MOTT MACDONALD

Llanwern Rail Facilities - Phase 1 Planning

Ground Conditions and Contamination Report

September 2018

Transport for Wales
367590-WTD-CAR-2653

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Transport for Wales
367590-WTD-CAR-2653

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	05/09/2018	V. Sin	C. Williams	C. Probert	Draft Issue – For TfW Review
B	28/09/2018	V. Sin	C. Williams	C. Probert	Issue for Pre-Application Consultation

Document reference: 367590-WTD-CAR-2653

Information class: Standard

Contents

Executive summary

Mott MacDonald has been commissioned by Transport for Wales (TfW), on behalf of Welsh Government, to prepare and submit a planning application, seeking full planning permission for the design and construction of a 1.6km long Major Events Stabling Line (MESL) on land adjacent to the existing Tata Steelworks Service Lines in Llanwern, South Wales. This is Phase 1 of the Llanwern Rail Facilities Programme. The purpose of this report is to provide an understanding of likely ground conditions, historic land use, the potential for contamination within the Scheme area and surrounding zone of influence.

The Site was in agricultural use until the late 1950's when the Spencer Steelworks was constructed on land to the south. In 2004 the western half of the steelworks was closed and demolished, with the eastern half still in operation. The western half of the historic steelworks is now the Glan Llyn development, a mixed-use residential and commercial development which has been partially completed. The Site is vegetated with trees and scrub. Multiple surface drainage ditches are present which flow into an east to west surface reen which in turn drains to the south into the Gwent Levels. Monks' Ditch flows south to the east of the site but is hydraulically isolated from the surrounding land. The ground is uneven and is likely to contain Made Ground from the construction of the steelworks. The extent of Made Ground is unknown and not proven.

The recorded underlying geology of the Site is limestone and mudstone of the Blue Lias Formation, which is mantled by Tidal Flat Deposits comprised of clay with interbedded peat and sand lenses. Historical boreholes on and near the Site recorded depths of Tidal Flat Deposits up to 10.9m. Groundwater was recorded within the Tidal Flat Deposits.

A qualitative risk assessment has determined a low risk to human and environmental receptors, with high risk to buried structures from sulphate degradation. A ground investigation will be necessary to inform the foundation design for the railway line and confirm the levels of contamination present at the Site.

1 Introduction

1.1 Project Description

Mott MacDonald has been commissioned by Transport for Wales (TfW), on behalf of Welsh Government, to prepare and submit a planning application, seeking full planning permission for the design and construction of a 1.6km long Major Events Stabling Line (MESL) on land adjacent to the existing Tata Steelworks Service Lines in Llanwern, South Wales. This is Phase 1 of the Llanwern Rail Facilities Programme.

The MESL will be used for stabling of rolling stock for major events in the area, to enable flexibility for future train requirements, and proving of trains prior to use on the rail network. The MESL will be electrified in a future phase of work. This proposed 1.6km length of MESL to the west of Monks' Ditch was formerly known as Option 6a.

The wider Llanwern Rail Facilities Programme will include an extension of the MESL by circa 2.4km east (to achieve a total length of circa 4km), electrification of the MESL, a new Llanwern railway station and passenger line (including Park & Ride and footbridge), and connections to the South Wales Main Line (Relief Lines). The further phases of the project will be the subject of a subsequent planning application.

The key parameters for the Scheme are listed below:

- Whole Site area is 3.1 hectares. This land is contained within the red line boundary shown on the Site Location Plan (Drawing number 367590-MMD-48-XX-DR-C-0001); and
- The Site length is approximately 1.6km long and 19m wide.

1.2 Scope of Works

The General Arrangement drawings (Drawing numbers 367590-MMD-48-XX-DR-C-0002 to 367590-MMD-48-XX-DR-C-0005) demonstrate the project scope which includes the design and construction of the following:

- A single track stabling line (MESL) circa 1.6km long;
- Associated earthworks and landscaping; and
- Drainage and other engineering works.

In order to obtain full planning permission for Phase 1, we have carried out the outline design and technical assessment of the above scope, as well as multiple assessments in terms of ecology, environment, heritage and archaeology.

1.3 Site Location

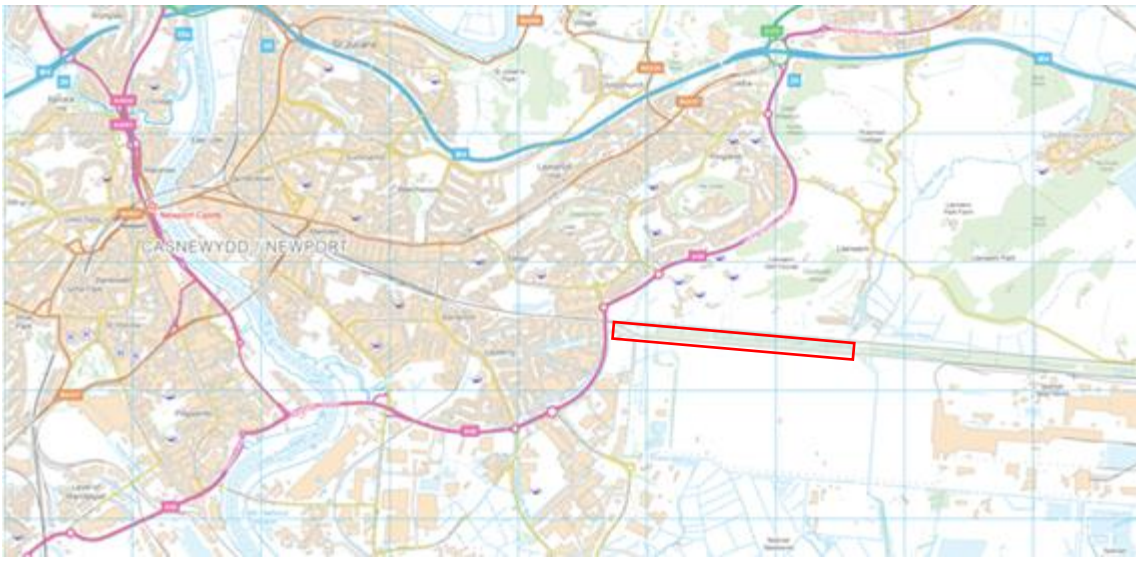
The proposed rail development Site is located approximately 8 miles east from the centre of Newport, South Wales (Figure 1.1).

The Site is aligned roughly west – east and bordered by the existing South Wales Mainline to the north and the Tata Steelworks to the south. Along the southern boundary of the steelworks site runs the A4810 which links the M4 from junction 23A at Magor with the A48 at Liswerry (a predominantly residential suburb on the south-eastern side of Newport. The site is more widely bordered by the M4 which runs approximately two and a half miles to the north and the Severn

Estuary which lays approximately three miles to the south. The Gwent Levels to the south is a significant area of wetlands.

The existing South Wales Mainline passes north of the proposed Site and provides opportunity for transport links for both passengers and freight.

Figure 1.1: Proposed Location Plan



Source: OS Open Data

1.4 Purpose of Report

The purpose of this report is to record the results of a geo-environmental desk study of the Site to inform the design of the Scheme.

The scope of the report includes detail of the topography, geology, hydrology, hydrogeology, presence of man-made features, and historical development of the Site. Information has been sought from generally available sources of information and a site walkover that are detailed and referenced within the following sections. A preliminary qualitative contaminated land risk assessment is produced and presented within this report.

1.5 Sources of Information

The following sources of information have been consulted in the preparation of this report utilizing published material that is publicly accessible:

- British Geological Survey (BGS) Onshore GeoIndex[1];
- BGS Lexicon[2];

[1] British Geological Survey (2016). Onshore GeoIndex [Online]. Available at: http://mapapps2.bgs.ac.uk/geoindex/home.html [Accessed 11th May 2017]

[2] British Geological Survey (2017). The Lexicon of Named Rock Units [Online]. Available at: http://www.bgs.ac.uk/lexicon/ [Accessed 11th May 2017]

- The Coal Authority Online Interaction Map[3];
- Natural Resources Wales (NRW) Long Term Flood Risk Map[4];
- BGS 1:125k Hydrogeological Map of South Wales[5];
- Lle geo-portal[6];
- National Library of Scotland Online Maps[7];
- Google Earth Pro;
- Zetica Unexploded Bomb risk maps[8]; and
- Department for Environment, Food, and Rural Affairs' (Defra) 'MAGIC' Online Interactive map[9].

1.6 Limitations

This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned Scheme only. It should not be relied upon by any other party or used for any other purpose.

We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

To the extent that this document is based on information obtained in previous or recent ground investigations, persons using or relying on it should recognise that any such investigation can examine only a fraction of the subsurface conditions. In any ground investigation there remains a risk that pockets or "hot-spots" of contamination or other ground hazards may not be identified, because investigations are necessarily based on sampling at localised points. Certain indicators or evidence of hazardous substances or conditions may have been outside the portion of the subsurface investigated or monitored, and thus may not have been identified or their full significance appreciated.

Mott MacDonald Ltd is not insured for, and therefore will not undertake surveys to identify asbestos or provide any guidance on the treatment of asbestos, or similarly for toxic mould. Should the presence of asbestos or toxic mould be suspected during the course of the study, Mott MacDonald Ltd would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

[3] The Coal Authority (2016). Interactive Map [Online]. Available at: http://mapapps2.bgs.ac.uk/coalauthority/home.html [Accessed 12th May 2017]

[4] Natural Resources Wales (2017). Long term flood risk map [Online]. Available at: https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en [Accessed 12th May 2017]

[5] British Geology Survey (1986). Hydrogeological Map of South Wales, 1:125,000. London: Ordnance Survey

[6] Welsh Government, Geography & Technology (2017). Lle Geo-Portal [Online]. Available at http://lle.gov.wales/home?lang=en [Accessed 15th May 2017]

[7] National Library of Scotland (2017). Maps [Online]. Available at: http://maps.nls.uk/ [Accessed 12th May 2017]

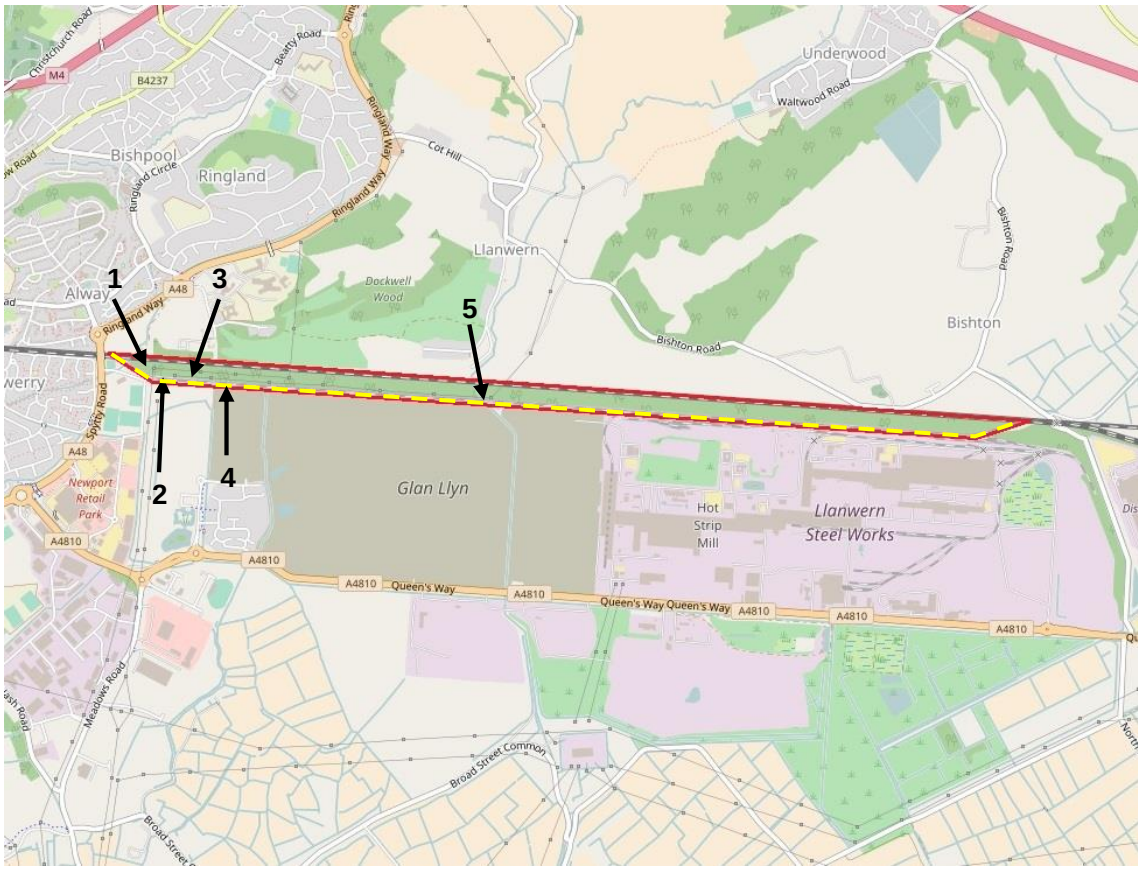
[8] Zetica UXO (2017). Unexploded Bomb Risk Maps [Online]. Available at: http://zeticauxo.com/downloads-and-resources/risk-maps/ [Accessed 11th May 2017]

[9] Department for Environment, Food, and Rural Affairs' (Defra) 'MAGIC' Online Interactive map

2 Site Walkover Survey

A Site walkover survey was conducted by Mott MacDonald Ltd staff on the 8 and 9 of June 2017. The walkover survey was conducted along the length of the Scheme, with Figure 2.1 presenting the approximate route of the survey. The length of the Scheme is approximately 1.6km, and approximately 19.0m wide. Selected photographs taken during the walkover survey are presented in this section where potentially contaminative features were identified during the walkover survey. Due to the dense vegetation present on-site, the walkover survey was not conducted in a continuous route within the Site boundary. It was achieved through walking along the southern boundary of the Scheme and where possible, gaining access through openings in the vegetation to visually inspect the conditions.

Figure 2.1: Walkover Route



Source: OpenStreet Map contributors

The walkover survey was undertaken over two days during overcast and rainy conditions.

Figure 2.2: Location 1

Location 1 viewing north-east. Main line can be seen to the centre left, with the dense vegetation seen representative of what was encountered most of the Site.

Beginning the survey at the western end of the Site, dense vegetation was noted to be present. Figure 2.2 is taken from Location 1 providing an idea of the dense vegetation encountered. The vegetation is mainly comprised of trees and shrubs, which are dense enough to prevent continuous access through the Site. This density of vegetation is present across most of the Site, limiting the amount of information which could be gained of the Site during the walkover survey.

The Site is noted to be bounded by steep embankments rising to approximately 3.0m to 4.0m, to the north and south. The main line railway runs along the northern embankment and the Tata Steel service lines run along the southern boundary. In Figure 2.2 the main line can be seen to the centre left.

The ground within the vegetated zone is uneven, with slight differences in elevation. The top soil is noted to be clayey with high organic content, which becomes gravelly towards the railway embankments towards the north and south. The ground was wet, with isolated patches of water pooling, this is likely attributed to the weather on the day of survey. Anecdotal evidence provided by Tata Steel staff that the ground can become boggy following rainfall. The gravel encountered consists of natural rock material along with concrete, clinker, and slag.

These observations are applicable along the length of the Scheme, as there are no significant changes to the vegetation or the material encountered across the Site. Therefore, this section

will focus on reporting any deviation from these observations, and any features that are potentially contaminative.

Figure 2.3: Location 2a

Location 2a viewing north. Gas pipeline signage in the upper centre of the image, along with sheet pile retaining feature at the centre of the image.

