***See Note 4***
Phenol[5]	<0.3	<0.3	**21,900**
PAH (Sum)[5]	<0.5	15	

Notes :- **1.** LQM/CIEH GAC in *Italics*. **2.** # Relative to soil pH of 6, 7, & 8. **3.** NYS - Not Yet Specified

4. Petroleum Hydrocarbons should be assessed as Aliphatic and Aromatic compounds (C5 - C70), for 1%, 2.5% & 5% Soil Organic Matter Content respectively (SOM). For individual petroleum hydrocarbon compounds/fractions, refer to LQM/CIEH GAC document.

5. Individual PAH's, Phenols, Toluene & Ethylbenzene given for the LOWEST concentration for either 1%, 2.5% & 5% Soil Organic Matter Content (SOM)

With the proposed development taking the form of industrial works, the results of any contaminative soils testing have been compared to the industrial/ commercial guidelines detailed in Table 5.

The CLEA Soil Guideline Values (SGV) provides thresholds to undertake generic risk assessments of sites in respect of risks to human health. The issuing of SGV's by DEFRA/EA is an ongoing process, with the suite of analytes for which published results are available being updated at regular intervals. The list of published SGV's is not complete when compared to the list of potential contaminants as detailed in the earlier CLEA publication CLR8, from which the suggested suite of contaminants tested for is derived. Where CLEA (2002) values are unavailable, the LQM/CIEH (2007) values have been used to allow comparisons to be made.

Of the analytes in the CLEA 2.1 suite, no analytes exceed the CLEA Soil Guideline Values (SGV) for commercial/ industrial.

By adopting the source-pathway-receptor analogy, where shallow lying soils and made ground are potential sources of contaminants, and the receptors being the site users such as workers, then should there have been raised values; a barrier preventing a direct pathway between the source and the receptor should be considered in the area.

It is envisaged that much of the site will be covered with hardstand typically comprising a sub-base granular blanket overlain by either concrete or tarmacadam. Parking areas and roadways would not pose a threat to site users as the hard standing would act as a barrier. This would sever the pollutant linkage that may exist between the contaminant source and potential receptors.

Full details of the source of all imported soils should be documented (including topsoil). Any material from a potentially contaminated (e.g. industrial) site should be rejected. It is advised that chemical (contamination) testing results are obtained and supplied for comment (unless the soil is from a virgin quarry site) prior to accepting the soils on site.

There are judged to be moderate risks to construction operatives from the contaminants identified. During earthwork's phases site workers will be exposed to soil contaminants. Operatives working with, or likely to come into contact with made ground and contaminated soil with the potential to harness raised concentrations of contaminants, should observe particular precautions concerning personal hygiene. They should be issued with the appropriate Personal Protective Equipment and should be instructed in safe working methods. Instructions should be issued in the recognition of potentially hazardous materials including oily and odorous soil and water and also any discoloured or fibrous substances for example. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food must be confined to designated clean areas. Suitable welfare (washing) facilities should be provided.

In assessing the risk posed on any development site, it must be borne in mind that marginal exceedance of particular threshold levels does not in itself constitute a risk, but that further assessment may be required or remedial action possibly taken.

6.3. RISK TO CONTROLLED WATERS

The risk to controlled waters, i.e. any aquifers or local rivers, will be defined by the potential for contaminants to leach from the soils on site. Once the leaching potential is known the risk from this can be assessed and if need be, addressed by remedial actions. Further to the contamination human health assessment discussed above, soil samples obtained from the made ground material underlying the site were subject to leachate testing. This testing assesses the leachate potential of the material on site, with the results compared to UK Drinking Water Standards (UKDWS) and Environmental Quality Standards (EQS), in order to assess the materials potential threat to local aquifers and waterways.

The nearest principle waterways are the River Rhymney, which is 1.6km to the north of the site and the Severn Estuary which lies 600m to the east of site. The site is set upon

superficial deposits of estuarine alluvium principally comprising silt and clay over strata of the Mercia Mudstone Formation. These deposits/strata are identified as being non-aquifers and are expected to have negligible permeability. Both EQS Freshwater and EQS Saltwater values have been used to gain a full comparison.

The results of the leachate testing are shown in Table 6 below along with the threshold levels given by the UKDWS as well as the EQS guideline values. Both sets of guidelines have been used to provide a more complete assessment of the leachate results.

Table 6: Summary of Leachate Testing Results

Determinants		**CLEA (2002) & LQM/CIEH (2007)**				
		Site Results (mg/kg)		**Environmental Quality Standards Freshwater[1]**	**Environmental Quality Standards Saltwater[1]**	**UK Drinking Water Standards[2]**
		Minimum	Maximum			
Arsenic	µg/l	<1	<1	50	25	10
Cadmium	µg/l	<2	<2	250	2.5	5
Chromium	µg/l	<10	<10	250	15	50
Lead	µg/l	<5	<5	4	25	25 (reducing to 10)
Mercury	µg/l	<0.05	<0.05	1	0.3	1
Selenium	µg/l	<3	<3	*Not Available*	*Not Available*	10
Barium	µg/l	21	91	*Not Available*	*Not Available*	1000
Copper	µg/l	<2	<2	28	5	2000
Boron	µg/l	<100	110	2000	*Not Available*	1000
Nickel	µg/l	<10	<10	200	30	20
Zinc	µg/l	<1	13	500	*Not Available*	5000
Vanadium	µg/l	16	28	60	100	*Not Available*
Cyanide (Free)	µg/l	<20	<20	*Not Available*	*Not Available*	50
Sulphate (Total)	mg/l	16	180	400	250	250
Sulphide	µg/l	<250	<250	250	*Not Available*	*Not Available*
pH Value	pH Units	7.3	11.6	*Not Available*	*Not Available*	*Not Available*
PAH	µg/l	0.28	0.66	*Not Available*	*Not Available*	0.1
TPH (C10/C40)	µg/l	110	120	(50) Surface water	*Not Available*	10
Phenol	µg/l	<0.5	<0.5	300	300	*Not Available*

[1]Figures for Environmental Quality Standards (EQS) are Annual Average Concentrations derived from the Environment Agency
[2]UK Drinking Water Standards taken from; Water Supply (Water Quality) Regulations 1989 (SI 1989/1147) (as amended), and Water Supply (Water Quality) Regulations 2000 (SI 2000/3184) (as amended).

The results show that all of the soil derived leachate samples tested for recorded results that are within the specified guidelines with the exception of polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH). The PAH is above the UK drinking water standards and TPH exceeds the UK drinking water and EQ fresh (surface) water standards. There are no EQ standards for PAH available for controlled fresh or saltwater available. The leachates commonly of concern are the results for arsenic and lead. The arsenic and lead levels are well within the guidance. Lead guidance values have changed recently, with new directives aimed at progressively reducing the lead threshold values to 10µg/l by 2013, with

the current level set at 25μg/l. This gradual reduction in threshold is in place to allow for the eventual replacement of all lead based water pipes.

Based on the leachibility analytical results and the non-presence of any controlled waterways within the immediate vicinity and strata of negligible permeability below, any metals or sulphates and oils within these soils are unlikely to have an adverse effect on the water environment, with the hazards posed deemed to be negligible. These leachability results agree with the results of samples sent for WAC testing detailed in section 6.5.

6.4. ASBESTOS

Four samples of the made ground encountered were sent for asbestos analysis. The results indicate that no asbestos fibres were found.

6.5. OFFSITE DISPOSAL ASSESSMENT OF EXCAVATED SOILS

The offsite disposal of excavated material may be required for this scheme with new regulations covering disposal criteria having come into effect in July 2004 - Landfill Directive. The Landfill Directive was charged with refocusing the way we dispose of contamination material with strict new controls brought in to manage the way we deal with contaminated soils. This new disposal directive gave rise to the Landfill (England and Wales) Regulations 2002, which required licensed waste facilities to provide a reclassification of their facility as inert, non-hazardous or hazardous. Non-hazardous waste sites can now only accept non-hazardous waste, with co-disposal only allowed within hazardous waste sites before July 2004. The aim of the new legislation is to promote waste minimisation.

Formerly guidance was sought from an Environment Agency document, 'Interim Guidance on the Disposal of Contaminated Soil', (1997) in order to determine the correct form of offsite disposal. Since the introduction of the Landfill Directive, certain changes have taken place in order to simplify the waste categorisation process.

New Waste Acceptance Criteria (WAC) came into force during 2005. The guidance is aimed at the producers of waste to help them better manage the environmental and cost implications of offsite disposal of waste material generated from developments. The initial step of the new WAC is confirming the type of waste visually on site by using the European Waste Catalogue to determine whether the waste is potentially hazardous. Once the waste has been categorised then further laboratory testing can be carried out in order to fully classify the waste material.

Waste is now classified as either *Inert; Stable Non-Reactive Hazardous Waste in Waste Landfill* or *Hazardous*. Threshold parameters are defined by the guidance, based on the levels of contamination in the solid form and leachate potential.

The 2005 guidance promotes a three level hierarchical approach to the determination and validation of a waste characterisation. This Waste Acceptance Compliance (WAC) hierarchical approach is summarised below.

Level 1 — *Full characterisation.* Determination of the short and long term leaching potential of the waste through visual assessment and laboratory testing. This step sets the disposal classification of the waste, and is performed via intrusive investigation.

Level 2 — *Compliance Testing.* Periodic testing of the waste generated to ensure the Level 1 classification is still applicable. The lag between sampling and testing visits is determined on a site-specific basis, and at a suitable interval determined by the engineer.

Level 3 — *On Site Verification*. Carried out at the point of disposal, regular visual inspection of loads before and after unloading at the landfill site. This action is the responsibility of the receiving landfill site.

The available guidance clarifies the individual points of responsibility for each of the levels of the hierarchical approach. Level 1 is the responsibility of the waste producer, Level 2 assessment can be carried out by both the waste producer and the landfill operator to ensure the landfill only accepts wastes that fulfil the waste acceptance criteria for his site. Level 3 is the responsibility of the landfill operator. This legislation only comes into effect if there is a requirement for the offsite disposal of material from a site. The restrictions placed as a result of the new legislation promotes the idea of reducing the amount of material going to landfill, and any possibility of excavated material being re-used on site should be explored as the costs related to offsite disposal can be extreme, depending on the contaminative nature of the materials and the nearest suitable landfill site.

