



Murphy Environmental Hollywood Ltd

Hollywood Great, Nag's Head, Naul, County Dublin
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EPA Waste Licence W0129-02

For the Attention of
Administration
Environmental Licensing Programme
Office of Climate, Licensing & Resource Use
Environmental Protection Agency
Headquarters
PO Box 3000
Johnstown Castle Estate
Co. Wexford

Our Ref.: W0129-03/150513
Direct Dial: 01 8433744
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Date: 15th May 2013

Dear Mr. Meaney,

Re.: Murphy Environmental Hollywood Ltd. (MEHL), EPA Ref. W0129-03

Please find enclosed a letter from our Hydrogeological consultants regarding the next phase of site investigation works at the site to provide further information to satisfy the EPA requirements under Item 8: Additional site investigations of Article 16(1) of the Waste Management (Licensing) Regulations.

Appended to the letter are:

- A plan of the proposed well locations at the site
- Interpretation of a geophysical study conducted at the site in November 2012
- A conceptual site model (CSM) with annotated geophysical information

It is intended to commence the site investigation works on Tuesday 21st May 2013.

If the Agency have any comments on the above please let us know in advance of the works commencing.

The Non-Technical Summary will be reviewed in full post-SI works and upon submission of final outstanding Art. 16 requested info.

Please accept this letter as a declaration that the content of the electronic files on the accompanying CD-ROMs is a true copy.

If you have any further queries in relation to this matter please do not hesitate to contact us.

Yours sincerely,

Patricia Rooney
Director & General Manager, MEHL



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Your ref
Our ref 326877-40/LC
File ref A

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15 May 2013

Dear Ms Rooney

Murphy Environmental Hollywood Ltd Application for Waste Licence Ref. WL 129-03 - Clarification in accordance with Article 16(1) of the Waste Management (Licensing) Regulations application number: W0129-03

We are to refer to the above referenced application for a waste licence for the Murphy Environmental Hollywood Ltd (MEHL) facility at Hollywood Great, Nags Head, The Naul, County Dublin. With reference to your notice under Article 16(1) of the Regulations and our request for clarification, we are to refer to your letters dated 23 March 2012 and 3 May 2012 and the subsequent meetings with the Agency and Marcus Ford (of Geosyntec Consultants, Environmental Consultant to the Agency) on 5 July 2012.

MEHL applied to the Agency for a review of the waste licence for the facility at Hollywood Great. The Agency requested additional information under Article 16(1) of the Waste Management (Licensing) Regulations, in a letter dated 23 March 2012. MEHL subsequently sought clarification of the Agency's requirements. The Agency responded to this request for clarification in a letter dated 3 May 2012. A meeting took place on 5 July 2012 to resolve any remaining clarification issues relating to the requirement for further site investigation, with a view to completing the application process for the licence. Refer to Appendix A, which includes the aforementioned letters. This letter is intended to address Article 16(1) Item 8: Additional site investigations and the outcomes of the meeting of 5 July 2012.

Following the meeting, Arup commissioned a down-hole geophysical survey during November 2012 on eight out of the eighteen boreholes on site (some boreholes decommissioned), and undertook an assessment of the hydrogeological isolation of the MEHL site in the wider context of the Bog of the Ring (BoR) area, which was submitted under a separate cover on 14 February 2013.

Directors Eoghan Lynch (Chairman) Joe Burns Paul Coughlan Denis Crowley Philip Dilley (British) Michael Evans Gregory Hodkinson (Australian) Liam Luddy
Donal McDaid Fergus Monaghan **Company Secretary** Ken Freeman

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Down-hole Geophysical Survey

The geophysical survey was commissioned in order to aid in the interpretation of the geology encountered in the various suites of wells drilled on site and to update the overall conceptual site model.

The geophysical survey included gamma-ray density, natural gamma, induction and fluid temperature and fluid conductivity, the results and interpretation of which are presented in Appendix B. It should be noted that certain boreholes could not be fully surveyed, or in some cases, not surveyed at all owing to constraints with the borehole completion, potential damage to the sonde and borehole diameter.

Whilst not changing the overall conceptual understanding of the site, the geophysical survey has provided useful information in terms of delineating the depths at which changes in lithology occur, the horizons at which significant volumes of water were encountered in a few boreholes and the presence of shales / mudstones in the upper part of the Balrickard formation.

This geophysical information has also been used to aid the design of the proposed next phase of site investigation works. A conceptual site model (CSM) with annotated geophysical information is presented in Appendix C.

Next phase of Investigation

The ultimate objective of the next phase of site investigation is to provide further information to satisfy the EPA requirements under Item 8: Additional site investigations of Article 16(1) of the Waste Management (Licensing) Regulations. This includes updating the conceptual understanding of the geological succession under the site and resolving any issues raised during the meeting on 5 July 2012 relating to the granting of a licence.

The rationale behind each of the proposed new site investigation (SI) locations and subsequent tests can be summarised under the following headings and are designed to satisfy all items relating to Article 16(1) Item 8: Additional site investigations above:

- Confirm the geological succession under each of the apparent fault blocks on the site.
- Confirm the geology encountered during previous site investigations.
- Characterise the hydrogeology of the underlying bedrock aquifer (Loughshinny Fm).
- Establish whether the fracture / faulting system on site is acting as a barrier or conduit to flow.
- Establish the vertical hydraulic gradient on site (if any), between the overlying Namurian deposits (Walshestown Fm / Balrickard Fm) and the underlying Viséan deposits (Donore Fm / Loughshinny Fm).

The boreholes will be drilled by a combination of coring and rotary drilling. All the new suite of wells will have subsequent geophysical logging carried out as per item 8.5 of Article 16(1).

Borehole and well locations have been chosen to provide the information listed above. Refer to Figure 1, which indicates the location of the proposed boreholes. It should be noted that ground conditions and hence the final locations of the boreholes will need to be confirmed on the ground during the next phase of investigation.

A detailed description of and the rationale behind each of the proposed further SI locations are as follows:

- **Abstraction Well** – As per Item 8.6 of Article 16(1), to be certain of recording impacts in the wells on site, the aquifer system needs to be stressed with a productive well, namely BH17. A constant rate test followed by a recovery test will be undertaken. The longer term nature of the constant rate test is designed with a view to dewater the overlying Balrickard Fm and Donore Fm to stress the underlying Loughshinny Fm (bedrock aquifer system). It is recommended to carry out a 7-day constant rate pumping test, however, if a drawdown of the order of 0.25 m is witnessed in the wells around the perimeter of the site, the pumping test may be shortened. It should be noted that BH17 is screened in all three formations and the results of the geophysical survey suggest that the base of the Balrickard Fm and Donore Fm could be part of the aquifer system on site. Hence, BH17 is the most suitable location for a longer term pumping test.
- **BH24** – As per Item 8.4 of Article 16(1), partially cored and proposed towards the north end of the mapped north-south fault targeting the Loughshinny Fm, with a view to establish whether the fracture / faulting system is acting as a barrier or conduit to flow in the bedrock aquifer. It should be noted that the Loughshinny Fm could be more than 75m deep on the northern section of the site.
- **BH25** – As per Item 8.3 of Article 16(1), rotary borehole proposed on the exposed Loughshinny Fm in the south-western quadrant (at the location of the proposed cell for non-hazardous waste). There is a pond located in this section of the site, hence it will be important to seal the shallow section of this well in order to prevent / minimise any hydraulic connection between the well and the ponding water.
- **BH26** - As per Item 8.1, 8.2 and 8.5 of Article 16(1), borehole proposed between existing borehole BH20 and the APEX mapped north-south fault. This partially cored borehole should confirm the geology of boreholes BH19 and BH20 (drilled using rotary flush drill method) and will target the Loughshinny Fm. The anticipated depth is of the Loughshinny Fm at this location is approx. 60m. This borehole will also be close to the fracture / faulting system and will also establish an additional well pair.
- **BH27** - As per Item 8.1, 8.2 and 8.5 of Article 16(1), the saturated thickness for the south-eastern quadrant is expected to be quite thin in this area as there is only approximately 3 – 5 m of saturated thickness above the screen at BH18. Hence, a new partially cored borehole, BH27, to be situated between BH18 and BH17 is suggested, targeting the Balrickard Fm and thereby establishing an additional well pair.
- **BH28** - As per Item 8.1 and 8.2 of Article 16(1), in order to target the Balrickard Fm and groundwater in the south-eastern quadrant, borehole BH28 is proposed between BH15a and BH23. It is anticipated that the Balrickard Fm will be thicker and the groundwater levels deeper. This borehole is also situated at the edge of the DAC liner and is intended as a well pairing with BH15a.
- **BH29/30** - As per Item 8.1, 8.2 and 8.5 of Article 16(1) and further to the clarification provided by the Agency on 3 May 2012, a well pair is proposed in the vicinity of the shallow borehole locations BH22/BH22A. New boreholes BH29/30 are proposed with the deeper partially cored well, BH28, targeting the Loughshinny Fm (anticipated depth approx. 60 – 70 m) and the shallower well, BH27, targeting the base of the Balrickard Fm to a depth of approx. 50m.

Table 1 overleaf summarises the rationale and screened depths of the new boreholes.

BH ID	Approx. Borehole Depth (mBGL)		Response Zone (mBGL)	Rationale				
	Partially Cored >	Rotary >		Establish vertical gradient	Establish fracture / fault conductivity	Increase in conceptual understand of four quadrants	Items addressed in Article 16(1) clarification 23 March 2012 (W0129-03)	Comments
BH24		60	Dependent on strata and volume of groundwater encountered	✓	✓	✓	Item 8.4	Located toward the north of the Apex mapped north-south fault on site. To be screened within the Loughshinny Fm only. Must recognise that the depth of the Loughshinny Fm is unknown.
BH25		25	15 – 20	✓	✓	✓	Item 8.3	Further SI data required in the non-hazardous south-western quadrant where the Loughshinny Fm is exposed. Ponding water located adjacent to this location. Vital to seal shallow part of borehole to avoid hydraulic communication with ponding water.
BH26		60	Loughshinny only	✓	✓	✓	Item 8.1, 8.2, 8.5	Further SI data required in the north-western quadrant. BH26 to be screened in the Loughshinny Fm. Depth of Loughshinny Fm not established but estimated to be approx. 60mBGL.
BH27		15	13 to 15	✓	✓	✓	Item 8.1, 8.2, 8.5	Establish well pair adjacent to BH18 (Screened in Loughshinny Fm) with the intention of screening the borehole at the base of the Balrickard Fm where geophysics indicates an increase in shale (approx. 13m – 15m). This will also enable analysis of the vertical hydraulic gradient (if any). BH18 was drilled using the Geobore S method and there is also packer test data available for in this area.
BH28		40	35 – 40	✓	✓	✓	Item 8.1, 8.2	Rotary to approx. 40mBGL and screen at the base of the Balrickard Fm.
BH29		40	Namurian only	✓	✓	✓	Item 8.1, 8.2, 8.4	EPA suggests well pair in this location (adjacent BH22/22a). Rotary drilling to approx. 40mBGL and screen at the base of the Balrickard Fm.
BH30		60	55 - 60	✓	✓	✓	Item 8.1, 8.2, 8.4, 8.5	Partially cored hole to approx. 60mBGL. To be screened in the Loughshinny Fm only.

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It is proposed to award the site investigations contract to a contractor that is able to part tri-cone and core during drilling. Coring will be targeted to provide more information on the Balrickard formation and the interface between the Balrickard and the Donore formations.

As Table 1 indicates, the boreholes on site will be finished as groundwater monitoring installations with a bentonite seal and pea gravel at the appropriate response zone depths. It is intended to screen 4 number boreholes at the base of the Balrickard formation and 3 number boreholes within the Loughshinny formation only. This will further aid in hydrogeological characterisation of the site during the planned constant rate pumping test.

Further to the proposed site investigation, a round of groundwater sampling will take place to establish whether there are differences in the hydrochemistry between the shallower and deeper groundwaters on site, that is, differences in the major ion chemistry of the groundwater encountered in the shallower Namurian and the deeper Visean deposits.

In addition to the constant rate pumping test, further analysis will be carried out on the historic constant rate pumping tests conducted on the wells screened within the Namurian deposits on site.


Summary

It is proposed to undertake another phase of site investigation and subsequent testing at the site to address the EPA notice in accordance with Article 16(1) of the Waste Management Licensing Regulations with reference to Item 8: Additional site investigations, as listed in Table 1. It is proposed to drill an additional 7 boreholes to an approximate cumulative depth of 300m, which will include partial coring and subsequent down-hole geophysical logging. The boreholes will be completed as 50mm monitoring wells with appropriate screens, gravel packs and grouted sections. The proposed well locations are based on the 23 March 2012 EPA notice in accordance with Article 16(1), the outcomes of the 5 July 2012 meeting and the recently updated conceptual site model.

Yours sincerely

For

Ove Arup & Partners Ireland Ltd t/a Arup


Ria Lyden

Enc

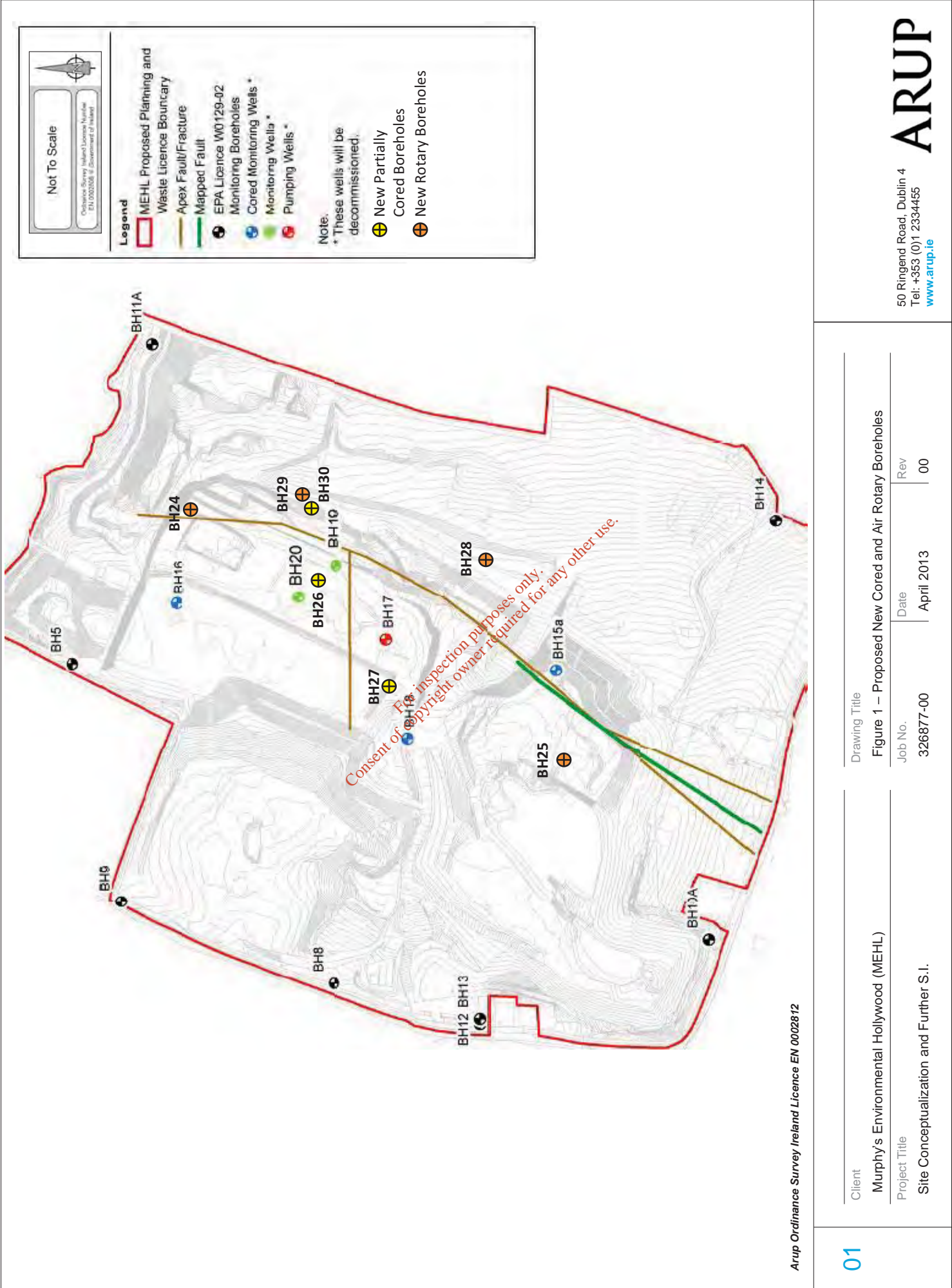
Figures

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Figure 1

Proposed New Cored and Air Rotary Boreholes

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Client	Murphy's Environmental Hollywood (MEHL)		
Project Title	Site Conceptualization and Further S.I.		
Drawing Title	Figure 1 – Proposed New Cored and Air Rotary Boreholes		
Job No.	326877-00	Date	April 2013
Rev	00		

Appendices

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Appendix A

EPA Correspondence

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Ms Patricia Rooney
 Murphy Environmental Hollywood Limited
 Hollywood Great
 Nags Head
 The Naul
 County Dublin

	Murphy Environmental Hollywood Ltd.
27 MAR 2012	
File Ref:	4.33 - 4.3.6
Site Ref:	PR KR 100 KM
Act taken:	PR KR 100 KM
Closed:	Kate

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23 March 2012

W0129-03

re: Notice in accordance with Article 16(1) of the Waste Management (Licensing) Regulations

Dear Ms Rooney

I am to refer to the above referenced application for a waste licence relating to a facility at Hollywood Great, Nags Head, The Naul, County Dublin. The Agency is giving detailed consideration to the application and to complete this task the following information, particulars and evidence are required in accordance with Article 16(1) of the Regulations.

Please provide complete answers to each question.

ARTICLE 16(1) - FURTHER INFORMATION, PARTICULARS AND EVIDENCE

1. With regard to the notification made to the Health and Safety Authority (Appendix B.8.1 of the application), provide a copy of any response received and any further correspondence and outline any actions taken on foot of such correspondence.
2. Clarify whether the estimate of “Total (over life of site)” of 1,511,000 tonnes per Table H.1(c) of the application includes waste already deposited in the landfill. Similarly, clarify whether the total waste acceptance in Table H.1(c), 6,865,125 tonnes, includes waste already deposited.
3. **Leachate and rainwater management**
 - 3.1. It is proposed that leachate collection systems will be kept separate to avoid recirculating leachate to the wrong cell type. Explain why, how and under what circumstances leachate will be recirculated in each of the three classes of landfill.
 - 3.2. State whether any hazardous waste proposed for deposition has leachate generating potential in its own right. Or, is rainwater infiltration the only source of leachate in the hazardous cells?
 - 3.3. State what will be done with surplus leachate from the hazardous cells that is not utilised in the solidification process.
 - 3.4. A leachate detection layer is proposed and drawing WLA_22_02 indicates a 250mm pipe with a junction into the body of the landfill liner. Provide a more detailed



diagram of the leak detection system, particularly its base, showing its design, the purpose of the junction in to the granular stabilisation layer of the liner, how it will be constructed and how it is proposed to detect, sample and pump leachate.

3.5. It is stated that temporary covers “will be installed on the hazardous cells, as required, in order to minimise leachate generation.”

- a) Explain “as required”.
- b) Describe the objective, design, construction, operation, maintenance and decommissioning of the proposed temporary covers.
- c) Clarify whether the covers will be permanently in place as covered storage areas or whether the cover will only be applied at night and on Sundays.
- d) A covered temporary storage area and a temporary cover are mentioned on pages 6 and 46 respectively of the Hydrogeological Quantitative Risk Assessment. Clarify whether these are the same as the temporary covers referred to above.

3.6. Explain what circumstances could result in an increased head of leachate in the DAC-lined and other cells and the mitigation measures in place to prevent this occurring and in the event that it does occur.

4. Solidification process

4.1. Provide an outline of operational experiences at the Indaver reference plant in Antwerp (mentioned in section H.3 of the application), including:

- a) the mixing ratios, materials and curing periods used in treating flue-gas treatment residues and how these parameters are determined;
- b) the storage arrangements for solidified waste awaiting final deposit in landfill cells;
- c) the frequency of solidified waste testing;
- d) the analysis of flue-gas treatment residues (including leaching tests) before and after treatment by solidification;
- e) the nature and composition of landfill leachate obtained from cells containing the solidified waste.