Figure 2.4: Location 2b

Location 2b viewing south. A view of the embankment and exposed sheet pile retaining structures

A buried high-pressure gas pipeline is noted at Location 2a (Figure 2.3). The directional alignment of the pipeline is unknown. Exposed sheet pile retaining features are also noted along the embankment to the service lines and suggest that their use is to act as a retaining structure to the embankment (Figure 2.4). The embankment to the service lines is mainly comprised of gravel, with cobble sized fragments dispersed amongst the gravel.

Figure 2.5: Location 3

Location 3 looking north. Gravel platform built on to the Site as a storage area for service line track repair.

A gravel platform is noted at Location 3 (Figure 2.5) and built on to the Site. Several of these platforms are noted to be present at irregular intervals, along the southern boundary of the Site and have been built using ballast to form a platform to the same topographic level as the service line. The platforms are used as storage areas for railway tracks, sleepers, and any associated equipment needed for the repair and maintenance of the service lines. The boundary of this embankment often slopes steeply onto the vegetated zone of the Site.

Figure 2.6: Location 4a

Location 4a viewing north-west. Provides a view of the service line, and Site towards the western boundary.

Figure 2.7: Location 4b

Location 4b viewing north-east. Provides view of the service line, and Site towards the eastern boundary.

Figures 2.6 and 2.7 provide a view of the Site from the service lines, viewing towards the western and eastern ends of the Scheme. The images provide a view of the difficulty of access on to Site, due to the dense vegetation. Note the two 132kV overhead power lines which are present within the western half of the Site.

Figure 2.8: Location 5

Location 5 viewing north-west. View of Monks' Ditch. To the left of the image is an area of raised ground.

Figure 2.8 provides a view of Monks' Ditch looking north-west. Monks' Ditch is a canalised stream that flows north to south immediately to the east of the Site. Monks' Ditch flows through a concrete channel and is culverted under the main line and under the sidings. The embankments on either side are raised above surrounding ground level. Plans of Monks' Ditch and the other drainage ditches on-site are presented in Appendix A.

2.1 Summary of Field Observations

The Scheme is approximately 1.6km in length and 19.0m in width and is densely vegetated, limiting the access points on to the Site. This in-turn limited the area which could be visually inspected, and the amount of information gained. The topography of the Site is generally flat with the embankment carrying the sidings to the south. The elevation difference between the embankments and the adjacent land is approximately 3.0m to 4.0m.

The ground surface towards the southern boundary contains some ballast which has spilled down the slope from the sidings. A clayey topsoil overlies most of the Site and is uneven to walk on. Anecdotal evidence obtained from Tata Steel staff indicate that the ground within the Site can become boggy after rainfall.

Monks' Ditch and several drainage ditches flow from north to south; culverted under the mainline railway and sidings. The embankments of these surface water bodies are typically heavily vegetated by hydrophilic plants. Embankments of drainage ditches within Tata Steel land are routinely cleared of vegetation.

A marker post for a buried high-pressure gas pipeline was found at the western end of the Site.

Gravel platforms were noted to be built at irregular intervals along the southern boundary of the Site. These were built as storage areas to hold railway tracks and sleepers for track repair and maintenance of the sidings.

Overall, the walkover survey did not identify signs of direct contamination, and a limited number of potentially contaminative sources. From the walkover survey, the main interests regarding potential contamination are as follows:

- Made Ground of gravel platforms built using railway ballast, comprising of natural rocks, slag, and clinker;
- Made Ground from the construction of overhead power lines, buried pipelines, drainage ditches and culverts, and raised embankments to the service line and main line; and
- Off-site contamination from service lines to the south, and the main line further to the north.

3 Site Description

3.1 Topography

Based on Ordnance Survey mapping the Site does not feature prominent changes in elevation. From the walkover survey the general topography of the Site is flat with raised elevations at the southern boundary as the land rises to carry the service lines for the steelworks. The intervening land is uneven with numerous drainage ditches.

3.2 Geology

Based on geological maps published by the British Geological Survey (BGS) and historic borehole records, the following geology can be established for the Site.

3.2.1 Bedrock

The BGS online geo index shows the Site's bedrock geology is comprised of mudstone and limestone of the Blue Lias Formation (Figure 3.1).

The Blue Lias Formation comprises thinly interbedded limestone and calcareous mudstones. It rests conformably on the Penarth Group, which is approximately 12.0m of dark grey and grey mudstone with subordinate sandstones, siltstones, and limestones. Underlying the Penarth Group are green and grey-green mudstones of the Blue Anchor Formation, which in certain areas can be thinly laminated with thin dolomitic limestone beds. All of which overlies the red mudstone of the Mercia Mudstone Group, which is suggested to underlie ground near the intersection between the main railway line and Monks' Ditch.

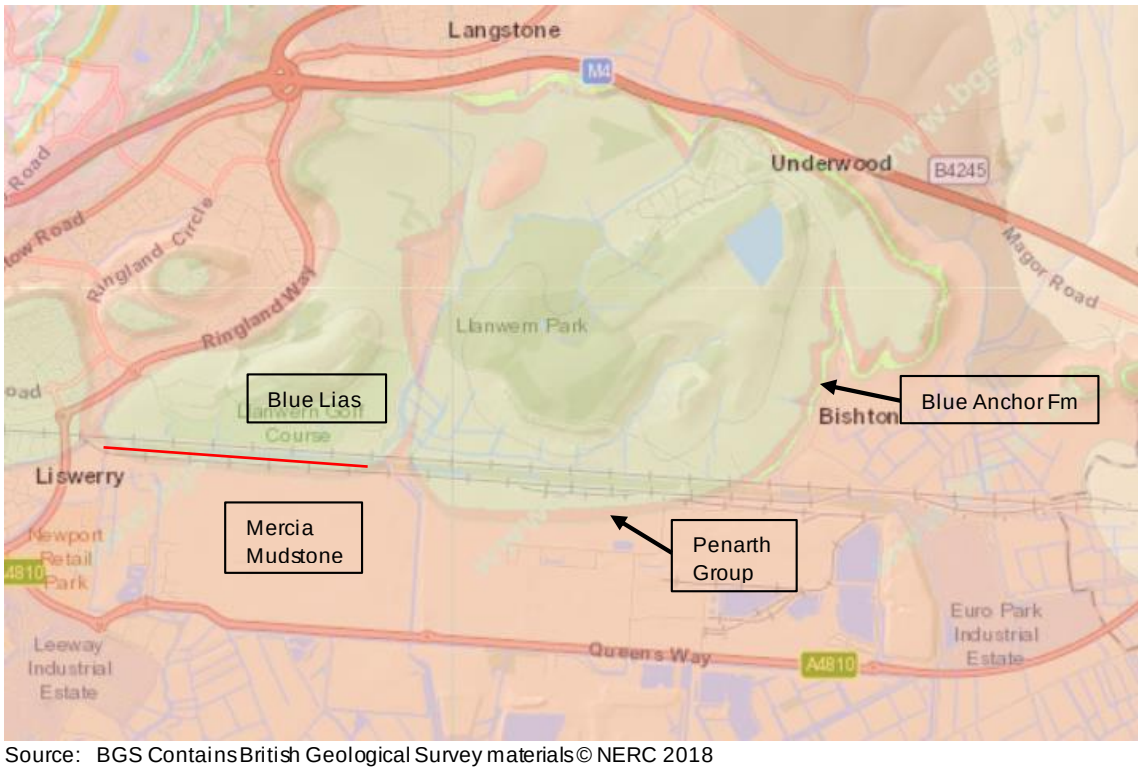
An inferred fault with a north to south trend and unknown displacement is marked near the intersection of the main railway line and Monks' Ditch.

Table 3.1 presents a summary of the bedrock geology with published descriptions. The BGS publication British Regional Geology of Wales was consulted for supplementary information.

Table 3.1: Bedrock Geology Geology	Material	Lithological Description
Blue Lias Formation	Limestone and mudstone	Thinly interbedded limestone (laminated, nodular, or massive and persistent) and calcareous mudstone or siltstone (locally laminated). Individual limestones are typically 0.1m to 0.3m thick. In some areas, intervening mudstone units with relatively few limestone beds. Also includes littoral limestone facies of the Radstock Shelf - Mendip area and South Wales.
Penarth Group	Mudstone	Grey to black mudstones with subordinate limestones and sandstones; predominantly marine in origin.
Blue Anchor Formation (Part of the Mercia Mudstone Group)	Mudstone	The formation typically comprises pale green-grey, dolomitic silty mudstones and siltstones with thin arenaceous lenses and a few thin, commonly discontinuous beds of hard, dolomitic, pale yellowish-grey, porcellanous mudstone and siltstone ("Tea Green Marl"). In southern England and Wales only, the "Tea Green Marl" is overlain by the "Grey Marls" comprising grey, black, green and, rarely, red-brown dolomitic mudstones with, in the higher beds, yellowish-grey dolostones; also present are laminated siltstone beds with mud cracks, scarce pseudomorphs after halite, and locally abundant gypsum; miospores occur throughout and bivalve fossils and bioturbation become increasingly common upwards.
Mercia Mudstone Group	Mudstone	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/anhydrite widespread; sandstones are also present.

Source: BGS

Figure 3.1: Bedrock Geology



Source: BGS Contains British Geological Survey materials © NERC 2018

3.2.2 Superficial Geology

The BGS online geo index shows the Site's superficial geology is comprised of Tidal Flat Deposits (TFD). TFD is described by the BGS as "normally a consolidated soft silty clay, with layers of sand, gravel and peat. TFD is not present on higher ground north of the Site, as it is beyond the range of the Severn Estuary tidal regime for sediment deposition. TFD may overlie Alluvium within the valley of the Monks' Ditch.

3.2.3 Made Ground

The BGS does not indicate any areas of Made Ground on or around the Site. However, field observations have indicated that the mainline and sidings are built on embankments of imported granular material and there are several platforms built into the Site. These embankments have been seen to contain clinker and slag, most likely derived from the same source of material that was used to build the development platform for the steelworks or derived from the operational steelworks.

3.3 Ground Investigation Information

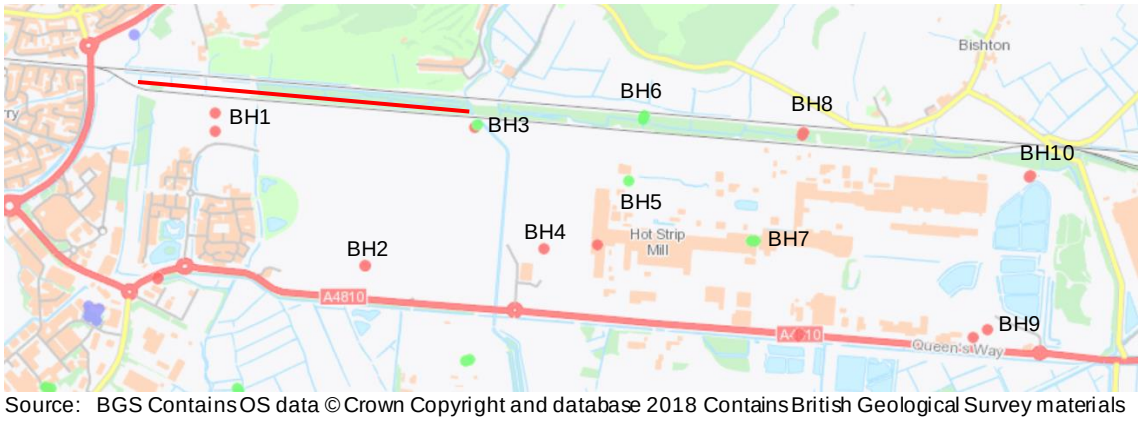
Historic borehole records of exploratory holes on and around the Site are available through the BGS Onshore GeoIndex. The boreholes that were consulted are summarised in Table 3.2 with locations shown in Figure 3.2. Scans of the borehole logs are presented in Appendix B.

Table 3.2: Historic Boreholes

BGS Reference	British National Grid Reference	Reference within this Report
ST38NE05	ST353872	BH01
ST38NE08	ST360865	BH02
ST38NE07	ST366872	BH03
ST38NE11	ST369866	BH04
ST38NE22	ST374869	BH05
ST38NE18	ST374872	BH06
ST38NE23	ST380866	BH07
ST38NE10	ST383872	BH08
ST38NE16	ST391561	BH09
ST38NE13	ST394870	BH10

Source: BGS

Figure 3.2: Borehole Locations



Source: BGS Contains OS data © Crown Copyright and database 2018 Contains British Geological Survey materials © NERC 2018

All boreholes were sunk prior to the construction of the steelworks south of the Scheme location. Therefore, the steelworks effect on ground condition reported from the historical borehole scans are not reflected. Interpreted geology provided by the scans are summarised in Table 3.3.

Table 3.3: Ground Condition Summary based on Historic Boreholes

Material	Description	BH Presence	Thickness (m)	Depth of top (m AOD)	Depth of base (m AOD)
Topsoil	Topsoil	01, 02, 03, 04, 05, 06, 07, 08, 09, 10	0.1 to 0.2	5.7 to 4.5	5.6 to 4.3
Tidal Flat Deposits	Clays with peat,	01, 02, 03, 04, 05, 06, 07, 08, 09, 10	4.1 to 10.8	5.6 to 4.3	0.5 to -6.4
Peat (Layers interbedded within Tidal Flat Deposits)	Peat	01, 02, 03, 04, 05, 06	0.3 to 3.0	4.3 to 2.7	1.0 to -2.0
Blue Lias Formation	Interbedded limestone and	06	8.0	0.5	-7.4

Material	Description	BH Presence	Thickness (m)	Depth of top (m AOD)	Depth of base (m AOD)
	calcareous mudstone				
Penarth Group	Mudstone	06, 08	1.5 to 2.4	-7.4	-3.7 to -9.8
Mercia Mudstone Group	Mudstone	01, 02, 03, 04, 05, 06, 07, 08, 09, 10	Unproven	-2.6 to -9.8	Unproven (-25.5)

Source: BGS

Mercia Mudstone Group and TFD were encountered in all boreholes. Peat layers were recorded to be interbedded within the TFD, with Boreholes BH01, BH02, BH03, and BH05 containing two separate peat layers. The geological stratigraphy is consistent with the published geology described in Section 3.2.1.

The historical boreholes record the TFD to be predominantly clay, with sandy clay with gravels and pebbles occurring above the bedrock boundary. Localised pockets of sand within the TFD may be present, evident from Borehole BH08 where a 5.9m thick sand layer is between weathered bedrock at the base, and clay above.

Based on the published geology and historic borehole scans, it is expected that the ground investigation to be conducted on Site will encounter the interbedded limestone and calcareous mudstone of the Blue Lias Formation, resting conformably above the mudstones of the Penarth Group and Mercia Mudstone Group.

3.4 Mining

Consulting the Coal Authority interactive map, the Site and surrounding area is not within a Coal Mining Reporting Area.

3.5 Hydrology

The main hydrological features are the drainage ditches which flow along the Site connecting the various north-south drains which are culverted beneath the steelworks. The plans for the drainage ditches for the Scheme are available in Appendix A.

Monks' Ditch flows within a concrete channel and is hydraulically isolated from the surrounding land.

3.6 Hydrogeology

Published BGS hydrogeological mapping (accessed via BGS Onshore GeoIndex) indicates the solid geological formations have low permeability. The Site's hydrogeology is summarised in Table 3.4.

Table 3.4: Hydrogeological Summary

Geological Unit	Aquifer Description	BGS Summary (Paraphrased descriptions are without quotation marks)
Blue Lias Formation	Rocks with essentially no groundwater	1:625k: "Largely mudstone sequence with limestone and Marlstone Rock forming local aquifers yielding small supplies". 1:125k: The Lower Lias comprises the Blue Lias. Yields from 100mm diameter boreholes into the Lower Lias are generally less than 0.5 l/s, but a 305mm diameter, 122.0m deep borehole into Blue Lias limestone at Rhoose cement works (ST 064 661) yielded 14.1 l/s.