Level 1 of the approach was carried out via the ground investigation exercises, wherein the material encountered is described by an Engineering Geologist and compared to entries contained within the European Waste Catalogue. This catalogue contains details of all wastes produced by various industrial processes and states whether they are likely to be hazardous or non-hazardous. It does not detail inert materials.

Previously once a comparison had been made and the likelihood of that material being either non hazardous or hazardous was determined, material that had been visually assessed as being hazardous could be placed into a hazardous landfill site on the visual basis only. This accepted the worst-case scenario for that material, and the resulting disposal option was most likely going to be the most expensive. However, in October 2007 additional Hazardous Waste Regulations came into effect whereby waste must be treated prior to its disposal. The regulations stipulate that the landfill operator ensures that the landfill is only used for land-filling waste, which is subject to prior treatment unless:

a. It is inert waste for which waste treatment is not technically possible; or
b. It is waste other than inert waste and treatment would not reduce its quantity or the hazard, which it poses to human health or the environment.

Treatment is defined as physical, thermal, chemical or biological processes (including sorting) that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery. Therefore non-inert waste must be treated if a treatment is available, which will reduce the amount of waste to be landfilled and or the hazards to human health or the environment. The undertaking of WAC testing will definitively assess the material classification previously visually assessed as hazardous material, and may return a more favourable outcome, i.e. an inert waste classification.

The WAC assessment focuses solely on the potential for any contamination present to be leached from the material and therefore adversely influence local waterways at the point of disposal. Assessing the human health aspect of the solid state contamination is not the primary objective of the WAC assessment and a waste with a high solid state contamination but a very low mobility potential can be re-classified as non hazardous or even inert, as long as all of the reported values are within the WAC Inert limit values given by the guidance.

WAC testing was conducted on one sample from TP4 at 4.0m and all values fall within the Inert Waste category

6.6 Hazardous Ground Gas

6.6.1 Radon

As discussed in Section 2.3, the BRE guidelines indicate that basic radon protection measures are required for the proposed development unless a BR211 report has been obtained from the BGS which indicates that an alternative level of radon protection measures would be required for new buildings at the site.

6.6.2 Monitoring of Installed Wells

The Made Ground encountered at the site does not contain large quantities of degradable or

other materials that would be capable of producing significant volumes of methane and/or carbon dioxide. However, the underlying estuarine deposits do contain organic horizons, which could act as a source of ground gas. In order to confirm that no such gases will pose a risk to the development, 2 gas wells have been installed and monitored for the presence of methane, carbon dioxide oxygen and hydrogen sulphide on four occasions. During these visits atmospheric pressures were recorded, and were seen to range from 1000 to 1014mB. The results of the gas monitoring are presented in Appendix IV.

The concentrations of methane varied between 0.0% and 0.2% by volume (with the maximum level in the boreholes corresponding to 4% of the lower explosive limit). No Carbon dioxide was detected. Oxygen levels ranged from 20.4% and 20.6% by volume.

The level of hydrogen sulphide was below detection limits during all visits. No flow was detected at any of the monitoring wells.

6.6.3 Risk Evaluation

The potential risk posed by hazardous ground gases has been evaluated using the guidance published by CIRIA (Wilson et al, 2007). In accordance with this guidance, a gas screening value (GSV) is calculated, taking into account the worst case recorded gas concentrations.

The maximum recorded concentrations of methane and carbon dioxide were 0.2 and 0.0% respectively. Therefore, the maximum concentration of 0.2% methane has been used in the calculation. No gas flows were measured during the monitoring, but for the purposes of this assessment the detection limit of the field instrument (0.3l/hr) has been used in the calculations. Given the above, the following GSV has been calculated:

$$GSV = (0.2\%/100) \times 0.3 = 0.006 l/hr.$$

On this basis, the site would be defined as Characteristic Situation CS-1, which is typical of natural soils of low organic content, organic–rich soils and peat.

7.0. GEOTECHNICAL APPRAISAL

7.1. General

It is proposed to develop part of the Celsa Steelworks site at Seawards Road, Tremorfa Cardiff for the construction of a new furnace.

Details received on the 9th September 2008 indicate that the proposed development will include the following elements:

- Furnace foundation and building enclosure. The Furnace foundation will comprise a pit approximately 6.5m depth (8m excavated depth).
- Recuperator structure,
- Water treatment plant and,
- 60m high stack.

It is proposed to provide piled foundations to all of the above with the piles having a maximum required capacity of 700kN.

7.2 Site Assessment

In order to assess the ground conditions underlying the site of the proposed furnace QGL were instructed to carry out 2 boreholes, which were drilled at locations set out by James and Nicholas LLP.

Groundwater seepage was encountered at a depth of approximately 4.0m in both boreholes (within the Made Ground horizon) and a standing groundwater level was recorded at approximately 4.36m depth below ground level during monitoring rounds following the main period of fieldwork.

Based on the information revealed by the boreholes, Made Ground extended to a maximum depth of 6.25m below ground level and comprises medium dense to very dense granular sand gravel and cobbles of slag and clinker debris. The underlying superficial deposits encountered comprised of very soft to stiff estuarine clay, silt and peat. Underlying the estuarine deposits Mercia Mudstone was encountered at approximately 13.50m below ground level.

7.3 Excavations

It is understood that the proposed furnace structure will require a large element of below ground construction, which will require the excavation of a pit the dimensions of which will be approximately 23m x 19m x 8m deep. This excavation will therefore extend through the full depth of Made Ground with the formation level of the proposed structure being within the underlying Estuarine alluvium. A stability analysis for this excavation is outside the remit of this report therefore only general observations are provided as follows:

- In order to excavate the pit the sides of the excavation will have to be supported with temporary works consisting of sheet piling. This excavation will have a free standing height of 8m therefore it is anticipated that the sheet piles will have to be keyed into the underlying Mercia Mudstones. A temporary works specialist should undertake the design of the temporary works. Due to the coarse and dense nature of the Made Ground it may be necessary to pre-dig or pre-bore the entire length of the proposed sheet pile wall in order to remove any obstructions prior to placement (driving) of the sheet piles.

- The excavation will penetrate the full depth of the Made Ground deposits within which a standing water level of approximately 4.0 to 4.3mbgl was encountered during the fieldworks and the post-fieldwork phase of monitoring. Therefore, in order to keep the excavation dry during the construction phase, a system of dewatering of the

adjacent ground mass will have to be put in place or a sump will have to be excavated within the main area of dig to collect excess water which would then be pumped out of the excavation. The design of either a dewatering system or a sump and pump system are outside the remit of this report.

- Care should also be taken to prevent swelling of the fine grained deposit exposed in the base of the pit as the removal of the overburden will produce a decrease in total stress on the soil element and the soil structure will have a tendency to swell due to the recoverable components of volume change.

- Excavations within the Made Ground strata would have to be undertaken using large excavators utilising breaker units and suitable excavating buckets due to the presence of large cobbles, boulders and fused or metal rich deposits that may be present within the superficial deposits.

- As man access may be required in any excavation, the HSE requires that any excavation less than 1.20 m deep should be shored for man access if unsuitable, or battered back to a suitable safe angle. Reference should be made to CIRIA Report No. 97, 'Trenching Practise' and BS 8004: 'Foundations', for guidance on excavation works. All excavation should be carried out under the supervision of an experienced and suitably qualified engineer.

- The proposed excavation will produce a large quantity of arisings, which will have to be disposed of off-site. It is not known whether the Celsa Steelworks currently has an area of land at its disposal, which it currently uses for the disposal of ash and clinker type wastes from the its manufacturing processes. If this is the case it would be advisable to seek the advice of the Environment Agency in respect of disposing of the arisings to such a site (should the results of the WAC testing and general contaminative testing indicate that the arisings are acceptable). If this is not the case the arisings will have to be disposed of to a suitably licensed tip facility.

7.4 FOUNDATION OPTIONS

7.3.1 General

The following recommendations and conclusions assume that the finished ground levels will be close to existing ground levels detailed above. If any significant changes are made to existing ground levels, the following conclusions and recommendations should be reviewed and, if necessary, amended.

7.3.2 Piling

Considering the nature (scale) of the proposed development and that the Made Ground and fine grained/organic deposits which underlie the site to depths of around 13.5m are considered unsuitable as a bearing stratum owing to their variable high to low strength and potential high compressibility. It is recommended that piled foundations are employed, extending through the full depth of the superficial sequence and into the underlying Mercia Mudstones which were encountered at depths of around 13.5m.

The piled foundations should be designed by an experienced and competent specialist piling contractor who should select appropriate design parameters and guarantee safe working loads together with maximum total and differential settlements, which should be within acceptable tolerances for the proposed structure. The choice of piling technique should be agreed with the contractor. Soil parameters for the strata to be penetrated will depend on the piling technique selected and the precise method of working. Further guidance can be given by this office once these choices have been finalised. Driven piles should only be considered if vibrations and environmental constraints can be maintained within acceptable limits, with regard to the proximity of existing buildings.

The piling contractor should satisfy himself and confirm to the Client that the available site investigation data provides sufficient information upon which to base his design. If the piling contractor requires any further data, any such requirements should be identified and the information should be obtained prior to the pile design being finalised. The piling contractor should monitor the pile installations and satisfy himself that the encountered ground conditions are as good as, or better than, assumed in his design.

In designing and constructing the piles it is recommended that, in addition to other factors, the piling contractor gives consideration to the following issues:

- The piles should be designed to accommodate any effects of lateral loading and negative skin friction in alluvial soils.
- The design should ensure that the piles do not buckle as a result of insufficient lateral support through soft/loose deposits.
- Measures should be taken to prevent the inward squeezing, or necking, of the piles through soft/loose/water bearing deposits.
- Due consideration should be given to, and appropriate allowances made for, the presence of cobbles, boulders, fused layers or old buried structures, which may obstruct or otherwise interfere with piling operations. Very dense deposits were encountered in both the shell and auger boreholes attempted.
- Appropriate load tests should be carried out during the early stages of the piling works and on a suitable proportion of the piles to confirm that they are able to support the required working loads and that actual settlements are within specified tolerances.
- Occasional fragments of slag have been encountered in the Made Ground and, if considered necessary, allowance should be made for mitigating the risks of potential future expansion of these materials. If extensive bodies of slag fill are encountered during the works it is recommended that such materials are removed and replaced with suitable, well compacted, inert fill.
- The design philosophy for pile bearing capacity, in particular, the estimation of pile bearing capacity in the Mercia Mudstone requires careful consideration of the skin resistance beneath the pile toe. Due to post glacial, chemical leaching of soluble minerals, the Mercia Mudstone is renowned for variable strength characteristics, including bands of low or zero strength.
- The requirement to minimise arisings from construction activities as much as possible, e.g. with all other factors being equal, a displacement piling solution may be preferred to a non-displacement method.