4.2. State whether any process tests have been carried out on flue-gas treatment residues generated in Ireland and whether it is possible to draw parallels between the Belgian experience and the proposed activity in terms of, *inter alia*, the list in item 4.1 above.

4.3. Provide a reference for the “current guidance” referred to in paragraph H.3.22 of the application.

5. LandSim model

5.1. The Hydrogeological Quantitative Risk Assessment refers to a number of appendices (including A1.1, A1.2, A1.3, A3.1, A3.2, A3.3, A3.4, A4.1, A4.2, A4.3 and A4.4) that do not appear to be included in the application. Please indicate their location in the documentation already submitted or provide a copy of the documents. (It may be appropriate to provide these documents in electronic format).

5.2. Justify whether Landsim is appropriate to use for a site having exposed bedrock, a high water table and a fractured aquifer system directly beneath the proposed landfill development. Although Landsim is considered necessary for evaluating a landfill site

generally, the results of the LandSim model should be combined with a more sophisticated numerical groundwater (contaminant transport) model, to consider the regional context and risk or justify why this is not appropriate.

- 5.3. It is stated that a period of 35 years for a management control period is conservative. In section 8.3.4.4 of the Hydrogeological Quantitative Risk Assessment it is stated: "The model assumes that after this period there is no leachate management and leachate head can rise within the cells resulting in greatly increased leakage."
- a) Explain how it follows in relation to the claims made for the DAC liner that increased head of leachate will result in increased leakage.
 - b) Describe the predicted/modelled effect of increasing the maximum leachate head in table 8.5 of the Hydrogeological Quantitative Risk Assessment for non-hazardous and hazardous cells to 2m and 5m.
- 5.4. Rainfall and infiltration
- a) Demonstrate that the data for Dublin Airport is adequately representative of the site given the different topography and elevation and taking into account the risk of underestimating site specific infiltration rates used in the LandSim model.
 - b) Justify not applying a further conservative factor to rainfall given these factors.
- 5.5. On page 59 of the Hydrogeological Quantitative Risk Assessment, it is stated that "of those contaminants potentially present in leachate at the site, only cadmium and mercury are classed as hazardous substances." State the source of this finding and explain the apparent rationale behind the thinking that no other hazardous substances will be present in the leachate.
- 5.6. Provide further information on the assumptions and justification behind selection of the model leachate inventory and initial leachate concentrations. There appears to be no justification/discussion on which potential contaminants have/have not been progressed to risk assessment, only that they are "likely contaminants which may arise in leachate from the hazardous cell". More proposed-waste-streams-specific data should be obtained if possible (from say other similar sites or proposed source sites) to ensure the modelled suite of potential contaminants is comprehensive enough. Bench-scale testing of some of the more significant waste streams proposed may be appropriate to demonstrate that unacceptably high leaching is not going to happen.
- 5.7. Much of the hazardous waste deposited is not expected to degrade with time and therefore may be expected to act as a constant source of potential leaching in the long term. A declining source term has been used in the model. Provide further information on the rationale behind such a selection and the form of the declining source term used. This includes what kappa values have been used (linked to the rate of predicted contaminant release from the waste).
- 5.8. Provide greater justification for the use of marker chemicals for certain potential contaminants present within the leachate inventory but excluded from the model simply because of an absence of WAC data. Provide detailed information on the mobility and toxicity similarities between markers and the excluded contaminants they are supposed to represent, under the expected geochemical conditions within the landfill.
- 5.9. Provide greater justification for the use of a single clay mineral layer to represent the

proposed DAC liner system, in particular whether attenuation (adsorption) capacities are appropriate for the DAC system that is designed to act as a structural barrier.

- 5.10. Confirm whether the same vertical saturated pathway was used for all waste phases and cell types modelled relative to the varying pathway properties across the site as a whole, in both south to north, and east to west. Justify not using multiple models to provide a cell specific assessment.
- 5.11. Specifically, provide information on the vertical saturated pathway hydraulic conductivity values used within the model.
- 5.12. Refine the overall modelling exercise on foot of the items above and following any additional site investigations and improvement to the conceptual site model – see the following sections of this letter.

6. Conceptual Site Model

- 6.1. Develop further the conceptual site model to encompass the requirements of this notice as a whole. As well as explanatory text, this might result in a series of diagrams including:
 - a) A plan showing all site investigation to date (including additional investigations conducted as a result of this notice), and topographic detail extending beyond the licence boundary to the limits of the monitoring points;
 - b) A plan showing regional groundwater flow, based on measured water levels and including a more accurate depiction of the groundwater divide between the site and the Bog of the Ring;
 - c) Two separate plans, one showing local groundwater piezometry in the Namurian Formation and one showing it in the Loughshinny Formation;
 - d) A series of cross-sections (e.g. one N-S through the proposed waste cells, and two E-W through the proposed waste cells) that accurately show the geology derived from borehole logs and head gradients derived from monitored water levels in boreholes screened in different strata;
 - e) A conceptual site model diagram showing the proposed development superimposed on one or more of the above cross-sections.
- 6.2. More detailed analysis of existing data and information, where available, is required to improve the overall conceptual model for the site. For example:
 - a) Detailed geological log for Dunne Drilling borehole “5668” drilled in November 2008. From Table 14.3 (p.221) of the EIS it seems this borehole may be BH4A, which is available, and if so, confirm that the “black rock” described by Dunnes is in fact the Loughshinny Formation.
 - b) Boreholes BH1, BH2 and BH3 were presumably drilled on-site in the past and details about these (location, depth, borehole logs etc.) should be presented.
 - c) Appendix A14.4 states that borehole logs are not available for BH4, BH10 and BH11; however the 1999 EIS has a log for BH10. Review the overall findings of the application with this new information.

d) Figures 14.2, 14.5 and 14.12 show most (not all) of the boreholes and trial pits that have been drilled or excavated on-site. Please provide this information all on one figure. The figure should include topographical detail for the area as a whole (including national grid coordinates), including the area beyond the licence boundary (where off-site monitoring wells and water courses are located).

6.3. Provide separate figures showing the shallow (Namurian) and deeper (Loughshinny) groundwater flow regimes. Also present groundwater flow in a regional context on a detailed figure including site and off-site data, householder/farm wells and the Bog of the Ring water supply wells and trial wells (Figure 12 of the Hydrogeological Quantitative Risk Assessment only shows the local site groundwater flow regime).

7. Geology, hydrology and hydrogeology

7.1. Any further analysis of the impact on groundwater should utilise vulnerability and aquifer classifications using GSI guidelines. This refers specifically to the claim that the Namurian bedrock at the site can be interpreted as low permeability subsoil for the purpose of groundwater vulnerability mapping. Bedrock is not subsoil and cannot necessarily be used in this way. Also, it is not clear that the Namurian bedrock has low permeability in the first place. If it is believed that site specific circumstances allow the aquifer to be considered differently, there is need for much more site specific information on the bedrock units beneath the site, as set out in detail in this notice.

7.2. Since the bases of the proposed landfill cells are expected to be only 2m above the current water table in places, more consideration of past, current and potential future water levels and abstraction scenarios related to the Bog of the Ring water supply scheme is required. Illustrate the effect of the abstraction on groundwater piezometry and potential for change in the (yet to be fully characterised) groundwater divide between the site and the Bog of the Ring.

a) For example, this requires analysis of groundwater level data for the MEHL site area prior to commencement of pumping at the Bog of the Ring (water level data is available in the 1999 EIS) as well as in the more recent past.

b) It also requires consideration of the impact of (a) increased abstraction and (b) reduced abstraction (there being evidence of reduced yields) from the active waste supply wells possibly leading to groundwater rebound beneath the proposed landfill cells.

c) In addition, more regional groundwater level data is required (for example, this might include local domestic well water levels, Bog of the Ring pumping/monitoring/trial well water levels, water level data from the Fingal County Council EIS, or the installation of additional wells to the north of the MEHL site).

d) If insufficient off-site wells are found to exist to define the groundwater divide location, particularly if fault controlled preferential groundwater movement to the north is an important factor, then this should be addressed.

- 7.3. Provide data that proves the upward head gradient currently depicted between the Loughshinny Formation and overlying Namurian Formation in Figure 13 (“Schematic Conceptual Model”) of the Hydrogeological Quantitative Risk Assessment. The groundwater level data presented in the EIS suggests there may be an upward head gradient in the north-east of the site, but there appears to be a downward head gradient for the majority of the rest of the site, including where the proposed landfill cells are located. The installation and monitoring of well pairs (each one of a pair screened either in Namurian or Loughshinny Formations) in the areas where landfill cells are proposed appears to be the only way to accurately prove the issue of head gradients (see item 8 below).
- 7.4. Illustrate on an appropriate map or drawing the location and course of the stream referred to as being 1.5km to the east of the site and hydraulically connected to the site via groundwater.

8. Additional site investigations

In order to improve the landfill site element of the CSM, additional site investigation is expected to be carried out. It is expected that there should be groundwater monitoring wells within the footprint of each of the proposed landfill cells. Specifically:

- 8.1. Where both Namurian and Loughshinny bedrock exist, well pairs are needed (comprising one well screened in Namurian and one in the Loughshinny Formations). Where one suitable well already exists the second can be installed close to it (within 5m).
- 8.2. Such well pairs are expected to be needed within each of four fault blocks created by the N-S fault and E-W fault that transect the site, allowing better assessment of groundwater flow across fault structures and between the Namurian and Loughshinny, and consideration of potential flow along fault zones during pump testing. As the proposed hazardous waste cell is located across all fault blocks and in an area where both formations exist (Namurian over Loughshinny), this will be the likely main area of focus.
- 8.3. There is also a need for good well data for the proposed non-hazardous waste cells and new inert cell. In some of the southern area (southwest quadrant) there appears to be insufficient well points, although, as only the Loughshinny is present only single well points are needed. Where it cannot be demonstrated to the EPA’s satisfaction that suitable monitoring wells already exist then additional ones are needed.
- 8.4. Because pump test data may suggest flow along the fault zone (from our review) there is a need to have a well pair at the north end of the proposed hazardous waste cell on the line of the main N-S fault zone.
- 8.5. As part of preparation for the additional investigation programme consideration should be given to the benefit of undertaking coring of certain boreholes and downhole geophysical logging to maximise understanding of lithology, fracture distribution and orientation, etc.
- 8.6. A 7-day pump test and associated step test and recovery test should be carried out. (For such a complex site a 2-day test is too short). It is also suggested that the suitability of BH17 as a pump test well should be reconsidered, and a new well (or a packer in BH17) potentially installed so that the pump test only draws water from the Loughshinny Formation. This will allow better interpretation of the main aquifer zone and the hydraulic connectivity to the overlying Namurian.

8.7. If the further assessment of off-site (down gradient) groundwater levels do not provide conclusive evidence of the location of the groundwater divide between the site and the Bog of the Ring abstraction scheme, then some off-site drilling may be required to address this data gap in the CSM.

9. Other matters

- 9.1. Provide a description of any works carried on at the facility where the details of these works have not previously been submitted in the application or further information to the Agency. The information should include additional drawings as appropriate.
- 9.2. Provide any additional environmental monitoring information which has been obtained but not previously forwarded to the Agency as part of the application. An assessment of the results should also be provided.

In the case where any drawings already submitted are subject to revision consequent on this request for further information, a revised drawing should be prepared in each case. It is not sufficient to annotate the original drawing with a textual correction. Where such revised drawings are submitted, provide a list of drawing titles, drawing numbers and revision status, which correlates the revised drawings with the superseded versions.

Your reply to this notice should include a revised non-technical summary (EIS and Application Form), which reflects the further information you supply in compliance with the notice, insofar as that information impinges on the relevant non-technical summary.

Please supply the information in the form of a one original plus two copies within 12 weeks of the date of this notice. In addition submit sixteen copies of the requested information to the Agency in electronic searchable PDF format on CD-ROM. Please note that all maps/drawings should not exceed A3 in size.

Please note that the application's register number is **W0129-03**. Please direct all correspondence in relation to this matter to *Administration, Environmental Licensing Programme, Office of Climate, Licensing & Resource Use, Environmental Protection Agency, PO Box 3000, Johnstown Castle Estate, County Wexford* quoting the register number.

Yours sincerely,



Brian Meaney
Inspector
Office of Climate, Licensing & Resource Use

Ms Patricia Rooney
Murphy Environmental Hollywood Limited
Hollywood Great
Nags Head
The Naul
County Dublin

Headquarters, PO Box 3000
Johnstown Castle Estate
County Wexford, Ireland

Cearncheathrú: Boscá Poist 3000
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Johnstown Castle Estate, Wexford, Éire
T: +353 53 91 60600
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W: www.epa.ie
LoCall 1890 33 55 99

	Murphy Environmental Hollywood Ltd.
08 MAY 2012	
File Ref:	4.3.6/4.3.3
Action By:	KM KR PR 200
SEA 12/01/11	KM KR PR 200
Closed:	date

3 May 2012

W0129-03

re: Clarification to notice in accordance with Article 16(1) of the Waste Management (Licensing) Regulations dated 23 March 2012

Dear Ms Rooney

I am to refer to the above referenced application for a waste licence relating to a facility at Hollywood Great, Nags Head, The Naul, County Dublin. With reference to our notice under Article 16(1) of the Regulations and your request for clarification, I am to offer the following clarification as requested in your letter dated 19 April 2012.

The proposed scope is not ideal and it is recommended that it be adjusted as set out below. The attached diagram illustrates the recommendations.

The four "well pairs" to be located in the four apparent fault blocks should not be so far apart. It may be preferable to have data points within 100-200m of each other. Therefore we suggest the following:

1. BH23 should not be next to BH16, but BH20. BH16 was drilled to 60m and did not report Loughshinny (it was cored so there's good data) and therefore another 60m well in this location will not "bottom out" the Loughshinny. It is considered that it may be better to have this second well closer to the fault system and therefore beside the existing well BH20. BH20 was not cored but is reported to be screened at the base of the Namurian. Therefore a second, deeper well targeting the Loughshinny should work at the BH20 location.
2. BH22 should not be in the northeast corner (too remote and Loughshinny apparently too deep). It may be appropriate for a new well pair to be installed close to the shallow borehole locations BH22/22A (in unconsolidated materials). It may be appropriate to install these two new wells to ~40m and ~60m depth and screened appropriately to be able to target the Namurian and Loughshinny, respectively.
3. BH24 next to BH18. BH18 appears to be screened in the Loughshinny at about 16-21m depth. It may be appropriate to install BH24 to 15m deep and screened between 5-15m (or thereabouts).



4. BH25 should not be in the southeast corner (too remote). A new well pair close to the shallow borehole location BH23 (in unconsolidated materials no water strikes to 23m depth) may be preferable with two new wells installed to ~40m and ~60m depth and screened appropriately to be able to target the Namurian and Loughshinny, respectively.

Additional wells already identified:

1. The well in the non-hazardous cell (BH26) might better serve as a monitoring well, not the pump test well.
2. Proposed well to the north (BH21) targeting the fault zone. It may be preferable for this well to be closer to the suggested end of this north-south fault (on your plan) and not at the north boundary of the site. It is designed to intercept the fault zone in this area. With this as the target our sense is having two wells one to 40m depth (screened 20-40m) and a second to 60m (screened 40-60m) may be better than the 90m option, recognising we may not reach the Loughshinny.
3. The pump test well may not usefully be BH26 (believed to be too remote from the main fault block intersection and area). The original pump test well (BH17) location was good, it was just the well was screened across the Namurian and Loughshinny so not that useful in this sense. Therefore it may be that a new pump test well about 25m east of existing BH17 (not too close to it) towards the main north-south fault, but not too close to it, is appropriate.

Not all boreholes need to be cored. However at the proposed locations near existing boreholes BH20, BH22/22A and BH23, coring the deep borehole would help a lot to understand the geology and aquifer units and fracture distribution and therefore could be invaluable. The pump test well might also of course benefit from being cored. If four is seen as prohibitively expensive then it may be appropriate that the pump test plus one of the two boreholes to the east of the main fault are prioritised for coring (so 2 not 4 cored).

The scope of the proposed pump test should be detailed and may be relayed to the EPA in advance of this later work being undertaken.

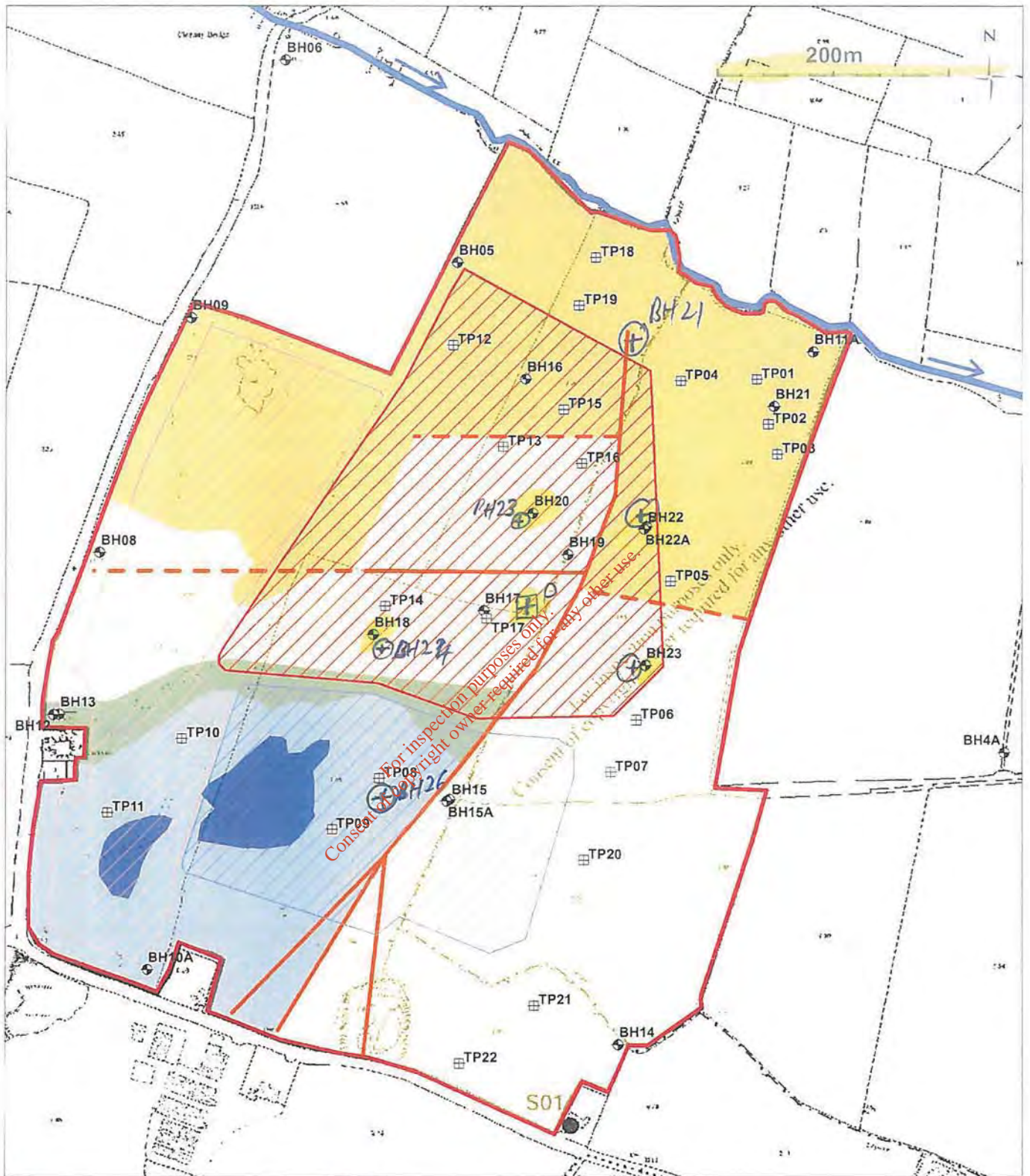
It is noted that the MEHL numbering system for the proposed new wells should be changed as there are already boreholes with the same reference (e.g., BH22 and BH23) which will be confusing later.