Geological Unit	Aquifer Description	BGS Summary (Paraphrased descriptions are without quotation marks)
Triassic Rocks (Penarth Group, Blue Anchor Formation, and Mercia Mudstone Group)	Low productivity aquifer	1:625k: "Largely argillaceous sequence with occasional sandstones yielding less than 0.5 l/s of water that can be highly mineralised". 1:125k: The Penarth Group yields small quantities of potable water. The Mercia Mudstone Group commonly yields 3.0 – 8.0l/s, however at Biglis, it yielded 22.0l/s from a 30.0m deep, 200mm diameter borehole (ST 145 699) and 52.0l/s from a 12.0m shaft (St 147 697). Water levels are normally within a few meters of the ground surface.

Source: BGS

Historical borehole scans discussed in Section 3.2 of this report also reported groundwater levels. These are summarised in Table 3.5. The groundwater level on and around the Site ranges between 3.4mAOD at the shallowest to 4.9mAOD at the deepest, with an average of 4.1mAOD. The historic boreholes indicate the groundwater expected on Site will be shallow, and within the superficial TFD. It should be noted that the boreholes were sunk prior to the construction of the Steelworks, and the effect on groundwater is not reflected on these historical groundwater levels. It is likely that a perched water table exists at the base of the Made Ground.

Table 3.5: Groundwater Levels in Historical Boreholes

Borehole	Stratum	Groundwater level (mAOD)	Groundwater level (mbgl)
BH01	TFD	4.9	0.8
BH02	n/a	No data	No data
BH03	TFD	4.3	0.7
BH04	TFD	4.2	0.8
BH05	TFD	4.2	0.6
BH06	TFD	4.5	0.2
BH07	TFD	3.1	1.4
BH08	TFD	4.4	0.7
BH09	TFD	3.4	1.8
BH10	TFD	4.4	0.4

Source: BGS

Groundwater flows in a southerly direction towards the Severn estuary.

3.7 Groundwater Protection Zones

GIS data obtained from the Lle geo-portal for source protection zones (SPZ) and nitrate vulnerable zone (NVZ) indicates the Site is not within a SPZ or NVZ. The closest SPZ is approximately 5.5km to the north-east, and the closest NVZ is approximately 17.0km to the north.

3.8 Historical Site Development

Historical Ordnance Survey mapping and satellite imagery of the Site have been consulted to obtain the development history of the area. Table 3.6 summarises the historical development of the Site.

Table 3.6: Historical Land Use Summary

Year	On-site	Off-site
1881 – 1882	Rural and agricultural land use. Drainage ditches likely representing agricultural field boundaries. Drainage ditch locations are as present-day outline.	The current Great Western Railway line is present, with Llanwern Station situated on the intersection between Monks' Ditch and the railway line. Rural and agricultural land use on-Site and surroundings. Multiple surface watercourses flow beneath the railway line from north to south. A limekiln is marked north of Cadwaladr's Church, which is located south-west of Bishton village.
1899 – 1900 (Revised)	Little change to land use.	Little change to land use. "Old Quarry" marked to the north-west of Llanwern Station. Limekiln north of Cadwaladr's Church is renamed to quarry.
1917 – 1920 (Revised)	Little change to land use.	Little change to land use. "Old Quarry" is now marked as "Llanwern Lime Works", with a "Goods Shed" likely to be related to the lime works constructed on the railway line. Railway line laid between the main railway line to the lime works.
1938 (Revised, western half of the Site only)	Little change to land use.	Little change to land use. "Llanwern Lime Works" and the associated railway line to the main line are no longer present, and its land use replaced by a Golf Club House
1949 (Revised)	Little change to land use.	Little change to land use. Roman Burials marked to the immediate north-west of Llanwern Station. Quarry to the north of Cadwaladr's Church is renamed to old limekiln.
1956	Little change to land use.	Little change to land use.
1961 (larger scale map used)	Little change to land use.	Little change to land use to land north of main railway line. Construction of a large "Works" south of the main railway line is marked on the map. Most surface watercourses are now covered. Monks' Ditch is still present, with alterations made to the flow path of the watercourse. New railway lines coming off the main line at Liswerry on to the "Works" are now marked, with railway sidings running parallel to the main line and further in to the "Works". Llanwern Station is now unmarked. Residential development of land north-west and west of Scheme begin to resemble the modern extent.
1968 – 1969 (land use detailed here likely to be present during 1961, but due to larger scale mapped used, individual structures were not identified)	Slight location changes to drainage ditches to resemble current layout. Construction of two overhead powerlines.	"Works" is identified as Spencer Steelworks, with little change to land north of the main railway line. The B4004 road is constructed (Footprint of which will subsequently be the current A48 Ringland Way). Extensive structures and railway sidings are shown within the Spencer Steelworks.
1973	Little change to land use.	Little change to land use to the steelworks and land north of the main railway line. Increase extent of settling ponds on the eastern edge of the steelworks.
1989 – 1994	Little change to land use.	Little change to land use to the steelworks and land north of the main railway line. Increased extent of settling ponds on the eastern edge of the steelworks.
2001 (Aerial photograph)	Little change to land use.	Little change to land use to the steelworks and land north of the main railway line. Western areas of the steelworks appear to be disused.
2004 – 2006 (Aerial photograph)	Little change to land use.	Little change to land use to the land north of the main railway line. Gradual demolition of the buildings and structures in the western areas of the steelworks, to today's steelworks extent.
Present (2016 Aerial photograph)	Little change to land use.	Land use as present. Small housing development (Part of the Glan Llyn development) on the south-western corner of the historic steelworks extent. With one commercial structure within the middle area of the historic steelworks extent.

Source: Ordnance Survey and Google Earth

The Site itself has not been subject to development, except for the platforms built out from the sidings comprising granular Made Ground. The most significant development near the Site is the construction of the steelworks to the south. The extent of the steelworks and the associated industrial processes, structures and railway sidings mean there is potential for land contamination, with a likely presence of a multitude of contaminant types. However the development site is located up hydraulic gradient from the former steelworks site which has been remediated for residential development and so no significant contamination is anticipated to remain which could affect the Scheme.

3.9 Unexploded Ordnance (UXO)

According to a UXO risk map obtained from Zetica, the Scheme is located within an area of low bomb risk. The risk map from Zetica is available in Appendix C.

3.10 Contaminated Land and Pollution Incidents

GIS datasets for historic landfill and pollution incidents were obtained from the Lle geo-portal. There are no historic landfills within 1.0km of the Site boundary. There is one historic landfill just over 1.0km to the south of the Site boundary, located south of the current steelworks. It is not anticipated that this landfill will have any effect on the Site.

There is a landfill within the Tata site which has been used historically during operation of the steel works. The contents of this landfill are not known but given its location down hydraulic gradient from the Site it is not considered to pose any constraints.

Multiple pollution incidents have been recorded within the surrounding area of the Site. A 1.0km search distance has been used to narrow down the list of incidents which may affect the Site, and the Scheme development. Table 3.7 provides pollution incident data stored prior to the 1 March 2016. Pollution incidents on and after the 1 March 2016 are presented with Table 3.8.

Table 3.7: Pollution Incidents Summary Prior to 1 March 2016

Date	Location	Incident Number	Impact to Air	Impact to Land	Impact to Water	Pollutant
2016	ST367878	1409510	No Impact	No Impact	Minor	Sewage Materials, and Storm Sewage.
2013	ST348869	1142480	No Impact	Minor	No Impact	Inert Materials and Wastes, and Demolition. Materials and Wastes.
2013	ST349865	1121870	Minor	Significant	No Impact	Contaminated Water, and other Contaminated Water.
2015	ST346865	1344970	No Impact	No Impact	No Impact	Sewage Materials, and Crude Sewage.
2015	ST372864	1342070	Minor	Minor	Minor	Burning of Waste with Multiple Pollutants including Smoke.

Source: Lle geo-portal

Table 3.8: Pollution Incidents Summary post 1 March 2016

Date	Location	Incident Number	Principle Impact	Secondary Impact	Pollutant
2016	ST368878	1600757	Water	No Secondary Impact	Sewage Material, and Grey Water.
2016	ST352876	1606445	Water	Land	Contaminated Water, and other Contaminated Water.
2016	ST341872	1604343	Flood	Water	No data.

Source: Lle geo-portal

Pollution incidents 1409510 and 1600757 occurred along the Monks' Ditch. This watercourse is hydraulically separate from the surrounding ground.

4 Qualitative Contaminated Land Risk Assessment

4.1 Background

The framework for the assessment of potential land contamination adopted in this report is based on Contaminated Land Research Report (CLR) 11[10], and CIRIA Report C552[11]. This section comprises a qualitative contamination risk assessment including the development of a conceptual model which is done by undertaking a Source-Pathway-Receptor analysis of the Site:

- Sources (S) are potential or known contaminant sources e.g. chemicals or materials present from a former land use;
- Pathways (P) are environmental systems through which a source could migrate e.g. direct contact, air or groundwater; and
- Receptors (R) are sensitive environmental receptors that could be adversely affected by contaminants e.g. site occupiers, groundwater resources.

Where a source, relevant pathway and receptor are present, a contaminant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur and a potential environmental liability is considered to exist.

4.2 Conceptual Site Model

4.2.1 Proposed Development

The new railway line will be constructed on an extension of the existing earthworks and on ballast to raise the level of the Site to the same level as the adjacent sidings. The ballast will be granular rock imported to Site. The track will be used to accommodate trains waiting to be deployed onto the main line to service peak demand during major events. As such the lines will not be used regularly.

4.2.2 Anticipated Contaminants

Based on the available information, historical land use and walkover survey the following have been identified as potential contaminants likely to be encountered on-site. Department of Environment industry profiles have been utilised to determine potential contaminants associated with current and historical land uses (Table 4.1).

Table 4.1: Potential Contaminants

Land Use	DoE industry Profile	Potential Contaminants
On-site		
Potential Made Ground Identified during walkover survey	n/a	Steelwork waste (e.g. slag, clinker, coal fines), metals and metalloids, hydrocarbons. This material was placed during construction of the original steelworks over 60 years ago.

[10] Environment Agency (2004). Model Procedures for Management of Land Contamination – Contaminated Land Report 11
[11] Construction Industry Research and Information Association (2001). Contaminated land risk assessment A guide to good practice

Land Use	DoE industry Profile	Potential Contaminants
Off-sSite		
Steelworks.	Metal manufacturing, refining and finishing works: Iron and steelworks.	Metals and metalloids, inorganic compounds (fluoride, ammoniacal liquor, cyanide, thiocyanate, sulphates, and phosphates), acids/alkalis, asbestos, hydrocarbons (fuels and oils [coal and coke], tar, PAHs, phenols, and polychlorinated biphenyls (PCBs).
Railway line and sidings.	Railway land.	Organic compounds (hydrocarbons and herbicides), metals (ferrous residues and metal fines), asbestos, sulphates.

Source: Dept of Environment Industry Profiles

4.2.3 Potential Contamination Sources

On-Site:

S1: Made Ground.

Off-Site:

S2: Current and historical industrial activity, e.g. main line to the north, sidings to the south.

4.2.4 Potential Contamination Transport Pathways

P1: Human uptake pathways:

- Inhalation;
- Ingestion; and,
- Dermal contact;

P2: Vertical migration of leachate in the unsaturated zone;

P3: Horizontal and vertical migration of contaminants in the saturated zone;

P4: Surface water runoff; and

P5: Direct contact with construction materials.

4.2.5 Potential Contamination Receptors

On-site:

R1: Future site users;

R2: Construction and maintenance workers;

R3: Groundwater, e.g. Tidal Flat Deposits, Blue Lias (rocks with essentially no groundwater), and Triassic rocks (low productivity aquifer);

R4: Buried structures and infrastructure, e.g. foundations, services;

R5: Surface water, i.e. drainage ditches, and

R6: Surface water, i.e. Monks' Ditch.

4.3 Preliminary Contamination Risk Assessment

For each possible contaminant linkage (source-pathway-receptor) identified, the potential risk can be evaluated based on the following principle:

Contamination risk = Probability of event occurring x Consequence of event occurring

This relationship can be represented graphically as a matrix (Table 4.2), which is adapted from the Construction Industry Research and Information Association (CIRIA) 552 guidance. Appendix D presents the risk assessment methodology. Table 4.3 sets out the assessment of potential linkages.

Table 4.2: Contamination Risk Matrix

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate/Low risk	Low risk
	Low likelihood	Moderate risk	Moderate/Low risk	Low risk	Very low risk
	Unlikely	Moderate/Low risk	Low risk	Very Low risk	Very Low risk

Source: CIRIA C552

Table 4.3: Qualitative Conceptual Risk Assessment

Source	Pathway	Receptor	Probability	Consequence	Risk Category
On-site					
S1: Made Ground.	**P1**: Human uptake pathways: Inhalation; Ingestion; and Dermal contact.	**R1**: Future site users.	Low likelihood: The stabling line will not be accessible to site users on a regular basis.	Medium: Identified potential contaminants can result in harm to human health.	Low
		R2: Construction and maintenance workers.	Unlikely: The development will comprise placement of clean ballast to provide the development platform. Occasional use by trains will not create significant contamination for maintenance workers to be exposed to and any contamination present will be managed through adoption of safe methods of working.		Low
	P2: Vertical migration of leachate in the unsaturated zone	**R3**: Groundwater, e.g. Tidal Flat Deposits	Unlikely: The site will not provide a source of contamination.	Medium: Contaminants can result in adverse effect on groundwater quality.	Low
	P3: Horizontal and vertical migration of contaminants in the saturated zone.				
	P5: Direct contact with construction materials	**R4**: Buried structures and infrastructure, e.g. foundations, services	Likely: Foundations and buried structures will be in contact with ground material on-site.	Severe: Tidal Flat Deposits proven to contain peat layers, which may be anoxic. This can cause sulphate attack to concrete structures, decreasing material's strength and stability. Bedrock lithologies contain s sulphate minerals	High
	P3: Horizontal and vertical migration of contaminants in the saturated zone;	**R5**: Surface water, i.e. drainage ditches.	Unlikely: The site will not provide a source of contamination.	Medium: Contaminants can result in adverse effect on water quality.	Low
	P4: Surface water runoff	**R6**: Surface water, i.e. Monks' Ditch.	Unlikely: Monks' Ditch flows through a concrete channel and is isolated from groundwater.		Low
Off-site					
S2: Current and historical industrial activity, e.g. Main line to the north, service line to the south, current, and historic Llanwern	**P4**: Surface water runoff.	**R3:** Groundwater, e.g. Tidal Flat Deposits, Blue Lias (rocks with essentially no groundwater), and Triassic	Unlikely: The Site is up hydraulic gradient from sources of contamination.	Medium: Contaminants can result in adverse effect on groundwater quality.	Low
	P2: Horizontal and vertical migration of contaminants in the saturated zone.				

Source	Pathway	Receptor	Probability	Consequence	Risk Category
and Spencer Steelworks.		rocks (low productivity aquifer).			
	P2: Horizontal and vertical migration of contaminants in the saturated zone.	**R4:** Buried structures and infrastructure, e.g. foundations, services.		Medium: Potential for water soluble sulphate to migrate on-site, leading to sulphate attack to concrete structures; decreasing material's strength and stability.	Low

4.4 Summary

The qualitative risk assessment has indicated a low risk to the Scheme from residual contaminants in the surrounding area and a low risk to the environment from the Scheme. The underlying geology presents a high risk to building materials containing cement; however, these risks are readily mitigated through use of the appropriate cement type.