All designs and site works should be assessed and supervised by a suitably qualified Geotechnical Engineer.

7.5. GROUND GAS ASSESSMENT

Ground gas can be found in filled ground. Gas-monitoring points were installed on the site in both boreholes BH1R and BH2R. Monitoring of ground gas was conducted on four rounds and the maximum concentrations of gases measured were: Methane CH_4 – 0.2%; Carbon Dioxide CO_2 – 0%; and Hydrogen Sulphide H_2S – 0ppmv. The minimum concentration of Oxygen recorded was, O_2 – 20.4%. The results of the monitoring exercise are provided in Appendix VI.

- Methane is a potentially flammable gas, which is explosive within the range of 5% to 15% by volume in air.
- Carbon Dioxide can act as an asphyxiant and is normally present in the atmosphere at concentrations of approximately 0.3% by volume. Health & Safety Guidance Note EH40, *Occupational Exposure Limits* short term exposure level of 1.5%v/v over 10 minutes and at the occupational exposure limit of 0.5%v/v, however Building Regulations Addendum C only suggest specific design measures where carbon dioxide concentrations exceed 5%v/v.
- The Health and Safety Executive Guidance Note EH40/90 recommends that the

Oxygen content of air in the workplace should never fall below a minimum of 18% by volume.

It is worth noting that periods of low atmospheric pressure can liberate greater concentrations of land gasses, and thus there is a potential for increased concentrations of Carbon Dioxide and the other land gasses to be liberated through periods of lower atmospheric pressure. If Carbon Dioxide is above 1.5% then gas ingress prevention should be considered, however if levels exceed 5% by volume then floor constructions incorporating a gas prevention scheme would be required. Reference should be made to Building Regulations 2000: Approved Document C^1 & C^2, 2004 Edition.

Due to the comparatively low costs involved and the potential for raised carbon dioxide and depleted oxygen concentrations during low atmospheric pressure, the installation of a gas membrane incorporating a passive venting system beneath the ground floor slab might be considered to allow diffusion of any potential build up of land gases be employed within the development scheme. This would also further reduce the potential for gas accumulation should concentrations vary in periods of low atmospheric pressure. This assessment was based on guidelines presented within the Midland Geotechnical Society's 1991 publication, 'The planning and Engineering of Landfills', as well as guidance given by the 1991 CIRIA publication 78, 'Building on Derelict Land', and BRE 212 'Construction of new buildings on gas contaminated land', 1991. This guidance suggests the minimum gauge of polyethylene sheeting required is a 300-micrometer or 1200 gauge for basic protective measure against migration of land gases into new buildings. This guidance provides the necessary information regarding the correct installation and maintenance of gas barriers during the construction process. However, it is best advised to check with manufacturer of the membrane you are considering to install is suitable for the intended application. A gas membrane should also mitigate against volatiles in the made ground below the structures from entering the structure.

7.5. CONCRETE CLASSIFICATION

The results of quantitative chemical tests carried out on samples of the soil indicate that the pH values range from 8.8 to 12.3. The content of soluble sulphate (SO_4) measured in a 2:1 aqueous extract is in the range of 0.11 to 2.1 g/l.

In the BRE Special Digest 1, 2005, the corresponding Design Sulphate class is DS-3 with an ACEC concrete class for the site of AC-3.

8.0. SUMMARY

- The proposed development is for a new furnace foundation and building enclosure, recuperator structure, 60m high stack and a water treatment plant.
- The investigation revealed the site to be mantled by tarmacadam and mixed hardcore layer overlying granular made ground of slag and clinker. This in turn is underlain by a sequence of estuarine silt/ clay with occasional interbedded peat layers, with mudstone (Marl) bedrock encountered beneath.
- Groundwater was encountered in each of the boreholes at around 4.0mbgl. and is standing at approximately 4.30mbgl in the standpipes
- Concrete should be designed to *Design Sulphate Class* DS-2 and ACEC AC-1s.
- Environmental assessment has revealed all analytes tested for fell below the specified health and safety thresholds for commercial end use. However, several potentially harmful contaminants were revealed to reside onsite, albeit at low levels, and thus it is recommended that during construction phase good health and safety work practice be implemented at all times to reduce exposure to any potentially contaminated areas on site.
- Should emplacement level be below ground level a sheet pile cofferdam is recommended and dewatering and ground water reduction may be required.

REFERENCES

British Geological Survey :-

- British Geological Survey, Sheet 263 Cardiff (solid and drift) – 1:50,000 Scale.

Specialist Publications :-

- Department for Environmental, Food and Rural Affairs and The Environment Agency *'Contamination Land Exposure Assessment'*, March 2002.
- Department for Environmental, Food and Rural Affairs and The Environment Agency, CLR 8 *Priority Contaminants for the Assessment of Land*, 2002
- Department for Environmental, Food and Rural Affairs and The Environment Agency, CLR 11 *Model Procedures for the Management of Contaminated Land, 2002*
- British Code of Practice BS 10175: (2001) *'Investigation of Potentially Contaminated Sites'*
- British Code of Practice BS 5930: (1999), *'Code of Practice for Site Investigations'*
- BRE, AGS, dti, NHBC – *'Cover Systems for Land Regeneration'*, March 2004
- CIRIA publication 78, *'Building on Derelict Land'*, 1991
- Tomlinson, M. J., 2001, *'Foundation Design and Construction'* 7th Edition.
- British Code of Practice BS 8004: (1986), *'Code of Practice for Foundations'*
- Carter, M. & Bentley, S. P., 1991, *'Correlations of Soil Properties'*.
- CIRIA publication 47, *'Further Work on the Engineering Properties of Keuper Marl'*, 1973.
- BRE Special Digest 1 Concrete in Aggressive Ground 2005.
- BRE 211 Radon Guidance on protective measures for new buildings (Scivyer) 2007.

For and on behalf of QUANTUM GEOTECHNICAL LIMITED

_____ _____

F. LOCKE MESci (Hons), F.G.S. Date
Engineering Geologist

_____ _____

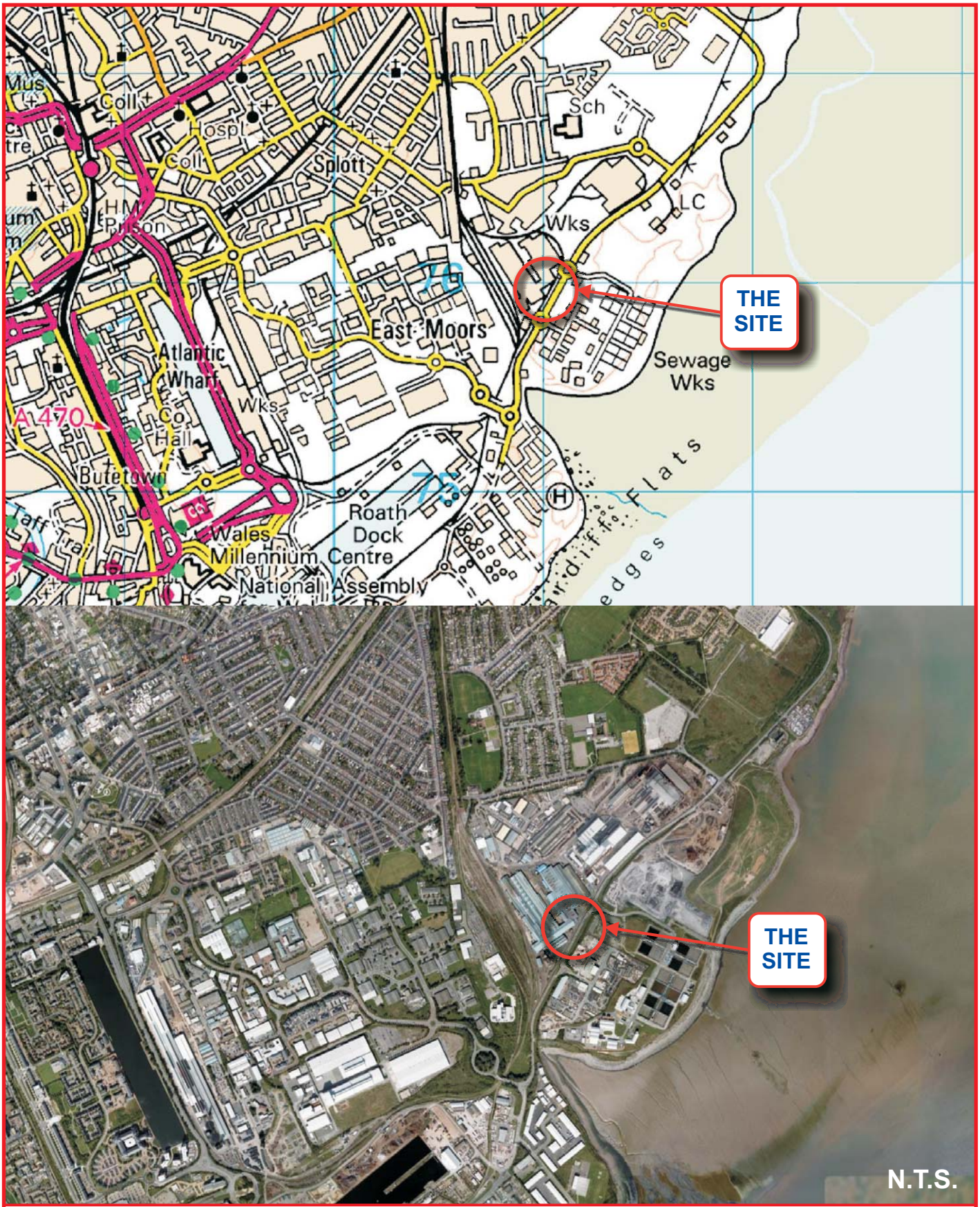
A. H. R. Davies, BSc (Hons.), MSc, F.G.S, C.Geol. Date
Principal Engineering Geologist