Please note that the application's register number is **W0129-03**. Please direct all correspondence in relation to this matter to *Administration, Environmental Licensing Programme, Office of Climate, Licensing & Resource Use, Environmental Protection Agency, PO Box 3000, Johnstown Castle Estate, County Wexford* quoting the register number.

Yours sincerely,



Brian Meaney
Inspector
Office of Climate, Licensing & Resource Use



- Key:**
- Site Waste Licence and Planning Boundary
 - Inferred bedrock fault, downthrown to east
 - ~ Stream
 - BH01 Borehole
 - TP07 Trial Pit
 - Proposed Inert Waste Cell
 - Proposed Non-hazardous Waste Cell
 - Proposed Hazardous Waste Cell

- Geology:**
- Walshestown Formation
 - Balrickard Formation
 - Donore Formation
 - Loughshinny Formation

Proposed Landfill Cells Superimposed on Site Geology		A4
Hollywood, Naul, Co. Dublin		JM
Environmental Protection Agency (EPA) Ireland		MF
00146-014/JM	March 2012	00146-014

Figure 2

Appendix B

Geophysics, Interpretation and Interpretative Borehole Logs

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Subject Downhole Geophysics Interpretation

Date 23 April 2013

Job No/Ref

D6877\5_Design\30

Downhole Geophysics Interpretation

This geophysics note details an initial assessment of the downhole geophysics undertaken by Robertson Geologging Ltd in January 2013. The information used to interpret the geophysical logs includes the Arup Hydrogeological Quantitative Risk Assessment (Dec 2010) and the monitoring well logs recorded during drilling. The geological logs are presented in Appendix A and the geophysical logs are presented in Appendix B.

It is intended that the text below can be reviewed and inserted into an interpretive report.

1 Downhole Geophysical Logging

In order to improve the geological model of the site and relate the geology from monitoring well logs to the geology from wells for which no logs are available, downhole geophysical logging was employed. Information from the geophysical logging has been used, in conjunction with existing geological information, to obtain an improved understanding of the underlying geology as well as identifying locations and depths to be investigated with subsequent site investigations.

1.1 Scope of Geophysical Logging

Eight of the existing monitoring wells were used for the geophysical logging: BH4a, BH11a, BH15a, BH16, BH17, BH18, BH19 and BH20. The downhole geophysical techniques used in these boreholes included:

1. **Formation density.** Also known as 'gamma-ray density' and includes the use of a radioactive source to bombard the material surrounding the boreholes with gamma rays. These gamma rays collide elastically with electrons and the number of collisions is a function of the formation density of the material (Crompton scattering). This technique can be used to estimate the porosity of rock if the matrix density and pore fluid density are known.
2. **Natural gamma.** Different materials contain varying small quantities of radioactive elements. Potassium rich evaporates present in clay minerals, micas and alkali feldspar produce a detectable level of radiation. Consequently sedimentary rocks with a relatively high clay and shale content can be identified in the logs.
3. **Induction.** An electromagnetic field created by the sonde induces eddy currents in the rock which generates a secondary electromagnetic field. The phase difference and strength of the secondary electromagnetic field is a function of the conductivity of the rock.
4. **Fluid temperature and fluid conductivity.** The variation in temperature with depth can give an indication of fissures or porous strata within a borehole where water of a different temperature or fluid electrical conductivity flows into the borehole. Meaningful results are not generated where the borehole is cased. Delta temperature (DELTA) and delta conductivity (DELTA) log the change in the parameter with depth.

Subject Downhole Geophysics Interpretation

Date 23 April 2013

Job No/Ref

D6877\5_Design\30

Note: There is no induction log for BH11a.

1.2 Results

The wells in which the sondes were used had been drilled using a rotary flush method and the cuttings logged at the surface. Logging with this method of drilling can miss information on the rock and can also leads to inaccuracies of the depth of changing strata due to the time required for the drilling mud to return to the surface.

The sondes used are 2m in length therefore no logging above 2m depth is possible and logs commence at 2mbgl. Robertsons have stated that some of the logs of the boreholes do not reach maximum depth as the liner pipe's internal diameter was very close to the tool diameter. When the pipe was vertical the tool could get down easily. However if there was any bend in the pipe the tool was not able to pass.

The interpretation for the results from the geophysical logs, for each borehole, has been tabulated below.

Borehole	Observations	Anomaly reference	Approx depth of anomaly (m bgl)	Comments
BH4a	Logged for full depth (i.e. 2 to 12mbgl). Borehole is steel cased to 5.18m. Water level shown at 1.3mbgl from fluid logs.	BH4a-01	Full depth	The borehole is located outside of the site boundary by ~250m to the east. There is no detailed interpretation of the geology in this area however both the induction and natural gamma reading suggest there is little variation in the strata logged (to 12mbgl).
BH11a	Logged for full depth (i.e. 2m to 28mbgl). Water level shown at approx 4mbgl. Plain cased to approx 20mbgl. No induction log.	BH11a-01	10.5 – 12	Relatively large increase in the natural gamma reading which may be indicative of the 'fractured shale' recorded on the borehole log, especially if the fractures are filled with clay.
		BH11a-02	19 – 23	Reduction in the natural gamma reading which is indicative of an increase in particle size. The borehole log records 'heavily weathered shale from 18m bgl going into to 'sandy shale' at 21m bgl. It is likely that the reduction in the natural gamma output is associated with the sandy shale on the borehole log.
BH15a	Logged for full depth (I.e. 2m to 26.3mbgl). Water level shown at 5.1mbgl. Plain cased to 28mbgl.	BH15a-01	5.1	Increase fluid logs indicative of the top of groundwater level.
		BH15a-02	12.5 – 15	Relatively large increase in the natural gamma reading which may be indicative of an increase in clay content.
		BH15a-03	20	The fluid logs show an increase which continues to base of hole, however as the well is cased to 28mbgl the cause of this fluid anomaly is uncertain.
		BH15a-04	2 – 13	The top portion of the induction log is relatively low, whereas the low part of the log records relatively

Borehole	Observations	Anomaly reference	Approx depth of anomaly (m bgl)	Comments
		BH15a-05	15 – 23	high. This may be indicative of the change between the Balrickard and Donore Formations.
BH16	Logged for full well depth (2m to 23.75mbgl), borehole originally drilled to 60mbgl. Fluid logs indicate water level at 2.2mbgl. Plain cased to 20mbgl.	BH16-01	2-13	Natural gamma log is very high in upper part of borehole, suggesting shale/clay. Similarly induction log is relatively high in the upper 13m, with a gradual decrease, suggesting high electrical conductivity rock (indicative of shale/clay).
		BH16-02	20-bottom of log	Fluid logs show a decrease, probably indicative of the screened section.
BH17	Logged for full depth (i.e. 2m to 53mbgl). Water level shown at 3.3mbgl. Plain cased to 25mbgl. Screen 25 to 27mbgl and 32 to 37mbgl and 42 to 48mbgl with plain casing between screened sections.	BH17-01	3.3	Increase in fluid logs indicative of the top of water level.
		BH17-02	7.5	Fluid conductivity logs shows increase, however as borehole is plain cased at this depth cause of anomaly unknown.
BH18	Logged to 12mbgl (fluid and natural gamma), and to 15.8mbgl (induction). Lithological log and installation details indicate total depth 21m. Plain cased except for with screen 17 to 19mbgl screened section. Water level shown at 8.2mbg.	BH18-01	8	Increase in fluid logs indicative of the top of water level..
		BH18-02	7 – 10	The natural gamma reading fluctuations observed correlate with the ‘interbedded sandstone and mudstone’ description provided on the borehole log. The spikes and troughs may be representative of the mudstone and sandstone respectively.
		BH18-03	12 -15	Induction log shows gradual increase in electrical conductivity suggesting increasing clay/shale content.
BH19	Logged for full depth (i.e. 2m to 18mbgl). Water level shown at 2.2mbgl. Plain cased to 16mbgl, screened 16 to 17mbgl.	BH19-01	11 – end of log	BH19 was drilled close to two fault zones. The increase in natural gamma response maybe indicative of material fractured by faulting as observed in the correlation discussed in anomaly BH11a-01.
BH20	Logged for full depth (i.e. 2m to 42mbgl). Water	BH20-01	10	Fluid conductivity logs shows increase, however as borehole is plain cased at this depth cause of anomaly unknown.

Borehole	Observations	Anomaly reference	Approx depth of anomaly (m bgl)	Comments
	level shown at 2mbgl. Plain cased to 40mbgl, screened 40 to 42mbgl.	BH20-02	34 to 42	Low natural gamma reading suggesting lower clay content, correlates with drillers log higher inflow rate (higher hydraulic conductivity).

1.3 Conclusions

Some methods used in the downhole geophysics logging suite have been more successful than others. The nature of the rock and the level of detail provided on the borehole lithological logs have limited the useful application of the geophysical logging for identifying specific geological boundaries and formations. Some aspects of the downhole geophysical logging have proved successful and are detailed below:

1. **Variations in clay content.** The natural gamma log identified layers of a relative variation in clay content. In some cases these correlated well with the geological description provided on the borehole logs.
2. **Layers of interbedded mudstone and sandstone.** Where borehole logs prove layers of interbedded sandstone and mudstone the readings from the natural gamma logs appear have a good correlation. Further site investigation can be used to obtain more accurate borehole logs and improve this correlation.
3. **Faulting / Fracturing.** The natural gamma log results were relatively high in locations identified on the borehole logs as being fractured (BH11a) or where the boreholes are close to a fault zone as indicated on the geological model (BH19). This may be due to the fractures being filled with clay. Further site investigation work would be required to confirm this correlation.
4. **Static water level in well.** The fluid logs indicated the static water level in each well.
5. **Inflow horizons.** As the boreholes have monitoring wells installed with plain and screened sections, identifying inflow horizons is difficult compared to fluid logs of open holes.
6. **Ambiguous geophysical anomalies.** Several of the geophysical logging techniques show various anomalous readings which cannot be associated with information on the borehole logs or the geological ground model. Subsequent site investigation can be used to identify changes in ground conditions at these locations.

Subject Downhole Geophysics Interpretation

Date 23 April 2013

Job No/Ref

D6877\5_Design\30

Appendix A

Geological Borehole Logs

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DUNNES DRILLING

No: 5668

DRILLERS LOG

Borehole for: Murphy Environmental Hollywood Ltd
at Hollywood Quarry

8" Monitoring Well

WELL DRILLING AND HORIZONTAL DRILLING ENGINEERS

Dublin Road, Dromiskin, Dundalk, Co. Louth.

E-Mail: info@dunnesdrilling.com website: www.dunnesdrilling.com

Tel: +353 42 9372188 Fax: +353 42 9372714

Date	Depth ft	Diam	Conditions
18.11.08	0 - 3	8"	Clay & stones
	3 - 14	8"	Sticky clay
	14 - 17	8"	Grey rock
	17 - 25	8"	Black rock - water at 25ft
	25 - 30	8"	Black rock
	30 - 40	8"	Black rock - water at 35ft

Total depth of well	40ft (12.19m)
Estimated yield	1000 gallons per hour
Depth to rock	14ft (4.27m)
Steel casing installed	17ft (5.18m) of 8" steel casing
PVC casing installed	7m of 2" PVC
Well screen	6m of 2" Screen
Other remarks	Install gravel pack from 40ft to 18ft. 6 bags of bentonite seal from 18ft to 3ft above ground level

Operator A Hoey

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PROJECT: 07507190035 Murphy's Hollywood

RECORD OF MONITORING WELL BH11A

SHEET 1 OF 1

LOCATION: Murphy's Hollywood

BORING DATE: 2/5/07

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	GEOTECH. NO.	ENV. NO.		TYPE	20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
0	Monitoring Borehole Air Rotary	GROUND SURFACE														Top of Pipe	
		Overburden/madeground		ELEV. DEPTH (m)													Elev. 100.01
		Weathered grey shale		0.00													Cement Backfill
5				2.00													
10			Fractured shale		8.00												Bentonite
15			Shale		12.00												
20			Heavily weathered shale		18.00												Gravel pack
25		Grey sandy shale		21.00												Screen and gravel pack	
30				30.00													
35																	
40																	
45																	
50																	
55																	
60																	
65																	
70																	

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DEPTH SCALE

1 : 350



LOGGED: AS

CHECKED: TVM

2_MURPHY_HOLLYWOOD.GPJ GLDR_LDN.GDT 177707 DATA INPUT:


MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH15a	Sheet 1 of 1
Date Drilled 16-22/04/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X; 315786.3	
Date Logged 16-22/04/2010	Site Engineer/Geologist Sarah Blake	Flush: Air/mist	Y: 257849.6	
Comments: Descriptions of chippings from drilling		Borehole diameter: 0.25 m (10") & 0.1m (8")	Z (mOD): 105.89	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)
		Casing/screen details		Construction	Filter pack		
		(m)					
5	<p>Static level 6.2 mbgl (28/5/10)</p> <p>200 g/h</p>	Well head 0.43m above ground level				Orange-brown, highly weathered, siltstone, mudstone and sandstone (Balrickard Fm.)	99.89
10	300 g/h	50 mm plain UPVC				Mid-brown, highly weathered siltstone, mudstone and sandstone (Balrickard Fm.) On completion this section took a significant volume volume of grout 60 mins airlifting at 12m	91.89
15	3000 g/h					Dark brown, highly weathered siltstone, mudstone and sandstone (Balrickard Fm.)	91.89
20						Large increase in yield at 18m Dark brown, highly weathered siltstone, mudstone and sandstone (very wet) (potentially Donore Fm.) On completion this section took a significant volume volume of grout	86.89
25						Dark brown, highly weathered mudstone, sandstone and limestone with calcite veining (Loughshinny Fm.)	81.89
26.00				Fine sand		45 mins surging and developing well at 24m Drilling after 24m causes the open section of the borehole to collapse. 60 mins surging and developing well at 27m gives 8000 g/h yield	
28.00	Increase to 8000 g/h	50mm slotted		Formation stabiliser (10mm grade)			
29.00		50mm plain with cap					
30.00	No water					60 mins surging and developing well at 30m. After casing installed to 30m yield dramatically reduced. End of borehole at 30m.	
35							

MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH16	Sheet 1 of 2
Date Drilled 12-20/04/2010	Driller S. Petersen	Drill method: Geobore 'S'	X; 315861.9	
Date Logged 20/04/2010	Site Engineer/Geologist D. O'Shea	Flush: Air/Polymer gel	Y: 258218.2	
Comments: Descriptions of cores from Geobore 'S' drilling		Borehole diameter 0.2 m (8")	Z (mOD): 104.79	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)
		Casing/screen details		Construction	Filter pack		
		(m)					
	 Static water level 3.09 mbgl (28/5/10)	Well head 0.41m above ground level			0.00	Brown highly weathered, shaley mudstones	104.29
5						Black, highly weathered fine-grained mudstone.	
10		50 mm plain UPVC		Cement/bentonite grout mix		Dark grey/black, moderately weathered interbedded sandstone and siltstone/mudstone. (Walshestown Fm.)	97.79
15						Orange/brown/black highly weathered, interbedded sandstone and mudstone. Fe-oxide staining. 30% flush loss to fm. between 12.2m and 19.6m	92.79
20						Orange/black/brown/grey, highly weathered interbedded sandstone and mudstone.	89.79
20					18.00	No recovery from 17.5 to 18m, probably highly weathered rock.	
20		50mm slotted UPVC		Fine sand	19.00	30% flush loss to fm. between 12.2m and 19.6m	84.79
22		50mm plain UPVC with cap		Formation stabiliser (10mm grade)	23.00	Grey/orange/brown, moderately weathered sandstone (Walshestown Fm.)	
25				Fine sand	24.00	20% flush losses to fm. between 19.6m and 24.6m	79.79
30						Dark grey/black/brown, interbedded sandstone and mudstone with large amounts of clay infill (Walshestown Fm.)	
35						Dark grey/black, largely fresh mudstone (Walshestown Fm.)	72.79
					36.00		

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MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH16	Sheet 2 of 2
Date Drilled 12-20/04/2010	Driller S. Petersen	Drill method: Geobore 'S'	X; 315861.9	
Date Logged 20/04/2010	Site Engineer/Geologist D. O'Shea	Flush: Air/Polymer gel	Y: 258218.2	
Comments: Descriptions of cores from Geobore 'S' drilling		Borehole diameter: 0.2 m (8")	Z (mOD): 104.79	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)
		Casing/screen details		Construction	Filter pack		
		(m)					
36					36.00	Dark grey/black, largely fresh mudstone (Walshestown Fm.)	68.79
40							
45							
50						10% flush losses to fm. between 48m and 55.5m	
55							
60					60.00	Walshestown Fm. possibly grading into the Balrickard Fm. from approx. 58m 12cm limestone layer from 58.07m End of borehole at 60m	46.79
65							
70							

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MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH17	Sheet 1 of 2
Date Drilled 05/05/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X; 315794.7	
Date Logged 05/05/2010	Site Engineer/Geologist Catherine Buckley	Flush: Air/mist	Y; 258003.1	
Comments: Descriptions of chippings from drilling		Borehole diameter: 0.25 m (10")	Z (mOD): 105.4	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)	
		Casing/screen details		Construction	Filter pack			
		(m)	(m)					
0.00	Well head 0.29m above ground level					0.00	Orange/brown highly weathered siltstone/mudstone/sandstone with Fe-oxide staining. (Poss. Balrickard Fm.) Driller using non-ballistic bit from 0-27m.	
5	Static water level: 4.53 mbgl on 28/05/2010							100.4
10		50 mm plain UPVC		Cement/bentonite grout mix				94.4
15	Strike 15 mbgl, 500 g/h							
20							Fluid losses to fm. from 20m. Added polymer mud.	
22.00					Fine sand	22.00		83.4
23.00	Increase to 5000 g/h					23.00	Black highly weathered siltstone, mudstone and sandstone with slight Fe-oxide staining. (Namurian Deposits)	
25		50mm slotted UPVC						
27.00		50 mm plain UPVC					Large gravel losses to fm. at 27m. Switch to a ballistic drill bit from 28m	
30					Formation stabiliser (10mm grade)			74.4
32.00	Increase to >15000 g/h	50mm slotted UPVC					Black/grey/brown highly weathered siltstone, mudstone and sandstone. (Poss. Namurian Deposits)	74.4
35							Dark brown highly weathered mudstone/sandstone and limestone. (Poss. Loughshinny Fm.)	72.4
36.00						36.00	Large mud losses to fm. between 33 and 35m	

MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH17	Sheet 2 of 2
Date Drilled 05/05/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X; 315794.7	
Date Logged 05/05/2010	Site Engineer/Geologist Catherine Buckley	Flush: Air/mist	Y: 258003.1	
Comments: Descriptions of chippings from drilling		Borehole diameter: 0.25 m (10")	Z (mOD): 105.4	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)
		Casing/screen details		Construction	Filter pack		
		(m)					
36		36.00	50mm slotted		36.00	69.4	
		37.00			37.00	68.4	
			50 mm plain UPVC		38.00	Dark brown highly weathered mudstone, sandstone and limestone. (Poss. Loughshinny Fm.)	
40					43.00	Large mud losses to fm. between 37 and 40m	
45		42.00	50mm slotted UPVC		48.00		
			50 mm plain UPVC with end cap	53.00			
				54.00	End of borehole at 54m		
55							
60							
65							
70							

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MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH18	Sheet 1 of 1
Date Drilled 20-24/04/2010	Driller S. Petersen	Drill method: Geobore 'S'	X; 315711	
Date Logged 24/04/2010	Site Engineer/Geologist D. O'Shea	Flush: Air/Polymer gel	Y: 257996.4	
Comments: Descriptions of cores from Geobore 'S' drilling		Borehole diameter: 0.2 m (8")	Z (mOD): 110.5	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)	
		Casing/screen details		Construction	Filter pack			
		(m)						(m)
		Well head				0.00	Brown highly weathered, shaley mudstones	110
		0.55m above ground level					Black/grey/brown moderately weathered, interbedded sandstone and mudstone with large amounts of clay infill. (Possibly Balrickard Fm.)	
5			50 mm plain UPVC		Cement/bentonite grout mix		Black/grey/dark-grey slightly weathered interbedded sandstone and mudstone (possibly Namurian Deposits.)	105.5
10	↓ Static water level 9.51 mbgl (28/5/10)							
15					Fine sand	15.00	100% flush losses to fm. from 14.80 m	95.5
						16.00	Palaeo-analysis indicate Namurian Deposits	
		50mm slotted UPVC			Formation stabiliser (10mm grade)	17.00		
						19.00	Grey/dark-grey/black, slightly to locally highly weathered, interbedded limestone and shaley mudstones (possibly Loughshinny Fm.)	
20		50mm plain with cap				20.00		
					Fine sand	21.00	End of borehole 21.2m	
25								
30								
35								





MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH19	Sheet 1 of 1
Date Drilled 21-22/04/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X; 315887.1	
Date Logged 21-22/04/2010	Site Engineer/Geologist Sarah Blake	Flush: Air/mist	Y: 258059.1	
Comments: Descriptions based on chippings from drilling		Borehole diameter: 0.25 m (10")	Z (mOD): 105.08	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)	
		Casing/screen details		Construction	Filter pack			
		(m)						(m)
	Well head 0.54m above ground level					0.00	No recovery	
5	<p>Static water level 2.98 mbgl (28/5/10)</p> <p>100 g/h</p>	50 mm plain UPVC		Cement/bentonite grout mix				100.08
10				Fine sand		13.00	Orange-brown, highly weathered siltstone, mudstone and sandstone (Balrickard Fm.)	
				Formation stabiliser (40mm grade)		14.00	60 mins surging and well development at 7m	
15							Dark brown, highly weathered mudstone, sandstone and siltstone (Namurian Deposits.)	94.08
							Dark brown, wet, highly weathered siltstone, mudstone and sandstone (Namurian Deposits.)	91.08
16.00		50mm slotted						
17.00		50mm plain with cap						
18.00						18.00	60 mins surging and well development at 18m	
20								
25								
30								
35								

MONITORING WELL LOG


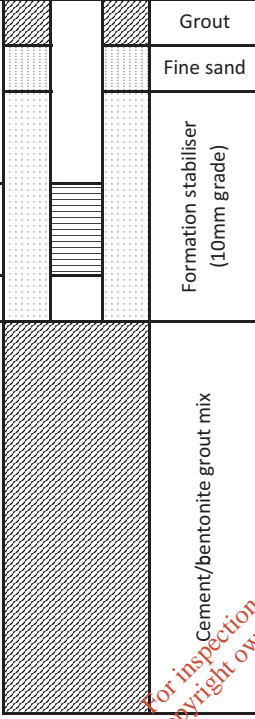
Project title Integrated Waste Management Facility		Client MEHL	Well No. BH20	Sheet 1 of 2
Date Drilled 22-27/04/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X; 315862.6	
Date Logged 22-27/04/2010	Site Engineer/Geologist Marie Fleming	Flush: Air/mist	Y; 258102.3	
Comments: Descriptions of chippings from drilling		Borehole diameter: 0.25 m (10")	Z (MOD): 104.84	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)
		Casing/screen details		Construction	Filter pack		
		(m)					
		Well head 0.45m above ground level			0.00	Grey/black/orange/brown highly weathered siltstone/mudstone. (Poss. Balrickard Fm.)	
5	 Static water level 3.52 mbgl (28/5/10)  Strike 6 mbgl, 100g/h					Dark brown/black highly weathered siltstone and mudstone. (Namurian Deposits)	99.84
10						Black, highly weathered siltstone, mudstone and sandstone. (Namurian Deposits)	97.84
15	 Increase to 500 g/h					Well developed for 30 mins. 500 g/h flow consistent	
20							
25							
30	 Increase to 3500 g/h					Significant increase in yield to 3500 g/h. Surging and well development for 60 mins.	
35						Black, highly weathered siltstone, mudstone and sandstone. Very wet. (Namurian Deposits)	70.84
		36.00	50 mm plain UPVC	Cement/bentonite grout mix	36.00		

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MONITORING WELL LOG

Project title Integrated Waste Management Facility		Client MEHL	Well No. BH20	Sheet 2 of 2
Date Drilled 22-27/4/2010	Driller Briody & Sons Ltd.	Drill method: Rotary flush	X: 315862.6	
Date Logged 22-27/4/2010	Site Engineer/Geologist Marie Fleming	Flush: Air/mist	Y: 258102.3	
Comments: Descriptions of chippings from drilling		Borehole diameter: 0.25 m (10")	Z (MOD): 104.84	

Depth (m)	Water strike details	Installation Details				Lithological description and driller's comments	Elev. (m OD)		
		Casing/screen details		Construction	Filter pack				
		(m)			(m)				
36	 <p>Large strike, >10,000 g/h</p>	36.00	50 mm plain UPVC		36.00	Grout	68.84		
					37.00	Fine sand	67.84		
40		40.00			50mm slotted UPVC	Formation stabiliser (10mm grade)	38.00		Black highly weathered siltstone, mudstone and sandstone. Wet. (Namurian Deposits)
		42.00			50mm plain with cap		43.00		Volume of water causing drilling problems. 90 mins airlifting, surging and foam
			43.00		Cement/bentonite grout mix	43.00		61.84	
45				48.00			Borehole still collapsing after 3 hrs cleaning and surging.		
			52.00			Chippings distorted after 48m as collapsing material washing away direct returns.			
						End of borehole 52m			
50									
55									
60									
65									
70									

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Subject Downhole Geophysics Interpretation

Date 23 April 2013

Job No/Ref

D6877\5_Design\30

Appendix B

Geophysical Logs

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REMARKS (C:\Winlogger\Data\Murphy Environmental\BH4a\BH4a_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH4a
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE: Dublin
 COUNTY: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

OTHER SERVICES

Consent of copyright owner required for any other use.

Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00

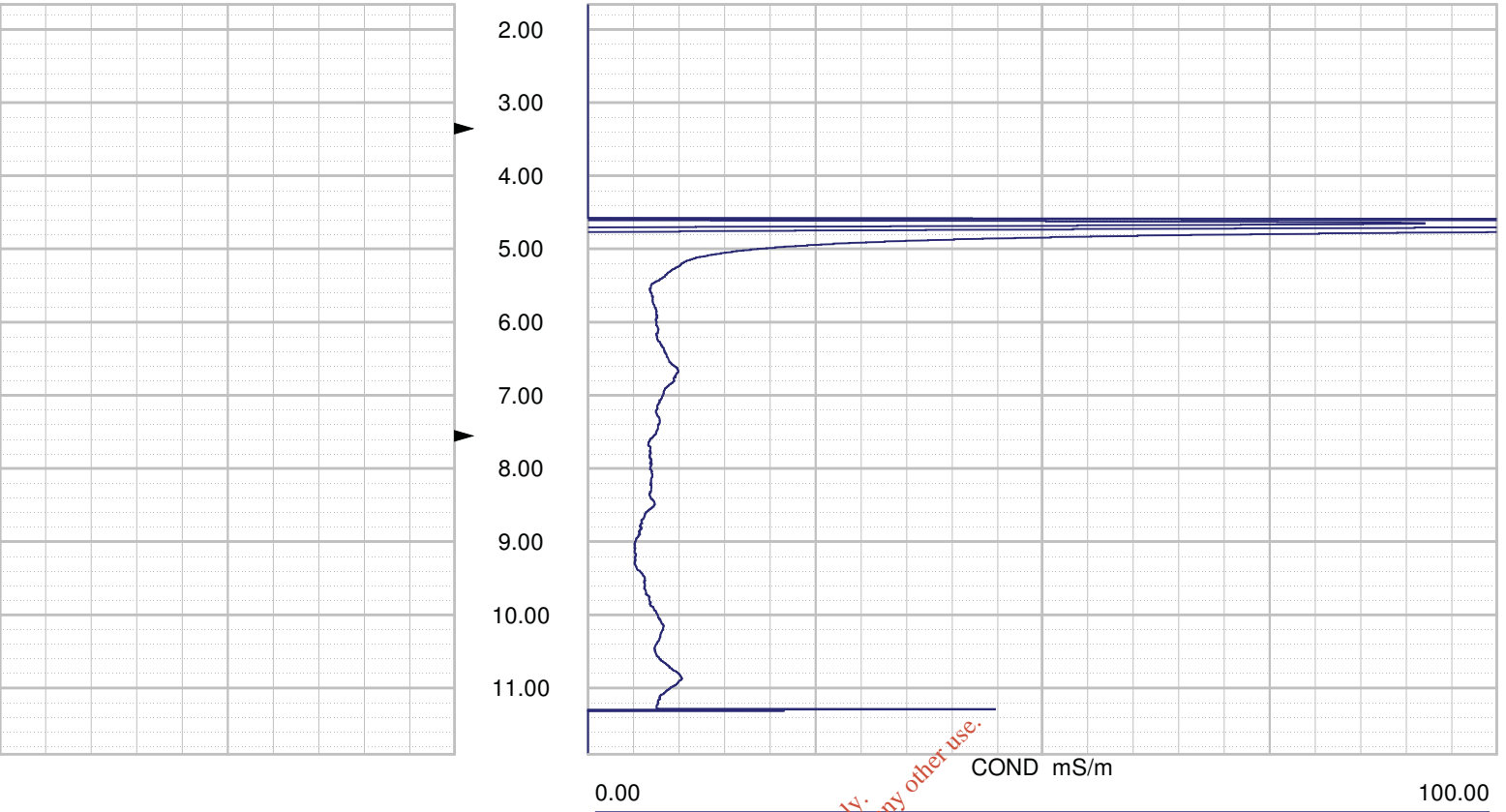
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DEPTH LOGGER	12.00	0.00	0.00
LOG DEEPEST	12.00	0.00	0.00
LOG SHALLOW	2.50	0.00	0.00
FLUID IN HOLE	Water		
SALINITY			
DENSITY			
LEVEL			
MAX TEMP °C	0.00	0.00	0.00
RIG TIME			
RECORDED BY	IJ		
WITNESSED BY			

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00

COND mS/m

0.00

100.00



0.00

COND mS/m

100.00

Depth: 1.00 m Date: 21 Nov 2012 Time: 15:24:22 File: "C:\Winlogger\Data\Murphy Environmental\BH4a\BH4a_INDS.LOG"

For inspection purposes only.
Consent of copyright owner required for any other use.

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH4a\BH4a_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
WELL: BH4a
FIELD: Murphy's Quarry
COUNTRY: Ireland
STATE: Dublin
COUNTRY: Ireland
L.A.T.:
LONG.:

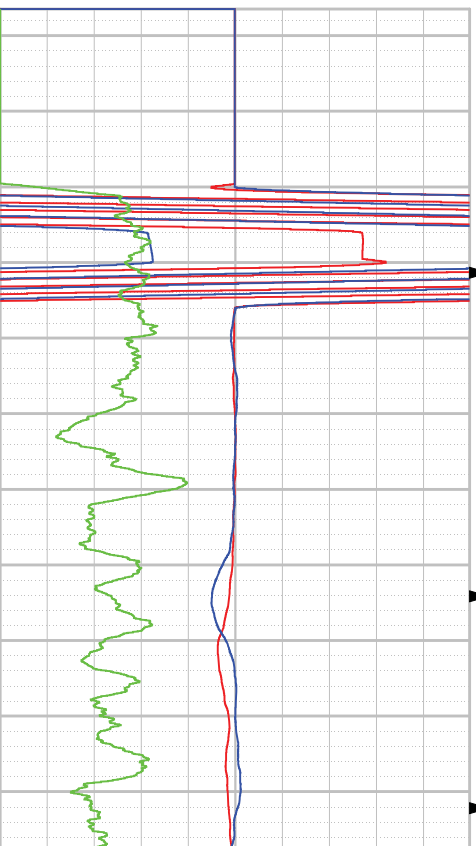
OTHER SERVICES

Consent of copyright owner required for any other use.

DATE	21 Nov 1	06 Nov 1	06 Nov 1
RUN#	0	0	0
TYPE OF LOG	TCDS		
DEPTH DRILLER	12.00	0.00	0.00
DEPTH LOGGER	12.00	0.00	0.00
LOG DEEPEST	12.00	0.00	0.00
LOG SHALLOW	0.00	0.00	0.00
FLUID IN HOLE	Water		
SALINITY			
DENSITY			
LEVEL			
MAX TEMP °C	0.00	0.00	0.00
RIG TIME			
RECORDED BY	IJ		
WITNESSED BY			

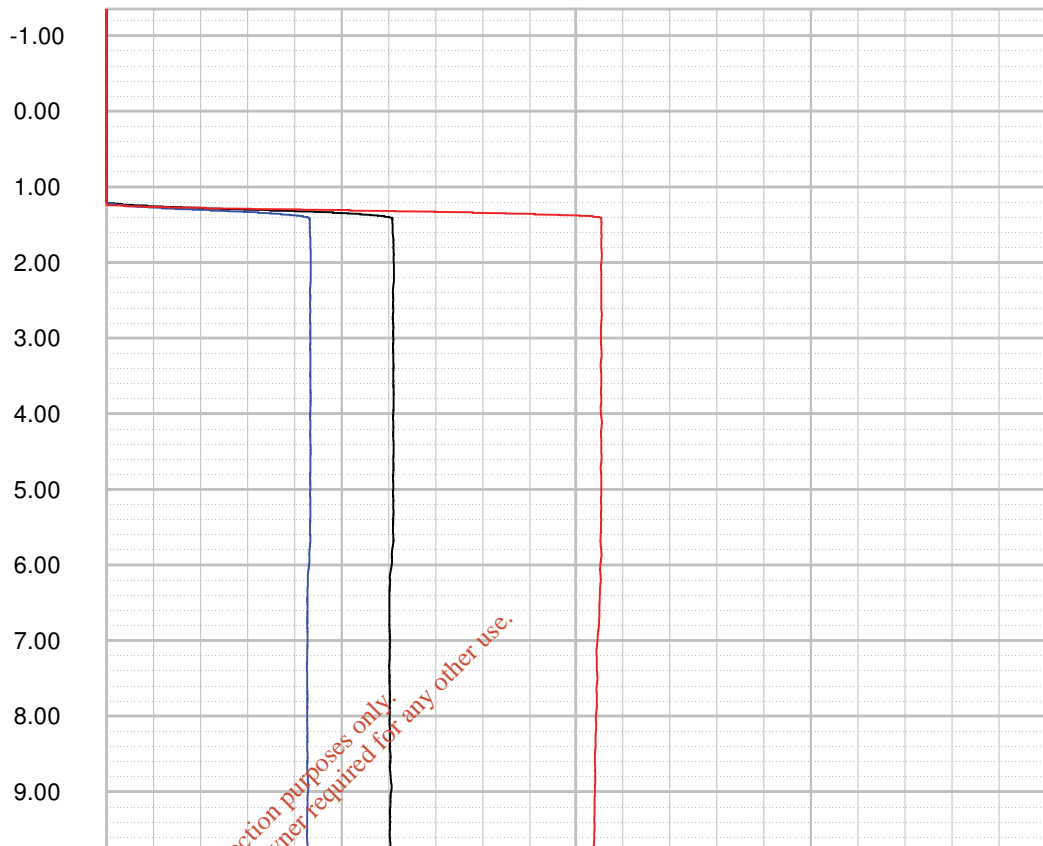
RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
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0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELTA DegC	1.00
-20.00	DELTA uS/cm	20.00
0.00	NGAM CPS	200.00



-1.00	DELTA DegC	1.00
-20.00	DELTA uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00



0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00

For inspection purposes only.
Consent of copyright owner required for any other use.

Depth: 9.00 m Date: 21 Nov 2012 Time: 15:13:09 File: "C:\Winlogger\Data\Murphy Environmental\BH4a\BH4a_TCDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH11a\BH11a_T..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
WELL: BH11a
FIELD: Murphy's Quarry
COUNTRY: Ireland
STATE: Dublin
COUNTRY: Dublin
LAT.:
LONG.:

OTHER SERVICES

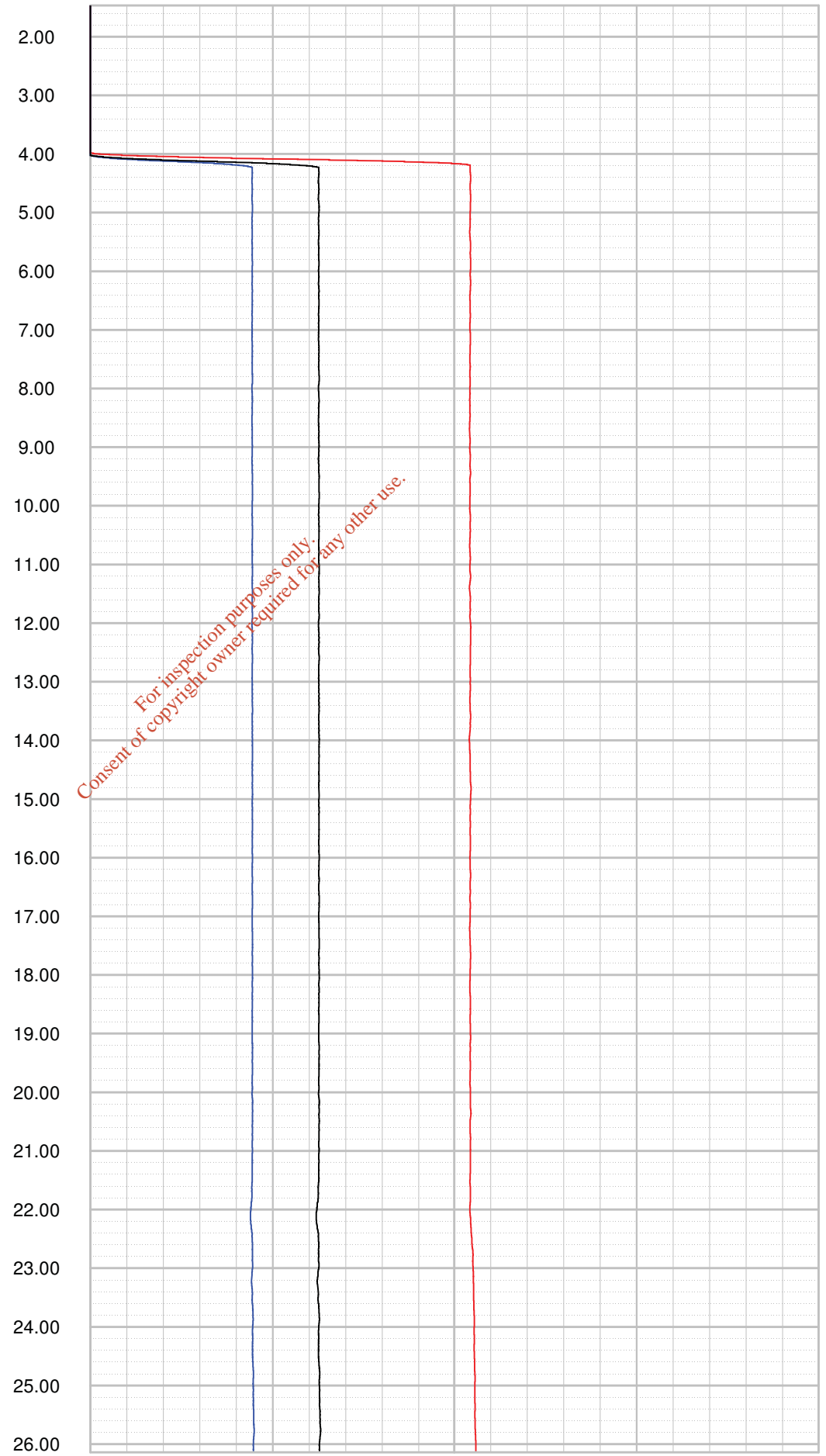
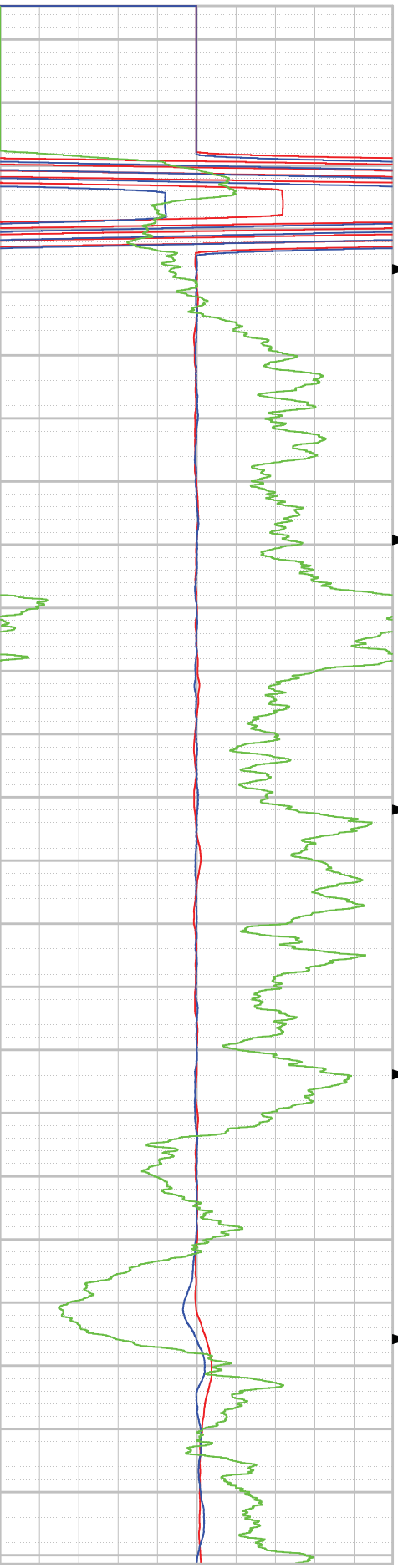
Consent of copyright owner required for any other use.

Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	0
RUN#	0	0	0	0
TYPE OF LOG	TCDS			
DEPTH DRILLER	30.00	0.00	0.00	0.00
DEPTH LOGGER	28.00	0.00	0.00	0.00
LOG DEEPEST	28.00	0.00	0.00	0.00
LOG SHALLOW	0.00	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00	0.00	0.00
RIG TIME				
RECORDED BY	IJ			
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELTA DegC	1.00
-20.00	DELTA uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	TEMP DegC	20.00
0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00



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-1.00	DELT DegC	1.00	0.00	TEMP DegC	20.00
-20.00	DELC uS/cm	20.00	0.00	COND uS/cm	500.00
0.00	NGAM CPS	200.00	0.00	COND uS/cm	500.00

Depth: 26.00 m Date: 21 Nov 2012 Time: 14:09:51 File: "C:\Winlogger\Data\Murphy Environmental\BH11a\BH11a_TCDS.LOG"

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REMARKS (C:\Winlogger\Data\Murphy Environmental\BH15a\BH15a_1_.INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



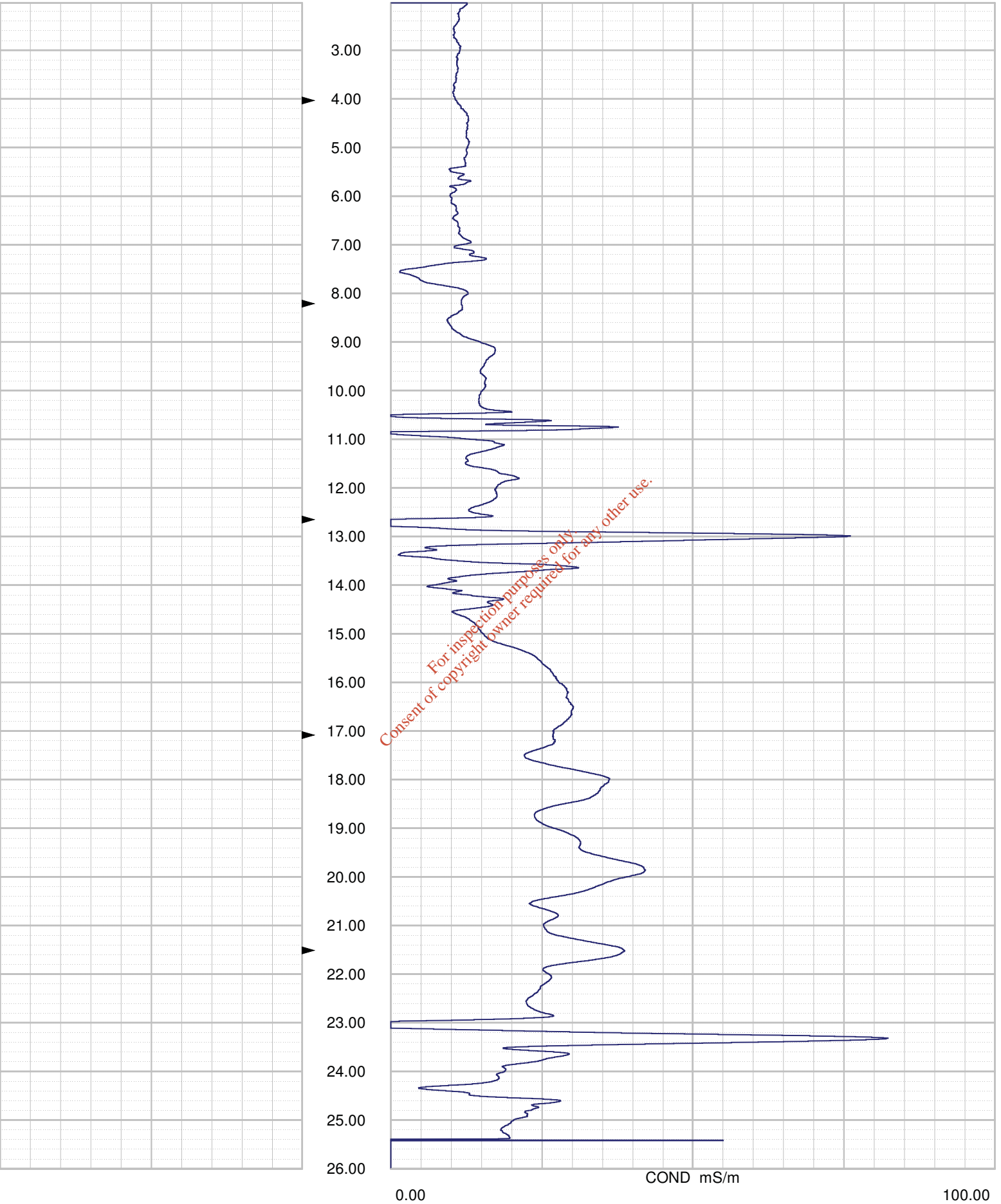
COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH15a
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

OTHER SERVICES

Consent of copyright owner required for any other use.

Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	06 Nov 1
RUN#	0	0	0	0
TYPE OF LOG	INDS			
DEPTH DRILLER	30.00	0.00	0.00	0.00
DEPTH LOGGER	26.30	0.00	0.00	0.00
LOG DEEPEST	26.30	0.00	0.00	0.00
LOG SHALLOW	2.50	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00		0.00
RIG TIME				
RECORDED BY	IJ			
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00



REMARKS (C:\Winlogger\Data\Murphy Environmental\BH15a\BH15a_T..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH15a
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

MURPHY'S ENVIRONMENTAL HOLLYWOOD LTD
 OTHER SERVICES

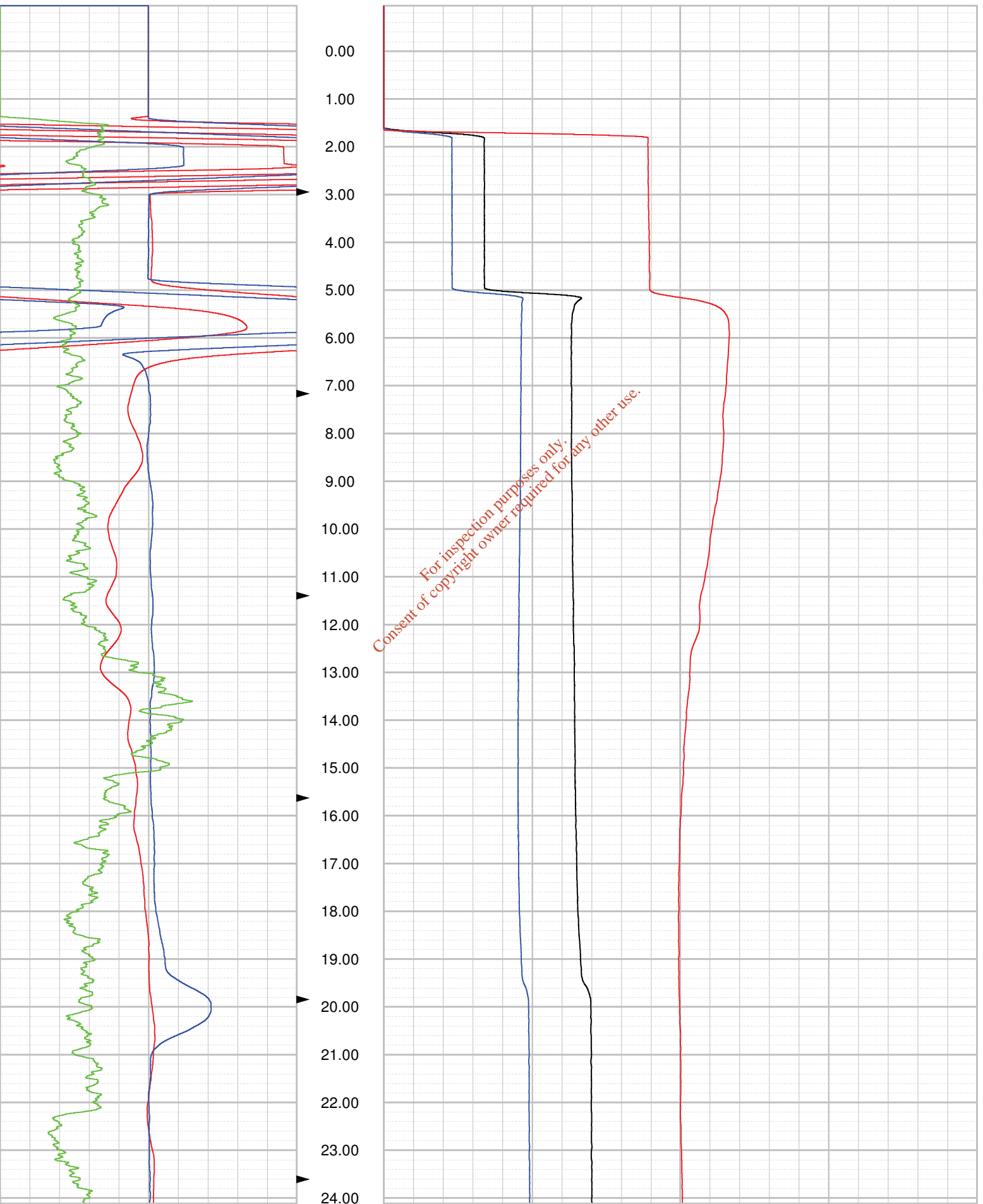
Consent of copyright owner required for any other use.

DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
21 Nov 1	0	TCDS	30.00	26.30	26.30	0.00	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM	TO	TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELT DegC	1.00
-20.00	DELC uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00



-1.00	DELT DegC	1.00	0.00	COND uS/cm	500.00
-20.00	DELC uS/cm	20.00	0.00	COND uS/cm	500.00
0.00	NGAM CPS	200.00	0.00	TEMP DegC	20.00

Depth: 24.00 m Date: 21 Nov 2012 Time: 11:04:46 File: "C:\Winlogger\Data\Murphy Environmental\BH15a\BH15a_TCDS.LOG"

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REMARKS (C:\Winlogger\Data\Murphy Environmental\BH16\BH16_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH16
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

OTHER SERVICES

Consent of copyright owner required for any other use.

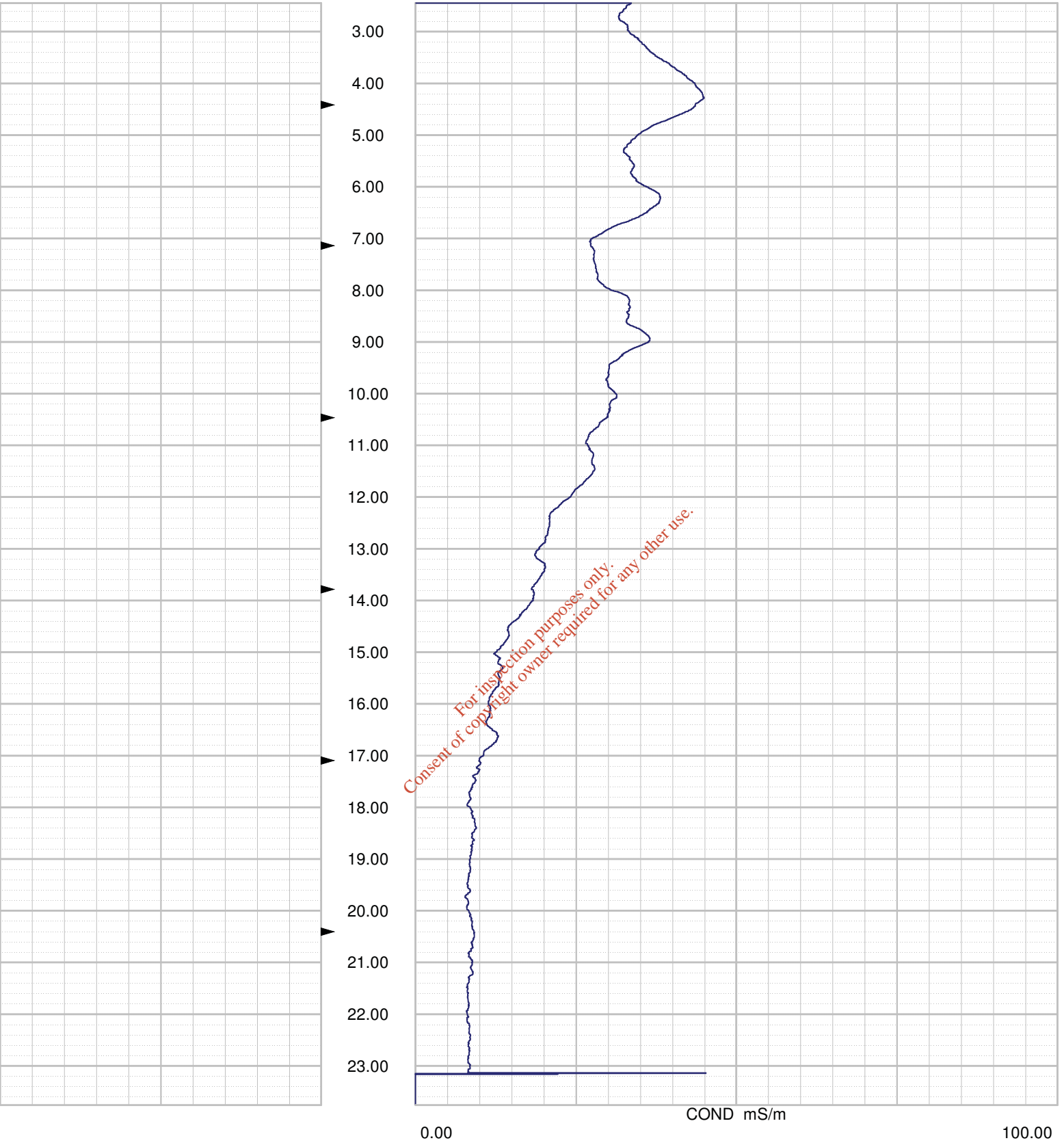
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TYPE OF LOG	Drill Datum			GL		
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DEPTH LOGGER					0.00	0.00
LOG DEEPEST					0.00	0.00
LOG SHALLOW					0.00	0.00
FLUID IN HOLE						
SALINITY						
DENSITY						
LEVEL						
MAX TEMP °C			0.00		0.00	0.00
RIG TIME						
RECORDED BY			IJ			
WITNESSED BY						

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
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0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00

COND mS/m

0.00

100.00



0.00

COND mS/m

100.00

Depth: 2.00 m Date: 22 Nov 2012 Time: 11:06:26 File: "C:\Winlogger\Data\Murphy Environmental\BH16\BH16_INDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH16\BH16_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH16
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

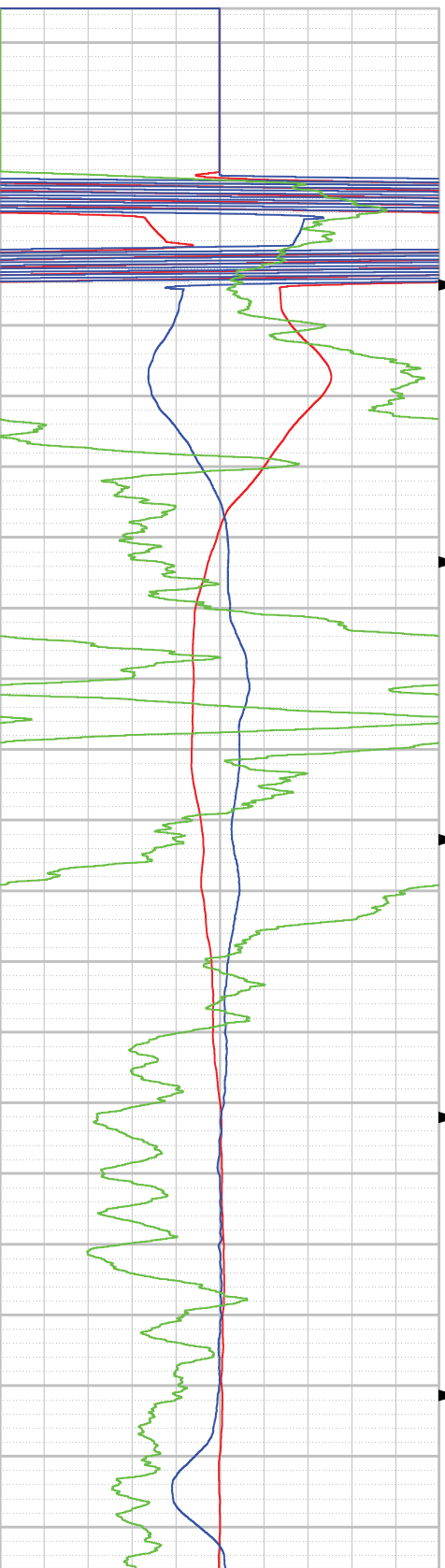
OTHER SERVICES

Consent of copyright owner required for any other use.

DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
22 Nov 1	0	TCDS	24.00	23.75	23.75	0.00	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				0.00	0

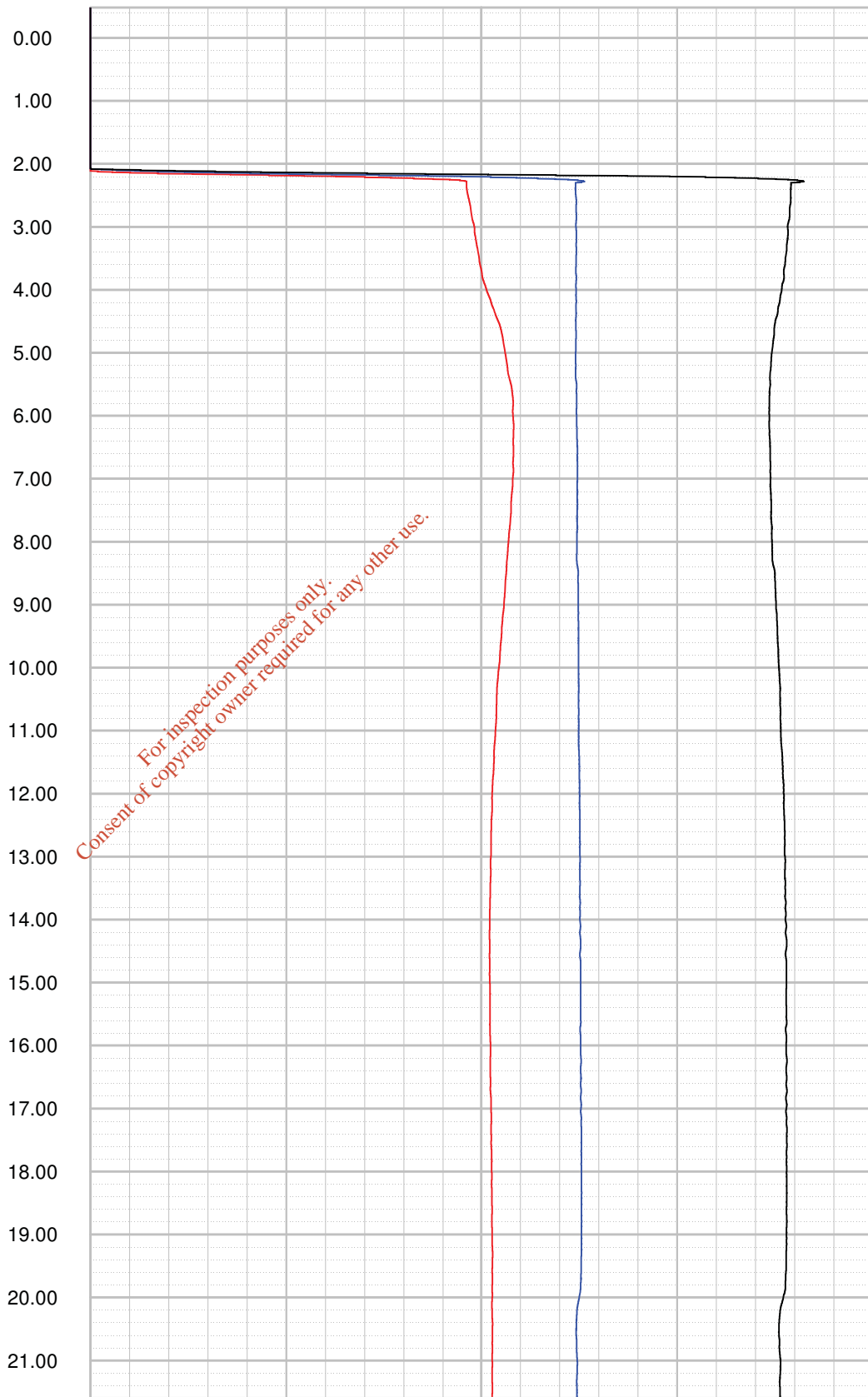
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	SIZE	FROM	TO	TO
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0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

DELT DegC	-1.00	1.00
DELC uS/cm	-20.00	20.00
NGAM CPS	0.00	200.00



DELT DegC	-1.00	1.00
DELC uS/cm	-20.00	20.00
NGAM CPS	0.00	200.00

TEMP DegC	0.00	20.00
COND uS/cm	0.00	500.00
COND uS/cm	0.00	500.00



TEMP DegC	0.00	20.00
COND uS/cm	0.00	500.00
COND uS/cm	0.00	500.00

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Consent of copyright owner required for any other use.

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH17\BH17_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



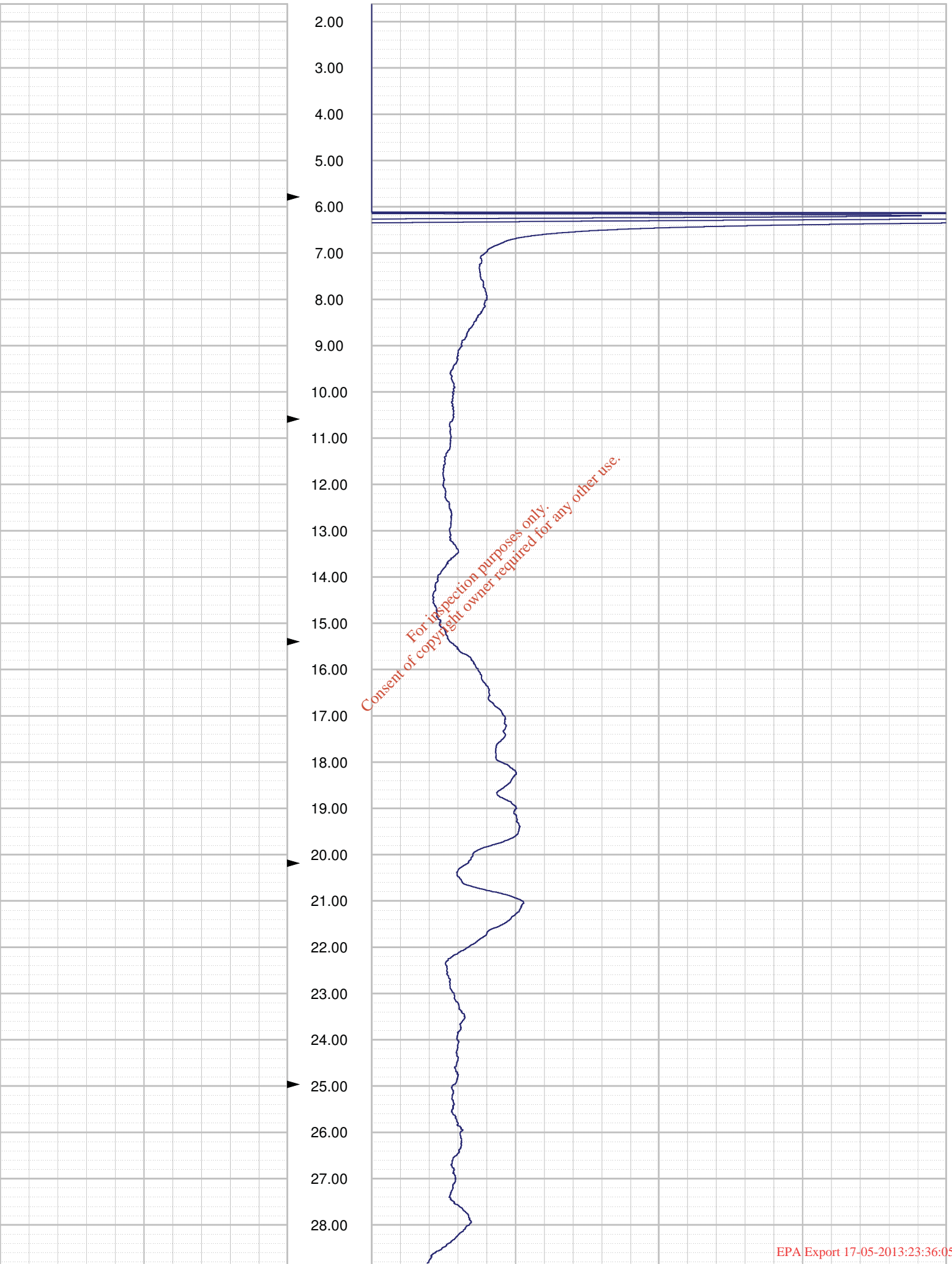
COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH17
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

OTHER SERVICES

Consent of copyright owner required for any other use.

Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	0
RUN#	0	0	0	0
TYPE OF LOG	INDS			
DEPTH DRILLER	54.00	0.00	0.00	0.00
DEPTH LOGGER	53.00	0.00	0.00	0.00
LOG DEEPEST	53.00	0.00	0.00	0.00
LOG SHALLOW	2.50	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00		0.00
RIG TIME				
RECORDED BY	IJ			
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00





Depth: 1.00 m Date: 21 Nov 2012 Time: 10:43:39 File: "C:\Winlogger\Data\Murphy Environmental\BH17\BH17_INDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH17\BH17_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH17
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

OTHER SERVICES

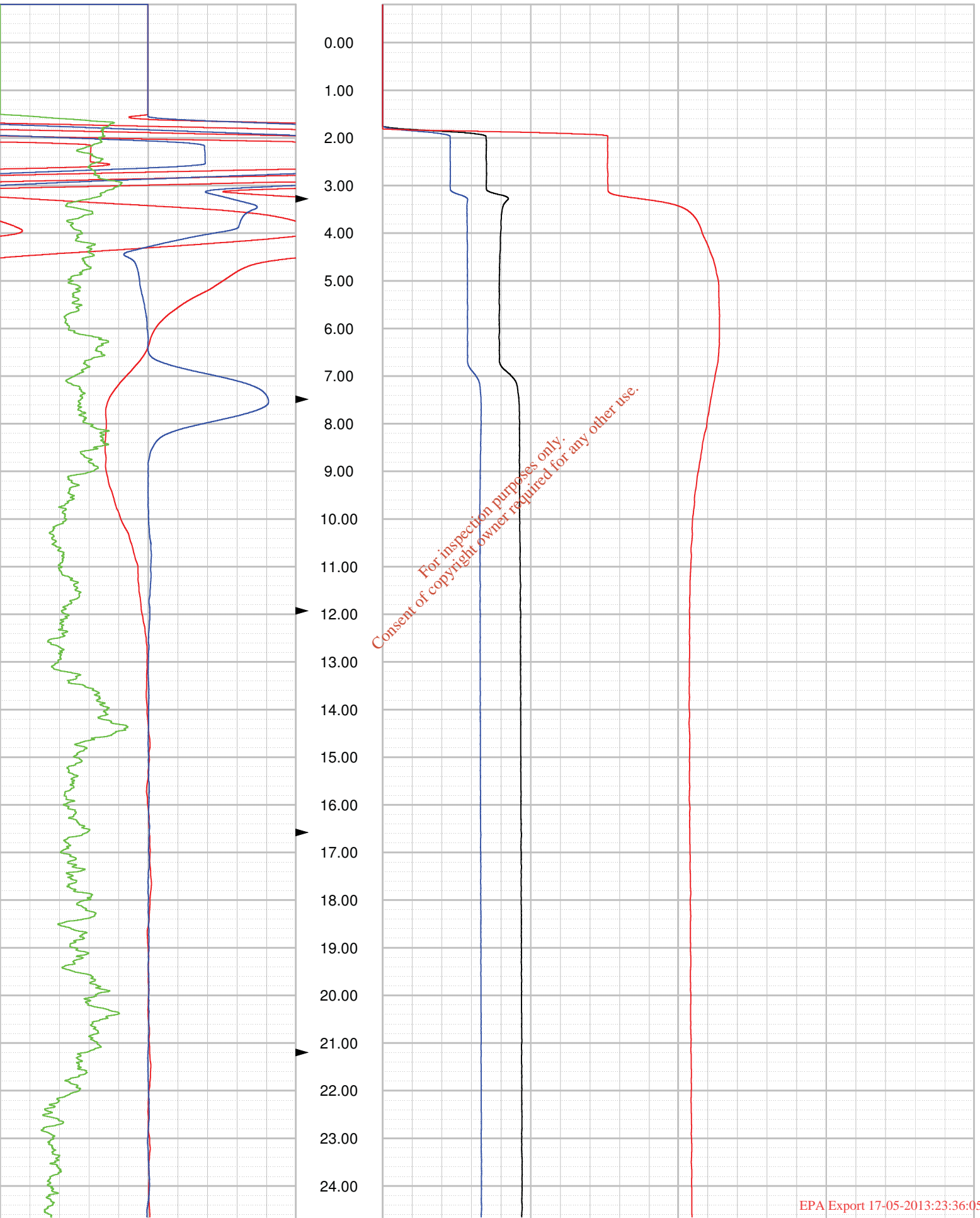
Consent of copyright owner required for any other use.

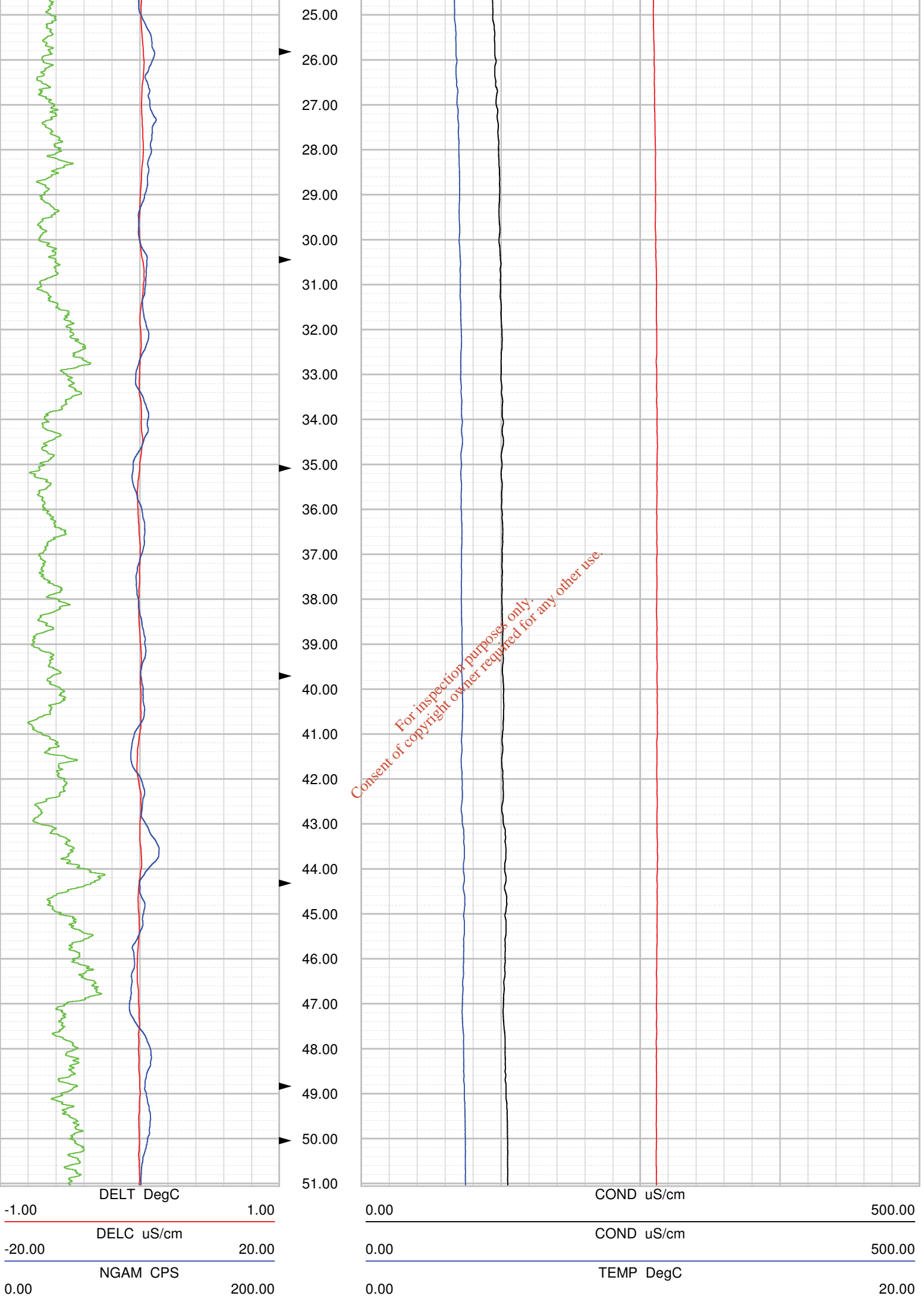
DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
21 Nov 1	0	TCDS	54.00	53.00	53.00	0.00	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM	TO	TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELT DegC	1.00
-20.00	DELC uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00





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REMARKS (C:\Winlogger\Data\Murphy Environmental\BH18\BH18_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH18
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE: Dublin
 COUNTY: Dublin
 LAT.:
 LONG.:

OTHER SERVICES

Consent of copyright owner required for any other use.

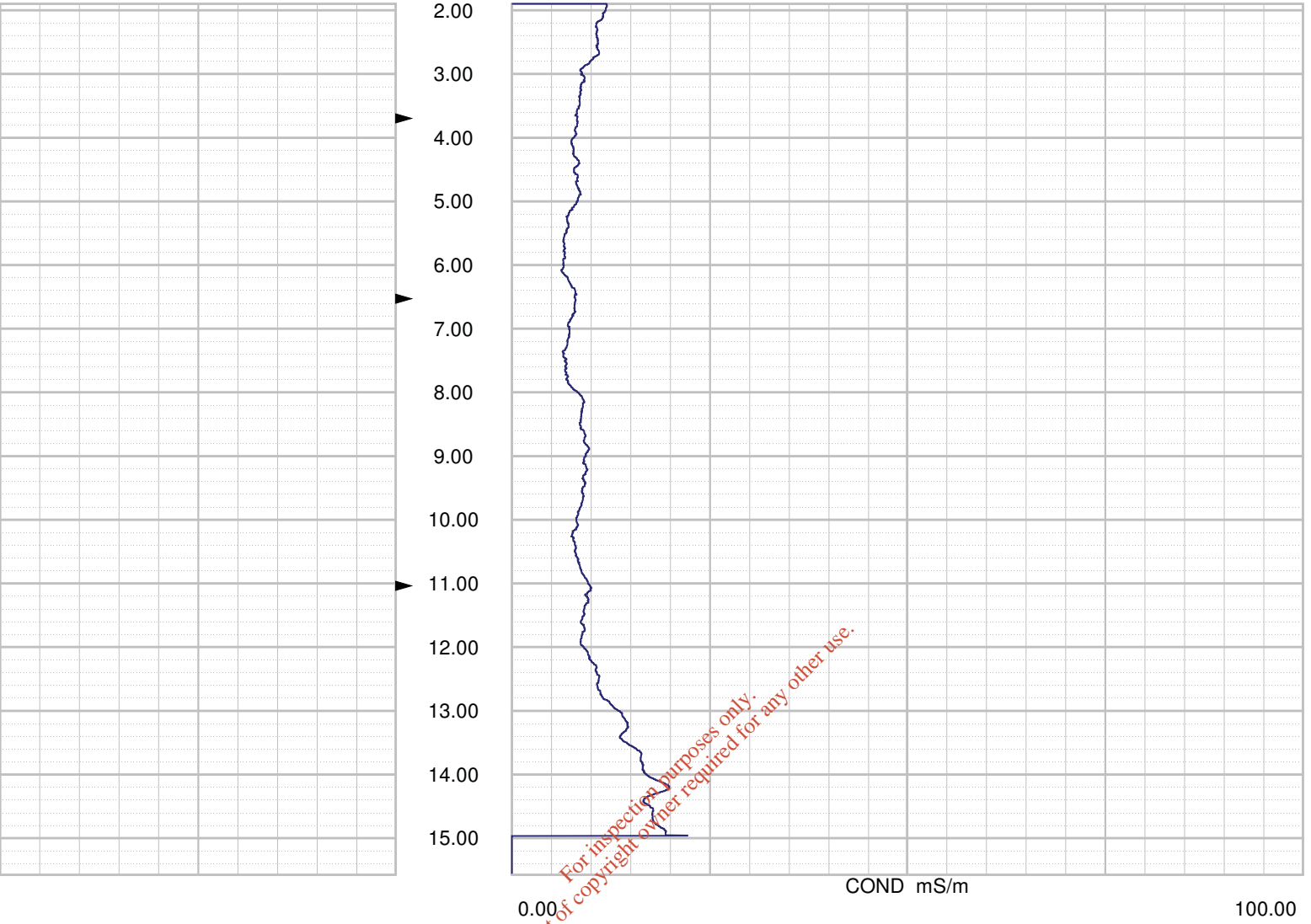
Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	06 Nov 1
RUN#	0	0	0	0
TYPE OF LOG	INDS			
DEPTH DRILLER	21.20	0.00	0.00	0.00
DEPTH LOGGER	15.80	0.00	0.00	0.00
LOG DEEPEST	15.80	0.00	0.00	0.00
LOG SHALLOW	2.50	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00		0.00
RIG TIME				
RECORDED BY	IJ			
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00

COND mS/m

0.00

100.00



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Depth: 1.00 m Date: 21 Nov 2012 Time: 12:01:57 File: "C:\Winlogger\Data\Murphy Environmental\BH18\BH18_INDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH18\BH18_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH18
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

MURPHY'S ENVIRONMENTAL HOLLYWOOD LTD

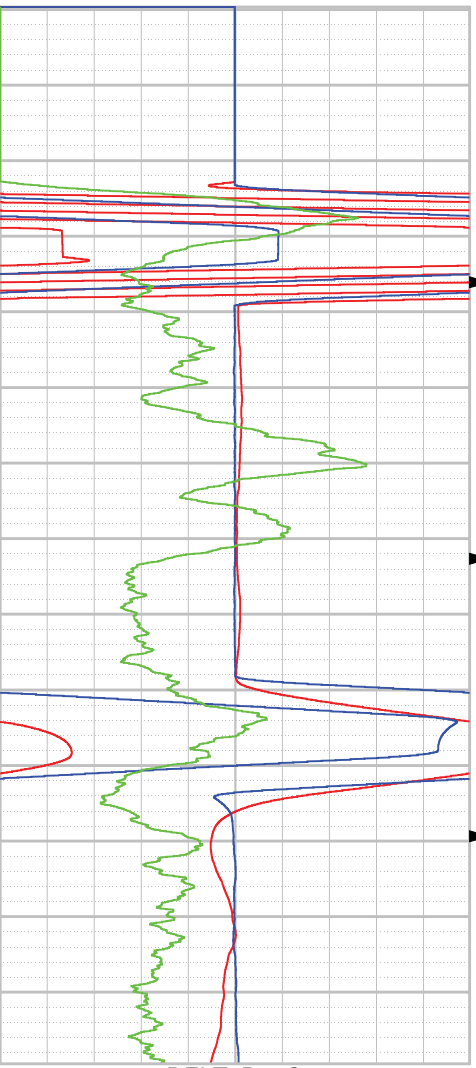
OTHER SERVICES

Consent of copyright owner required for any other use.

DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
21 Nov 1	0	TCDS	21.20	12.00	12.00	0.00	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0

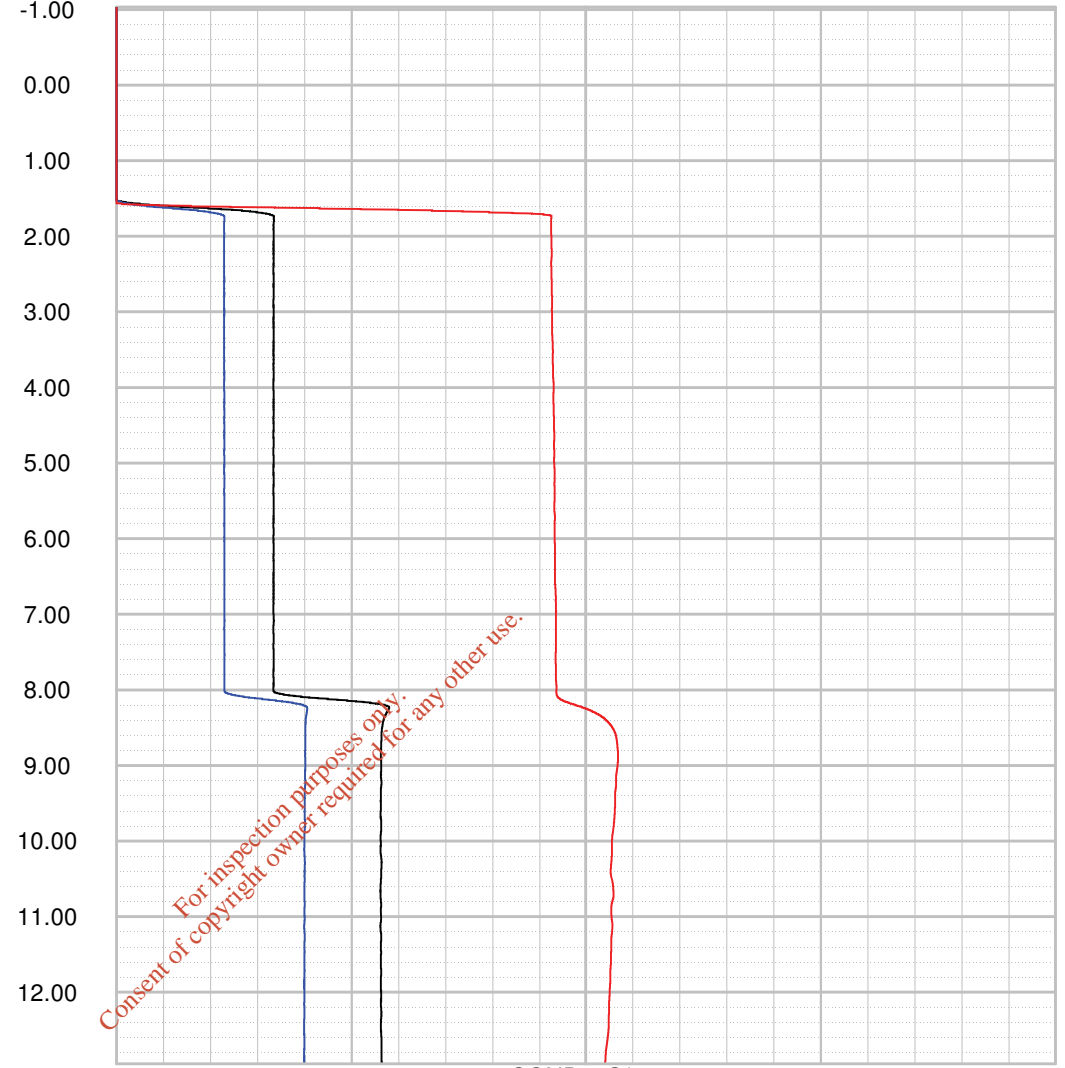
RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM	TO	TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELT DegC	1.00
-20.00	DELC uS/cm	20.00
0.00	NGAM CPS	200.00



-1.00	DELT DegC	1.00
-20.00	DELC uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00



0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00

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Depth: 12.00 m Date: 21 Nov 2012 Time: 11:52:30 File: "C:\Winlogger\Data\Murphy Environmental\BH18\BH18_TCDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH19\BH19_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH19
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

OTHER SERVICES

Consent of copyright owner required for any other use.

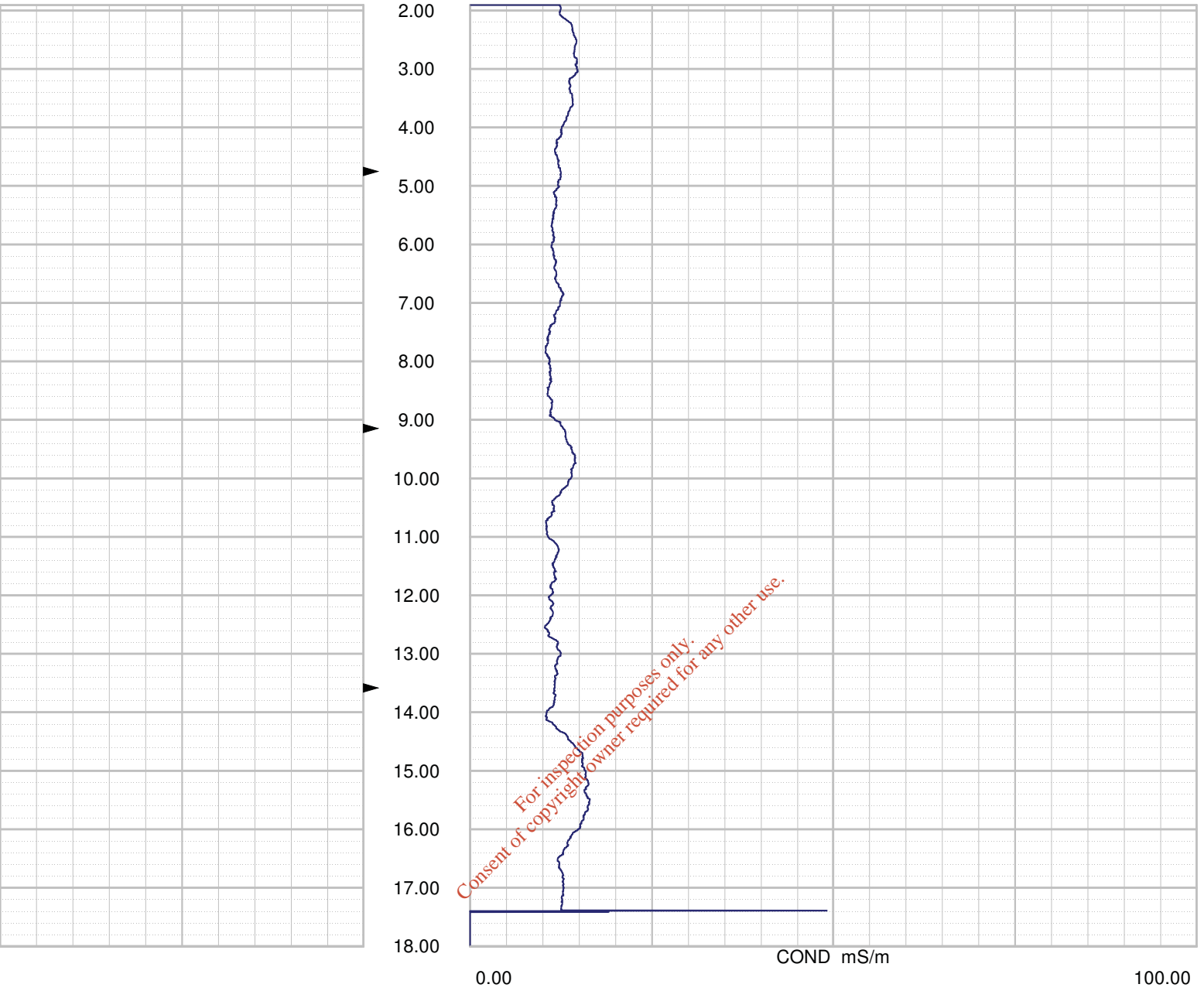
Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	06 Nov 1
RUN#	0	0	0	0
TYPE OF LOG	INDS			
DEPTH DRILLER	18.00	0.00	0.00	0.00
DEPTH LOGGER	18.00	0.00	0.00	0.00
LOG DEEPEST	18.00	0.00	0.00	0.00
LOG SHALLOW	2.50	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00		0.00
RIG TIME				
RECORDED BY	IJ			
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00
0	0.00	0.00 0.00	0.00	0.00 0.00

COND mS/m

0.00

100.00



Depth: 1.00 m Date: 21 Nov 2012 Time: 09:53:53 File: "C:\Winlogger\Data\Murphy Environmental\BH19\BH19_INDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH19\BH19_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH19
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

OTHER SERVICES

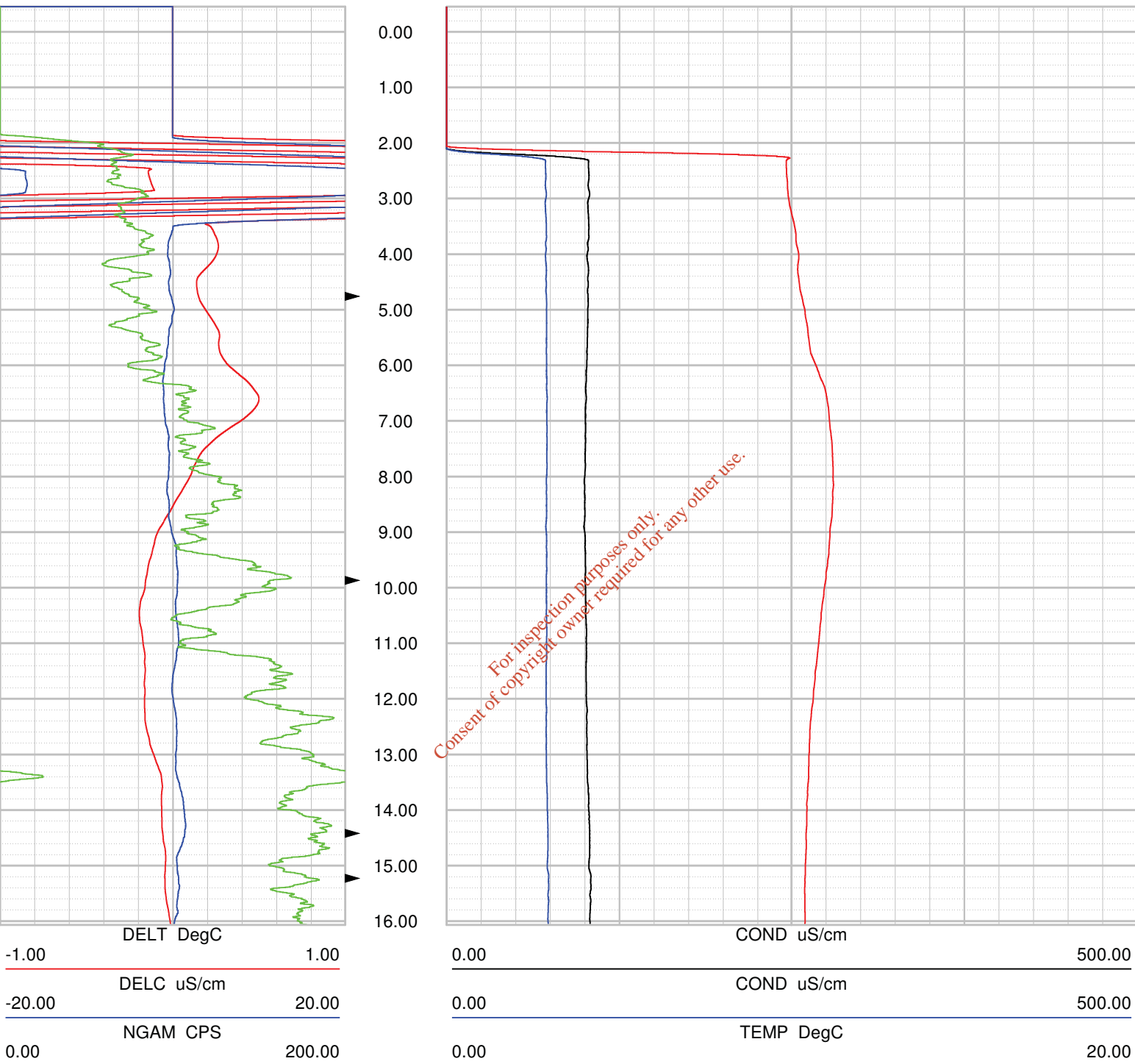
Consent of copyright owner required for any other use.

Perm. Datum	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00
DATE	21 Nov 1	06 Nov 1	06 Nov 1	0
RUN#	0	0	0	0
TYPE OF LOG	TCDS			
DEPTH DRILLER	18.00	0.00	0.00	0.00
DEPTH LOGGER	18.00	0.00	0.00	0.00
LOG DEEPEST	18.00	0.00	0.00	0.00
LOG SHALLOW	0.00	0.00	0.00	0.00
FLUID IN HOLE	Water			
SALINITY				
DENSITY				
LEVEL				
MAX TEMP °C	0.00	0.00		0.00
RIG TIME	IJ			
RECORDED BY				
WITNESSED BY				

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELT DegC	1.00
-20.00	DELC uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00



Depth: 16.00 m Date: 21 Nov 2012 Time: 09:24:26 File: "C:\Winlogger\Data\Murphy Environmental\BH19\BH19_TCDS.LOG"

REMARKS (C:\Winlogger\Data\Murphy Environmental\BH20\BH20_IND..
INDS 3197

Downhole Geophysics - Existing BH

Induction - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH20
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE:
 COUNTY: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

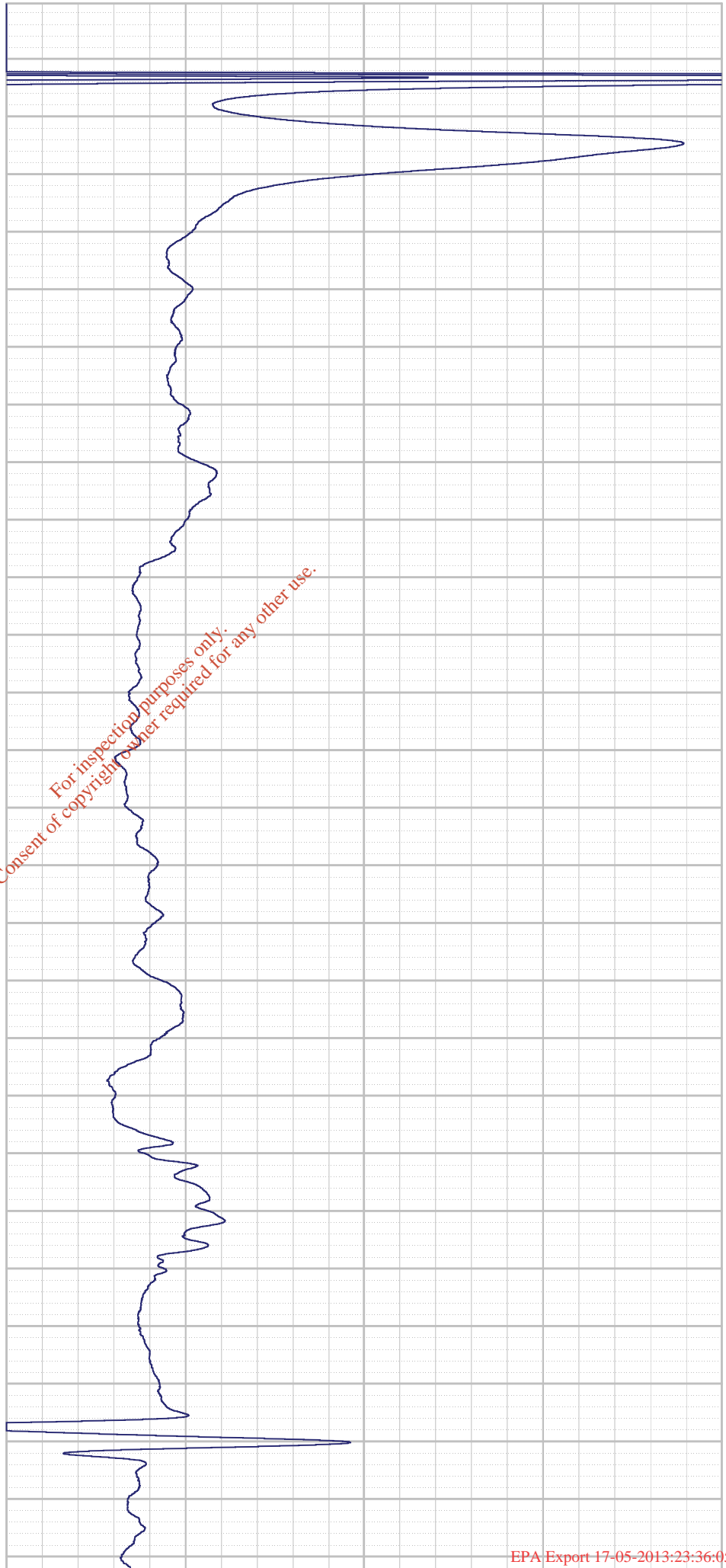
OTHER SERVICES

Consent of copyright owner required for any other use.