5 Recommendations for Further Studies and Ground Investigation

There is insufficient information available from the historical ground investigations undertaken to allow design of the Scheme. A site-specific ground investigation will be required to confirm the ground conditions along the route of the railway.

This ground investigation will comprise boreholes and trial pits to investigate the load bearing capacity of the underlying sediments in order to inform foundation design. Provision for testing any Made Ground for contamination will be included. Piezometers will be installed to monitor groundwater levels, and samples of the groundwater analysed for contamination.

Appendices

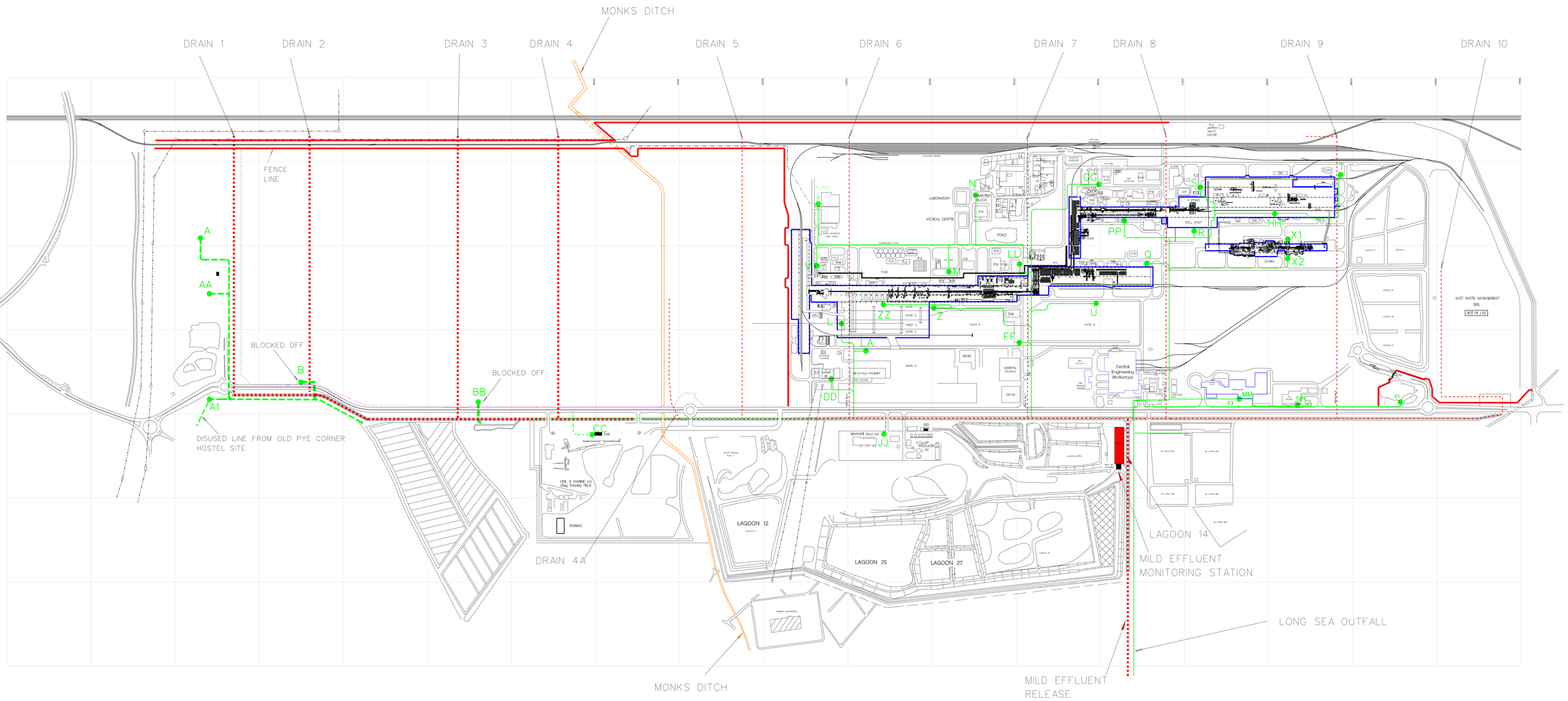
A. Site Drainage Plans

FIRST ANGLE PROJECTION

CONFIDENTIAL - Tata Steel UK Limited

DO NOT SCALE

WELD SYMBOLS TO B.S. EN 22553
UNDIMENSIONED RADII TO BE 1mm
GENERAL TOLERANCES TO BS EN 22768 - PART 1 (MEDIUM CLASS)



MILD EFFLUENT

FOUL EFFLUENT

FF — RISING MAINS AND EJECTOR STATIONS

MONKS DITCH

W — RISING MAINS AND EJECTOR STATIONS ON REGENERATION SITE

*THIS DRAWING BASED ON DRAWING 839184

No. OFF	ITEM	DRG. No. OR MATL.	ITEM	DESCRIPTION
	SCALE	1 : 5000 @ A0	PLANT	LLANWERN
	UNIT OF MEASUREMENT		SECTION	DRAINAGE SYSTEM
	DRAWN	C. TUTSSEL 02-08	DESCRIPTION	OUTLINE LAYOUT OF DRAINAGE AND MONITORING SYSTEMS

Tata Steel UK Limited
Llanwern Works

REVISIONS

REV E	REV D	REV C	REVISION B	REVISION A
SLAB YARDS - NEW RAIL TRACK ADDED & KRESS ROUTE AMENDED	NEW LINE FROM P62 TO LLANWERN HOUSE INC NEW C2 & C3 CHAMBERS FOR FUTURE CONNECTIONS	NEW ENTRANCE ADDED	UPDATED	SLURRY PIPE WORK REMOVED
S.FLOOK 06/10/2014	S.FLOOK 06/10/2014	C.TUTSSEL 11/04/2013	RT 17/03/10	J.P.B. 10/03/10

JOB REF :

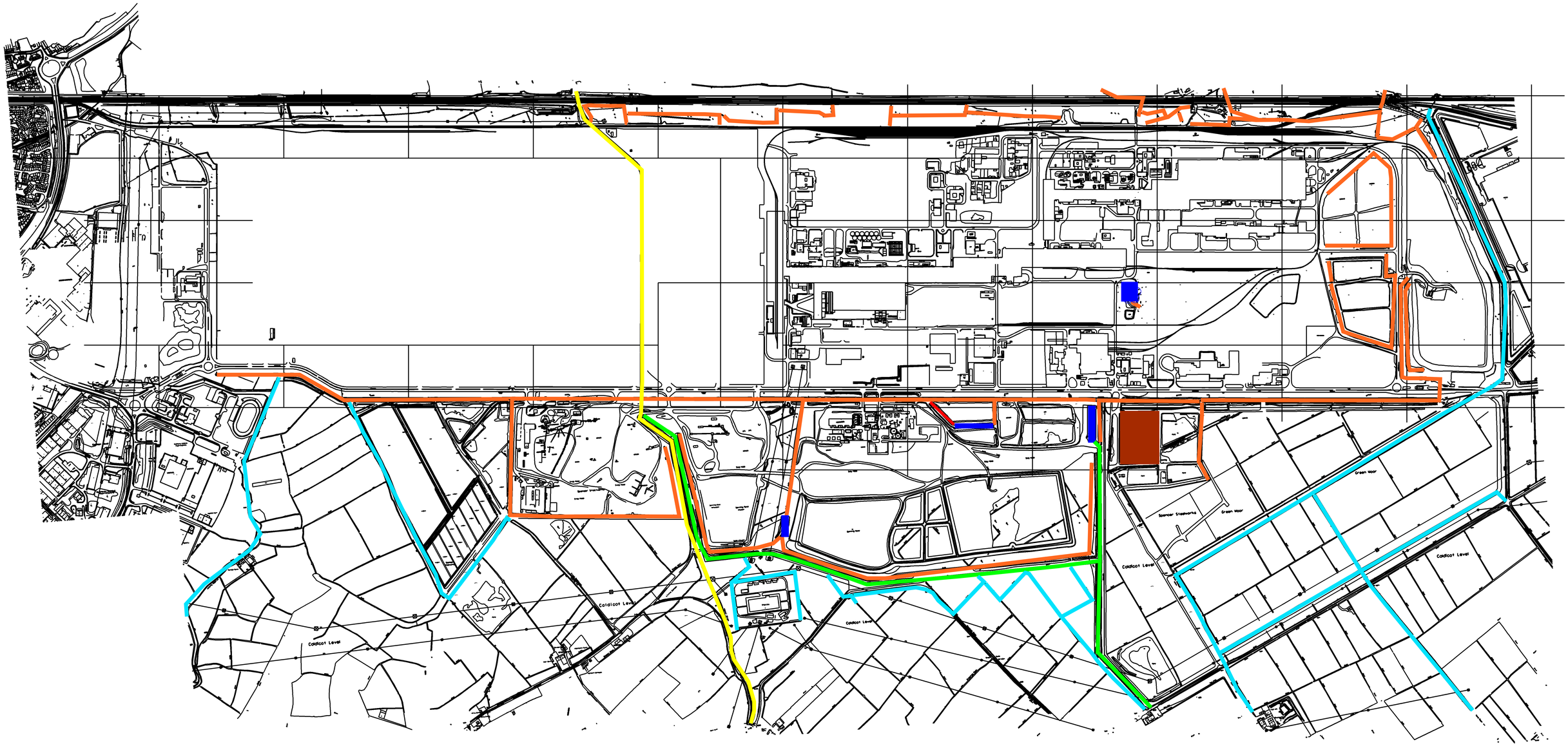
CAD FILE :

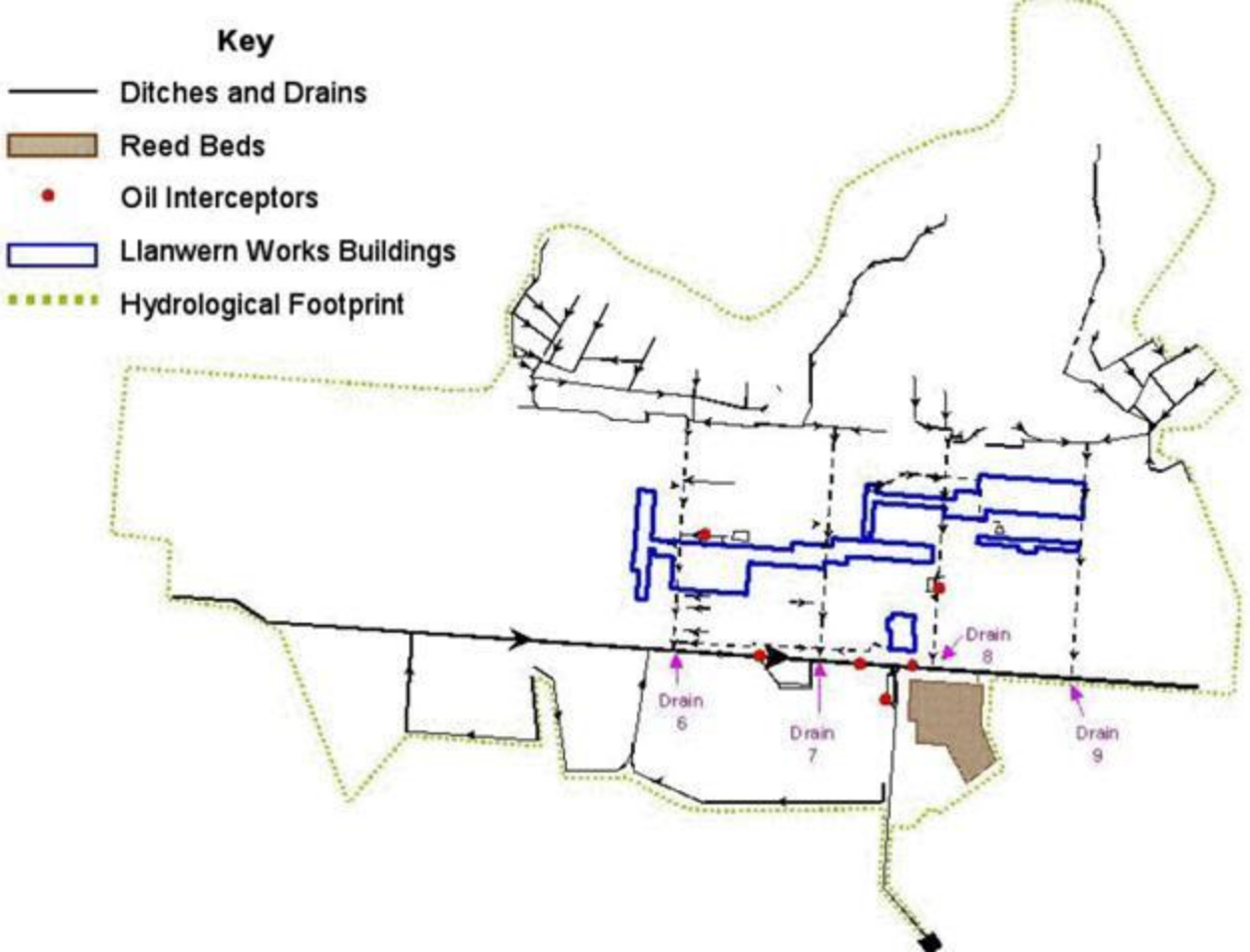
ORIGINATING OFFICE LLANWERN
DRG. No. 212069 REV E

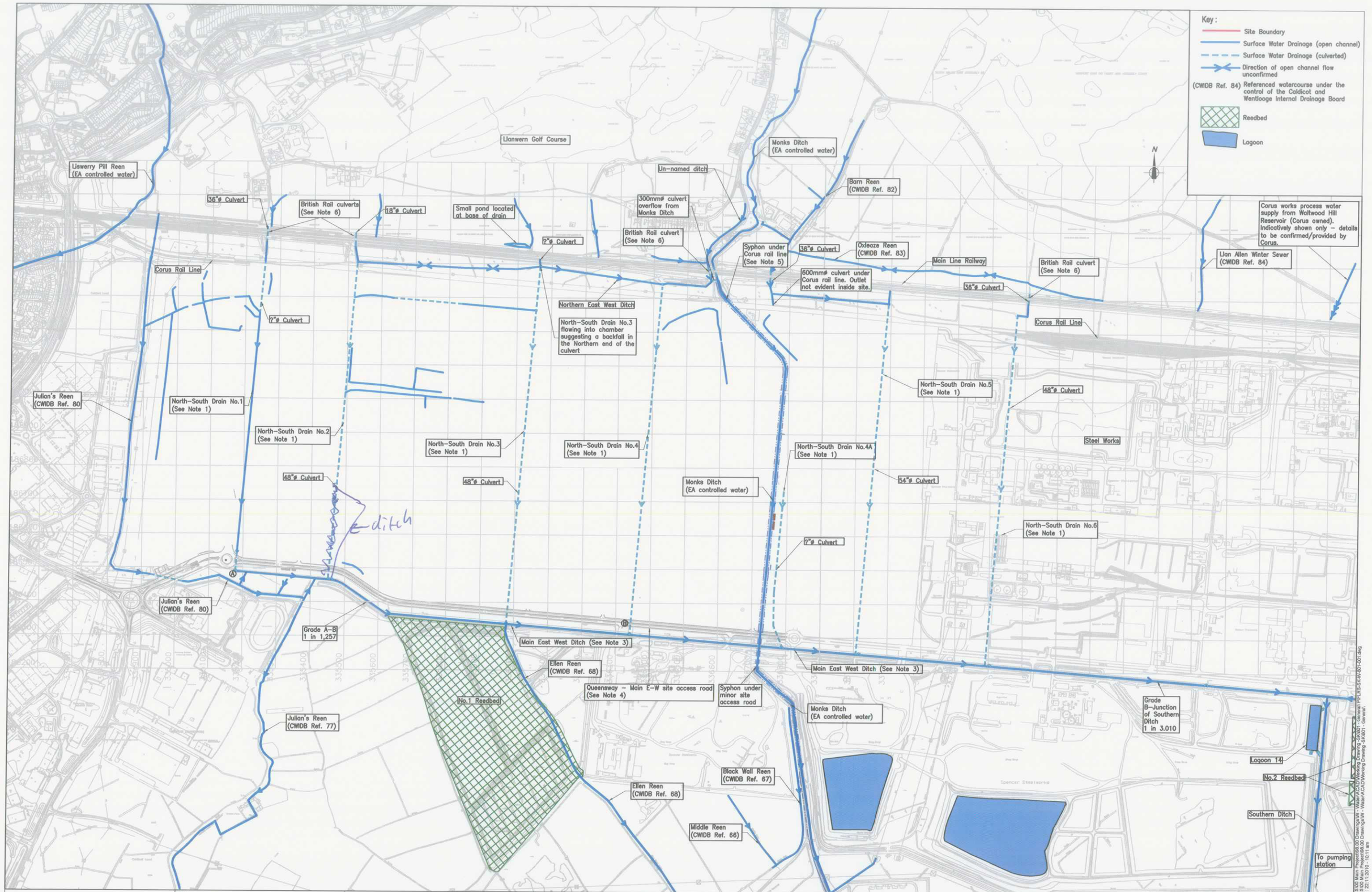
RECEIVING OFFICE
DRG. No. REV

A0

$FILEABBREV$ $TIME$ $DATE$ $FILEABBREV$


Caldicot Level
Caldicot Level
Caldicot Level
Caldicot Level
Caldicot Level
Caldicot Level
Spencer Steelworks
Green Moor
Green Moor