_____ _____

J.E. STARK, B.Sc. (Hons), C.Geol., F.G.S. Date
Technical Director

Digitally signed by Miles Davis
DN: cn=Miles Davis, o=Quantum (GB) Ltd, ou, email=mdavis@quantum-gb.co.uk, c=GB
Location: Ty Berwig, Bynea, Llanelli, Carmarthenshire SA14 9ST
Date: 2008.10.08 11:50:31 +01'00'

APPENDIX I – SITE LOCATION PLANS



QUANTUM

Quantum Geotechnical
Bynea, Llanelli, Carmarthenshire, SA14 9ST
Tel: 01554 744880 Fax: 01554 776150
E-mail: enquiries@quantum-gb.co.uk

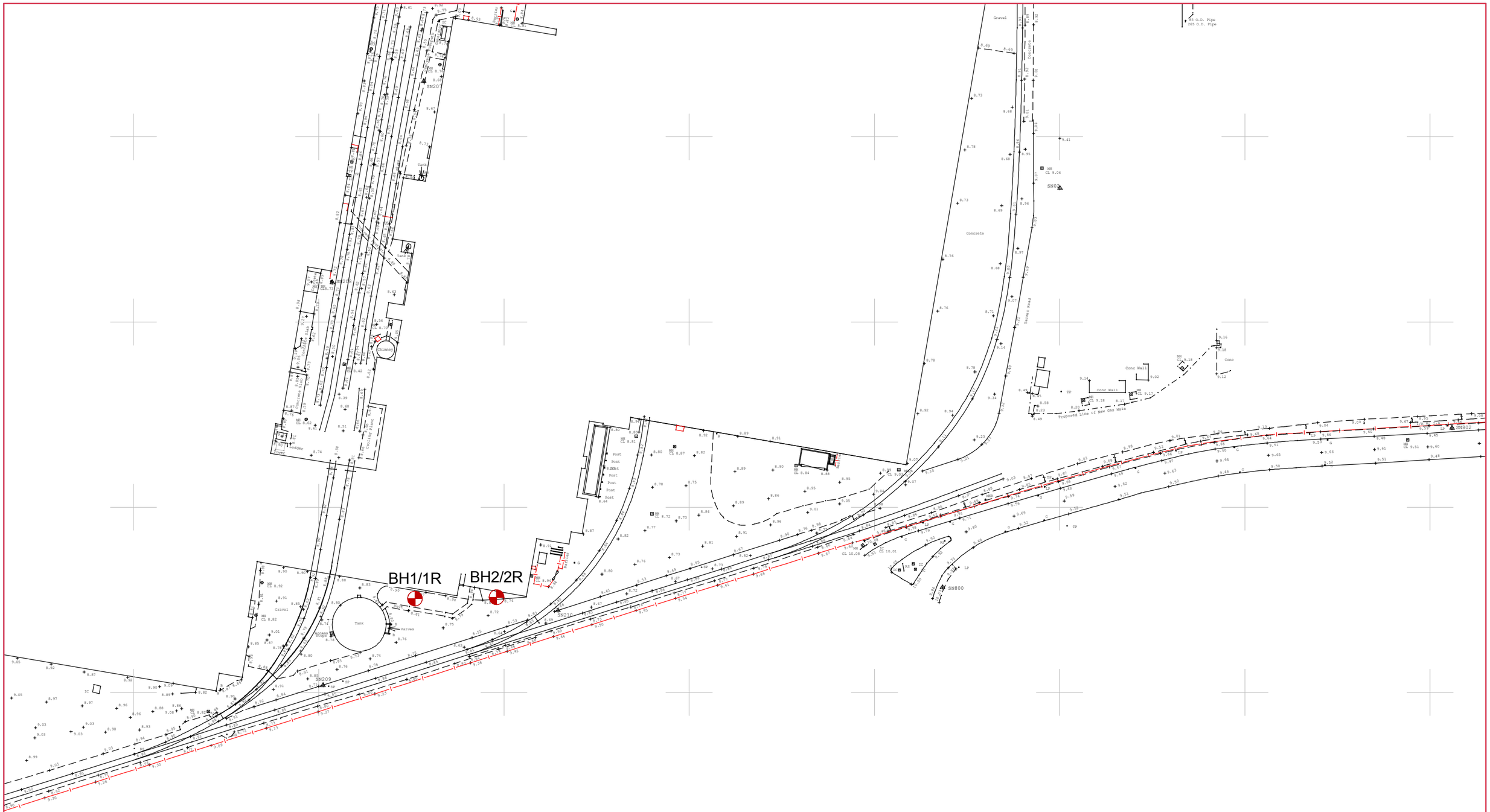
CELSA TREMORFA WORKS, CARDIFF

SITE LOCATION PLAN

FIGURE 1

SCALE: 1 : 25000

JOB No. X081206



QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Fax: 01554 776150
Email: enquiries@quantum-gb.co.uk

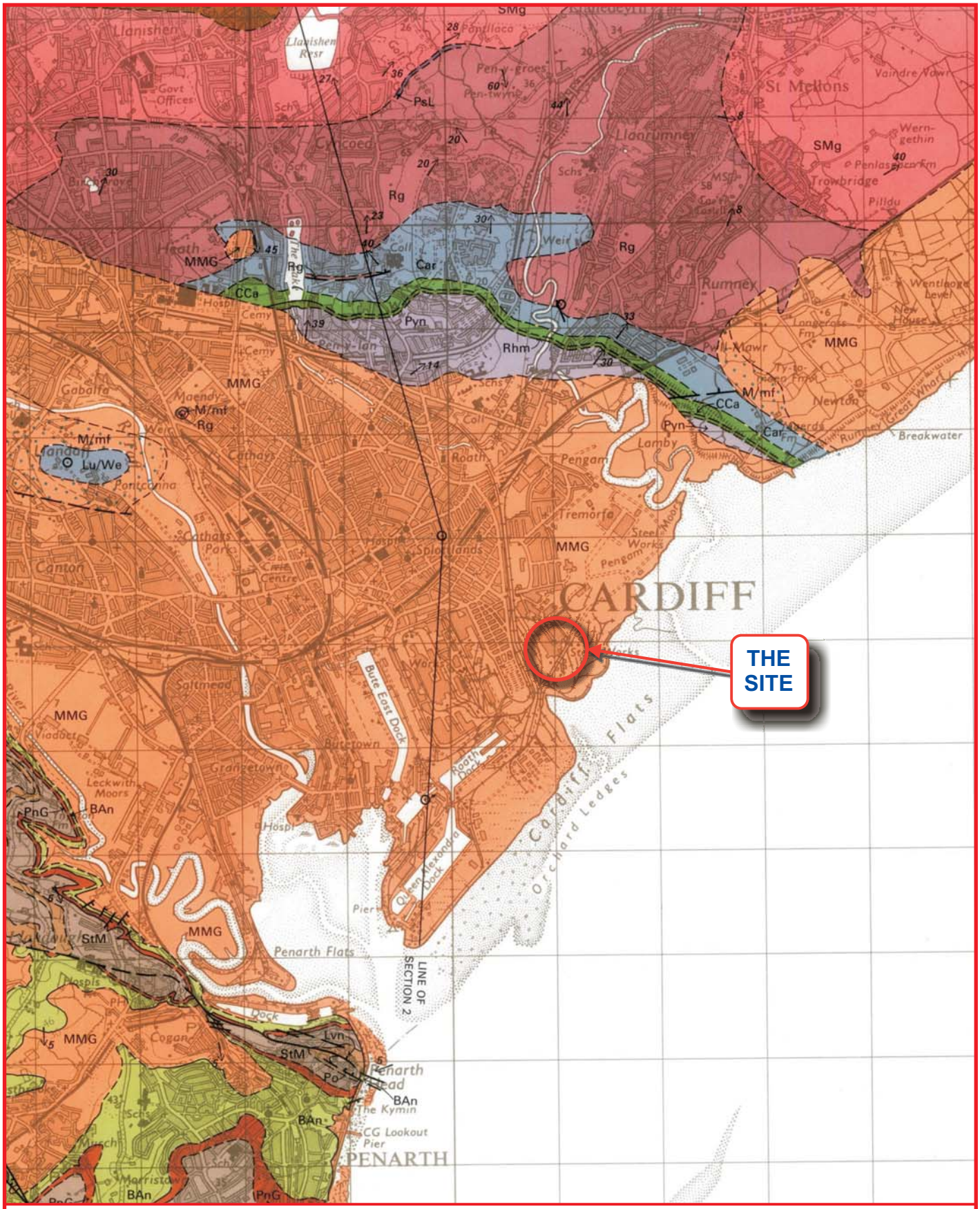
PROJECT
CELSA TREMORFA

DRAWING TITLE:
EXPLORATORY HOLE LOCATION PLAN

JOB NO.	FIGURE NO.
X081206	2
DATE	SCALE
20/08/08	1:1000

KEY

- Borehole
- Trial Pit
- Monitoring / Test Point
- Window Sample
- Dynamic Probe
- Historical Hole



QUANTUM

Quantum Geotechnical
Bynea, Llanelli, Carmarthenshire, SA14 9ST
Tel: 01554 744880 Fax: 01554 776150
E-mail: enquiries@quantum-gb.co.uk

CELSA TREMORFA WORKS, CARDIFF

GEOLOGICAL MAP EXTRACT SHEET 263 CARDIFF

FIGURE 3

SCALE: 1 : 50000

JOB No. X081206

APPENDIX II – EXPLORATORY HOLE LOGS

KEY TO BOREHOLE AND TRIAL PIT LOGS

SAMPLE AND TEST TYPES

U	Undisturbed driven tube sample - 102mm diameter, 450mm long.
P	Undisturbed pushed piston sample - 102mm diameter, 1000mm long.
TW	Undisturbed thin walled push in sample - 100mm diameter, 750mm long.
B	Bulk disturbed sample.
BLK	Block Sample
CBR	Heavy duty undisturbed sample - 154 mm diameter (CBR mould).
D	Small disturbed sample.
LB	Large Bulk disturbed sample (for earthworks testing)
C	Core sample
W	Water sample
G	Gas sample
j	Jar sample
t	Tub sample
p	Pot sample
s	Small sample
v	Vial sample

S	Standard Penetration Test using split spoon sampler. (See Note).
C	Standard Penetration Test using a solid 60 degree cone. (See Note).