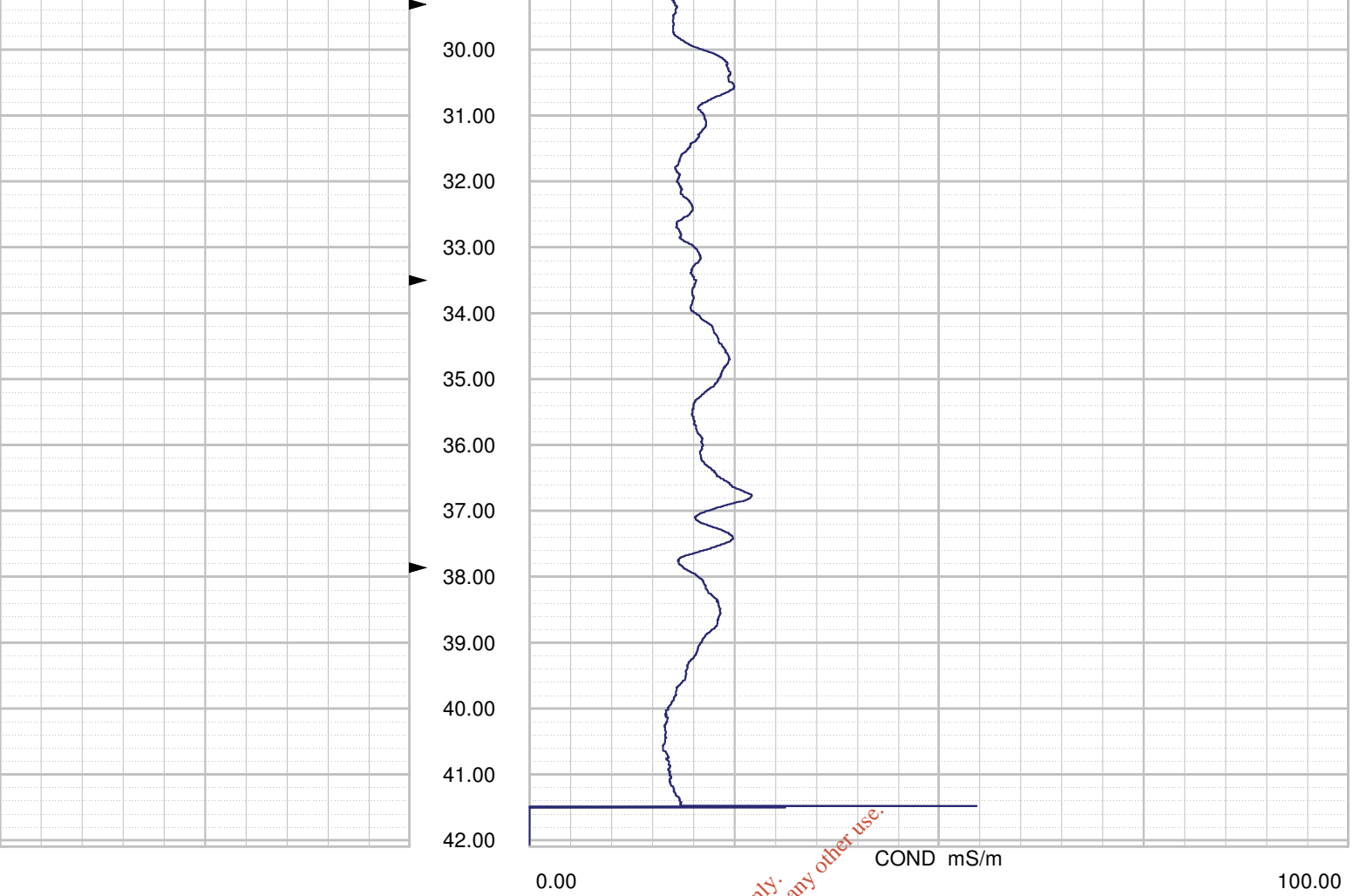
DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
22 Nov 1	0	INDS	42.00	42.00	42.00	2.50	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				06 Nov 1	0

RUN#	BIT RECORD		SIZE	CASING RECORD	
	FROM	TO		WEIGHT	FROM TO
0	0.00	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00	0.00

3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
19.00
20.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00



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Depth: 2.00 m Date: 22 Nov 2012 Time: 10:19:23 File: "C:\Winlogger\Data\Murphy Environmental\BH20\BH20_INDS.LOG"

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REMARKS (C:\Winlogger\Data\Murphy Environmental\BH20\BH20_TC..
TCDS 1365

Downhole Geophysics - Existing BH

Temperature & Conductivity - 1:100



COMPANY: Murphy's Environmental Hollywood Ltd
 WELL: BH20
 FIELD: Murphy's Quarry
 COUNTRY: Ireland
 STATE: Dublin
 LAT.:
 LONG.:

Murphy's Environmental Hollywood Ltd

OTHER SERVICES

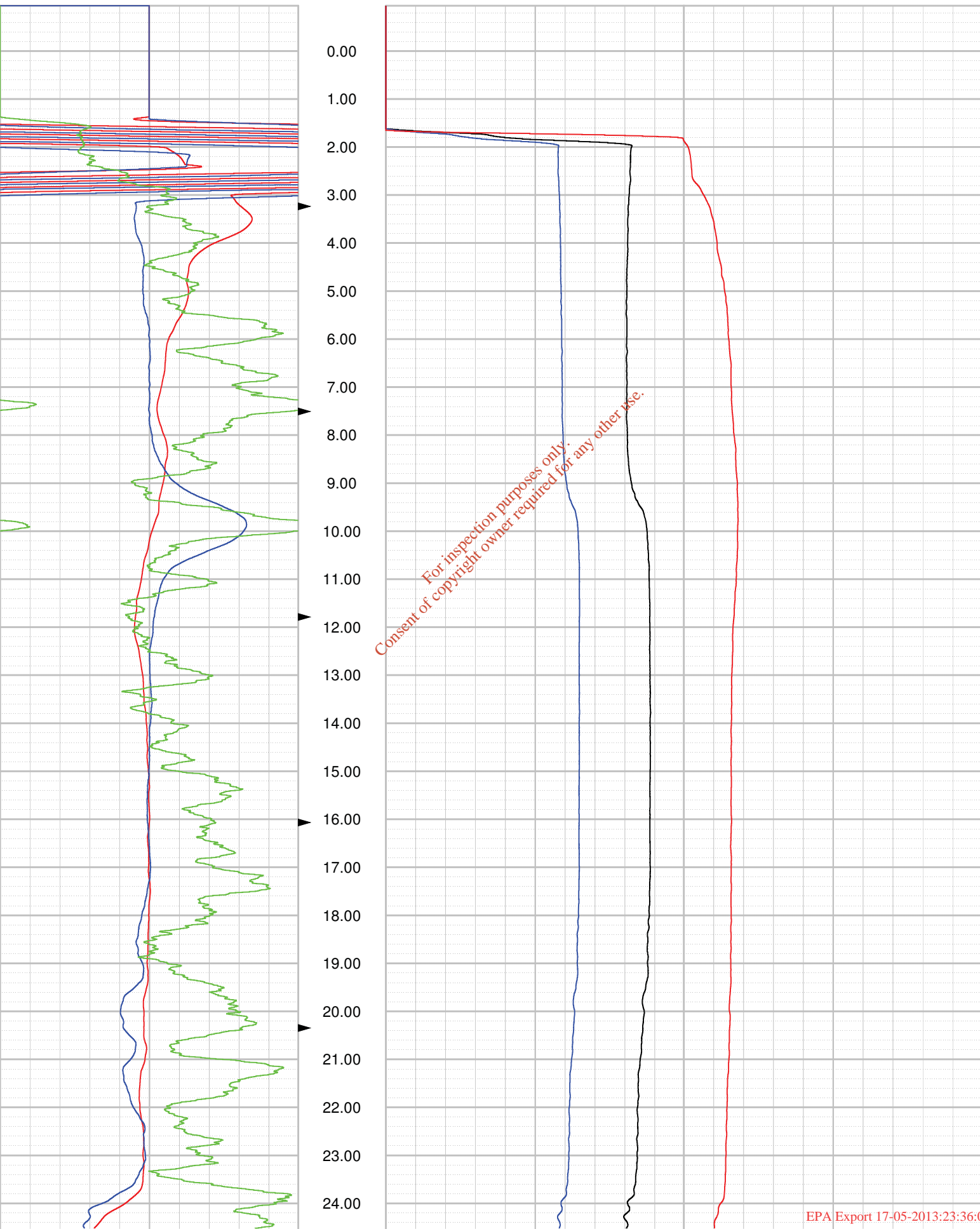
Consent of copyright owner required for any other use.

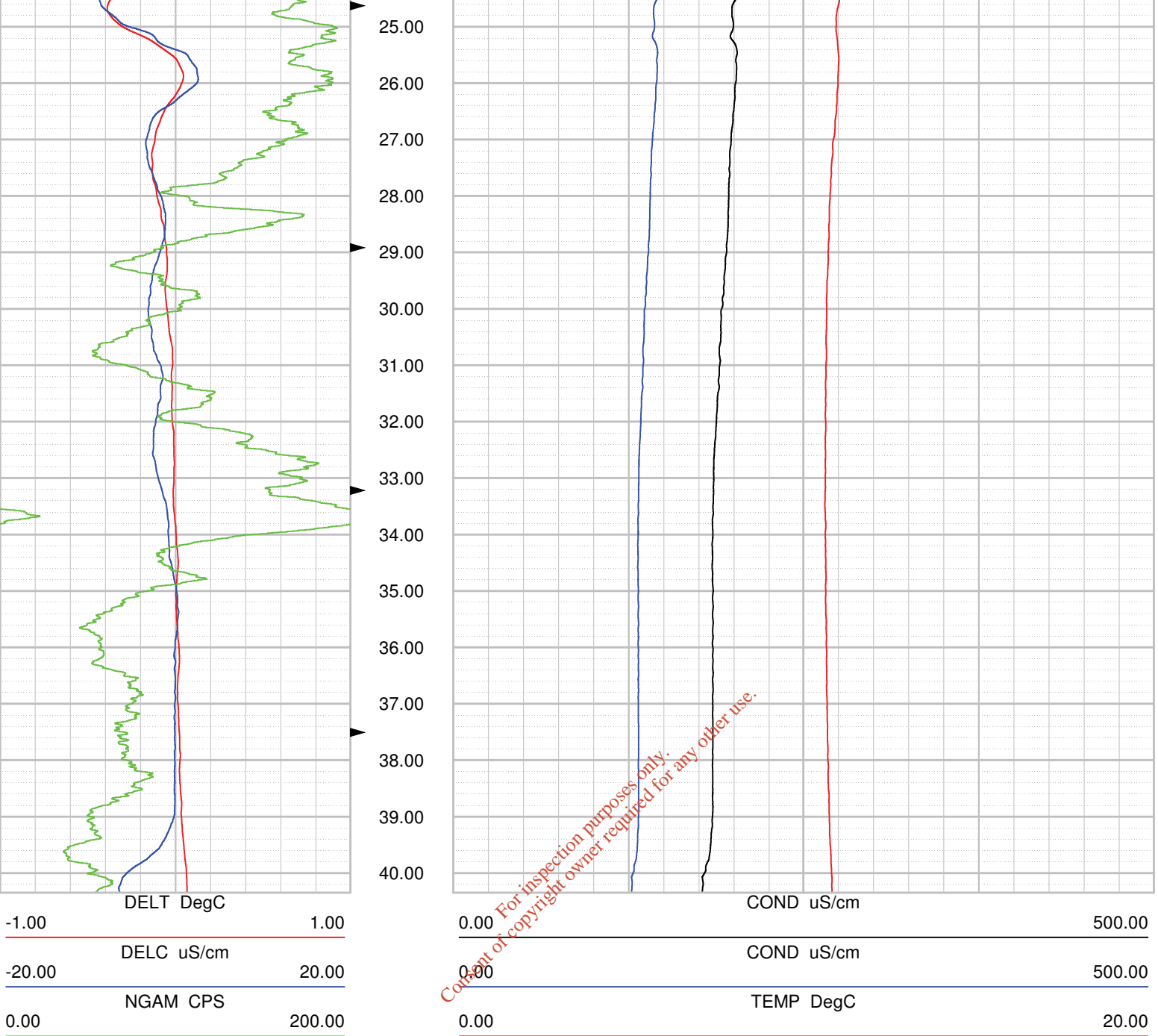
DATE	RUN#	TYPE OF LOG	DEPTH DRILLER	DEPTH LOGGER	LOG DEEPEST	LOG SHALLOW	FLUID IN HOLE	SALINITY	DENSITY	LEVEL	MAX TEMP °C	RIG TIME	RECORDED BY	WITNESSED BY	Elev	
															GL	GL
22 Nov 1	0	TCDS	42.00	42.00	42.00	0.00	Water				0.00	IJ			06 Nov 1	0
			0.00	0.00	0.00	0.00					0.00				0.00	0

RUN#	BIT RECORD		CASING RECORD	
	SIZE	FROM TO	WEIGHT	FROM TO
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

-1.00	DELTA DegC	1.00
-20.00	DELTA uS/cm	20.00
0.00	NGAM CPS	200.00

0.00	COND uS/cm	500.00
0.00	COND uS/cm	500.00
0.00	TEMP DegC	20.00



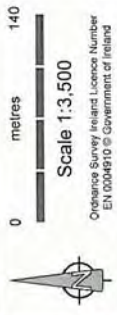


Depth: 40.00 m Date: 22 Nov 2012 Time: 09:59:42 File: "C:\Winlogger\Data\Murphy Environmental\BH20\BH20_TCDS.LOG"

Appendix C

Site Conceptual Model (CSM)

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Legend

- MEHL Proposed Planning and Waste Licence Boundary
- Apex Fault/Fracture
- Mapped Fault
- + EPA Licence W0129-02 Monitoring Boreholes
- + Cored Monitoring Wells *
- + Monitoring Wells *
- + Pumping Wells *

Note:
* These wells will be decommissioned.

ARUP

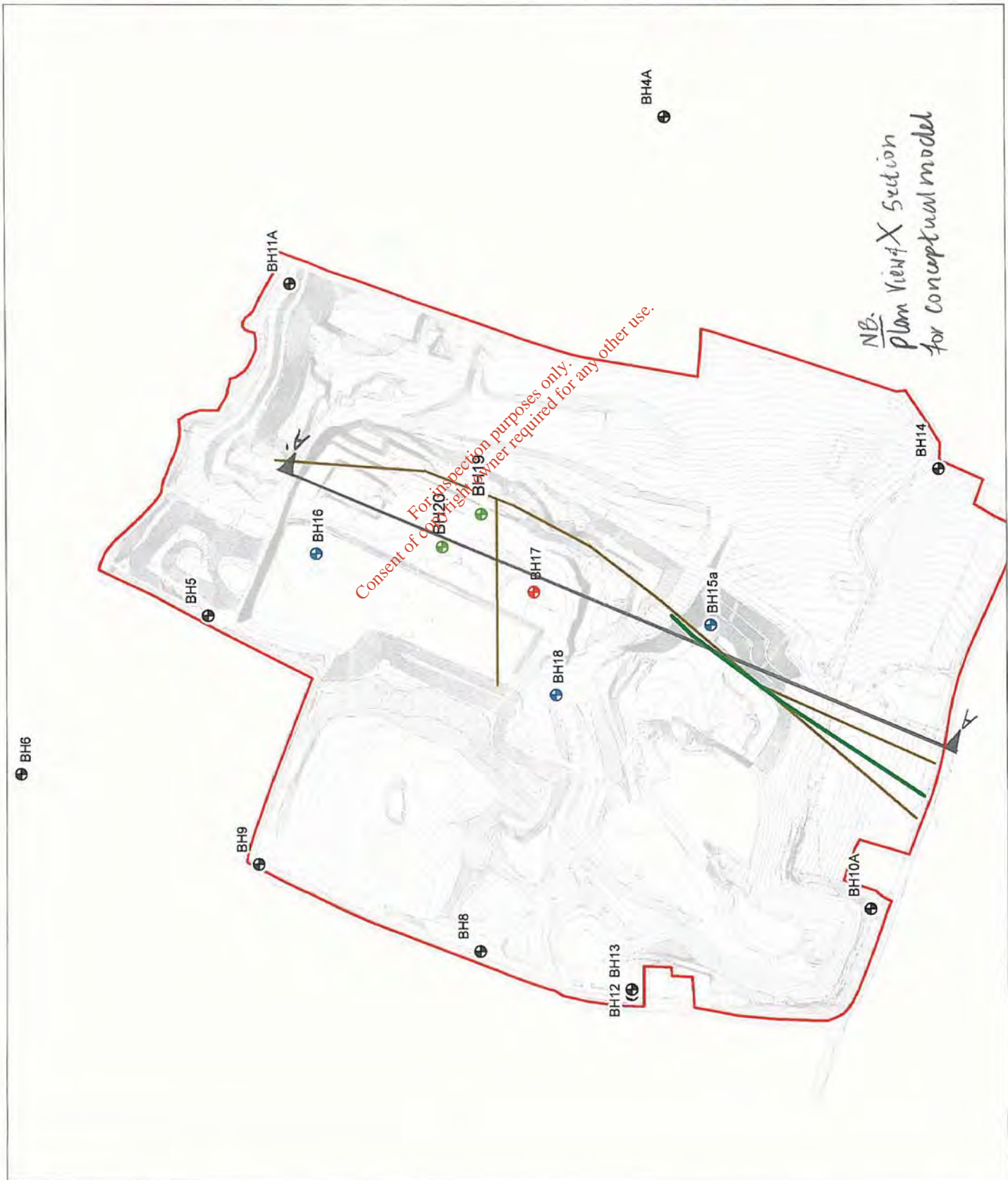
MAHARAJA PLANNERS
Chartered Town Planning Consultants

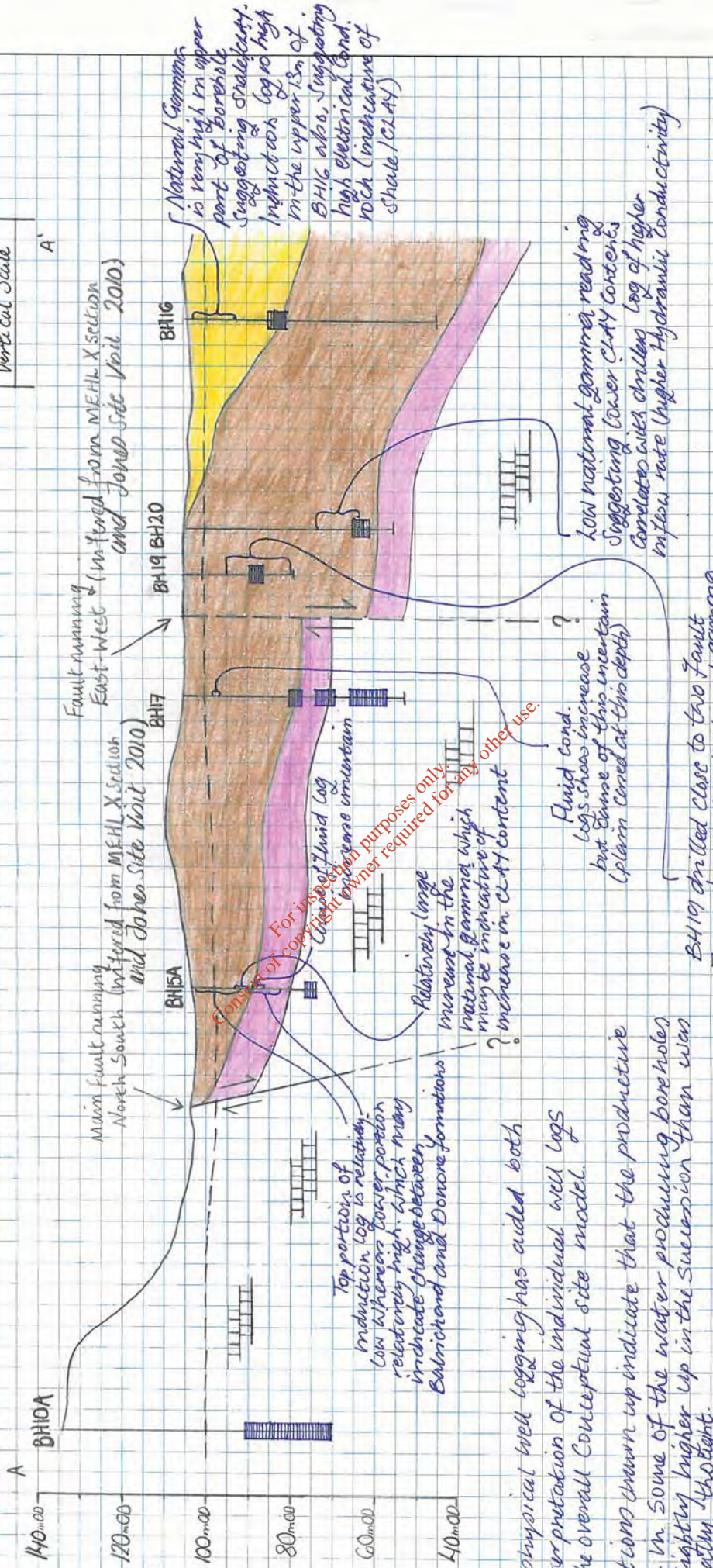
Murphy Environmental Hollywood Ltd

MEHL Integrated Waste Management Facility
Hollywood Great, Nags Head, Naul, Co Dublin

Groundwater Monitoring Network used for EIS data collection

December 2010 Figure 14.12





Note:

The geophysical well logging has aided both the interpretation of the individual well logs and the overall Conceptual site model.

The sections shown up indicate that the productive strata in some of the water producing boreholes are slightly higher up in the succession than was originally thought.

Much of the water obtained was in the base of the Balnrickard Fm / Donore Fm. The latter is thought to represent an unconformity and may explain the weathered / broken nature of the strata horizon.

The geophysical well logs show shale / marlstone beds in most of the boreholes penetrating the upper part of the Balnrickard formation.

ARUP		Sketch Sheet	
Job Title	MEHL	Sketch No.	1
Job No.	326877-01	Rev.	
Made by	LC	Date	19/4/13
		Chd.	