Key
Ditches and Drains
Reed Beds
Oil Interceptors
Llanwern Works Buildings
Hydrological Footprint
Drain 6
Drain 7
Drain 8
Drain 9



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e-mail: cardiff@halcrow.com
www.halcrow.com
Halcrow

Client
St. MODWEN DEVELOPMENTS LIMITED

LLANWERN REGENERATION SITE

Notes
1. Refer to Corus Drawing No.850.05.10200 for detailed information of drains 1–6 inclusive.
2. For existing topographical survey information refer to Drawing No.PI/FLRS/SK-801, sheets 2&3 of 3.
3. Refer to Corus Drawing No.850.05.10201 for detailed information of ditch.
4. Refer to Richard Thomas and Baldwins Ltd Drawing Nos.2/127/5 to 2/127/11 inclusive for detailed information of road drainage layout and discharge arrangements to Main East–West Ditch.
5. Refer to Richard Thomas and Baldwins Ltd Drawing No.850/05/14204 for detailed information of inverted syphon under rail tracks.
6. Refer to Corus Drawing No.850.05.10200 for detailed information of British Rail culverts. Indicatively shown only.

Rev	By	Chkd	Apprvd	Date	Description
-	-	-	-	-	-

Drawing
Existing Drainage Plan
(Sheet 1 of 3)

Drawn by: ZP	Date: Jan 08
Checked by: AJWJ	Date: Feb 08
Approved by: MW	Date: Feb 08
Drawing No. PI/FLRS/SK/W/801/001	Revision
Drawing Scale: 1:5,000 at A1	

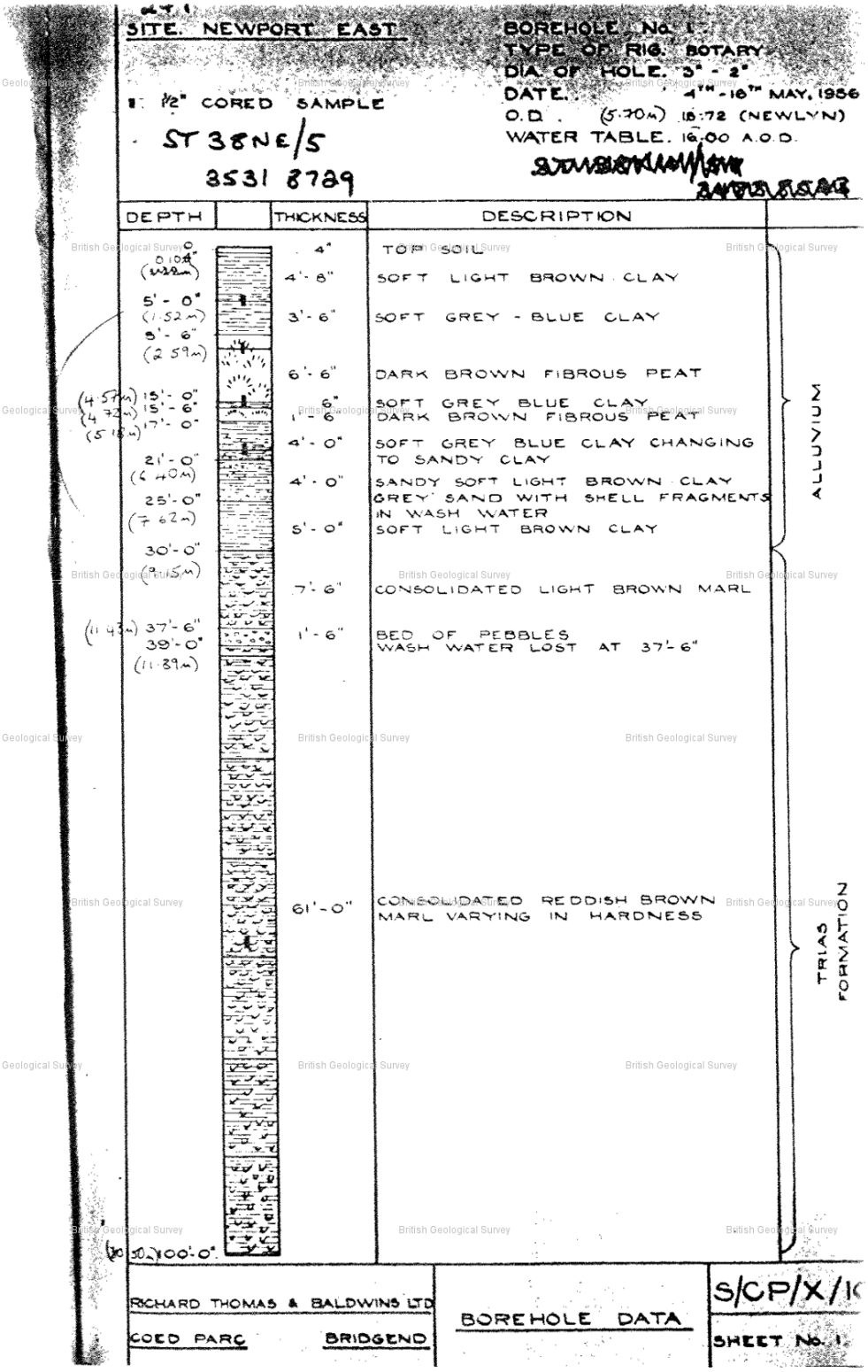
Drawing file path & name : V:\PI\FLRS\00 Main Project\06.00 Drawings\W - Water\ACAD\Working Drawing -SK\801 - General\PI\FLRS-SK-W-801-001.dwg
Xrefs & Images : V:\PI\FLRS\00 Main Project\06.00 Drawings\W - Water\ACAD\Working Drawing -SK\801 - General\
User and Plot Date : BallardG 22/11/2010 - 10:11 am

B. Historic Borehole Records

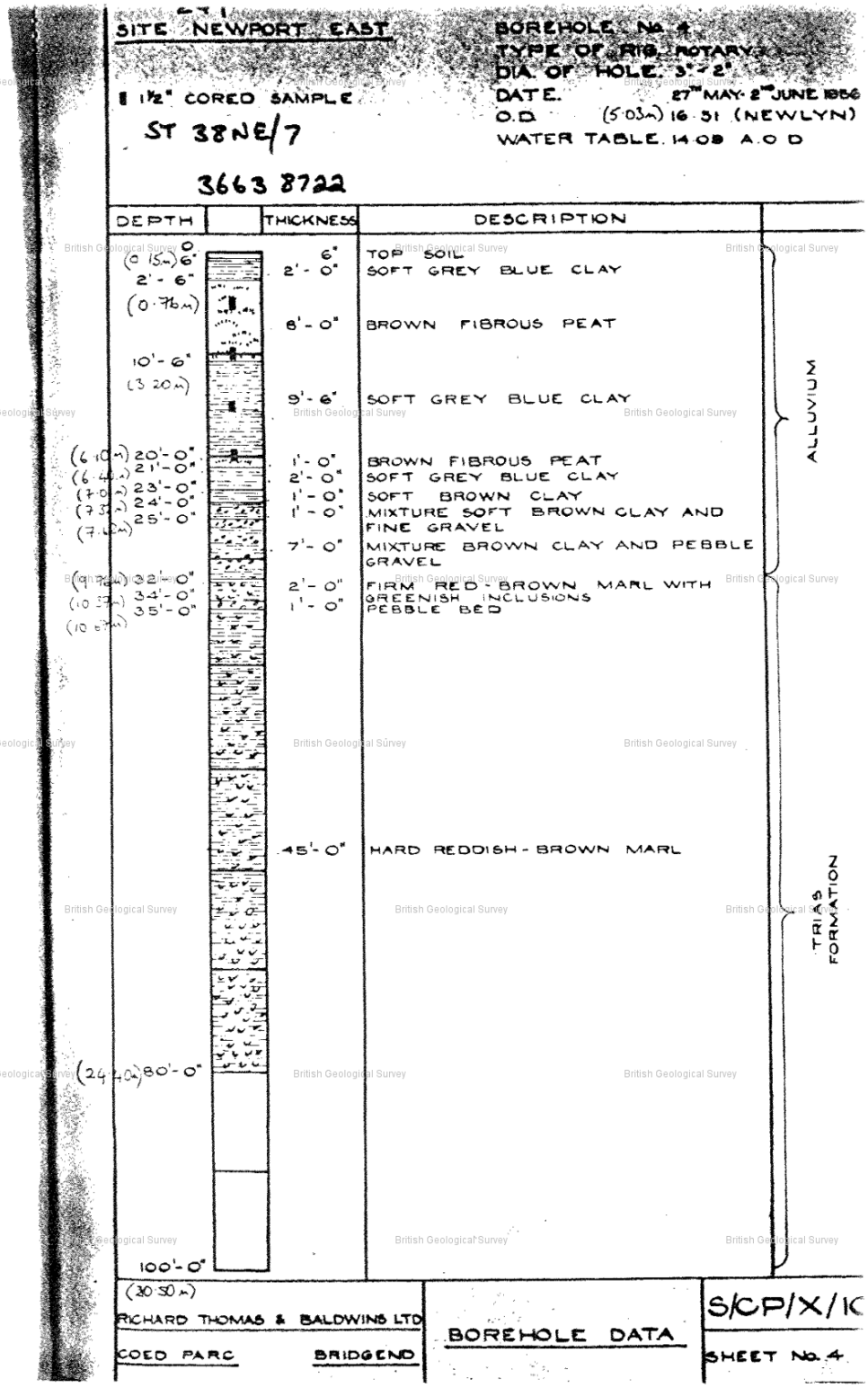
Records included are as follows (in order):

- ST38NE05
- ST38NE07
- ST38NE08
- ST38NE10
- ST38NE11
- ST38NE13
- ST38NE16
- ST38NE18
- ST38NE22
- ST38NE23

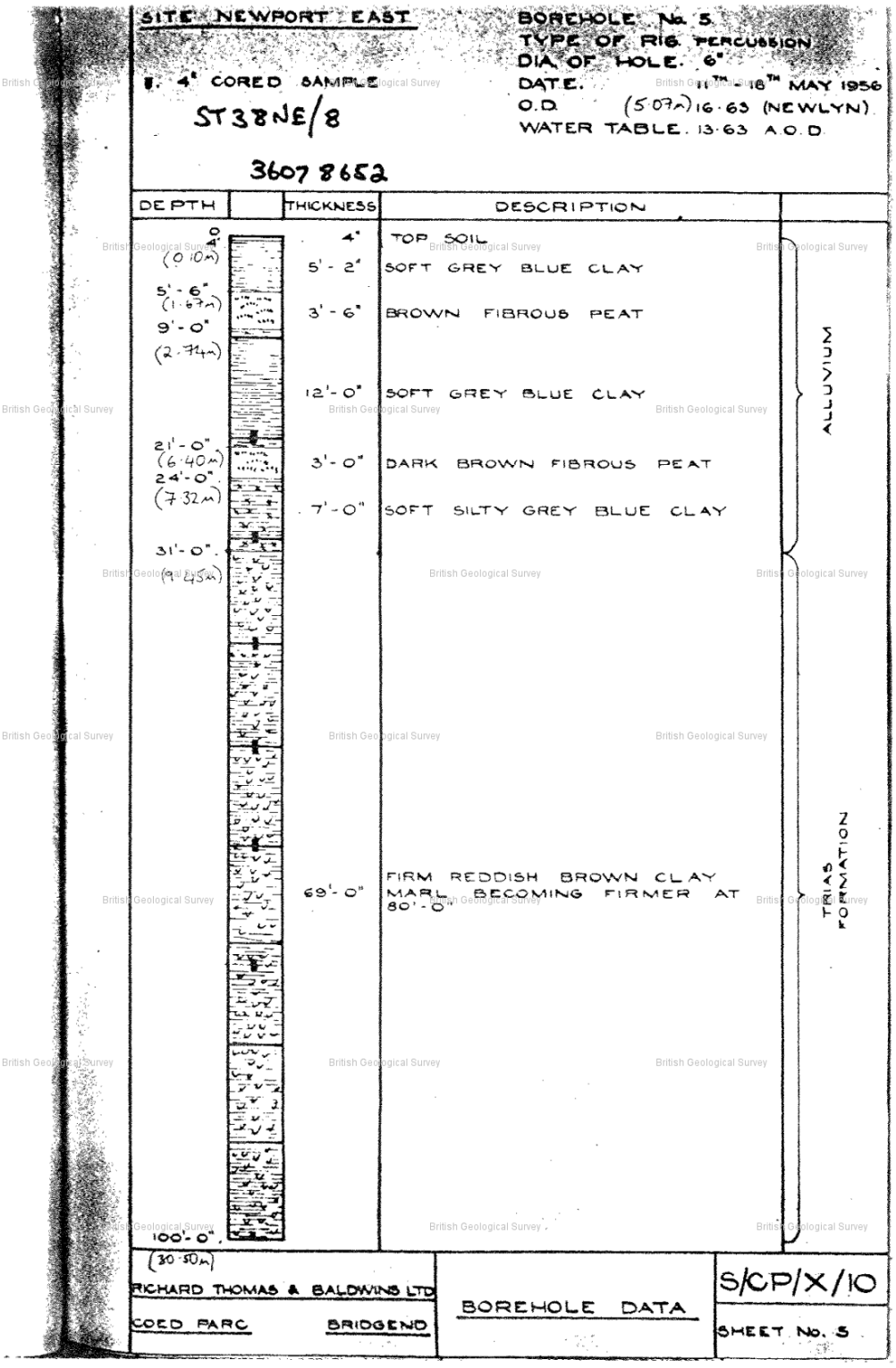
ST38NE05


SITE. NEWPORT EAST
BOREHOLE No. 1
TYPE OF RIG. ROTARY
DIA. OF HOLE. 3" - 2"
DATE. 4TH - 16TH MAY, 1956
O.D. (5.70m) 18.72 (NEWLYN)
WATER TABLE. 16.00 A.O.D.
1 1/2" CORED SAMPLE
ST 38NE/5
3531 8789
DEPTH
THICKNESS
DESCRIPTION
4" TOP SOIL
4'-8" SOFT LIGHT BROWN CLAY
3'-6" SOFT GREY - BLUE CLAY
6'-6" DARK BROWN FIBROUS PEAT
6" SOFT GREY BLUE CLAY
1'-6" DARK BROWN FIBROUS PEAT
4'-0" SOFT GREY BLUE CLAY CHANGING TO SANDY CLAY
4'-0" SANDY SOFT LIGHT BROWN CLAY
GREY SAND WITH SHELL FRAGMENTS IN WASH WATER
5'-0" SOFT LIGHT BROWN CLAY
7'-6" CONSOLIDATED LIGHT BROWN MARL
1'-6" BED OF PEBBLES
WASH WATER LOST AT 37'-6"
61'-0" CONSOLIDATED REDDISH BROWN MARL VARYING IN HARDNESS
0
0.104"
(0.22m)
5'-0"
(1.52m)
8'-6"
(2.59m)
15'-0"
(4.57m)
15'-6"
(4.72m)
17'-0"
(5.18m)
21'-0"
(6.40m)
25'-0"
(7.62m)
30'-0"
(9.15m)
37'-6"
(11.43m)
39'-0"
(11.89m)
100'-0"
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/1
SHEET No. 1