NOTE: Where a single value is quoted this is the N value for 300 mm penetration following a seating drive of 150 mm. Where this full penetration is not achieved the number of blows is quoted for the penetration below the seating drive eg. 63/160 mm.
Where total penetration is less than the seating drive this is indicated by a + and the number of blows for total penetration is quoted eg. +50/75 mm.

HV	Hand Vane Test. Vane undrained shear strength, c_u, quoted in kPa.
V	Borehole Vane Test. Vane undrained shear strength, c_u, quoted in kPa.
FHT/RHT	Falling / Rising Head Permeability Test.

CORE RUN DETAILS

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
FI	Fracture Index. NI - Non intact where > 25 No. per metre length.

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level after first strike, second strike etc.


Seepage.

QUANTUM

NOTE:
Legend symbols in accordance with BS 5930 (1999)

KEY TO BOREHOLE AND TRIAL PIT LOGS

MATERIAL LEGENDS

 Made Ground	 Topsoil	 Clay
 Gravel	 Sand	 Silt
 Peat	 Boulders	 Cobbles
 Chalk	 Conglomerate	 Volcaniclastic
 Asphalt	 Void	 Mudstone
 Siltstone	 Sandstone	 Limestone
 Ironstone	 Mudstone / Siltstone	 Breccia
 Coal	 Coral	 Bedrock
 Shale	 Gypsum	 Igneous (Coarse Grained)
 Igneous (Fine Grained)	 Igneous (Medium Grained)	 Metamorphic (Coarse Grained)
 Metamorphic (Fine Grained)	 Metamorphic (Medium Grained)	

INSTALLATION / BACKFILL DETAILS

 Arisings	 Concrete	 Bentonite cement grout
 Bentonite seal	 Filter	 Pea Gravel
 Plain pipe	 Slotted pipe	Piezometer / Standpipe tip

QUANTUM

NOTE:
Legend symbols in accordance with BS 5930 (1999)

Contract : Celsa Tremorfa

Client : Celsa

Borehole No.
BH1

Dates : 01/07/08 - 02/07/08
Location : Proposed furnace site

Job Number : X081206
Engineer : James and Nicholas

Ground Level :

Coordinates: 1325.97 E
Approximate 375.33 N
Co-ordinates Only *Co-ordinates to Local Grid*

m B.G.L.	Samples Depth	Samples Type No. - UBlows	Tests Depth	Tests Test Results	STRATA Depth (Thick-ness)	STRATA DESCRIPTION	STRATA Legend	STRATA Depth (Thick-ness)	Water	Install/ Backfill
0					(0.15)	MADE GROUND: Tarmacadam.		(0.15)		
	0.25 - 0.75	B1			0.15	MADE GROUND: Medium dense to dense sand gravel and cobbles of slag with concrete debris and hardcore. Ashy. Occasional clinker and metal.		0.15		
					(1.20)			(1.20)		
1										
			1.2	SPT (C) 50/75mm (18-7/30mm-**50**---)						
					1.35	BH terminated at 1.35m on engineers instruction.		1.35		

Water Observations			Casing		Groundwater			Chiselling		
Date / Time	Depth	Water	Depth	Cas. Dia.	Struck	Behaviour	Sealed	From	To	Hours
			4.00	200mm		Dry		1.20	1.30	01.20

Remarks: Dando 150 Cable Percussion drilling rig using 200mm casing and tools. CPT test at 1.2m abandoned as rods bouncing and no progress.

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Fax: 01554776150
email: enquiries@quantum-gb.co.uk

Operator:	Logged By.	Sheet No.	Scale:	
NF	FL	1 Of 1	1:60.98	All measurements in metres unless otherwise stated

AGS

Contract : Celsa Tremorfa

Client : Celsa

Borehole No.
BH2

Dates : 02/07/08 - 03/07/08
Location : Proposed furnace site

Job Number : X081206
Engineer : James and Nicholas

Ground Level :

Coordinates: 1348.01 E
Approximate 375.70 N
Co-ordinates Only *Co-ordinates to Local Grid*

m B.G.L.	Samples Depth	Samples Type No. - UBlows	Tests Depth	Tests Test Results	STRATA Depth (Thick-ness)	DESCRIPTION	Legend	Depth (Thick-ness)	Water	Install/ Backfill
0					(0.20)	MADE GROUND: Concrete.		(0.20)		
	0.25 - 0.75	B1			0.20	MADE GROUND: Loose to very dense sand gravel and cobbles of slag with concrete debris and hardcore. Occasional clinker and metal. Pockets of ashy deposit.		0.20		
1										
	1.20 - 1.65	B2	1.2	SPT (C) 8 (3-1-**3**-**2**-**2**-**1**)						
2	2.00 - 2.45	B3	2	SPT (C) 39 (9-8-**10**-**16**-**8**-**5**)	(3.90)			(3.90)		
3	3.00 - 3.45	B4	3	SPT (C) 40 (18-7/10mm-**30**-**5**-**3**-**2**)						
4	4.00 - 4.10	D5	4	SPT () 50+/75mm (---)	4.10	BH terminated at 4.1m on engineers instruction.		4.10		

Water Observations

Date / Time	Depth	Water

Casing

Depth	Cas. Dia.
4.00	200mm

Groundwater

Struck	Behaviour	Sealed
	Dry	

Chiselling

From	To	Hours
1.70	1.90	00.30
2.20	2.40	00.30
2.90	3.00	00.30
3.00	3.20	00.30
3.70	3.90	01.00
4.00	4.10	06.00

Remarks: Dando 150 Cable Percussion drilling rig using 200mm casing and tools. CPT test at 4.0m abandoned as rods bouncing and no progress.

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Fax: 01554776150
email: enquiries@quantum-gb.co.uk

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NF	FL	1 Of 1	1:60.98	All measurements in metres unless otherwise stated

AGS

Contract : Celsa Tremorfa

Client : Celsa

Borehole No. BH1R

Dates : 07/07/08 - 10/07/08

Location : Proposed furnace site

Job Number : X081206

Engineer : James and Nicholas

Ground Level :

Coordinates: 1325.97 E
Approximate 375.33 N
Co-ordinates Only *Co-ordinates to Local Grid*

Samples			STRATA				
Sample Depth	Depth	Test Results	Depth (Thick-ness)	Description	Legend	Depth (Thick-ness)	Water Depth / Install/ Backfill
	1.5	SPT (C) 50+/75mm (50----)	(4.00)	MADE GROUND: Medium dense to dense grey fill of slag and clinker.		(4.00)	
	3	SPT (C) 26 (16-3-**5-6-6-9**)					
	4.5	SPT (C) 33 (4-5-**6-12-5-10**)	4.00	MADE GROUND: Medium dense to dense grey sandy fill of slag. (Wet).		4.00	
			(2.10)			(2.10)	
6.00 - 6.45	6	SPT (S) 4 (1-1-**1-1-1-1**)	6.10	Soft grey SILT/ CLAY.		6.10	6.45
			(1.75)			(1.75)	
7.50 - 7.95	7.5	SPT (S) 4 (1-1-**1-1-1-1**)	7.85	Very soft to soft grey and brown SILT/ CLAY with bands of PEAT.		7.85	7.95
9.00 - 9.45	9	SPT (S) 5 (1-2-**1-1-2-1**)					9.45

Drilling Progress and Water Observations

Date / Time	Depth	Casing	Core Dia.	Water

Groundwater

Struck	Sealed	Flow Rate Remarks
4.00		Seepage at 4.0m.

Flush

Depth	Type	Returns
0 - 19.5	Air mist	100

Remarks: Commachio MC800 tracked rotary drilling rig using 115mm ODX drilling system. CPT in made ground and SPT in natural strata at 1.5m intervals at end of rod runs.

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Fax: 01554776150
email: enquiries@quantum-gb.co.uk

Operator:	Logged By.	Sheet No.	Scale:	
RM	FL	1 Of 2	1:63.87	All measurements in metres unless otherwise stated

AGS

Contract : Celsa Tremorfa

Client : Celsa

Borehole No. BH1R

Dates : 07/07/08 - 10/07/08

Location : Proposed furnace site

Job Number : X081206

Engineer : James and Nicholas

Ground Level :

Coordinates: 1325.97 E
Approximate 375.33 N
Co-ordinates Only *Co-ordinates to Local Grid*

Samples			STRATA				
Sample Depth	Depth	Test Results	Depth (Thick-ness)	Description	Legend	Depth (Thick-ness)	Water Depth / Install/ Backfill
10.50 - 10.95	10.5	SPT (S) 7 (1-1-**2-1-1-3**)	(6.15)	Very soft to soft grey and brown SILT/ CLAY with bands of PEAT.		(6.15)	10.95
12.00 - 12.45	12	SPT (S) 43 (4-8-**6-10-12-15**)					12.45
13.50 - 13.95	13.5	SPT (S) 62 (7-10-**8-12-20-22**)					
			14.00	Stiff red brown fine to medium rounded gravelly CLAY. (Recovered as Soft red brown fine to medium rounded gravelly CLAY). Possibly highly weathered marl.		14.00	13.95
15.00 - 15.45	15	SPT (S) 58 (8-8-**14-10-14-20**)	(2.00)			(2.00)	15.45
			16.00	Very weak (hard) red partially weathered MUDSTONE with possible sand of harder mudstone. Marl.		16.00	16.767
16.50 - 16.77	16.5	SPT (S) 50/117mm (12-14-**25-25/42mm**–)					
18.00 - 18.31	18	SPT (S) 50/165mm (3-4-**13-26-11/15mm**–)	(3.50)			(3.50)	18.317
19.50 - 19.83	19.5	SPT (S) 50/107mm (5-12-**21-29/32mm**–)	19.50	BH terminated at 19.5m.		19.50	19.832

Drilling Progress and Water Observations						Groundwater			Flush		
Date / Time		Depth	Casing	Core Dia.	Water	Struck	Sealed	Flow Rate Remarks	Depth	Type	Returns
10/07/2008	07:00	16.50	16.50	115	10.00						

Remarks: Commachio MC800 tracked rotary drilling rig using 115mm ODX drilling system. CPT in made ground and SPT in natural strata at 1.5m intervals at end of rod runs.

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Fax: 01554776150
email: enquiries@quantum-gb.co.uk

Operator:	Logged By.	Sheet No.	Scale:	
RM	FL	2 Of 2	1:63.87	All measurements in metres unless otherwise stated

AGS

Contract : Celsa Tremorfa

Client : Celsa

Borehole No. BH2R

Dates : 11/07/08 - 15/07/08

Location : Proposed furnace site

Job Number : X081206

Engineer : James and Nicholas

Ground Level :

Coordinates: 1348.01 E
Approximate 375.70 N
Co-ordinates Only *Co-ordinates to Local Grid*

Samples			STRATA				
Sample Depth	Depth	Test Results	Depth (Thick-ness)	Description	Legend	Depth (Thick-ness)	Water Depth / Install/ Backfill
				MADE GROUND: Medium dense to dense grey fill of slag and clinker.			
			(4.00)			*(4.00)*	
			4.00	MADE GROUND: Medium dense to dense grey sandy fill of slag and clinker. (Wet).		4.00	
4.50 - 4.95	4.5	SPT (C) 30 (3-6-8-5-7-10)	(2.25)			*(2.25)*	4.95
6.00 - 6.45	6	SPT (S) 4 (1-1-1-1-1-1)	6.25	Soft grey SILT/ CLAY with dark brown peat.		6.25	
			(0.75)			*(0.75)*	6.45
			7.00	Very soft to firm grey with brown SILT/ CLAY with bands of PEAT.		7.00	
7.50 - 7.95	7.5	SPT (S) 10 (1-1-2-1-3-4)					7.95
9.00 - 9.45	9	SPT (S) 10 (1-2-3-2-2-3)					9.45
			(6.50)			*(6.50)*	

Drilling Progress and Water Observations

Date / Time	Depth	Casing	Core Dia.	Water

Groundwater

Struck	Sealed	Flow Rate Remarks
4.00		Seepage at 4.0m.

Flush

Depth	Type	Returns
0 - 19.5	Air mist	100

Remarks: Commachio MC800 tracked rotary drilling rig using 115mm ODX drilling system. CPT in made ground and SPT in natural strata at 1.5m intervals at end of rod runs.

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Job Number : X081206

Engineer : James and Nicholas

Ground Level :

Coordinates: 1348.01 E
Approximate Co-ordinates Only 375.70 N *Co-ordinates to Local Grid*

Samples			STRATA					
Sample Depth	Depth	Test Results	Depth (Thick-ness)	Description	Legend	Depth (Thick-ness)	Water Depth	Install/ Backfill
10.50 - 10.95	10.5	SPT (S) 10 (1-1-**1-2-3-4**)		Very soft to firm grey with brown SILT/ CLAY with bands of PEAT.			10.95	
12.00 - 12.45	12	SPT (S) 22 (2-3-**5-7-3-7**)					12.45	
13.50 - 13.95	13.5	SPT (S) 34 (8-7-**8-9-7-10**)	13.50	Weak red weathered clayey MUDSTONE with occasional grey clay smears.		13.50	13.95	
15.00 - 15.45	15	SPT (S) 37 (10-9-**5-7-10-15**)	(3.00)			*(3.00)*	(3.00) 15.45	
16.50 - 16.95	16.5	SPT (S) 80 (10-14-**17-22-22-19**)	16.50	Very weak (hard) red partially weathered MUDSTONE with possible fine gravel of harder mudstone. Marl.		16.50	16.95	
18.00 - 18.29	18	SPT (S) 50/135mm (3-5-**25-25/60mm**–)	(3.00)			*(3.00)*	(3.00) 18.285	
19.50 - 19.68	19.5	SPT (S) 50/30mm (5-7-**50/30mm**–)	19.50	BH terminated at 19.5m.		19.50	19.68	

Drilling Progress and Water Observations						Groundwater			Flush		
Date / Time		Depth	Casing	Core Dia.	Water	Struck	Sealed	Flow Rate Remarks	Depth	Type	Returns
14/07/2008	07:00	13.50	13.50	115	10.00						

Remarks: Commachio MC800 tracked rotary drilling rig using 115mm ODX drilling system. CPT in made ground and SPT in natural strata at 1.5m intervals at end of rod runs.

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RM	FL	2 Of 2	1:63.87	All measurements in metres unless otherwise stated

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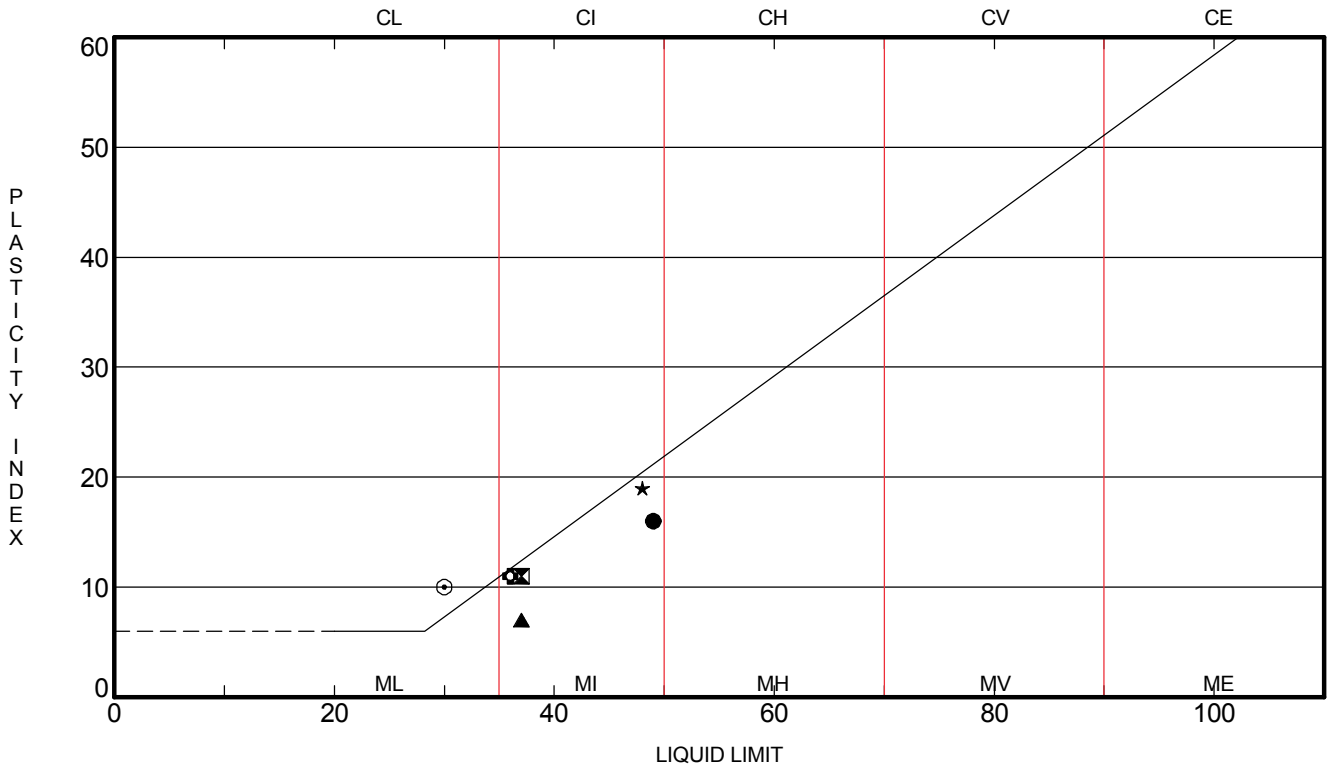
APPENDIX III – LABORATORY TESTING RESULTS



Hole ID		Sample Number	Depth (m)	Moisture Content % Clause 3.2	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	% Passing .425mm	Classification
●	**BH1R**	**SPT**	**9.00**	**45.70**	**49**	**33**	**16**	**98.00**	**Intermediate Plasticity, MI**
⊠	**BH1R**	**SPT**	**12.00**	**25.00**	**37**	**26**	**11**	**98.00**	**Intermediate Plasticity, MI**
▲	**BH1R**	**SPT**	**15.00**	**18.10**	**37**	**30**	**7**	**75.00**	**Intermediate Plasticity, MI**
★	**BH2R**	**SPT**	**7.50**	**70.00**	**48**	**29**	**19**	**99.00**	**Intermetiate Plasticity, MI**
⊙	**BH2R**	**SPT**	**12.00**	**27.20**	**30**	**20**	**10**	**98.00**	**Low Plasticity, CL**
✿	**BH2R**	**SPT**	**15.00**	**25.20**	**36**	**25**	**11**	**95.00**	**Intermediate Plasticity, MI**

QUANTUM LABORATORIES

Bynea House, Bynea
Llanelli, Carmarthenshire SA14 9SU
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Fax: 01554 776150
enquiries@quantum-gb.co.uk

AGS

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

Client: Celsa
Project: Celsa Tremorfa
Number: X081206

Certificate of Analysis

2139

Certificate Number: 08-21142-1

Date: 14/08/2008

Client:	Quantum GB Ltd Ty Berwig Bynea Llanelli Carmarthenshire SA14 9ST
Our Reference:	08-21142-1
Client Reference:	X081206
Contract Title:	Celsa Tremorfa, Cardiff
Description:	3 leachate samples, 11 soil samples
Date Received:	24/07/2008
Date Started:	24/07/2008
Date Completed:	14/08/2008
Test Procedures:	Identified by prefix DETSn, details available upon request.
Notes:	**This report supersedes 08-21142, extra testing carried out** Observations and interpretations are outside the scope of UKAS accreditation * denotes test not included in laboratory scope of accreditation # denotes test that holds MCERT accreditation $ denotes tests completed by approved subcontractors I/S denotes insufficient sample to carry out test N/S denotes that the sample is not suitable for testing DETSM denotes tests carried out by DETS Midlands laboratory Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate Asbestos subsamples will be kept for 6 months
Approved By:	
Authorised Signatories:	Richard Bennett Director

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • Fax 01207 582444 • email: info@dets.co.uk • www.dets.co.uk