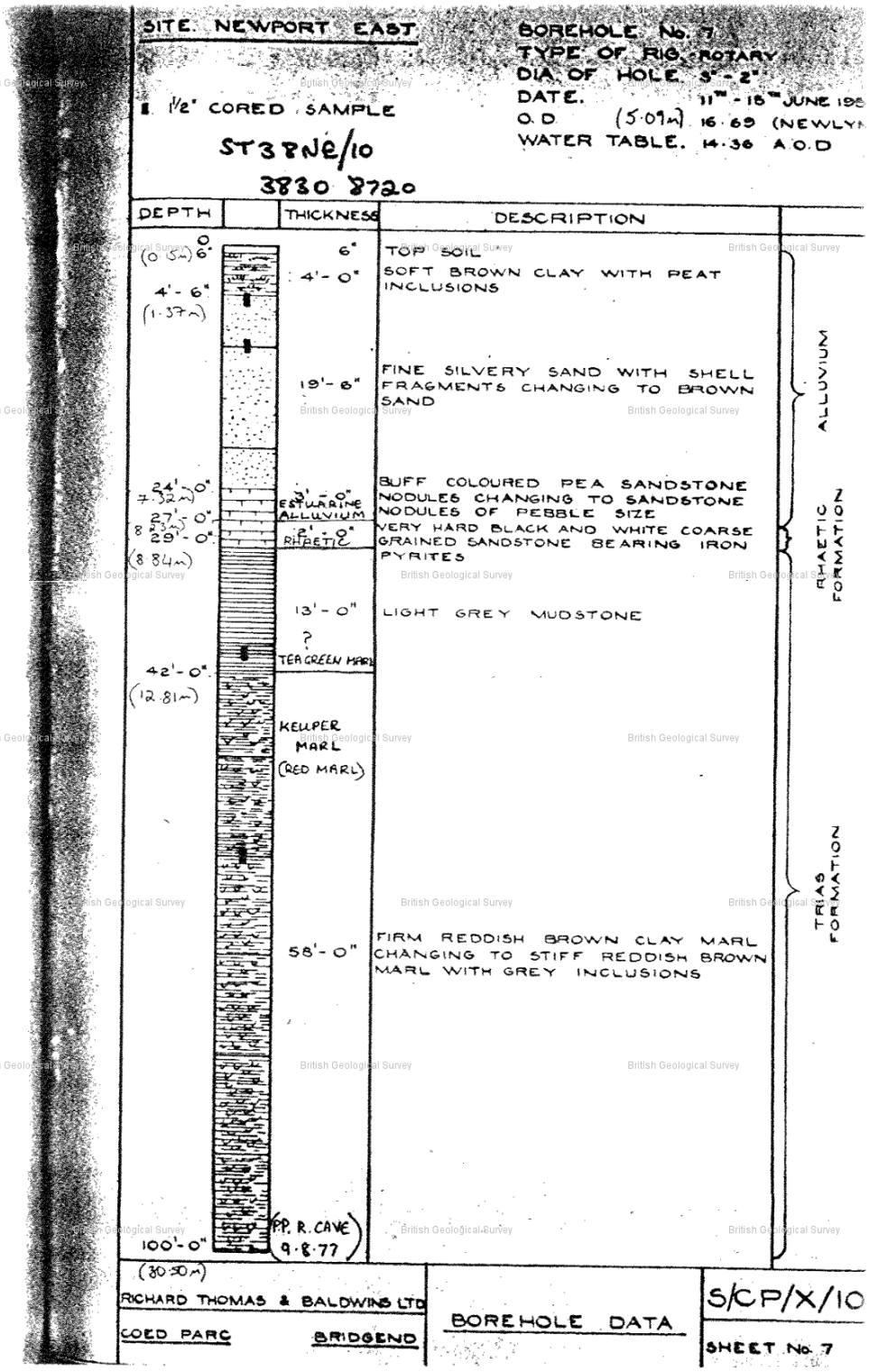
ST38NE07


SITE NEWPORT EAST
BOREHOLE No 4
TYPE OF RIG ROTARY
DIA. OF HOLE. 3" - 2"
DATE. 27TH MAY - 2ND JUNE 1956
O.D (5·03m) 16·51 (NEWLYN)
WATER TABLE. 14·08 A.O.D
1 1/2" CORED SAMPLE
ST 38NE/7
3663 8722
DEPTH
THICKNESS
DESCRIPTION
0
(0·15m) 6"
2'-6"
(0·76m)
10'-6"
(3·20m)
(6·10m) 20'-0"
(6·40m) 21'-0"
(7·01m) 23'-0"
(7·31m) 24'-0"
25'-0"
(7·62m)
(9·75m) 32'-0"
(10·37m) 34'-0"
35'-0"
(10·67m)
(24·40m) 80'-0"
100'-0"
(30·50m)
6" TOP SOIL
2'-0" SOFT GREY BLUE CLAY
8'-0" BROWN FIBROUS PEAT
9'-6" SOFT GREY BLUE CLAY
1'-0" BROWN FIBROUS PEAT
2'-0" SOFT GREY BLUE CLAY
1'-0" SOFT BROWN CLAY
1'-0" MIXTURE SOFT BROWN CLAY AND FINE GRAVEL
7'-0" MIXTURE BROWN CLAY AND PEBBLE GRAVEL
2'-0" FIRM RED - BROWN MARL WITH GREENISH INCLUSIONS
1'-0" PEBBLE BED
45'-0" HARD REDDISH - BROWN MARL
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/1C
SHEET No. 4

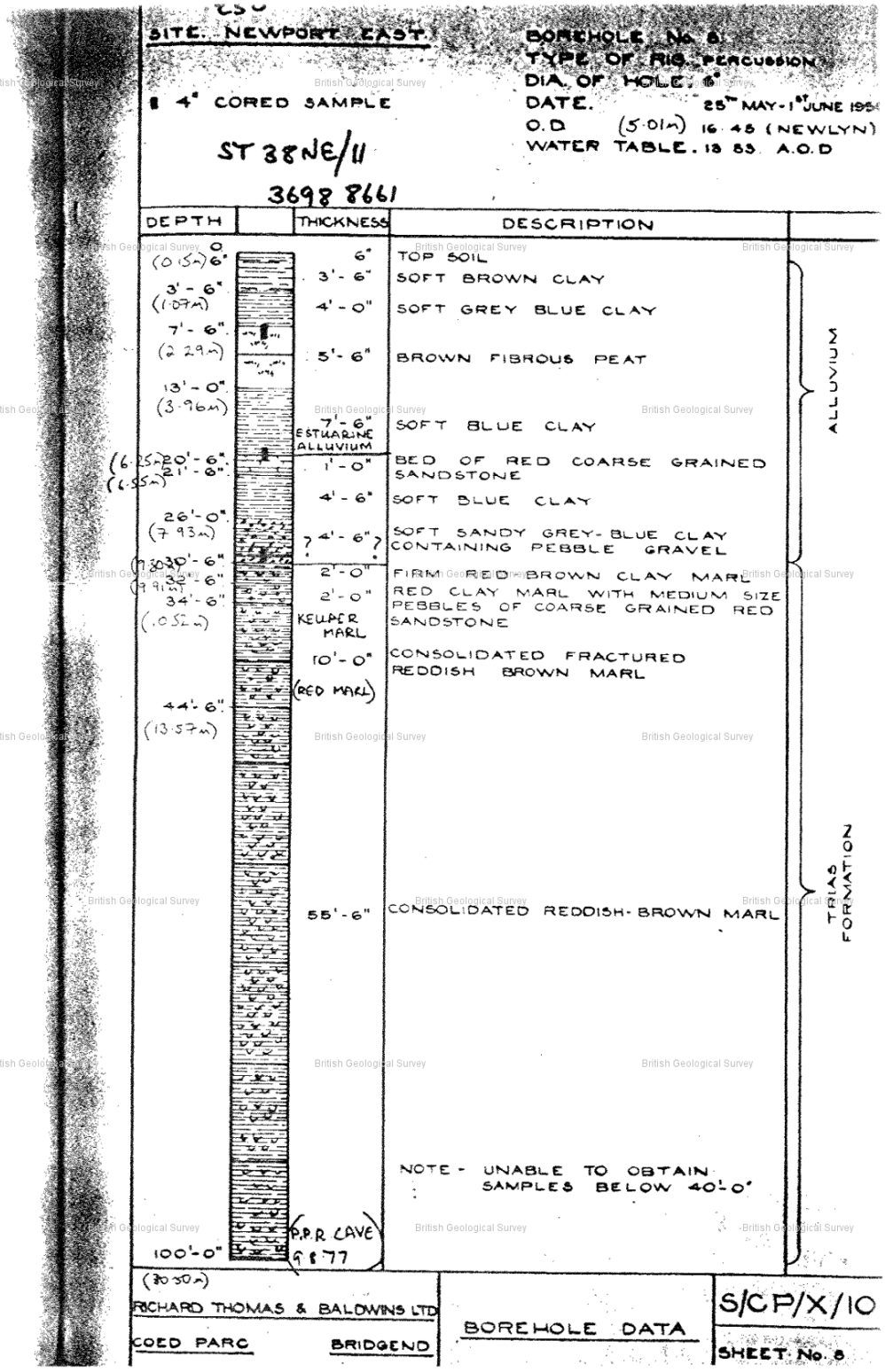
ST38NE08


SITE NEWPORT EAST
BOREHOLE No. 5
TYPE OF RIG PERCUSSION
DIA. OF HOLE. 6"
DATE. 11TH - 18TH MAY 1956
O.D. (5.07m) 16.63 (NEWLYN)
WATER TABLE. 13.63 A.O.D.
1. 4" CORED SAMPLE
ST38NE/8
3607 8652
DEPTH
THICKNESS
DESCRIPTION
0
4"
(0.10m)
4" TOP SOIL
5'-2" SOFT GREY BLUE CLAY
5'-6" (1.67m)
3'-6" BROWN FIBROUS PEAT
9'-0" (2.74m)
12'-0" SOFT GREY BLUE CLAY
21'-0" (6.40m)
3'-0" DARK BROWN FIBROUS PEAT
24'-0" (7.32m)
7'-0" SOFT SILTY GREY BLUE CLAY
31'-0" (9.45m)
ALLUVIUM
69'-0" FIRM REDDISH BROWN CLAY MARL BECOMING FIRMER AT 80'-0"
TRIAS FORMATION
100'-0" (30.50m)
RICHARD THOMAS & BALDWINS LTD
COED PARC BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 5

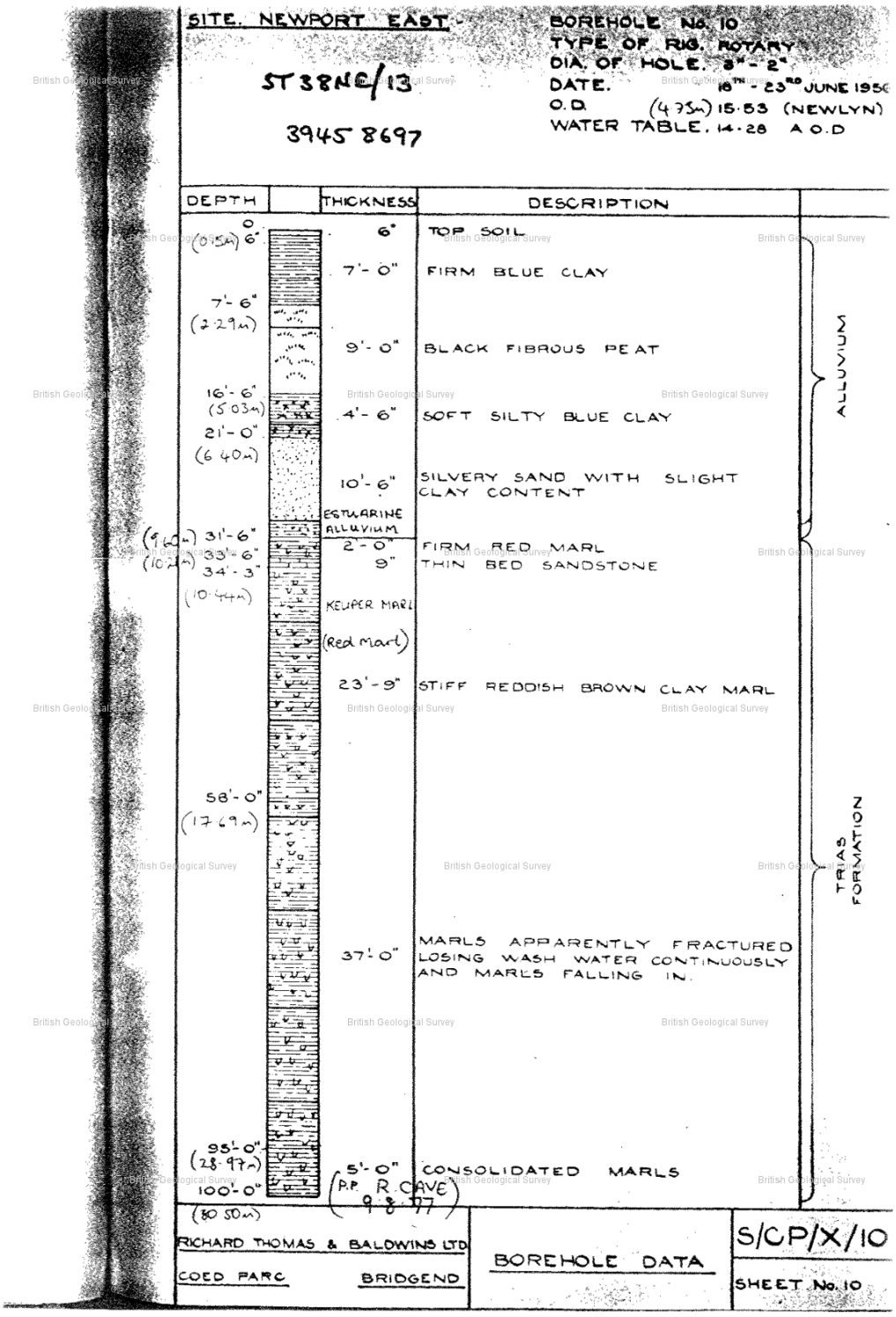
ST38NE10


SITE. NEWPORT EAST
BOREHOLE No. 7
TYPE OF RIG. ROTARY
DIA. OF HOLE. 3"-2"
DATE. 11TH - 15TH JUNE 195
O.D (5.09m) 16.69 (NEWLYN
WATER TABLE. 14.36 A.O.D
1 1/2" CORED SAMPLE
ST38NE/10
3830 8720
DEPTH
THICKNESS
DESCRIPTION
0 (0.15m) 6"
4'-6" (1.37m)
24'-0" 7.32m)
27'-0" 8.23m)
29'-0" (8.84m)
42'-0" (12.81m)
100'-0" (30.50m)
6"
4'-0"
19'-6"
3'-0"
2'-0"
13'-0"
58'-0"
ESTUARINE ALLUVIUM
RHAETIC
? TEA GREEN MARL
KEUPER MARL (RED MARL)
P.P. R. CAVE 9.8.77
TOP SOIL
SOFT BROWN CLAY WITH PEAT INCLUSIONS
FINE SILVERY SAND WITH SHELL FRAGMENTS CHANGING TO BROWN SAND
BUFF COLOURED PEA SANDSTONE NODULES CHANGING TO SANDSTONE NODULES OF PEBBLE SIZE
VERY HARD BLACK AND WHITE COARSE GRAINED SANDSTONE BEARING IRON PYRITES
LIGHT GREY MUDSTONE
FIRM REDDISH BROWN CLAY MARL CHANGING TO STIFF REDDISH BROWN MARL WITH GREY INCLUSIONS
ALLUVIUM
RHAETIC FORMATION
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 7