Our Ref: 08-21142-1
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

Sample Details

Sample ID	Number	Depth	DETS Ref	Matrix Description	Date Sampled	Time Sampled	Preservation	Analysis Complete
BH1	B1	0.25-0.75	144511	Loose dark brown sandy GRAVEL	Not Provided	Not Provided	None	14/08/2008
BH2	B1	0.25-0.75	144513	Loose brown sandy GRAVEL	Not Provided	Not Provided	None	14/08/2008
BH2	B4	3.00-3.45	144515	Firm grey gravelly sandy CLAY	Not Provided	Not Provided	None	14/08/2008

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21142-1
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

		Lab No.	144511	144513	144515	144516	144517
		Sample Ref	BH1	BH2	BH2	BH1R	BH1R
		Depth	0.25-0.75	0.25-0.75	3.00-3.45	6.00-6.45	7.50-7.95
		Other Ref	B1	B1	B4	SPT	SPT
		Sample Type					
Test	**Units**	**DETSxx**					
Arsenic	mg/kg	DETS 042#	12	10	3		
Barium	mg/kg	DETS 042#	140	150	39		
Berylium	mg/kg	DETS 042*	< 1	< 1	< 1		
Cadmium	mg/kg	DETS 042#	1.5	1.1	1.1		
Chromium	mg/kg	DETS 042#	590	330	850		
Copper	mg/kg	DETS 042#	69	54	30		
Lead	mg/kg	DETS 042#	120	80	6		
Mercury	mg/kg	DETS 081#	0.6	0.3	< 0.1		
Nickel	mg/kg	DETS 042#	12	13	5		
Selenium	mg/kg	DETS 042#	4.8	5.6	11		
Vanadium	mg/kg	DETS 042#	600	440	1200		
Zinc	mg/kg	DETS 042#	190	160	13		
Nitrate	mg/kg	DETS 055	2.4	1.7	< 1.00		
Boron (water soluble)	mg/kg	DETS 020#	2.7	2.2	1.6		
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1		
Cyanide complex	mg/kg	DETS 067	< 0.2	< 0.2	< 0.2		
Sulphur (free)	mg/kg	DETS 049#	3.6	6.1	340		
Sulphide	mg/kg	DETS 024#	1300	44	1200		
Total Sulphate as SO4	%	DETS 075#	0.02	0.15	0.72		
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.11	0.5	2.1	0.39	
pH		DETS 008#	12.2	11.1	12.3	11.2	
PAH	mg/kg	DETS 050	15	6.6	< 5.0		
EPH (C10-C40)	mg/kg	DETS 051#	240	270	35		
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3		
Organic matter	%	DETS 002					> 25

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-21142-1
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

		Lab No.	144518	144519	144520	144521
		Sample Ref	BH1R	BH1R	BH2R	BH2R
		Depth	13.50-13.95	19.50-19.75	9.00-9.45	16.50-16.95
		Other Ref	SPT	SPT	SPT	SPT
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#				
Barium	mg/kg	DETS 042#				
Berylium	mg/kg	DETS 042*				
Cadmium	mg/kg	DETS 042#				
Chromium	mg/kg	DETS 042#				
Copper	mg/kg	DETS 042#				
Lead	mg/kg	DETS 042#				
Mercury	mg/kg	DETS 081#				
Nickel	mg/kg	DETS 042#				
Selenium	mg/kg	DETS 042#				
Vanadium	mg/kg	DETS 042#				
Zinc	mg/kg	DETS 042#				
Nitrate	mg/kg	DETS 055				
Boron (water soluble)	mg/kg	DETS 020#				
Cyanide free	mg/kg	DETS 067#				
Cyanide complex	mg/kg	DETS 067				
Sulphur (free)	mg/kg	DETS 049#				
Sulphide	mg/kg	DETS 024#				
Total Sulphate as SO4	%	DETS 075#				
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	1.4	0.24		0.4
pH		DETS 008#	9.5	8.9		8.8
PAH	mg/kg	DETS 050				
EPH (C10-C40)	mg/kg	DETS 051#				
Phenol - Monohydric	mg/kg	DETS 067#				
Organic matter	%	DETS 002			12	

Summary of Asbestos Analysis
Soil Samples

Our Ref: 08-21142-1
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

Laboratory Number	Sample Ref	Depth	Other Ref	Material	Result
144511	BH1	0.25-0.75	B1	Soil	NAD
144513	BH2	0.25-0.75	B1	Soil	NAD
144514	BH2	1.20-1.65	B2	Soil	NAD
144515	BH2	3.00-3.45	B4	Soil	NAD

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos
NAD = No Asbestos Detected. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos

Samples are analysed using polarised light microscopy in accordance with HSG248 and documented in-house methods. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'.

Summary of Chemical Analysis
Leachate Samples

Our Ref: 08-21142-1
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

		Lab No.	144523	144524
		Sample Ref	BH1	BH2
		Depth	0.25-0.75	3.00-3.45
		Other Ref	B1	B4
		Sample Type		
Test	**Units**	**DETSxx**		
Arsenic Dissolved	ug/l	DETS 010	< 1	< 1
Barium Dissolved	ug/l	DETS 042*	21	91
Berylium Disolved	ug/l	DETS 042*	< 1	< 1
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10
Copper Dissolved	ug/l	DETS 042	< 2	< 2
Lead Dissolved	ug/l	DETS 042	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10	< 10
Selenium Dissolved	ug/l	DETS 017	< 3	< 3
Zinc Dissolved	ug/l	DETS 042	13	< 1
Vanadium Dissolved	ug/l	DETS 042*	28	16
Sulphate	mg/l	DETS 055	16	180
Boron	ug/l	DETS 020	110	< 100
Cyanide free	ug/l	DETS 067	< 20	< 20
Cyanide complex	ug/l	DETS 067	< 40	< 40
Sulphur (free)	ug/l	DETS 049	< 90	< 90
Sulphide	ug/l	DETS 024	< 250	< 250
pH		DETS 008	7.3	11.6
PAH	ug/l	DETS 074*	0.28	0.66
EPH (C10-C40)	ug/l	DETS 051	110	120
Phenol	ug/l	DETS 054*	< 0.50	< 0.50

WASTE ACCEPTANCE CRITERIA TESTING
ANALYTICAL REPORT

Job Title:	Celsa Tremorfa, Cardiff	**Job Number:**	08-21142-1
Client Reference:	X081206	**Sample Number:**	144514 / 144522
Sample ID:	BH2 / 1.20-1.65	**Date Analysed:**	07/08/2008

Test Results On Waste			**WAC Limit Values**		
Determinand and Method Reference	**Units**	**Result**	**Inert Waste**	**SNRHW**	**Hazardous Waste**
002 Total Organic Carbon	%	1.3	3	5	6
003 Loss On Ignition	%	2.7	n/a	n/a	10
062 BTEX	mg/kg	<0.04	6	n/a	n/a
052 PCB's (7 congeners)	mg/kg	<0.01	1	n/a	n/a
051 TPH (C10 - C40)	mg/kg	46	500	n/a	n/a
050 PAH's	mg/kg	<5.0	100	n/a	n/a
008 pH	pH Units	11.8	n/a	>6	n/a
073 Acid Neutralisation Capacity (pH4)*	mol/kg	2.8	n/a	TBE	TBE
073 Acid Neutralisation Capacity (pH7)*	mol/kg	<1.0	n/a	TBE	TBE

Test Results On Leachate					**WAC Limit Values** limit values for LS10 Leachate		
Determinand and Method Reference	**Conc in Eluate ug/l**		**Amount Leached mg/kg**		**Inert Waste**	**SNRHW**	**Hazardous Waste**
	2:1	**8:1**	**LS2**	**LS10**			
010 Arsenic as As	<1	<1	<0.002	<0.01	0.5	2	25
042 Barium as Ba*	110	70	0.22	0.77	20	100	300
042 Cadmium as Cd	<2	<2	<0.004	<0.02	0.04	1	5
042 Chromium as Cr	<10	<10	<0.02	<0.1	0.5	10	70
042 Copper as Cu	<2	<2	<0.004	<0.02	2	50	100
078 Mercury as Hg*	<0.2	<0.2	<0.0004	<0.002	0.01	0.2	2
042 Molybdenum as Mo*	<10	<10	<0.02	<0.1	0.5	10	30
042 Nickel as Ni	<10	<10	<0.02	<0.1	0.4	10	40
042 Lead as Pb	<5	<5	<0.01	<0.05	0.5	10	50
042 Antimony as Sb*	<5	<5	<0.01	<0.05	0.06	0.7	5
017 Selenium as Se	<3	<3	<0.006	<0.03	0.1	0.5	7
042 Zinc as Zn	<1	<1	<0.002	<0.01	4	50	200
055 Chloride as Cl	24000	5800	48	<100	800	15,000	25,000
055 Fluoride as F	2300	2200	4.6	22	10	150	500
055 Sulphate as SO4	170000	36000	340	594	1000	20,000	50,000
035 Total Dissolved Solids	240000	84000	480	1113	4000	60,000	100,000
067 Phenol Index*	<100	<100	<0.2	<1.0	1	n/a	n/a
033 Dissolved Organic Carbon*	<5000	<5000	<10	<50	500	800	1000
Additional Information							
008 pH	7.6	7.8					
009 Conductivity uS/cm	347	123					
Temperature*	20	21					
Mass of Sample Kg	0.130						
Mass of dry Sample Kg	0.120						
Stage 1							
Volume of Leachant L2	0.230						
Volume of Eluate VE1	0.210						
Stage 2							
Volume of Leachant L8	0.960						
Volume of Eluate VE2	0.870						