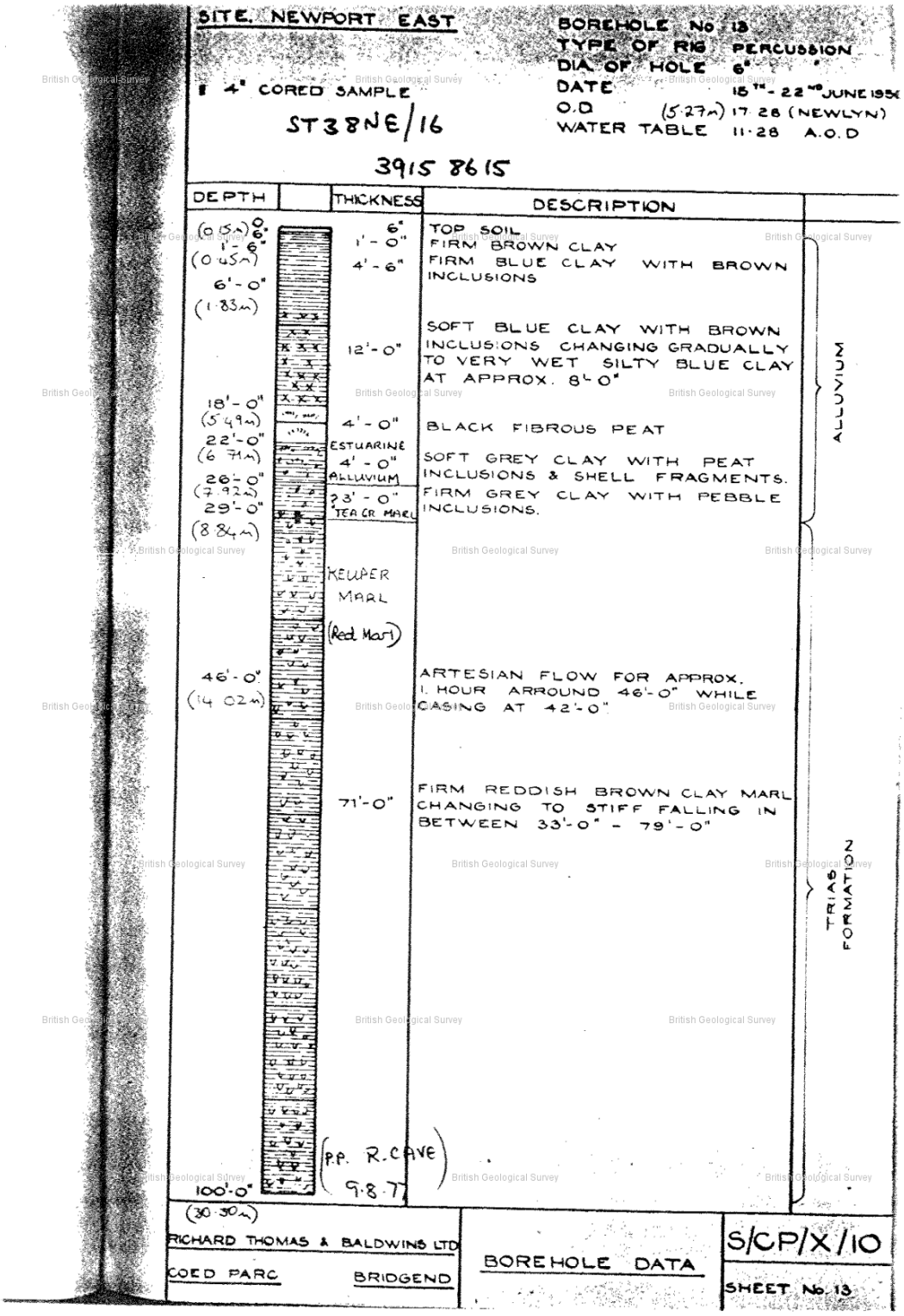
ST38NE11


SITE. NEWPORT EAST.
BOREHOLE No. 8
TYPE OF RIG. PERCUSSION
DIA. OF HOLE. 16"
DATE. 25TH MAY - 1ST JUNE 195
O.D (5.01m) 16.45 (NEWLYN)
WATER TABLE. 13.83 A.O.D
4" CORED SAMPLE
ST 38NE/11
3698 8661
DEPTH
THICKNESS
DESCRIPTION
0
(0.15m) 6"
3'-6"
(1.07m)
7'-6"
(2.29m)
13'-0"
(3.96m)
20'-6"
(6.25m)
21'-8"
(6.55m)
26'-0"
(7.93m)
30'-6"
(9.30m)
32'-6"
(9.91m)
34'-6"
(10.52m)
44'-6"
(13.57m)
100'-0"
(30.50m)
6"
3'-6"
4'-0"
5'-6"
7'-6"
ESTUARINE ALLUVIUM
1'-0"
4'-6"
? 4'-6" ?
2'-0"
2'-0"
KEUPER MARL
10'-0"
(RED MARL)
55'-6"
P.P.R CAVE 9.8.77
TOP SOIL
SOFT BROWN CLAY
SOFT GREY BLUE CLAY
BROWN FIBROUS PEAT
SOFT BLUE CLAY
BED OF RED COARSE GRAINED SANDSTONE
SOFT BLUE CLAY
SOFT SANDY GREY-BLUE CLAY CONTAINING PEBBLE GRAVEL
FIRM RED-BROWN CLAY MARL
RED CLAY MARL WITH MEDIUM SIZE PEBBLES OF COARSE GRAINED RED SANDSTONE
CONSOLIDATED FRACTURED REDDISH BROWN MARL
CONSOLIDATED REDDISH-BROWN MARL
NOTE - UNABLE TO OBTAIN SAMPLES BELOW 40'-0"
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 8

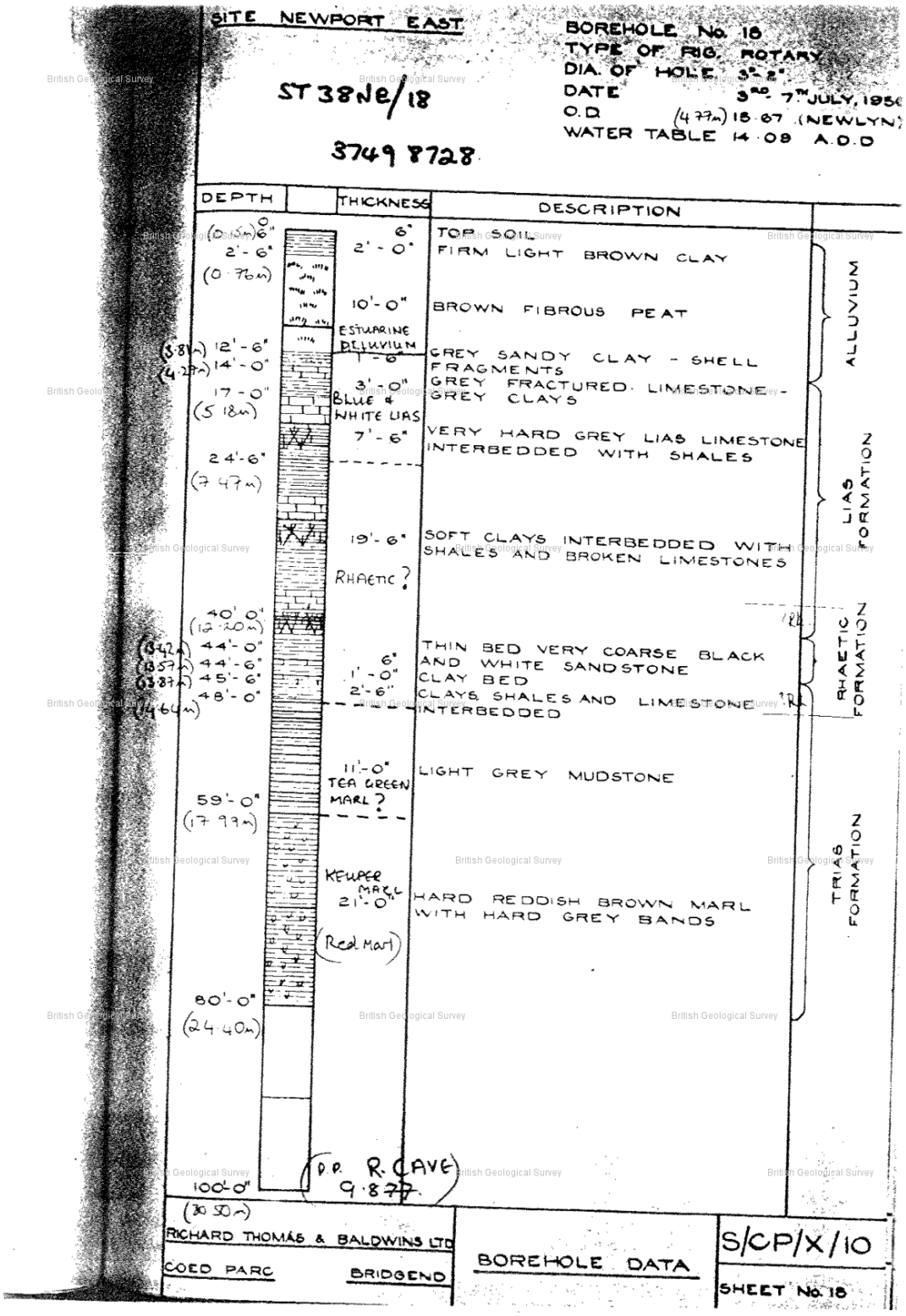
ST38NE13


SITE. NEWPORT EAST
ST 38NE/13
3945 8697
BOREHOLE No. 10
TYPE OF RIG. ROTARY
DIA. OF HOLE. 3" - 2"
DATE. 18TH - 23RD JUNE 1956
O.D (4.73m) 15.53 (NEWLYN)
WATER TABLE. 14.28 A.O.D
DEPTH
THICKNESS
DESCRIPTION
0
(0.15m) 6"
6"
TOP SOIL
7'-0"
FIRM BLUE CLAY
7'-6"
(2.29m)
9'-0"
BLACK FIBROUS PEAT
16'-6"
(5.03m)
4'-6"
SOFT SILTY BLUE CLAY
21'-0"
(6.40m)
10'-6"
SILVERY SAND WITH SLIGHT CLAY CONTENT
ESTUARINE ALLUVIUM
(9.60m) 31'-6"
2'-0"
FIRM RED MARL
(10.21m) 33'-6"
9"
THIN BED SANDSTONE
34'-3"
(10.44m)
KEUPER MARL
(Red Marl)
23'-9"
STIFF REDDISH BROWN CLAY MARL
58'-0"
(17.69m)
37'-0"
MARLS APPARENTLY FRACTURED LOSING WASH WATER CONTINUOUSLY AND MARLS FALLING IN.
95'-0"
(28.97m)
5'-0"
CONSOLIDATED MARLS
100'-0"
(30.50m)
(P.P. R. CAVE 9.8.77)
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 10

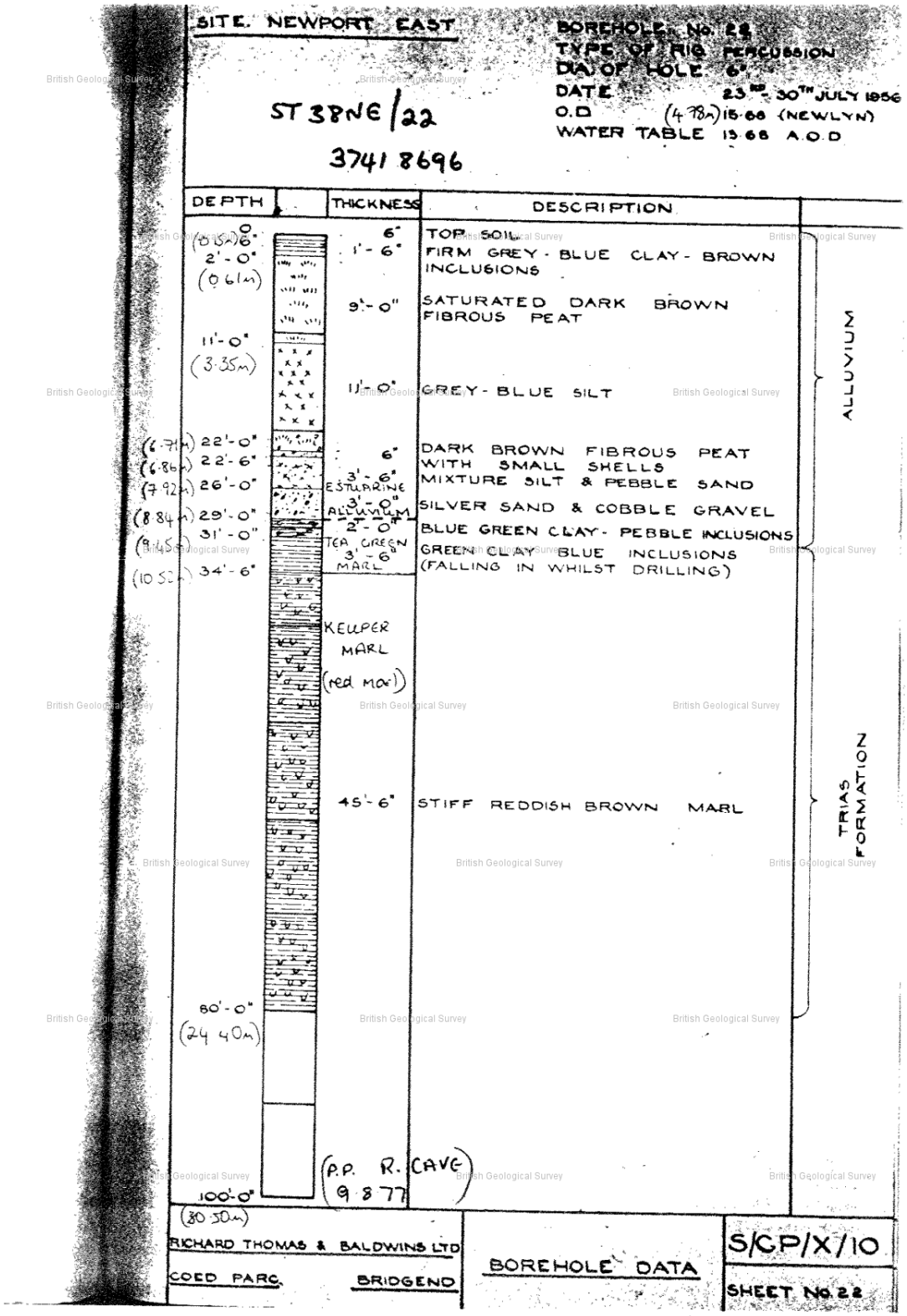
ST38NE16


SITE. NEWPORT EAST
BOREHOLE No 13
TYPE OF RIG PERCUSSION
DIA. OF HOLE 6"
DATE 15TH - 22ND JUNE 195
O.D (5.27m) 17.28 (NEWLYN)
WATER TABLE 11.28 A.O.D
4" CORED SAMPLE
ST38NE/16
3915 8615
DEPTH
THICKNESS
DESCRIPTION
(0.15m) 0
6"
1'-6"
(0.45m)
6'-0"
(1.83m)
18'-0"
(5.49m)
22'-0"
(6.71m)
26'-0"
(7.92m)
29'-0"
(8.84m)
46'-0"
(14.02m)
100'-0"
(30.50m)
6"
1'-0"
4'-6"
12'-0"
4'-0"
ESTUARINE
4'-0"
ALLUVIUM
?3'-0"
TEA CR MARL
KEUPER
MARL
(Red Marl)
71'-0"
(P.P. R.CAVE
9.8.77)
TOP SOIL
FIRM BROWN CLAY
FIRM BLUE CLAY WITH BROWN INCLUSIONS
SOFT BLUE CLAY WITH BROWN INCLUSIONS CHANGING GRADUALLY TO VERY WET SILTY BLUE CLAY AT APPROX. 8'-0"
BLACK FIBROUS PEAT
SOFT GREY CLAY WITH PEAT INCLUSIONS & SHELL FRAGMENTS.
FIRM GREY CLAY WITH PEBBLE INCLUSIONS.
ARTESIAN FLOW FOR APPROX. 1. HOUR ARROUND 46'-0" WHILE CASING AT 42'-0"
FIRM REDDISH BROWN CLAY MARL CHANGING TO STIFF FALLING IN BETWEEN 33'-0" - 79'-0"
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 13

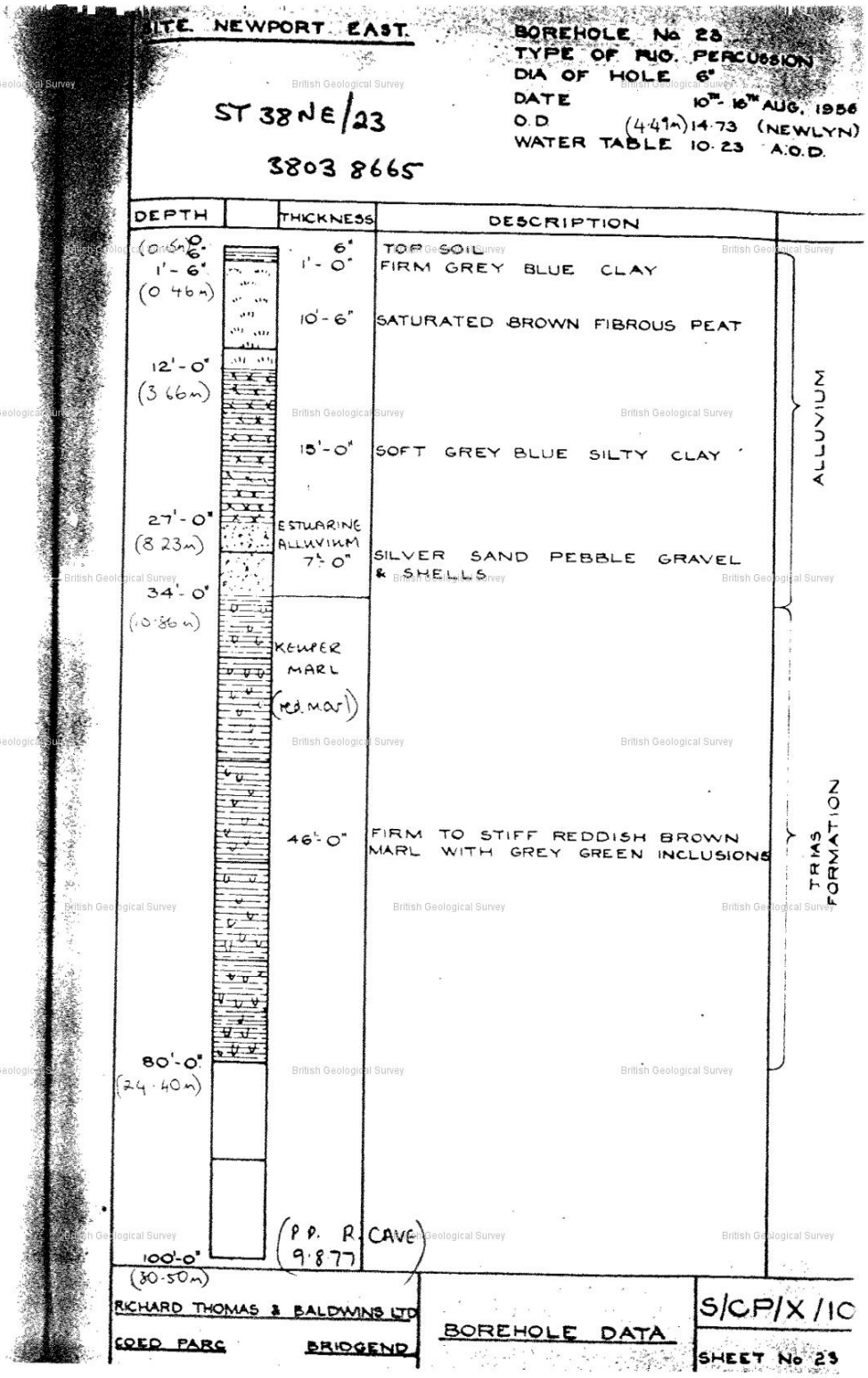
ST38NE18


SITE NEWPORT EAST
ST 38NE/18
3749 8728
BOREHOLE No. 18
TYPE OF RIG. ROTARY
DIA. OF HOLE 3" 2"
DATE 3RD 7TH JULY, 1956
O.D (4.77m) 15.67 (NEWLYN)
WATER TABLE 14.09 A.O.D
DEPTH
THICKNESS
DESCRIPTION
(0.15m) 0 6"
2'-6" (0.76m)
6"
2'-0"
TOP SOIL
FIRM LIGHT BROWN CLAY
10'-0"
BROWN FIBROUS PEAT
ESTUARINE ALLUVIUM
1'-6"
GREY SANDY CLAY - SHELL FRAGMENTS
(3.81m) 12'-6"
(4.27m) 14'-0"
17'-0" (5.18m)
3'-0"
GREY FRACTURED LIMESTONE - GREY CLAYS
BLUE & WHITE LIAS
7'-6"
VERY HARD GREY LIAS LIMESTONE INTERBEDDED WITH SHALES
24'-6" (7.47m)
19'-6"
SOFT CLAYS INTERBEDDED WITH SHALES AND BROKEN LIMESTONES
RHAETIC ?
40'-0" (12.20m)
(13.42m) 44'-0"
(13.57m) 44'-6"
(13.87m) 45'-6"
48'-0" (14.64m)
6"
1'-0"
2'-6"
THIN BED VERY COARSE BLACK AND WHITE SANDSTONE
CLAY BED
CLAYS, SHALES AND LIMESTONE INTERBEDDED
11'-0"
TEA GREEN MARL ?
LIGHT GREY MUDSTONE
59'-0" (17.99m)
KEUPER MARL
21'-0"
HARD REDDISH BROWN MARL WITH HARD GREY BANDS
(Red Marl)
80'-0" (24.40m)
100'-0" (30.50m)
P.P. R. CAVE 9.8.77
ALLUVIUM
LIAS FORMATION
RHAETIC FORMATION
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC
BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 18

ST38NE22


SITE. NEWPORT EAST
BOREHOLE No. 22
TYPE OF RIG PERCUSSION
DIA OF HOLE 6"
DATE 23RD - 30TH JULY 1956
O.D (4.78m) 15.68 (NEWLYN)
WATER TABLE 15.68 A.O.D
ST 38NE/22
3741 8696
DEPTH
THICKNESS
DESCRIPTION
0
(0.15m) 6"
2'-0"
(0.61m)
11'-0"
(3.35m)
(6.71m) 22'-0"
(6.86m) 22'-6"
(7.92m) 26'-0"
(8.84m) 29'-0"
31'-0"
(9.45m)
(10.52m) 34'-6"
80'-0"
(24.40m)
100'-0"
(30.50m)
6"
1'-6"
TOP SOIL
FIRM GREY - BLUE CLAY - BROWN INCLUSIONS
9'-0"
SATURATED DARK BROWN FIBROUS PEAT
11'-0"
GREY - BLUE SILT
6"
DARK BROWN FIBROUS PEAT WITH SMALL SHELLS
3'-6"
ESTUARINE
MIXTURE SILT & PEBBLE SAND
3'-0"
ALLUVIUM
SILVER SAND & COBBLE GRAVEL
2'-0"
BLUE GREEN CLAY - PEBBLE INCLUSIONS
TEA GREEN
3'-6"
MARL
GREEN CLAY BLUE INCLUSIONS (FALLING IN WHILST DRILLING)
KEUPER MARL
(red marl)
45'-6"
STIFF REDDISH BROWN MARL
(P.P. R. CAVE 9.8.77)
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC. BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No. 22

ST38NE23


SITE. NEWPORT. EAST.
BOREHOLE No 23
TYPE OF RIG. PERCUSSION
DIA OF HOLE 6"
DATE 10TH - 16TH AUG. 1956
O.D (4·49m) 14·73 (NEWLYN)
WATER TABLE 10·23 A.O.D.
ST 38 NE/23
3803 8665
DEPTH
THICKNESS
DESCRIPTION
0 (0·15m)
6"
TOP SOIL
1'-6" (0·46m)
1'-0"
FIRM GREY BLUE CLAY
10'-6"
SATURATED BROWN FIBROUS PEAT
12'-0" (3·66m)
15'-0"
SOFT GREY BLUE SILTY CLAY
27'-0" (8·23m)
ESTUARINE ALLUVIUM 7'-0"
SILVER SAND PEBBLE GRAVEL & SHELLS
34'-0" (10·36m)
KEUPER MARL (Rd. Mar)
46'-0"
FIRM TO STIFF REDDISH BROWN MARL WITH GREY GREEN INCLUSIONS
80'-0" (24·40m)
100'-0" (30·50m)
(P.P. R. CAVE 9·877)
ALLUVIUM
TRIAS FORMATION
RICHARD THOMAS & BALDWINS LTD
COED PARC BRIDGEND
BOREHOLE DATA
S/CP/X/10
SHEET No 23

C. UXO Risk Map

UNEXPLODED BOMB RISK MAP

zeticauxo

SITE LOCATION

Map Centre: 336815,187150

LEGEND

- **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- **Low:** Areas indicated as having 15 bombs per 1000acre or less.

miltary | industry | UXO find | transport | dock | Luftwaffe targets | utilities | other

How to use your Unexploded Bomb (UXB) risk map?
The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?
Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?
If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: **(https://zeticauxo.com/downloads-and-resources/risk-maps/)**

Zetica cannot guarantee the accuracy or completeness of the information or data used and cannot accept any liability for any use of the maps. These maps can be used as part of a technical report or similar publication, subject to acknowledgment. The copyright remains with Zetica Ltd.

It is important to note that this map is not a UXO risk assessment and should not be reported as such when reproduced.

*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

D. Risk Assessment Methodology

The following risk assessment methodology has been undertaken, to quantify the potential risk to the proposed development from the potential contamination sources identified. The assessment uses qualitative descriptors to determine the overall risk category and identify actions which may be required to further determine to scale of any potential risks.

The methodology requires the classification of:

- The magnitude of the consequence (severity) of a risk occurring; and
- The magnitude of the probability (likelihood) of a risk occurring.

The potential consequences of contamination risks occurring at this Site are classified in accordance with table below, which is adapted from the CIRIA guidance.

Table D.1: Classification of Consequences

Classification	Definition of Consequence	Examples
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.	Significant harm to humans is defined in circular 01/2006 as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Major fish kill in surface water from large spillage of contaminants from site. Highly elevated concentrations of List I and II substances present in groundwater close to small potable abstraction (high sensitivity). Explosion, causing building collapse (can also equate to immediate human health risk if buildings are occupied).
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.	Significant harm to humans is defined in circular 01/2006 as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Damage to building rendering it unsafe to occupy e.g. foundation damage resulting in instability. Ingress of contaminants through plastic potable water pipes.
Mild	Exposure to human health unlikely to lead to "significant harm". Equivalent to EA Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture, or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.	Exposure could lead to slight short-term effects (e.g. mild skin rash). Surface spalling of concrete.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable	The loss of plants in a landscaping scheme.

Classification	Definition of Consequence	Examples
	effects of damage to buildings, structures, and services.	Discoloration of concrete.

Source: EA R&D Report 66

*For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction, or extensive skin ailments. Mental dysfunction is included only as far as it is attributable to the effects of a pollutant on the body of the person concerned.

The probability of contamination risks occurring at this site will be classified in accordance with Table D.2 below which is also adapted from the CIRIA guidance. Note that for each category, it is assumed that a contaminant linkage exists. Where a linkage does not exist, the likelihood is zero, and so there is no risk.

Table D.2: Classification of Probability

Classification	Definition of Probability	Examples
High likelihood	There is a contaminant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.	a) Elevated concentrations of toxic contaminants are present in soils in the top 0.5m in a residential garden. b) Ground/groundwater contamination could be present from chemical works, containing a number of Underground Storage Tanks (USTs), having been in operation on the same site for over 50 years.
Likely	There is a contaminant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long term.	a) Elevated concentrations of toxic contaminants are present in soils at depths of 0.5-1.0m in a residential garden, or the top 0.5m in public open space. b) Ground/groundwater contamination could be present from an industrial site containing a UST present between 1970 and 1990. The tank is known to be single skin. There is no evidence of leakage although there are no records of integrity tests.
Low likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place and is less likely in the shorter term.	a) Elevated concentrations of toxic contaminants are present in soils at depths >1.0m in a residential garden, or 0.5-1.0m in public open space. b) Ground/groundwater contamination could be present on a light industrial unit constructed in the 1990s containing a UST in operation over the last 10 years – the tank is double skinned but there is no integrity testing or evidence of leakage.
Unlikely	There is a contaminant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.	a) Elevated concentrations of toxic contaminants are present below hardstanding. b) Light industrial unit <10 years old containing a double skinned UST with annual integrity testing results available.

Source: EA R&D Report 66

For each possible pollution linkage (source-pathway-receptor) identified, the potential risk can be evaluated based on the following principle:

Contamination risk = Probability of event occurring x Consequence of event occurring

This relationship can be represented graphically as a matrix presented in Table D.3 below, which is adapted from the CIRIA guidance.

Table D.3: Overall Contamination Risk Matrix

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Based upon this, CIRIA C552 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case, as in Table D.4 below. These risk categories apply to each pollutant linkage, not simply to each hazard or receptor.

Table D.4: Definition of Risk Categories and Likely Actions Required

Risk Category	Definition and Likely Actions Required
Very high	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.
High	Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.
Low	It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.
Very low	It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.
No potential risk	There is no potential risk if no pollution linkage has been established.

The preliminary qualitative risk assessment for the Scheme has been summarised in this report. It should be noted that this process considers the risk with the incorporation of only standard mitigation measures as outlined in the table. Risks may decrease following further investigation, allowing the refinement of the conceptual model and the incorporation of appropriate mitigation measures.

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