TBE = To Be Evaluated

SNRHW = Stable Non-Reactive Hazardous Waste

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

DERWENTSIDE ENVIRONMENTAL SERVICES TESTING LIMITED

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 002	Organic Matter	%	0.01	Air Dried	No	Yes	No
DETS 003	Loss on Ignition	%	0.01	Air Dried	No	Yes	Yes
DETS 004	Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETS 075	Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETS 004	Water Soluble Sulphate	g/l	0.01	Air Dried	No	Yes	Yes
DETS 076	Water Soluble Sulphate	g/l	0.01	Air Dried	No	Yes	Yes
DETS 006	Chloride	mg/kg	0.01	Air Dried	No	Yes	Yes
DETS 008	pH	pH Units	0.10	Air Dried	No	Yes	Yes
DETS 042	Selenium	mg/kg	0.50	Air Dried	No	Yes	Yes
DETS 055	Ammonia	mg/kg	0.02	Air Dried	No	No	No
DETS 020	Boron (Water Soluble)	mg/kg	0.20	Air Dried	No	Yes	Yes
DETS 024	Sulphide	mg/kg	10.00	Air Dried	No	Yes	Yes
DETS 042	Antimony	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Arsenic	mg/kg	0.20	Air Dried	No	Yes	Yes
DETS 042	Barium	mg/kg	1.50	Air Dried	No	Yes	Yes
DET S 042	Beryllium	mg/kg	0.20	Air Dried	No	Yes	No
DETS 042	Cadmium	mg/kg	0.10	Air Dried	No	Yes	Yes

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 042	Cobalt	mg/kg	0.70	Air Dried	No	Yes	Yes
DETS 042	Copper	mg/kg	0.20	Air Dried	No	Yes	Yes
DETS 042	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETS 042	Iron	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Lead	mg/kg	0.30	Air Dried	No	Yes	Yes
DETS 042	Manganese	mg/kg	20.00	Air Dried	No	Yes	Yes
DETS 081	Mercury	mg/kg	0.05	Air Dried	No	No	No
DETS 042	Molybdenum	mg/kg	0.40	Air Dried	No	Yes	Yes
DETS 042	Nickel	mg/kg	0.20	Air Dried	No	Yes	Yes
DETS 042	Thallium	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Vanadium	mg/kg	0.80	Air Dried	No	Yes	Yes
DETS 042	Zinc	mg/kg	1.00	Air Dried	No	Yes	Yes
DETS 049	Sulphur (Free)	mg/kg	0.50	As Received	No	Yes	Yes
DETS 050	PAH	mg/kg	0.10	As Received	No	Yes	No
DETS 051	TPH (C10 - C40)	mg/kg	20.00	As Received	No	Yes	Yes
DETS 052	PCB	mg/kg	0.01	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzne	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 067	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 067	Easily Liberatable Cyanide	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 067	Complex Cyanide	mg/kg	0.30	Air Dried	No	Yes	No
DETS 067	Total Cyanide	mg/kg	0.40	Air Dried	No	Yes	Yes
DETS 067	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETS 068	VOC	mg/kg	0.01	As Received	No	No	No

Derwentside Environmental Testing Services

2139

Certificate of Analysis

Date: 04/08/2008

Certificate Number: 08-21206

Client:

Quantum GB Ltd
Ty Berwig
Bynea
Llanelli
Carmarthenshire
SA14 9ST

Our Reference: 08-21206

Client Reference: X081206

Contract Title: Celsa Tremorfa, Cardiff

Description: 2 water samples

Date Received: 28/07/2008

Date Started: 28/07/2008

Date Completed: 04/08/2008

Test Procedures: Identified by prefix DETSn, details available upon request.

Notes:

Observations and interpretations are outside the scope of UKAS accreditation
* denotes test not included in laboratory scope of accreditation
# denotes test that holds MCERT accreditation
$ denotes tests completed by approved subcontractors
I/S denotes insufficient sample to carry out test
N/S denotes that the sample is not suitable for testing
DETSM denotes tests carried out by DETS Midlands laboratory
Solid samples will be disposed 1 month and liquids 2 weeks
after the date of issue of this test certificate
Asbestos subsamples will be kept for 6 months

Approved By:

Authorised Signatories: Richard Bennett
Director

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • Fax 01207 582444 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Water Samples

Our Ref: 08-21206
Client Ref: X081206
Contract Title: Celsa Tremorfa, Cardiff

		Lab No.	144987	144988
		Sample Ref	BH1R	BH2R
		Depth	4.36	4.36
		Other Ref	W1	W1
		Sample Type		
Test	**Units**	**DETSxx**		
Arsenic Dissolved	ug/l	DETS 010	< 1	< 1
Barium Dissolved	ug/l	DETS 042*	37	21
Berylium Disolved	ug/l	DETS 042*	< 1	< 1
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10
Copper Dissolved	ug/l	DETS 042	< 2	9
Lead Dissolved	ug/l	DETS 042	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10	< 10
Selenium Dissolved	ug/l	DETS 017	3	< 3
Vanadium Dissolved	ug/l	DETS 042*	70	< 10
Zinc Dissolved	ug/l	DETS 042	< 1	< 1
Sulphate	mg/l	DETS 055	250	92
Boron	ug/l	DETS 020	330	500
Cyanide free	ug/l	DETS 067	< 20	< 20
Cyanide complex	ug/l	DETS 067	100	65
Sulphur (free)	ug/l	DETS 049	< 90	< 90
Sulphide	ug/l	DETS 024	< 250	< 250
pH		DETS 008	10.1	10.2
PAH	ug/l	DETS 074*	< 0.20	0.23
EPH (C10-C40)	ug/l	DETS 051	120	130
Phenol	ug/l	DETS 054*	< 0.50	< 0.50

APPENDIX IV – MONITORING RESULTS

LAND GAS AND GROUNDWATER MONITORING DETAILS

PROJECT: Celsa Tremorfa **PROJECT No.: X081206**

Location No.	Monitoring Engineer	Monitoring Equipment Used	Comments
BHs A	FL	GA 94 Gas Analyser	

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Tel: 01554 776150
email: enquiries@quantum-gb.co.uk

Calibration details available on request.

LAND GAS AND GROUNDWATER MONITORING RESULTS

PROJECT: Celsa Tremorfa **PROJECT No.: X081206**

Location No.		Date	Time	Installation Level mAD	CH_4 %	CO_2 %	O_2 %	VOC ppm	H_2S ppm	Atmos Pressure m bar	Flow l/hr	Air Temp °C	Water Temp °C	LNAPL Depth m	Water Depth m	DNAPL Depth m	Water µS Value	Water pH Value	Remarks	Water Samples
BH1R	A	24/07/06	16:15:10	0.00	0.00	0.00	20.50			1010		22.00								
BH1R	A	24/07/08	16:15:00	0.00					0	1010		22.00								
BH1R	A	24/07/08	16:15:30	0.00	0.00	0.00	20.50			1010		22.00								
BH1R	A	24/07/08	16:16:00	0.00	0.00	0.00	20.40			1010		22.00			4.36					3x 1L
BH1R	A	30/07/08	07:50:00	0.00					0	1014		16.00								
BH1R	A	30/07/08	07:50:10	0.00	0.20	0.00	20.70			1014		16.00								
BH1R	A	30/07/08	07:50:30	0.00	0.20	0.00	20.70			1014		16.00								
BH1R	A	30/07/08	07:51:00	0.00	0.20	0.00	20.60			1014		16.00			4.38					
BH1R	A	06/08/08	16:55:00	0.00					0	1006	0.00	22.00								
BH1R	A	06/08/08	16:55:10	0.00	0.00	0.00	20.50			1006		22.00								
BH1R	A	06/08/08	16:55:30	0.00	0.00	0.00	20.50			1006		22.00								
BH1R	A	06/08/08	16:56:00	0.00	0.00	0.00	20.50			1006		22.00			4.36					
BH1R	A	13/08/08	16:35:00	0.00					0	1000	0.00	12.00								
BH1R	A	13/08/08	16:35:10	0.00	0.00	0.00	20.60			1000		12.00								
BH1R	A	13/08/08	16:35:30	0.00	0.10	0.00	20.60			1000		12.00								
BH1R	A	13/08/08	16:36:00	0.00	0.10	0.00	20.60			1000		12.00			4.27					

QUANTUM
Ty Berwig, Bynea
Llanelli, Carmarthenshire SA14 9ST
Tel: 01554 744880
Tel: 01554 776150
email: enquiries@quantum-gb.co.uk

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LAND GAS AND GROUNDWATER MONITORING RESULTS

PROJECT: Celsa Tremorfa **PROJECT No.: X081206**

Location No.		Date	Time	Installation Level mAD	CH_4 %	CO_2 %	O_2 %	VOC ppm	H_2S ppm	Atmos Pressure m bar	Flow l/hr	Air Temp °C	Water Temp °C	LNAPL Depth m	Water Depth m	DNAPL Depth m	Water µS Value	Water pH Value	Remarks	Water Samples
BH2R	A	24/07/08	16:30:00	0.00					0	1010		22.00								
BH2R	A	24/07/08	16:30:10	0.00	0.00	0.00	20.50			1010		22.00								
BH2R	A	24/07/08	16:30:30	0.00	0.00	0.00	20.50			1010		22.00								
BH2R	A	24/07/08	16:31:00	0.00	0.00	0.00	20.50			1010		22.00			4.36					3x 1L
BH2R	A	30/07/08	07:55:00	0.00					0	1013		16.00								
BH2R	A	30/07/08	07:55:10	0.00	0.00	0.00	20.60			1013		16.00								
BH2R	A	30/07/08	07:55:30	0.00	0.00	0.00	20.60			1013		16.00								
BH2R	A	30/07/08	07:56:00	0.00	0.00	0.00	20.60			1013		16.00			4.35					
BH2R	A	06/08/08	17:05:00	0.00					0	1005	0.00	22.00								
BH2R	A	06/08/08	17:05:10	0.00	0.00	0.00	20.50			1005		22.00								
BH2R	A	06/08/08	17:05:30	0.00	0.00	0.00	20.50			1005		22.00								
BH2R	A	06/08/08	17:06:00	0.00	0.00	0.00	20.40			1005		22.00			4.36					
BH2R	A	13/08/08	16:45:00	0.00					0	1000	0.00	12.00								
BH2R	A	13/08/08	16:45:10	0.00	0.00	0.00	20.60			1000		12.00								
BH2R	A	13/08/08	16:45:30	0.00	0.20	0.00	20.60			1000		12.00								
BH2R	A	13/08/08	16:46:00	0.00	0.20	0.00	20.60			1000		12.00			4.26					

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Llanelli, Carmarthenshire SA14 9ST
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Tŷ Berwig
Bynea
Llanelli
Carmarthenshire
SA14 9ST
T: 01554 744880
F: 01554 776150
E: enquiries@quantum-gb.co.uk
W: http://www.quantum-gb.co.uk